Accounting for Managers

v. 1.0

This is the book Accounting for Managers (v. 1.0).

Table of Contents

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Kurt began his career in public accounting with Ernst & Young and continued as a manager of a large local accounting firm in California. He received his MBA at the University of California—Davis and is currently a certified management accountant (CMA) and certified public accountant (CPA). The knowledge Kurt gained from his seven years in industry and more than 15 years in education has enabled him to write a clear and concise book filled with real world examples.

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Joe Hoyle is an associate professor of accounting at the Robins School of Business at the University of Richmond. In 2006, he was named by *BusinessWeek* as one of 26 favorite undergraduate business professors in the United States. In 2007, he was selected as the Virginia Professor of the Year by the Carnegie Foundation for the Advancement of Teaching and the Council for the Advancement and Support of Education. In 2009, he was judged to be one of the 100 most influential members of the accounting profession by *Accounting Today*.

Joe has two market-leading textbooks published with McGraw-Hill—*Advanced Accounting* (eleventh edition, 2012) and *Essentials of Advanced Accounting* (fifth edition, 2012), both coauthored with Tom Schaefer of the University of Notre Dame and Tim Doupnik of the University of South Carolina.

At the Robins School of Business, Joe teaches fundamentals of financial accounting, intermediate financial accounting I, intermediate financial accounting II, and advanced financial accounting. He earned his BA degree in accounting from Duke University and his MA degree in business and economics, with a minor in education, from Appalachian State University. He has written numerous articles and continues to make many presentations around the country on teaching excellence. He maintains a blog on teaching at http://www.joehoyle-teaching.blogspot.com.

Joe also has three decades of experience operating his own CPA (Certified Public Accountant) Exam review programs. In 2008, he created CPA Review for Free (http://www.CPAreviewforFREE.com), which provides thousands of free questions to help accountants around the world prepare for the CPA Exam.

Joe and his wife, Sarah, have four children and four grandchildren.

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Dedication

Kurt Heisinger

To my parents for their continued optimism and support; to my wife and children for their patience and encouragement; and to Michael Maher, professor of management at the University of California—Davis, who served as my mentor and encouraged me to write this book. I could not have done it without him.

Preface

Brief, Focused, Essential

Student learning styles continue to evolve as we move into the twenty-first century. Students want to learn accounting in the most efficient way possible, balancing coursework with personal schedules. They tend to focus on their studies in short intense segments between jobs, classes, and family commitments. Meanwhile, the accounting industry has endured dramatic shifts since the collapse of Enron and WorldCom, causing a renewed focus on ethical behavior in accounting.

Core Themes

This book is aimed squarely at the new learning styles evident in today's students and addresses accounting industry changes as well. Accordingly, three core themes lie at the foundation of this text:

1. **Focused.** Students want to be as efficient as possible in their learning. This book adopts a concise, jargon-free, and easy-to-understand approach. Key concepts are provided in short segments with bullet points and step-by-step instructions to simplify concepts. A thoughtful, stepwise approach helps students avoid distractions and focuses attention on the big picture.
2. **Reinforcement.** Review Problems at the end of each major section offer practical opportunities for students to apply what they have learned. These Review Problems allow students to immediately reinforce what they have learned and are provided within the body of the chapter along with the solutions.
3. **Relevance.** Students perform better when they can answer the "why" question. Why is managerial accounting important? Meaningful references to companies throughout the chapters help students tie the concepts presented in each chapter to real organizations.

In addition, realistic managerial scenarios present an issue that must be addressed by the management accountant. These pique student interest and are designed to show how issues can be resolved using the concepts presented in the chapter.

Finally, Business in Action features in this text link managerial decision making to real business decisions.

Other Key Features

- **A focus on decision making.** This book focuses on the essential managerial accounting concepts used within organizations for decision-making purposes and covers these concepts in 13 straightforward and concise chapters. Knowing that the majority of students taking managerial accounting at the introductory level are general business majors and will not become accountants, this text was written to help students make informed business decisions using managerial accounting concepts.
- **Thorough end-of-chapter coverage.** The Exercises, Problems, and Cases were developed to give student a wide range of reinforcement at different levels of complexity and to help build critical thinking skills.
- **Ethics coverage.** The importance of ethics is evident from the outset since the book begins with an entire segment on ethical issues facing the accounting industry. This segment includes the Institute of Management Accountants' revised standards of ethical conduct and describes professional codes of conduct provided by the American Institute of Certified Public Accountants, Financial Executives International, and International Federation of Accountants. Ethics questions and cases are included throughout the text.
- **Group projects.** The accounting industry and business in general have made it clear employees must be able to work effectively and efficiently in groups. In addition, studies show students learn concepts more effectively when working in groups. To reinforce this idea, we have included group projects throughout the book.
- **Spreadsheet applications.** Computer Application features and End-of-Chapter Exercises emphasize the importance of using Excel spreadsheets for analytical purposes.

Chapter 1

What Is Managerial Accounting?

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Dana Matthews is the president of Sportswear Company, a producer of hats and jerseys for fans of several professional sports teams. Imagine you are the accountant in charge of all accounting functions at Sportswear. Dana just reviewed the financial statements for the most recent fiscal year for the first time and has the following conversation with you:

President (Dana):	*I just reviewed our most recent financial statements, and I noticed we did not do as well as we had planned. I would like to look more closely at the profitability of each of our products to determine exactly what happened, but I don't have this information in the financial statements. Is there a reason we don't include this in the financial statements?*
Accountant:	*Yes, the financial statements are prepared following U.S. Generally Accepted Accounting Principles (U.S. GAAP) and are intended for outside users, such as owners, banks, and suppliers. U.S. GAAP does*

	not require us to disclose profitability by product, and we prefer not to make this information public. Product profitability information stays in-house and is prepared by our managerial accountant, Dave Hicks.
President:	*That makes sense. Can you have Dave pull together product profitability information for the past year so we can take a close look at which products are doing well and which are not?*
Accountant:	*You bet. We'll have the information for you early next week.*

1.1 Characteristics of Managerial Accounting

LEARNING OBJECTIVE

1. Compare characteristics of financial and managerial accounting.

Question: The issue facing the president at Sportswear is a common one. Companies prefer not to disclose more information than is required by U.S. GAAP, but they would like to have more detailed information for internal decision-making and performance-evaluation purposes. This is why it is important to distinguish between financial and managerial accounting. What is the difference between information prepared by financial accountants and information prepared by managerial accountants?

Answer: **Financial accounting**[1] focuses on providing historical financial information to external users. External users are those outside the company, including owners (e.g., shareholders) and creditors (e.g., banks or bondholders). Financial accountants reporting to external users are required to follow **U.S. Generally Accepted Accounting Principles (U.S. GAAP)**[2], a set of accounting rules that requires consistency in recording and reporting financial information. This information typically summarizes overall company results and does not provide detailed information.

Managerial accounting[3] focuses on internal users—executives, product managers, sales managers, and any other personnel within the organization who use accounting information to make important decisions. Managerial accounting information need not conform with U.S. GAAP. In fact, conformance with U.S. GAAP may be a deterrent to getting useful information for internal decision-making purposes. For example, when establishing an inventory cost for one or more units of product (each jersey or hat produced at Sportswear Company), U.S. GAAP requires that production overhead costs, such as factory rent and factory utility costs, be included. However, for internal decision-making purposes, it might make more sense to include nonproduction costs that are directly linked to the product, such as sales commissions or administrative costs.

1. Provides historical financial information to external users.
2. A set of accounting rules that must be followed to provide consistency in reporting financial information to external users.
3. Focuses on internal users, including executives, product managers, sales managers, and any other personnel in the organization who use accounting information for decision making.

Question: It's clear that financial accounting focuses on reporting to outside users while managerial accounting focuses on reporting to inside users. What specific characteristics would we expect to see in managerial accounting information?

Answer: Managerial accounting often focuses on making future projections for segments of a company. Suppose Sportswear Company is considering introducing a new line of coffee mugs with team logos on each mug. Management would certainly need detailed financial projections for sales, costs, and the resulting profits (or losses). Although historical financial accounting data from other product lines would be useful, preparing projections for the new line of mugs would be a managerial accounting function.

Another characteristic of managerial accounting data is its high level of detail. As noted in the opening dialogue between the president and accountant at Sportswear Company, the financial information in the annual report provides a general overview of the company's financial results but does not provide any detailed information about each product. Information, such as product profitability, would come from the managerial accounting function.

Finally, managerial accounting information often takes the form of nonfinancial measures. For example, Sportswear Company might measure the percentage of defective products produced or the percentage of on-time deliveries to customers. This kind of nonfinancial information comes from the managerial accounting function.

Table 1.1 "Comparison of Financial and Managerial Accounting" summarizes the characteristics of both managerial and financial accounting.

Table 1.1 Comparison of Financial and Managerial Accounting

	Managerial Accounting	Financial Accounting
Users	Inside the organization	Outside the organization
Accounting rules	None	U.S. Generally Accepted Accounting Principles (U.S. GAAP)
Time horizon	Future projections (sometimes historical if in detail)	Historical information

	Managerial Accounting	Financial Accounting
Level of detail	Often presents segments of an organization (e.g., products, divisions, departments)	Presents overall company information in accordance with U.S. GAAP
Performance measures	Financial and nonfinancial	Primarily financial

Follow-Up at Sportswear Company

Question: What did the president at Sportswear Company learn about product profitability from the information provided by the managerial accountant?

Answer: The president at Sportswear, Dana Matthews, learned that the hats product line was much more profitable than expected, accounting for 55 percent of the company's profits even though initial estimates were that the hat segment would account for 40 percent of company profits. Conversely, the jerseys product line was much less profitable than expected, accounting for 45 percent of the company's profits.

There are many issues associated with determining product profitability, including how to allocate costs that are not easily traced to each product and whether the product revenue and cost information is accurate enough to make important managerial decisions. These important issues will be addressed throughout the book.

KEY TAKEAWAY

- Financial accounting provides historical financial information for external users in accordance with U.S. GAAP. Managerial accounting provides detailed financial and nonfinancial information for internal users who use the information for decision making, planning, and control purposes.

REVIEW PROBLEM 1.1

1. Suppose you are the co-owner and manager of a retail store that sells and repairs mountain bikes. Provide one example of a *financial* accounting report that would be useful to you and your co-owner. Provide two examples of *managerial* accounting reports that would be useful to you as the manager.
2. Provide two examples of nonfinancial measures used by a pizza eatery that serves food in the restaurant and offers delivery services.

3. For each report listed in the following, indicate whether it relates to financial or managerial accounting. Explain the reasoning behind your answer for each item.

    1. Projected net income for next quarter by division
    2. Defective goods produced as a percentage of all goods produced
    3. Income statement for the most current year, prepared in accordance with U.S. GAAP
    4. Monthly sales broken down by geographic region
    5. Production department budget for the next quarter
    6. Balance sheet at the end of the current year, prepared in accordance with U.S. GAAP

Solution to Review Problem 1.1

1. Financial accounting reports provided to owners typically include the income statement, statement of owners' equity, balance sheet, and statement of cash flows. All are prepared in accordance with U.S. GAAP. Managerial accounting reports prepared for managers might include a quarterly budget for revenues and expenses for each segment of the business (e.g., bike sales and bike repairs), returns for defective merchandise as a percent of total monthly sales, income projections to be used in deciding whether to open a new store, and projected sales for each bike model. (There are many correct answers to this problem. Use Table 1.1 "Comparison of Financial and Managerial Accounting" as a guide in determining the accuracy of your answer.)
2. Examples of nonfinancial measures include percentage of on-time deliveries, percentage of burned pizzas, average time required to prepare pizza for restaurant customers (from taking a customer's order to providing the pizza at the customer's table), and results of customer

satisfaction surveys. (These are just a few examples. There are many correct answers to this problem.)

3. The answers appear as follows. Be sure you explained your answers.

    1. Managerial accounting—information is for future projections and involves segments of the company
    2. Managerial accounting—nonfinancial detailed measure of defective products
    3. Financial accounting—historical information prepared in accordance with U.S. GAAP
    4. Managerial accounting—detailed information provided monthly
    5. Managerial accounting—information is for future projections and involves a segment of the company
    6. Financial accounting—historical information prepared in accordance with U.S. GAAP

1.2 Planning and Control Functions Performed by Managers

LEARNING OBJECTIVE

1. Describe the planning and control functions performed by managers.

Question: Managers of most organizations continually plan for the future, and after the plan is implemented, managers assess whether they achieved their goals. What are the two functions that enable management to go through the process of continually planning and evaluating?

Answer: The two important functions that enable management to continually plan for the future and assess implementation are called planning and control. **Planning**[4] is the process of establishing goals and communicating these goals to employees of the organization. The **control**[5] function is the process of evaluating whether the organization's plans were implemented effectively.

Planning

Question: Continually planning for the future is an important quality of many successful organizations, such as Southwest Airlines (discussed in Note 1.11 "Business in Action 1.1"). How do organizations formalize their strategic plans?

Answer: Organizations formalize their plans by creating a **budget**[6], which is a series of reports used to quantify an organization's plans for the future. For example, **Ernst & Young**, an international accounting firm, plans for the future by establishing a budget indicating the labor hours required to perform specific services for each client. The process of creating a budget for each client enables the firm to plan for future staffing needs and communicate these needs to employees of the company. Rather than simply hoping it all works out in the end, **Ernst & Young** projects the labor hours required in the future, hires accounting staff based on these projections, and schedules the staff required for each client.

4. The process of establishing goals and communicating these goals to employees of the organization.
5. The process of evaluating whether the organization's plans were effectively implemented.
6. A series of reports used to quantify an organization's plan for the future.

A budget can take a variety of forms. A budgeted income statement indicates a profit plan for the future. A capital budget shows the long-term investments planned for the future. A cash flow budget outlines cash inflows and outflows for the future. We provide more information about how budgets can be used for planning purposes in later chapters.

Business in Action 1.1

Plans for the Future

Review the annual report or 10K for just about any company, and you are likely to find information regarding plans for the future. Here are some examples:

- **Southwest Airlines.** A low-fare, short-haul carrier that targets business commuters as well as leisure travelers states in its annual report, "We are focused on four big initiatives: the AirTran integration, the All-New Rapid Rewards program, the addition of the Boeing 737–800 in 2012, and the replacement of our reservations system."
- **Sears Holdings Corporation.** A multiline retailer that offers a wide array of merchandise and related services states in its 10K report, "We will continue to invest in our online properties. By integrating our vast store network with our online properties, we believe that Sears Holdings will succeed in the rapidly evolving retail environment."
- **Nordstrom, Inc.** A fashion specialty retailer indicates in its 10K report that its "strategic growth plan includes opening new Nordstrom full-line and Nordstrom Rack stores, with 6 announced Nordstrom full-line and 18 announced Nordstrom Rack store openings, the majority of which will occur by 2012."

As these companies go through the process of making decisions about the future, developing plans based on their decisions, and controlling the implementation of their plans, managerial accounting information will play a key role in all phases of the process.

Sources: **Southwest Airlines**, "Annual Report, 2010," http://www.southwest.com; **Sears Holdings Corporation**, "10K Report, 2010," http://www.searsholdings.com; **Nordstrom, Inc.**, "10K Report, 2010," http://www.nordstrom.com.

Control

Question: Although planning for the future is important, plans are only effective if implemented properly. How do organizations assess the implementation of their plans?

Answer: The control function evaluates whether an organization's plans were implemented effectively and often leads to recommendations for the future. Many organizations compare actual results with the initial plan (or budget) to evaluate performance of employees, departments, or the entire organization.

For example, assume **Ernst & Young** creates a budget indicating the labor hours needed to perform tax services for a particular client (this is the *planning* function). After the work is performed, actual labor hours used to complete the work are compared to budgeted labor hours. This analysis is then used to evaluate whether employees were able to complete the work within the budgeted time and often results in recommendations for the future. Recommendations might include the need for adding more labor hours to the budget or obtaining better support documents from the client.

Planning and controlling operations are critical functions within most organizations. In today's business environment, effective planning and control by managers can be the key to survival.

KEY TAKEAWAY

- Managers continually plan and control operations within organizations. Planning involves establishing goals and communicating these goals to employees of the organization. The control function assesses whether goals were achieved and is often used to evaluate the performance of employees, departments, and the organization as a whole.

REVIEW PROBLEM 1.2

Assume you are preparing a personal budget of all income and expenses for next month.

1. Describe the planning and control functions of this process.
2. What benefits might be derived from performing the planning and control functions for a personal budget?

Solution to Review Problem 1.2

1. The planning function would involve establishing income and expense goals for next month. Possible sources of income include wages, scholarships, or student loans. Expenses might include rent, textbooks, tuition, food, entertainment, and transportation.

   The control function occurs after the end of the month and involves comparing actual income and expenses with budgeted income and expenses. This allows for the evaluation of whether income and expense goals were achieved.

2. There are several benefits to using a planning and control process. The planning function establishes income and expense goals and helps to identify any deviations from these goals. For example, planned expenditures are clearly outlined in the budget and provide guidelines for making expenditure decisions throughout the month. Without clear guidelines, money might be spent on items that are not needed.

   The control function allows for an evaluation of how well you met the goals established in the planning process. Perhaps some goals were achieved (e.g., food expenditures were close to what was budgeted) while other goals were not (e.g., transportation expenditures were higher than what was budgeted). The control function identifies these areas and leads to refined goals in the future. For example, the decision might be made to carpool next month to save on transportation costs or to earn more income to pay for transportation by working additional hours.

1.3 Key Finance and Accounting Personnel

LEARNING OBJECTIVE

1. Describe the functions of key finance and accounting personnel.

Question: From the previous discussion, we know that planning and control functions are often designed to evaluate the performance of employees and departments of an organization. This often includes employees overseeing financial information. Thus it is important to understand how most large companies organize their accounting and finance personnel. What are the accounting and finance positions within a typical large company, and what functions do they perform?

Answer: Let's look at an example to answer this question. Suppose you are the president of Sportswear Company, mentioned earlier in the chapter, which produces hats and jerseys for fans of professional sports teams. Assume this is a large public company. (The term **public company**[7] refers to a company whose shares of stock are publicly traded—that is, the general investing public can purchase and sell ownership in the company.) As president of Sportswear, you ask the following questions:

1. How much will we owe the government in income taxes for the year?
2. What was total net income for the last fiscal year?
3. Should we expand into new geographic markets?
4. If we do decide to expand into new markets, should we obtain financing by issuing bonds, obtaining a loan from a bank, or issuing common stock?
5. How profitable is each segment of our business (hats and jerseys)?
6. How effective are our internal controls over cash?

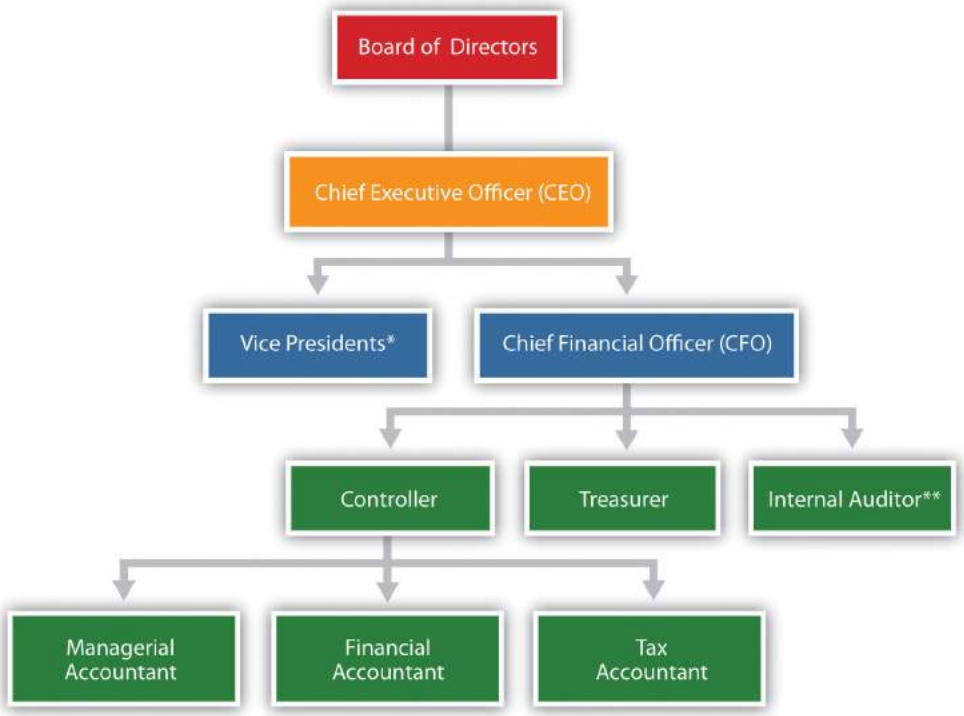
The challenge is to determine who within Sportswear would be best suited to answer each of these questions. An organization chart will help in finding a solution.

7. A company whose shares of stock are publicly traded.

Organizational Structure

Figure 1.1 "A Typical Organization Chart" is a typical organization chart; it shows how accounting and finance personnel fit within most companies. The personnel at the bottom of the chart report to those above them. For example, the managerial accountant reports to the controller. At the top of the chart are those who control the company, typically the board of directors (who are elected by the owners or shareholders). Review Figure 1.1 "A Typical Organization Chart" before moving on to the detailed discussion of each important finance and accounting position.

Figure 1.1 *A Typical Organization Chart*



**Represents vice presidents of various departments outside of accounting and finance such as production, personnel, and research and development.*

***In addition to reporting to the chief financial officer, the internal auditor typically reports independently to the board of directors and/or the audit committee (made up of select members of the board of directors).*

Chief Financial Officer

8. The person in charge of all finance and accounting functions within the organization.

The **chief financial officer (CFO)**[8] is in charge of all the organization's finance and accounting functions and typically reports to the chief executive officer.

Controller

The **controller**[9] is responsible for managing the accounting staff that provides managerial accounting information used for internal decision making, financial accounting information for external reporting purposes, and tax accounting information to meet tax filing requirements. The three accountants the controller manages are as follows:

- **Managerial accountant.** The **managerial accountant**[10] reports directly to the controller and assists in preparing information used for decision making within the organization. Reports prepared by managerial accountants include operational budgets, cost estimates for existing products, budgets for new product lines, and profit and loss reports by division. (Note that some people use the term *cost accountant* interchangeably with *managerial accountant*. Others consider cost accounting a specific function of managerial accounting that focuses on measuring costs. In this text, we use the term *managerial accountant* and assume that cost accountants focus on measuring costs.)
- **Financial accountant.** The **financial accountant**[11] reports directly to the controller and assists in preparing financial information, in accordance with U.S. GAAP, for those outside the company. Reports prepared by financial accountants include a quarterly report filed with the Securities and Exchange Commission (SEC) that is called a 10Q and an annual report filed with the SEC that is called a 10K.
- **Tax accountant.** The **tax accountant**[12] reports directly to the controller and assists in preparing tax reports for governmental agencies, including the Internal Revenue Service.

Treasurer

The **treasurer**[13] reports directly to the CFO. A treasurer's primary duties include obtaining sources of financing for the organization (e.g., from banks and shareholders), projecting cash flow needs, and managing cash and short-term investments.

Internal Auditor

An **internal auditor**[14] reports to the CFO and is responsible for confirming that the company has controls that ensure accurate financial data. The internal auditor often verifies the financial information provided by the managerial, financial, and tax accountants (all of whom report to the controller and ultimately to the CFO). If conflicts arise with the CFO, an internal auditor can report directly to the board of directors or to the audit committee, which consists of select board members.

9. The person responsible for managing the accounting staff that provides managerial accounting information used for internal decision making, financial accounting information for external reporting purposes, and tax accounting information to meet tax filing requirements.
10. The person who assists in preparing information used for decision making within the organization.
11. The person who assists in preparing financial information in accordance with U.S. GAAP for external users.
12. The person who assists in preparing tax reports for governmental agencies.
13. The person responsible for obtaining financing, projecting cash flow needs, and managing cash and short-term investments for the organization.
14. The person responsible for confirming that controls within the company are effective in ensuring accurate financial data.

Not All Organizations Are Alike!

Question: The organization chart in Figure 1.1 "A Typical Organization Chart" is intended to serve as a guide. However, all organizations are not the same, particularly smaller organizations. How might the organizational structure differ for a small organization?

Answer: Smaller organizations tend to have only one or two key finance and accounting personnel who perform the functions described previously. For example, one accountant might perform the financial and managerial accounting duties while another takes care of the tax work (or the tax work might be contracted out to a tax firm). Instead of employing its own internal auditor, an organization might hire one from an outside consulting firm. Some organizations may not have a CFO, or they may have a CFO but not a controller. An organization's structure depends on many different factors, including its size and reporting requirements, as indicated in the Note 1.23 "Business in Action 1.2".

Business in Action 1.2

The Organizational Structure of a Not-for-Profit Symphony

Financial limitations prevent a small not-for-profit symphony in California from hiring full-time finance and accounting employees. In spite of having annual revenues approaching $200,000, all financial transactions are processed and recorded by a part-time bookkeeper hired by the symphony. The bookkeeper also inputs budget information and provides monthly financial reports to the treasurer. The treasurer, a volunteer member of the board of directors, is responsible for establishing the annual budget and providing monthly financial reports to the board of directors. An outside firm prepares and processes all tax filings, assembles annual financial statements, and performs a review of the accounting operations at the end of each fiscal year.

Notice how the symphony does not have any of the formal positions identified in Figure 1.1 "A Typical Organization Chart", with the exception of the treasurer. This illustrates how financial constraints and reporting requirements may require an organization to be creative in establishing its organizational structure.

KEY TAKEAWAY

- It is important to understand the key accounting and finance positions within a typical company and how each position fits into the organizational structure. The chief financial officer (CFO) oversees all accounting and finance personnel, including the controller, treasurer, and internal auditor. The controller is responsible for the managerial, financial, and tax accounting staff.

REVIEW PROBLEM 1.3

For each of the six questions listed at the beginning of this section for Sportswear Company, determine who within the company would be responsible for providing the appropriate information. Assume Sportswear has the same organizational structure as the one shown in Figure 1.1 "A Typical Organization Chart".

Solution to Review Problem 1.3

1. The tax accountant is responsible for determining the income taxes to be paid to various government agencies.
2. The financial accountant prepares the annual report, which includes the income statement where net income can be found.
3. Although several personnel would likely be involved, the managerial accountant is responsible for providing financial projections. However, the financial accountant might provide historical information for existing geographic segments, which would form the basis for the managerial accountant's estimates.
4. The treasurer handles financing decisions.
5. Detailed financial information that goes beyond what is required by U.S. GAAP may be provided by the managerial accountants.
6. The internal auditors are responsible for evaluating the effectiveness of internal controls.

1.4 Ethical Issues Facing the Accounting Industry

LEARNING OBJECTIVE

1. Use standards of ethical conduct to resolve ethical conflicts facing accountants.

Imagine you are the accountant for Drive Write, a company that produces computer disk drives, and you are in charge of all accounting functions within the company. The president has informed you that if the company's profits grow by 20 percent this year, you will receive a $20,000 bonus, and she will receive a $50,000 bonus. No bonuses will be awarded if profit growth is less than 20 percent. Because the company's profits have grown 20 percent annually for the last 10 years, investors have come to expect significant growth from one year to the next. Near the end of this fiscal year, the president and you have the following conversation:

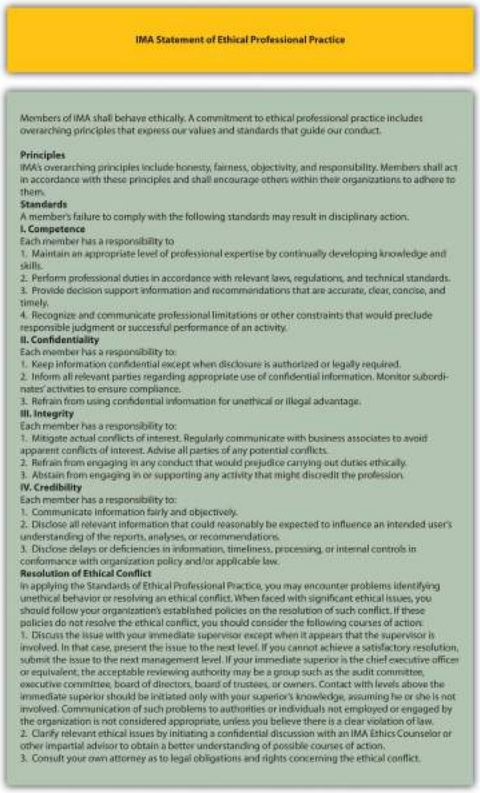
President:	*We are awfully close to hitting our numbers and getting to the 20 percent target. With two weeks remaining, projections show we will come in at 18 percent for the year. What can we do on the accounting side to increase current year profits?*
Accountant:	*Well, I'm not sure there is anything we can do. Our accounting is squeaky clean, as confirmed by our independent auditors. Perhaps our sales will improve next year.*
President:	*There has to be something we can do—I could sure use the bonus money, and our investors would appreciate an increase in their investment! I know we have a large customer order to be filled the first week of next year. Why not include that sale in this year's numbers?*
Accountant:	*I'm not comfortable recording sales in the wrong fiscal year.*
President:	*We're only talking about moving sales by a few days! I would like you to consider this carefully. If you can't do this, I may have to find an accountant who can! Let's talk about our options later this week.*

Question: The situation at Drive Write creates a serious ethical dilemma. (The Drive Write example is based on a real company called MiniScribe Corporation, subsequently purchased by a competitor.) Companies are constantly under pressure to meet sales and profit goals. Employees who succeed in meeting these goals often reap huge monetary rewards; those who fail may be penalized with lower pay or may even lose their jobs. What would you do if asked to record information in a way that distorts the company's financial results?

Answer: As the accountant for Drive Write, your response to the president's request would likely affect your reputation as a professional and your future as an accountant. The unethical behavior at corporations like **Xerox**, **Enron**, and **WorldCom** in recent years makes it imperative that we know both how to act ethically and how to resolve ethical conflicts.

To help guide accounting professionals through ethical dilemmas like the one at Drive Write, the Institute of Management Accountants (IMA) has established a *Statement of Ethical Professional Practice*, which appears in Figure 1.2 "IMA Statement of Ethical Professional Practice". The standards outlined in this statement are guidelines that can help accountants choose an ethically acceptable course of action. As you review Figure 1.2 "IMA Statement of Ethical Professional Practice", notice that the IMA specifies four core responsibilities (competence, confidentiality, integrity, and credibility) as well as guidelines on how to resolve ethical conflicts. The "Resolution of Ethical Conflict" section provides specific guidance on how to resolve the conflict at Drive Write.

Figure 1.2 *IMA Statement of Ethical Professional Practice*



IMA Statement of Ethical Professional Practice

Members of IMA shall behave ethically. A commitment to ethical professional practice includes overarching principles that express our values and standards that guide our conduct.

Principles
IMA's overarching principles include honesty, fairness, objectivity, and responsibility. Members shall act in accordance with these principles and shall encourage others within their organizations to adhere to them.

Standards
A member's failure to comply with the following standards may result in disciplinary action.

I. Competence
Each member has a responsibility to
1. Maintain an appropriate level of professional expertise by continually developing knowledge and skills.
2. Perform professional duties in accordance with relevant laws, regulations, and technical standards.
3. Provide decision support information and recommendations that are accurate, clear, concise, and timely.
4. Recognize and communicate professional limitations or other constraints that would preclude responsible judgment or successful performance of an activity.

II. Confidentiality
Each member has a responsibility to:
1. Keep information confidential except when disclosure is authorized or legally required.
2. Inform all relevant parties regarding appropriate use of confidential information. Monitor subordinates' activities to ensure compliance.
3. Refrain from using confidential information for unethical or illegal advantage.

III. Integrity
Each member has a responsibility to:
1. Mitigate actual conflicts of interest. Regularly communicate with business associates to avoid apparent conflicts of interest. Advise all parties of any potential conflicts.
2. Refrain from engaging in any conduct that would prejudice carrying out duties ethically.
3. Abstain from engaging in or supporting any activity that might discredit the profession.

IV. Credibility
Each member has a responsibility to:
1. Communicate information fairly and objectively.
2. Disclose all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, analyses, or recommendations.
3. Disclose delays or deficiencies in information, timeliness, processing, or internal controls in conformance with organization policy and/or applicable law.

Resolution of Ethical Conflict
In applying the Standards of Ethical Professional Practice, you may encounter problems identifying unethical behavior or resolving an ethical conflict. When faced with significant ethical issues, you should follow your organization's established policies on the resolution of such conflict. If these policies do not resolve the ethical conflict, you should consider the following courses of action:
1. Discuss the issue with your immediate supervisor except when it appears that the supervisor is involved. In that case, present the issue to the next level. If you cannot achieve a satisfactory resolution, submit the issue to the next management level. If your immediate superior is the chief executive officer or equivalent, the acceptable reviewing authority may be a group such as the audit committee, executive committee, board of directors, board of trustees, or owners. Contact with levels above the immediate superior should be initiated only with your superior's knowledge, assuming he or she is not involved. Communication of such problems to authorities or individuals not employed or engaged by the organization is not considered appropriate, unless you believe there is a clear violation of law.
2. Clarify relevant ethical issues by initiating a confidential discussion with an IMA Ethics Counselor or other impartial advisor to obtain a better understanding of possible courses of action.
3. Consult your own attorney as to legal obligations and rights concerning the ethical conflict.

Source: Adapted from the Institute of Management Accountants, http://www.imanet.org.

Question: The IMA is just one of many professional accounting organizations. Do other professional accounting organizations also provide guidance regarding ethics in accounting?

Answer: Yes, other professional organizations do provide ethical guidance. Several are listed as follows:

- The American Institute for Certified Public Accountants (AICPA) has a *Code of Professional Conduct* (see http://www.aicpa.org).
- Financial Executives International provides a *Model Code of Ethical Conduct for Financial Managers* (see http://www.financialexecutives.org).
- The International Federation of Accountants has a *Code of Ethics and Statement of Policy Implementation & Enforcement of Ethical Requirements* (see http://www.ifac.org).
- The Securities and Exchange Commission (SEC), in compliance with the Sarbanes-Oxley Act of 2002, requires a company to disclose whether it has adopted a code of ethics (see http://www.sec.gov).
- The Institute of Management Accountants even provides an ethics help line to give financial professionals a resource to provide guidance in making the right decisions (see http://www.imanet.org).

Because of alleged wrongdoing, such as that reported in the Note 1.27 "Business in Action 1.3", improving ethics is a top priority for most businesses as shown in the Note 1.28 "Business in Action 1.4". As a result, professional organizations like those we have cited have become instrumental in providing ethical guidelines.

Business in Action 1.3

Production Firm Employees Charged with Fraud

The Securities and Exchange Commission (SEC) filed three actions against **Diebold, Inc.**, a manufacturer and seller of automated teller machines, for improperly inflating earnings over a five-year period. Three former employees—the CFO, controller, and director of accounting—were accused of improperly inflating revenue on factory orders, improperly recognizing revenue on a lease transaction, manipulating reserves and accruals, improperly capitalizing expenses, and improperly increasing the value of inventory. These actions allegedly resulted in over 40 misstated annual, quarterly, and other reports filed with the SEC, along with numerous inaccurate press releases.

The company agreed to pay a $25,000,000 civil penalty, and the three former employees remain in litigation. Although the CEO was not accused of wrongdoing, he settled with the SEC and agreed to pay back cash bonuses, stock, and stock options received during the periods when the financial fraud was committed.

Source: Securities and Exchange Commission, "SEC Charges Diebold and Former Executives with Accounting Fraud," news release, June 2, 2010.

Business in Action 1.4

The Code of Ethics at **Home Depot** and **Hewlett-Packard**

Ethics policies are becoming increasingly important to organizations. **Home Depot, Inc.**, has an ethics code that "provides the basic principles for associates to make business decisions consistent with how Home Depot operates" and "forms the groundwork for our ethical behavior."

Hewlett-Packard Company has established "business ethics guided by enduring values." The company states it is committed to the following principles: honesty, excellence, responsibility, compassion, citizenship, fairness, and respect.

Sources: Home Depot, "Home Page," http://www.homedepot.com; Hewlett-Packard, "Home Page," http://www.hp.com.

KEY TAKEAWAY

- Should you encounter ethical conflicts during your career, use the resources provided by internal company policies, by professional organizations such as the IMA and AICPA, and by governmental organizations such as the SEC as a guide to ethical behavior and the resolution of ethical conflicts.

REVIEW PROBLEM 1.4

1. Describe the four key standards of ethical conduct for IMA members outlined in Figure 1.2 "IMA Statement of Ethical Professional Practice".
2. What steps does the IMA recommend for resolving ethical conflicts?
3. Using Figure 1.2 "IMA Statement of Ethical Professional Practice" as a guide, discuss your options as the accountant at Drive Write.

Solution to Review Problem 1.4

1. The four key standards shown in Figure 1.2 "IMA Statement of Ethical Professional Practice" are outlined as follows:

    1. **Competence.** Members of the IMA must maintain an adequate level of skill to perform duties in an accurate and professional manner.
    2. **Confidentiality.** Members of the IMA must not disclose confidential information for any reason unless legally obligated to do so.
    3. **Integrity.** Members of the IMA must avoid any actual or apparent conflict of interest, including receiving gifts or favors, and must not engage in any activity that would discredit the profession.
    4. **Credibility.** Members of the IMA must disclose all relevant information fairly and objectively.

2. Several options exist for resolving ethical conflicts. The IMA suggests the following courses of action:

    1. Follow the policies of the organization involving the resolution of ethical conflicts.
    2. If following the organization's policies does not effectively resolve the conflict, discuss the problem with your immediate supervisor unless the supervisor is involved.
    3. If the immediate superior cannot reach a satisfactory resolution, the problem should be presented to the next higher managerial level.
    4. If all higher levels of management do not reach a satisfactory resolution, an acceptable reviewing authority may be a group, such as the audit committee, executive committee, board of directors, board of trustees, or owners.

5. Another option includes consulting an objective advisor (e.g., IMA ethics counseling service or an attorney).

3. Several options are available. The IMA suggests first following the organization's policies with regard to resolving ethical conflicts. If Drive Write does not have policies in place or if following the organization's policies does not resolve the conflict, the next step is to discuss the conflict with the immediate supervisor. However, the president of Drive Write (the immediate supervisor) is involved in the conflict, so approaching the president's superiors would be best. This could be the audit committee, executive committee, board of directors, or owners. If after pursuing these different courses of action the ethical conflict still exists, it may be appropriate to consult an objective advisor (e.g., the IMA helpline) and perhaps consult an attorney as to legal obligations and rights concerning the ethical conflict. (Many would argue that regardless of the outcome, one would not want to work for a company where this type of unethical behavior occurs at the top, or anywhere within the organization, and that resigning is the best course of action.)

1.5 Computerized Accounting Systems

LEARNING OBJECTIVE

1. Understand how accounting systems can help organizations.

Question: Many companies today are growing out of their accounting systems. In the old days, accounting systems were designed primarily to track daily transactions and provide reports to external users on a monthly, quarterly, or annual basis. But times have changed, and companies now need more information internally to make good decisions. Accounting systems are currently used for both external reporting (financial accounting) and internal reporting (managerial accounting). Even relatively small accounting packages, such as QuickBooks and Peachtree, provide features that are important for managerial accounting. However, most agree that no single accounting system will meet the needs of every organization and that two important factors must be considered when choosing a system. What are the two factors that must be considered when deciding on an accounting system?

Answer: The two factors are (1) the size of the organization and (2) the information needs of the organization. Each factor is discussed next.

How Big Is Your Company?

Accounting software is designed to serve different-sized companies. The size of a company is commonly measured in sales revenue. Experts express varying opinions on what constitutes a small, midsized, or large company. Some believe that small companies have sales up to $10,000,000, midsized companies have sales up to $100,000,000, and large companies have sales greater than $100,000,000. Others prefer different amounts. Regardless of the number used, the goal is to find an accounting system that best meets the needs of the organization, and the size of the organization plays a big part in finding the best-fitting system.

What Information Is Needed?

Before selecting an accounting system, an organization must determine its accounting needs. Some organizations simply need the equivalent of a check register, which provides easy tracking of expense codes as checks are issued and

makes bank reconciliations a snap. Other organizations require more than a check register; they may demand a system that can create invoices, process payroll, and track inventory. More complex organizations will want the ability to perform more advanced functions. Such organizations might need to customize reports (e.g., create an income statement by division or customer), modify input screens, send financial reports via e-mail, export reports to spreadsheet software such as Excel, and create reports with graphics (e.g., tables, pie charts, and line charts).

Enterprise Resource Planning System

Question: Clearly the size and information needs of a company will drive the selection of an accounting system for the company. As the need for accounting data has become more complex, accounting systems have been developed that perform a wide variety of tasks. These systems are called enterprise resource planning systems. What is an enterprise resource planning system, and how does this system help companies utilize accounting data?

Answer: **Enterprise resource planning (ERP)**[15] systems are designed to record and share information across functional areas (e.g., accounting, marketing, human resources, and shipping) and across geographical areas (e.g., from a sales office in California to headquarters in Hong Kong). ERP systems continually update information to provide real-time data to all users, and the data can be organized in different formats to meet the needs of internal and external users. For example, in his book *Onward*, Howard Schultz describes how as CEO of **Starbucks** he reviews comparative financial data for **Starbucks** stores daily. This information comes from the ERP system at **Starbucks**.

The idea behind ERP software, and a central theme in managerial accounting, is that accurate and up-to-date financial information will help organizations make better decisions. Better decisions typically lead to improvements in profitability, efficiency, and customer satisfaction.

ERP systems are expensive. Annual costs for large organizations can easily exceed $10,000,000. However, smaller systems for midsized companies are available at a much lower cost. Most ERP software is offered in modules for functional accounting areas, such as accounts receivable, accounts payable, payroll, inventory, and job costing. The more modules included, the higher the cost will be. Popular makers of ERP systems include **Microsoft**, **Oracle**, and **SAP Corporation**.

15. A system designed to record and share information across functional and geographical areas to meet the needs of internal and external users.

In deciding whether to upgrade to an ERP system, organizations must be sure that the benefits of using the data from a new system outweigh the costs of implementing the system. If management does not intend to use the information to improve planning and decision making, then going with a less sophisticated accounting system may be the better approach.

Using Spreadsheet Software

Question: ERP systems commonly provide a means to download data to spreadsheets for further analysis. How can spreadsheet software help us to analyze financial information?

Answer: Since managers make extensive use of spreadsheets to organize and analyze data, most computerized accounting systems are designed to export data to spreadsheet software programs such as Excel. For example, Figure 1.3 "Excel Spreadsheet for Southwest Airlines" shows how a spreadsheet was used to import data directly from **Southwest Airlines'** 2010 annual report. This allows the user to analyze the data more easily. Notice that in Figure 1.3 "Excel Spreadsheet for Southwest Airlines" the total operating revenue increased over the three years shown. We could use Excel to quickly determine the exact percentage increase from 2008 to 2009 and from 2009 to 2010.

Figure 1.3 *Excel Spreadsheet for Southwest Airlines*

	A	B	C	D	E
1	SOUTHWEST AIRLINES CO.				
2	CONSOLIDATED STATEMENT OF INCOME				
3	Years Ended December 31, 2010, 2009, 2008				
4	(In millions)				
5		2010	2009	2008	
6	Operating revenues:				
7	Passenger	$11,489	$9,892	$10,549	
8	Freight	125	118	145	
9	Other	490	340	329	
10	Total operating revenues	$12,104	$10,350	$11,023	
11	Operating expenses:				
12	Salaries, wages, and benefits	$3,704	$3,468	$3,340	
13	Fuel and oil	3,620	3,044	3,713	
14	Maintenance materials and repairs	751	719	721	
15	Aircraft rentals	180	186	154	
16	Landing fees and other rentals	807	718	662	
17	Depreciation and amortization	628	616	599	
18	Other operating expenses	1,426	1,337	1,385	
19	Total operating expenses	$11,116	$10,088	$10,574	
20	Operating income	$988	$262	$449	
21	Other expenses (income):				
22	Interest expense	$167	$186	$130	
23	Capitalized interest	(18)	(21)	(25)	
24	Interest income	(12)	(13)	(26)	
25	Other (gains) losses, net	106	(54)	92	
26	Total other expenses (income)	$243	$98	$171	
27	Income before income taxes	$745	$164	$278	
28	Provision for income taxes	286	65	100	
29	Net income	$459	$99	$178	
30					
31					

Question: Let's assume you are asked to prepare an income statement showing revenue and expense projections for next year. How might you use Excel to prepare your projections?

Answer: You could start by exporting this year's results from the accounting system to an Excel spreadsheet. Then you could set up a new column to show estimates for next year. You would likely discuss different aspects of the income statement with various personnel in the organization—making changes as you go—before finalizing your projections.

Imagine the work involved if you did not use a computer but instead had to write the information down by hand. If there were any changes to the information, you would have to make time-consuming calculations, and once the data were finalized, you would be faced with the manual preparation of formal reports. With the relatively recent advances in business technology, the days of preparing

information manually are over. Most organizations require their accounting and finance personnel to have advanced computer spreadsheet skills. Our goal is to provide you with an opportunity to use spreadsheets in a way that mirrors the real world.

KEY TAKEAWAY

- Throughout this text, you will learn about different methods of recording, sorting, analyzing, and reporting financial information for internal users. Before deciding to implement one of these methods, ask yourself the following question: Will the benefits derived from a new system, such as an ERP system, exceed the costs of putting the system in place? If the answer is "yes," then go for it! If the answer is "no," consider other alternatives.

REVIEW PROBLEM 1.5

Assume you are the CFO for an electronics consulting firm with annual revenues of $30,000,000 and annual profit of $5,000,000. The current accounting system is used for basic functions, such as issuing checks, creating invoices, and processing payroll. The company is considering upgrading its accounting system by purchasing an ERP system. Describe the factors to be considered by the company in making this decision.

Solutions to Review Problem 1.5

This company is a midsized company with $30,000,000 in revenues, although some would argue that this is a small company. Going to an ERP system is probably not appropriate if management is simply looking for a few reports beyond what most financial accounting systems can provide.

If management has a need for more detailed and complex financial information—other than processing checks, invoices, and payroll—then a low-end ERP system might be appropriate. However, the benefits derived from such a system must outweigh the costs.

1.6 Cost Terminology

LEARNING OBJECTIVE

1. Understand the terms used for costing purposes.

Question: Much of what we discuss in this book relates to companies that manufacture products, such as Nike and Apple, and terminology is a key component of accounting for manufacturing companies. The challenge is in classifying costs correctly for items such as production materials, production labor, marketing department labor, rent for production facilities, and rent for the administrative services facilities. These costs must be classified accurately so that they appear correctly in company financial reports. The starting point for learning how to classify costs correctly is in understanding two broad categories of costs. What are the two broad terms used to categorize cost information in a manufacturing setting?

Answer: The two broad categories of costs are *manufacturing costs* and *nonmanufacturing costs*. Each category is described in detail as follows.

Manufacturing Costs

All costs related to the production of goods are called **manufacturing costs**[16]; they are also referred to as **product costs**[17]. A manufacturer purchases materials, employs workers who use the materials to assemble the goods, provides a building where the materials are stored and goods are assembled, and sells the goods. We classify the costs associated with these activities into three categories: *direct materials*, *direct labor*, and *manufacturing overhead*.

To help clarify which costs are included in these three categories, let's look at a furniture company that specializes in building custom wood tables called Custom Furniture Company. Each table is unique and built to customer specifications for use in homes (coffee tables and dining room tables) and offices (boardroom and meeting room tables). The sales price of each table varies significantly, from $1,000 to more than $30,000. Figure 1.4 "Direct Materials, Direct Labor, and Manufacturing Overhead at Custom Furniture Company" shows examples of production activities at Custom Furniture Company for each of the three categories (we continue using

16. All costs related to the production of goods; also called product costs.

17. All costs related to the production of goods; also called manufacturing costs.

this company as an example in Chapter 2 "How Is Job Costing Used to Track Production Costs?").

Figure 1.4 *Direct Materials, Direct Labor, and Manufacturing Overhead at Custom Furniture Company*

© Thinkstock

Direct Materials

Question: Raw materials used in the production process that are easily traced to the product are called **direct materials**[18]*. What materials used in the production process at Custom Furniture would be classified as direct materials?*

Answer: The wood used to build tables and the hardware used to attach table legs would be considered direct materials. Small, inexpensive items like glue, nails, and masking tape are typically not included in direct materials because the cost of tracing these items to the product outweighs the benefit of having accurate cost data. These minor types of materials, often called *supplies* or *indirect materials*, are included in manufacturing overhead, which we define later.

Direct Labor

Question: Workers who convert materials into a finished product and whose time is easily traced to the product are called **direct labor**[19]*. Who represents direct labor at Custom Furniture?*

18. Raw materials used in the production process that are easily traced to the product.

19. Labor performed by workers who convert materials into a finished product and whose time is easily traced to the product.

Answer: Direct labor would include the workers who use the wood, hardware, glue, lacquer, and other materials to build tables.

Manufacturing Overhead

Question: All costs associated with the production process other than direct material costs and direct labor costs are called **manufacturing overhead**[20]*. Terms synonymous with manufacturing overhead include factory overhead, factory burden, and overhead. What items are included in manufacturing overhead?*

Answer: Manufacturing overhead consists of the following:

- **Indirect material costs**[21]**.** The cost of materials necessary to manufacture a product that are *not* easily traced to the product or not worth tracing to the product.
- **Indirect labor costs**[22]**.** The cost of workers who are involved in the production process but whose time *cannot* easily be traced to the product. For example, supervisors in the production process who oversee several different products and are responsible for hiring employees, scheduling employees, and ordering materials are considered indirect labor.
- **Other manufacturing costs.** These are all other costs for items associated with the factory, including equipment maintenance, insurance, utilities, and depreciation.

Table 1.2 "Manufacturing Costs at Custom Furniture Company" provides several examples of manufacturing costs at Custom Furniture Company by category.

20. All costs associated with the production process other than direct material costs and direct labor costs.

21. The costs of materials necessary to manufacture a product that are not easily traced to the product or that are not worth tracing to the product.

22. The costs of workers who are involved in the production process but whose time cannot easily be traced to the product.

Table 1.2 Manufacturing Costs at Custom Furniture Company

Direct Materials
• Wood: cherry, maple, oak, and mahogany • Hardware: drawer handles
Direct Labor

• Workers who cut, plane, and glue wood • Workers who fill and sand tables • Workers who stain and finish tables
Manufacturing Overhead
• Indirect materials: glue, screws, nails, sandpaper, stain, and lacquer • Indirect labor: factory supervisors • Other manufacturing costs: equipment maintenance, equipment depreciation, factory utilities, factory insurance, factory building depreciation, and factory property taxes

Note 1.43 "Business in Action 1.5" details the materials, labor, and manufacturing overhead at a company that has been producing boats since 1968.

Business in Action 1.5

Photo courtesy of Brian Miller, http://www.flickr.com/photos/13233728@N00/5155012186/

Manufacturing Costs at **MasterCraft**

MasterCraft produces boats for water skiers and wake boarders. Each boat produced incurs significant manufacturing costs. **MasterCraft** records these manufacturing costs as inventory on the balance sheet until the boats are sold, at which time the costs are transferred to cost of goods sold on the income statement.

Examples of direct materials for each boat include the hull, engine, transmission, carpet, gauges, seats, windshield, and swim platform. Examples of indirect materials (part of manufacturing overhead) include glue, paint, and screws. Direct labor includes the production workers who assemble the boats and test them before they are shipped out. Indirect labor (part of manufacturing overhead) includes the production supervisors who oversee production for several different boats and product lines.

Manufacturing overhead includes the indirect materials and indirect labor mentioned previously. Other manufacturing overhead items are factory building rent, maintenance and depreciation for production equipment, factory utilities, and quality control testing.

Source: MasterCraft, “Home Page,” http://www.mastercraft.com.

Nonmanufacturing Costs

Costs that are *not* related to the production of goods are called **nonmanufacturing costs**[23]; they are also referred to as **period costs**[24]. These costs have two components—*selling costs* and *general and administrative costs*—which are described next. Examples of nonmanufacturing costs appear in Figure 1.5 "Examples of Nonmanufacturing Costs at Custom Furniture Company".

Selling Costs

Question: Costs incurred to obtain customer orders and provide customers with a finished product are called **selling costs**[25]*. (They are also often called marketing costs or selling and advertising costs.) What activities would be classified as selling costs at Custom Furniture?*

Answer: Examples of selling costs include advertising, sales commissions, salaries for marketing and advertising personnel, office space for marketing and advertising personnel, finished goods storage costs, and shipping costs paid by the seller for products shipped to customers.

General and Administrative Costs

Question: Costs related to the overall management of an organization are called **general and administrative costs**[26]*. What activities would be classified as general and administrative costs at Custom Furniture?*

Answer: Examples include personnel and support staff in the following areas: accounting, human resources, legal, executive, and information technology. Depreciation of office equipment and buildings associated with these areas would also be included as general and administrative costs. General and administrative costs are often simply called *administrative costs*.

23. Costs that are not related to the production of goods; also called period costs.
24. Costs that are not related to the production of goods; also called nonmanufacturing costs.
25. Costs incurred to obtain customer orders and provide customers with a finished product.
26. Costs related to the overall management of an organization.

Figure 1.5 *Examples of Nonmanufacturing Costs at Custom Furniture Company*

Although selling costs and general and administrative costs are considered nonmanufacturing costs, managers often want to assign some of these costs to products for decision-making purposes. For example, sales commissions and shipping costs for a specific product could be assigned to the product. This does not comply with U.S. GAAP because, under U.S. GAAP, only product costs can be assigned to products. However, as we noted earlier, managerial accounting information is tailored to meet the needs of the users and need not follow U.S. GAAP.

Distinguishing between manufacturing and nonmanufacturing costs is not always simple. For example, if legal staff works on an issue associated with production personnel and if human resources staff hires assembly line workers, are the costs involved manufacturing or nonmanufacturing costs? It is up to each organization to determine how to handle such costs for product costing purposes. The advantage of managerial accounting over financial accounting is that costs can be organized in any manner that helps managers make decisions. However, in this chapter, to avoid ambiguity, we follow the definitions provided by U.S. GAAP.

Presentation of Manufacturing and Nonmanufacturing Costs in Financial Statements

Question: At this point, you should be able to distinguish between manufacturing costs and nonmanufacturing costs. Why is it important to make this distinction?

Answer: Distinguishing between the two categories is critical because the category determines where a cost will appear in the financial statements. All manufacturing costs (direct materials, direct labor, and manufacturing overhead) are attached to inventory as an asset on the balance sheet until the goods are sold, at which point the costs are transferred to cost of goods sold on the income statement as an expense. As we indicated earlier, nonmanufacturing costs are also called *period costs*; that is because they are expensed on the income statement in the time period in which they are incurred.

Table 1.3 "Manufacturing Versus Nonmanufacturing Costs" clarifies the relationship between manufacturing and nonmanufacturing costs. It also describes the point at which these costs are recorded as expenses on the income statement. (Remember that the terms *manufacturing cost* and *product cost* are interchangeable, as are the terms *nonmanufacturing cost* and *period cost*.)

Table 1.3 Manufacturing Versus Nonmanufacturing Costs

Manufacturing Costs (Also Called Product Costs)	Nonmanufacturing Costs (Also Called Period Costs)
• Direct materials • Direct labor • Manufacturing overhead	• Selling • General and administrative
Timing of expense: Costs are expensed when goods are sold.	**Timing of expense:** Costs are expensed during the time period incurred.

Note 1.48 "Business in Action 1.6" provides examples of nonmanufacturing costs at **PepsiCo, Inc.**

Business in Action 1.6

Source: Photo courtesy of JeffBedord, http://www.flickr.com/photos/jeffbedford/6218820224/in/photostream/.

Nonmanufacturing Costs at **PepsiCo**

PepsiCo, Inc., produces more than 500 products under several different brand names, including Frito-Lay, Pepsi-Cola, Gatorade, Tropicana, and Quaker. Net sales for 2010 totaled $57,800,000,000, resulting in operating profits of $6,300,000,000. Cost of sales represented the highest cost on the income statement at $26,600,000,000. The second highest cost on the income statement—selling and general and administrative expenses—totaled $22,800,000,000. These expenses are period costs, meaning they must be expensed in the period in which they are incurred.

Examples of selling costs for **PepsiCo** include television advertising (probably the biggest piece of the $22,800,000,000), promotional coupons, costs of shipping products to customers, and salaries of marketing and advertising personnel.

Examples of general and administrative costs include salaries and bonuses of top executives and the costs of administrative departments, including personnel, accounting, legal, and information technology.

Source: PepsiCo, "PepsiCo 2010 Annual Report," http://www.pepsico.com.

KEY TAKEAWAY

- All manufacturing costs that are easily traceable to a product are classified as either direct materials or direct labor. All other manufacturing costs are classified as manufacturing overhead. All nonmanufacturing costs are not related to production and are classified as either selling costs or general and administrative costs.

REVIEW PROBLEM 1.6

1. The following manufacturing items are for a construction company working on several custom homes. Identify whether each item should be categorized as direct materials, direct labor, or manufacturing overhead.

    1. Nails
    2. Lumber
    3. Drywall
    4. Workers building the house frame
    5. Supervisor responsible for three homes
    6. Light bulbs
    7. Cabinets
    8. Depreciation of construction equipment

2. Identify whether each item in the following should be categorized as a product (manufacturing) cost or as period (nonmanufacturing) cost. Also indicate whether the cost should be recorded as an expense when the cost is incurred or as an expense when the goods are sold.

    1. Advertising
    2. Shipping costs for raw materials coming from a supplier
    3. Shipping costs for goods shipped to a customer
    4. Chief executive officer's salary
    5. Production supervisor's salary
    6. Depreciation on production equipment
    7. Raw materials used in production
    8. Paper used by the accounting staff
    9. Commissions paid to salespeople
    10. Janitorial services provided for production facility
    11. Supplies used by human resources personnel
    12. Utility costs for retail store
    13. Insurance costs for production facility
    14. Assembly line workers
    15. Clerical support for chief executive officer
    16. Maintenance of production equipment

3. Identify whether each item listed in item **2** should be categorized as direct materials, direct labor, manufacturing overhead, selling cost, or general and administrative cost.

Solution to Review Problem 1.6

1.

    1. Manufacturing overhead
    2. Direct materials
    3. Direct materials
    4. Direct labor
    5. Manufacturing overhead
    6. Manufacturing overhead (You might call this a direct material, but the benefit of tracking this item as a direct material probably does not outweigh the cost.)
    7. Direct materials
    8. Manufacturing overhead

2.

    1. Period cost, expensed when incurred
    2. Product cost, expensed when goods are sold
    3. Period cost, expensed when incurred
    4. Period cost, expensed when incurred
    5. Product cost, expensed when goods are sold
    6. Product cost, expensed when goods are sold
    7. Product cost, expensed when goods are sold
    8. Period cost, expensed when incurred
    9. Period cost, expensed when incurred
    10. Product cost, expensed when goods are sold
    11. Period cost, expensed when incurred
    12. Period cost, expensed when incurred
    13. Product cost, expensed when goods are sold
    14. Product cost, expensed when goods are sold
    15. Period cost, expensed when incurred
    16. Product cost, expensed when goods are sold

3.

    1. Selling
    2. Direct materials or manufacturing overhead, depending on if the materials are easily traced to the product (direct) or not (indirect manufacturing overhead)
    3. Selling

4. General and administrative
5. Manufacturing overhead
6. Manufacturing overhead
7. Direct materials or manufacturing overhead, depending on if the materials are easily traced to the product (direct) or not (indirect manufacturing overhead)
8. General and administrative
9. Selling
10. Manufacturing overhead
11. General and administrative
12. Selling
13. Manufacturing overhead
14. Direct labor
15. General and administrative
16. Manufacturing overhead

1.7 How Product Costs Flow through Accounts

LEARNING OBJECTIVE

1. Identify how costs flow through the three inventory accounts and cost of goods sold account.

Question: Custom Furniture Company's direct materials include items such as wood and hardware. Direct labor involves the employees who build the custom tables. Manufacturing overhead includes items such as indirect materials (glue, screws, nails, sandpaper, and stain), indirect labor (production supervisor), and other manufacturing costs, such as factory equipment maintenance and factory utilities. What accounts are used to record the costs associated with these items, and where do these accounts appear in the financial statements?

Answer: All the costs mentioned previously for Custom Furniture are product costs (also called *manufacturing costs*). Product costs are recorded as an asset on the balance sheet until the products are sold, at which point the costs are recorded as an expense on the income statement. To record product costs as an asset, accountants use one of three inventory accounts: raw materials inventory, work-in-process inventory, or finished goods inventory. The account they use depends on the product's level of completion. They use one expense account—cost of goods sold—to record the product costs when the goods are sold.

Table 1.4 "Accounts Used to Record Product Costs" summarizes the accounts used to track product costs. Figure 1.6 "Flow of Product Costs through Balance Sheet and Income Statement Accounts" shows how product costs flow through the balance sheet and income statement. Lastly, Note 1.57 "Business in Action 1.7" provides an example of how the accounts shown in Table 1.4 "Accounts Used to Record Product Costs" and Figure 1.6 "Flow of Product Costs through Balance Sheet and Income Statement Accounts" appear in financial statements. Take time to review these items carefully. Your understanding of them will help clarify how product costs flow through the accounts and where product costs appear in the financial statements. The following discussion provides further clarification.

Product Costs on the Balance Sheet

Question: What is the difference between raw materials inventory, work-in-process inventory, and finished goods inventory?

Answer: Each of these accounts is used to record product costs depending on where the product is in the production process, and each account is an asset account on the balance sheet.

Raw Materials

The **raw materials inventory**[27] account records the cost of materials not yet put into production. For Custom Furniture Company, this account includes items such as wood, brackets, screws, nails, glue, lacquer, and sandpaper.

Work in Process

The **work-in-process (WIP) inventory**[28] account records the costs of products that have not yet been completed. Suppose Custom Furniture Company has eight tables that are still in production at the end of the year. All manufacturing costs associated with these incomplete eight tables—direct materials, direct labor, and manufacturing overhead—are included in the WIP inventory account.

Once goods in WIP inventory are completed, they are transferred into finished goods inventory. The cost of completed goods that are transferred out of WIP inventory into finished goods inventory is called the **cost of goods manufactured**[29].

Finished Goods

The **finished goods inventory**[30] account records the manufacturing costs of products that are completed and ready to sell. Suppose Custom Furniture Company has five completed tables at the end of the year (in addition to the eight partially completed tables in work-in-process inventory). The manufacturing costs of these five tables—direct materials, direct labor, and manufacturing overhead—are included in the finished goods inventory account until the tables are sold. (For the purposes of this example, assume the tables are "sold" when delivered to the customer.)

27. An account used to record the cost of materials not yet put into production.
28. An account used to record costs associated with products in the production process that are not yet complete.
29. The cost of completed goods transferred from work-in-process inventory into finished goods inventory.
30. An account used to record the manufacturing costs associated with products that are completed and ready to sell.

Product Costs on the Income Statement

Question: The costs of materials not yet put into production are included in raw materials inventory. The costs associated with products that are not yet complete are included in WIP inventory. And the costs associated with products that are completed and ready to sell are included in finished goods inventory. What happens to the product costs in finished goods inventory when the products are sold?

Answer: When completed goods are sold, their costs are transferred out of finished goods inventory into the **cost of goods sold**[31] account. Cost of goods sold is an expense account on the income statement that represents the product costs of all goods sold during the period.

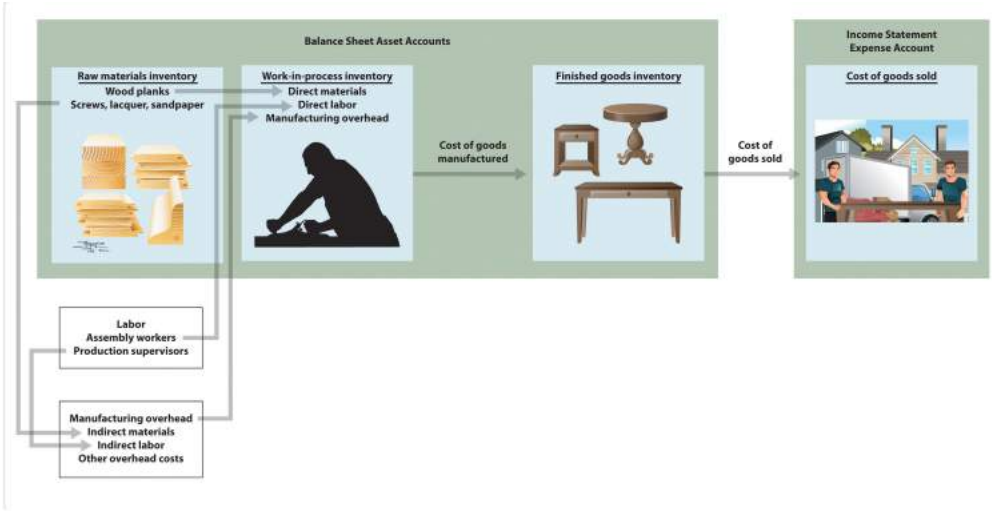
For example, suppose Custom Furniture Company sells one table that cost $3,000 to produce (i.e., direct materials, direct labor, and manufacturing overhead costs incurred to produce the table total $3,000). The $3,000 cost is in finished goods inventory until the entry is made to record the sale, at which time finished goods inventory is reduced by $3,000 (the table is no longer in inventory) and cost of goods sold is increased by $3,000.

Table 1.4 Accounts Used to Record Product Costs

Account Name	Description	Financial Statement
Raw materials inventory	Cost of unused production materials	Balance sheet (asset)
Work-in-process inventory	Cost of incomplete products	Balance sheet (asset)
Finished goods inventory	Cost of completed products not yet sold	Balance sheet (asset)
Cost of goods sold	Cost of products sold	Income statement (expense)

31. An expense account on the income statement that represents the product costs for all goods sold during the period.

Figure 1.6 *Flow of Product Costs through Balance Sheet and Income Statement Accounts*



Business in Action 1.7

Source: Photo courtesy of Matthew Rutledge, http://www.flickr.com/photos/rutlo/4252743250//.

Presentation of Product Costs at **Advanced Micro Devices**

Advanced Micro Devices (AMD), a producer of microprocessors and flash memory devices for personal and networked computers, has annual revenues of $6,500,000,000. A summarized version of **AMD's** balance sheet appears as follows (all amounts are in millions). Notice that three inventory accounts, totaling $632,000,000, support the total inventory amount that appears in the asset section of the balance sheet. The raw materials inventory account ($28,000,000) is used to record the cost of materials not yet put into production. The work-in-process inventory account ($441,000,000) is used to record costs associated with microprocessors and flash memory devices in the production process that are not yet complete. The finished goods inventory account ($163,000,000) is used to record the product costs associated with **AMD's** products that are completed and ready to sell.

Advanced Micro Devices
Balance Sheet
December 25, 2010

Assets			**Liabilities**	
Cash and short-term investments		$ 1,789	Accounts payable	$ 581
Accounts receivable, net		968	Accrued liabilities	698
Inventories:			Other liabilities	2,672
Raw materials	$ 28			
Work in process	441		**Stockholders' Equity**	
Finished goods	163		Common stock	6,481
Total inventories		632	Accumulated deficit	(5,468)
Property, plant and equipment		700	Total liabilities and	
Other assets		875	stockholders' equity	$ 4,964
Total assets		$4,964		

When **AMD** sells finished goods, the cost of these goods is transferred out of finished goods inventory into the cost of goods sold account, which this company calls *cost of sales*, as many companies do. The operating portion of **AMD's** income statement follows—again, all amounts are in millions. Notice that cost of sales appears below net sales and above all other operating expenses.

Advanced Micro Devices
Income Statement
Year Ended December 25, 2010

Net sales	$ 6,494
Expenses:	
Cost of sales	3,533
Research and development	1,405
Marketing, general and administrative	934
Legal settlement (income)	(283)
Other operating expenses	57
Operating income	$ 848

Source: Advanced Micro Devices, "Advanced Micro Devices 2010 Annual Report," http://www.amd.com.

KEY TAKEAWAY

- The raw materials inventory account is used to record the cost of materials not yet put into production. The work-in-process inventory account is used to record the cost of products that are in production but that are not yet complete. The finished goods inventory account is used to record the costs of products that are complete and ready to sell. These three inventory accounts are assets accounts that appear on the balance sheet. The costs of completed goods that are sold are recorded in the cost of goods sold account. This account appears on the income statement as an expense.

REVIEW PROBLEM 1.7

Match each of the following accounts with the appropriate description that follows.

- _____ Raw materials inventory
- _____ Work-in-process inventory
- _____ Finished goods inventory
- _____ Cost of goods sold

1. Used to record product costs of goods that are completed and ready to sell
2. Used to record product costs of goods that have been sold
3. Used to record product costs of goods that are still in production
4. Used to record the cost of materials not yet put into production

Solutions to Review Problem 1.7

Raw materials inventory	4. Used to record cost of materials not yet put into production.
Work-in-process inventory	3. Used to record product costs associated with incomplete goods in the production process.
Finished goods inventory	1. Used to record product costs associated with goods that are completed and ready to sell.
Cost of goods sold	2. Used to record product costs associated with goods that are sold.

1.8 Income Statements for Manufacturing Companies

LEARNING OBJECTIVE

1. Describe how to prepare an income statement for a manufacturing company.

Question: Companies that provide services, such as Ernst & Young (accounting) and Accenture LLP (consulting), do not sell goods and therefore have no inventory. The accounting process and income statement for service companies are relatively simple. Merchandising companies (also called retail companies) like Macy's and Home Depot buy and sell goods but typically do not manufacture goods. Since merchandising companies must account for the purchase and sale of goods, their accounting systems are more complex than those of service companies. Manufacturing companies, such as Johnson & Johnson and Honda Motor Company, produce and sell goods. Such companies require an accounting system that goes well beyond accounting solely for the purchase and sale of goods. Why are accounting systems more complex for manufacturing companies?

Answer: Accounting systems are more complex for manufacturing companies because they need a system that tracks manufacturing costs throughout the production process to the point at which goods are sold. Since income statements for manufacturing companies tend to be more complex than for service or merchandising companies, we devote this section to income statements for manufacturing companies. Understanding income statements in a manufacturing setting begins with the inventory cost flow equation.

Inventory Cost Flow Equation

Question: How do companies use the cost flow equation to calculate unknown balances?

Answer: We can use the basic cost flow equation to calculate unknown balances for just about any balance sheet account (e.g., cash, accounts receivable, and inventory). The equation is as follows:

Key Equation

Beginning balance *(BB)* + Transfers in *(TI)* – Ending balance *(EB)* = Transfers out *(TO)*

We will apply this equation to the three inventory asset accounts discussed earlier (raw materials, work in process, and finished goods) to calculate the cost of raw materials used in production, cost of goods manufactured, and cost of goods sold.

Raw materials used in production shows the cost of direct and indirect materials placed into the production process. *Cost of goods manufactured* represents the cost of goods completed and transferred out of work-in-process (WIP) inventory into finished goods inventory. *Cost of goods sold* represents the cost of goods that are sold and transferred out of finished goods inventory into cost of goods sold.

Accountants need all these amounts—raw materials placed in production, cost of goods manufactured, and cost of goods sold—to prepare an income statement for a manufacturing company. We describe how to calculate these amounts using three formal schedules in the following order:

1. Schedule of raw materials placed in production
2. Schedule of cost of goods manufactured
3. Schedule of cost of goods sold

Question: The basic cost flow equation can be used in three supporting schedules to help us determine the cost of goods sold amount on the income statement for manufacturing companies. What information is included in these schedules, and what do they look like for Custom Furniture Company?

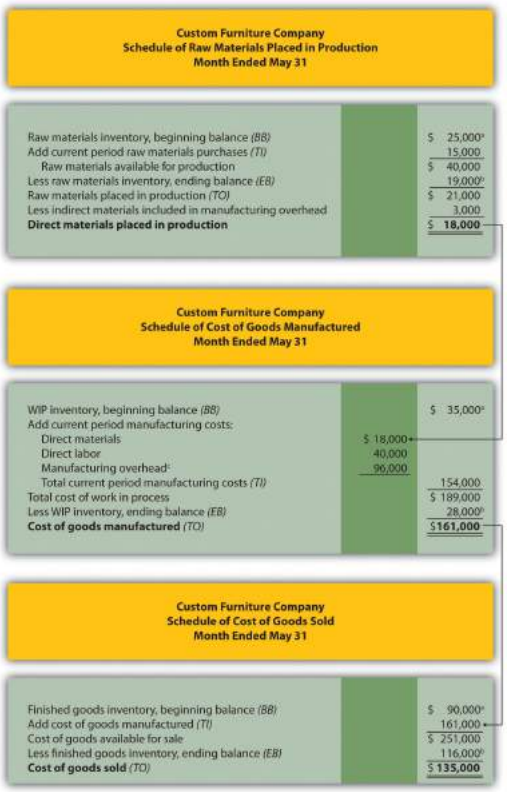
Answer: Figure 1.7 "Income Statement Schedules for Custom Furniture Company" shows these three schedules for Custom Furniture Company for the month of May. As you review these schedules, note that each schedule provides information required for the next schedule, as indicated by the arrows. Remember the inventory

cost flow equation is used for each schedule. This is why you see abbreviations for each element of the equation: beginning balance *(BB)*, transfers in *(TI)*, ending balance *(EB)*, and transfers out *(TO)*.

The goal of going through the process shown in Figure 1.7 "Income Statement Schedules for Custom Furniture Company" is to arrive at a cost of goods sold amount, which is presented on the income statement. Custom Furniture Company's income statement for the month ended May 31 is shown in Figure 1.8 "Income Statement for Custom Furniture Company". As you review Figure 1.7 "Income Statement Schedules for Custom Furniture Company" and Figure 1.8 "Income Statement for Custom Furniture Company", look back at Figure 1.6 "Flow of Product Costs through Balance Sheet and Income Statement Accounts" to see how costs flow through the three inventory accounts and the cost of goods sold account.

In Chapter 2 "How Is Job Costing Used to Track Production Costs?", we provide the detailed information necessary to prepare the schedules and income statement presented in Figure 1.7 "Income Statement Schedules for Custom Furniture Company" and Figure 1.8 "Income Statement for Custom Furniture Company". At this point, your job is to understand how we use the inventory cost flow equation to calculate raw materials placed in production, cost of goods manufactured, and cost of goods sold. (Note: Companies using a perpetual inventory system do not necessarily prepare these formal schedules because perpetual systems update records immediately when inventory is transferred from one inventory account to another. However, these companies take a physical count periodically to ensure the accuracy of inventory accounts and use the cost flow equation and similar schedules to ensure their perpetual system balances are accurate. Note 1.62 "Business in Action 1.8" shows how the cost flow equation can be used to analyze the effects of fraud that was allegedly committed at Rite Aid.)

Figure 1.7 *Income Statement Schedules for Custom Furniture Company*



[a] *From the company's balance sheet at April 30 (April 30 ending balance is the same as May 1 beginning balance).*

[b] *From the company's balance sheet at May 31.*

[c] *This is actual manufacturing overhead for the period and includes indirect materials, indirect labor, factory rent, factory utilities, and other factory-related expenses for the month. In Chapter 2 "How Is Job Costing Used to Track Production Costs?", we look at an alternative approach to recording manufacturing overhead called normal costing.*

Figure 1.8 *Income Statement for Custom Furniture Company*

Custom Furniture Company
Income Statement
Month Ended May 31

Sales	$ 190,000
Cost of goods sold	135,000 *
Gross profit	$ 55,000
Less operating (nonmanufacturing) expenses:	
Selling	18,000
General and administrative	26,000
Operating profit	$ 11,000

**$135,000 comes from the schedule of cost of goods sold in Figure 1.7 "Income Statement Schedules for Custom Furniture Company".*

Business in Action 1.8

Using the Cost Flow Equation to Analyze Fraud

Rite Aid Corporation operates 3,400 drug stores in the United States. In 2002, the Securities and Exchange Commission (SEC) filed accounting fraud charges against several former executives of **Rite Aid**. The SEC complaint alleged that **Rite Aid** had significantly overstated income for several years.

According to the complaint, **Rite Aid** executives committed financial fraud in several areas, one of which involved inventory. At the end of the company's fiscal year, the physical inventory count showed $9,000,000 less than **Rite Aid's** inventory balance on the books, presumably due to physical deterioration of the goods or theft. **Rite Aid** executives allegedly failed to record this shrinkage, thereby overstating ending inventory on the balance sheet and understating cost of goods sold on the income statement.

Using the cost flow equation, you can see how failing to record the $9,000,000 loss would understate cost of goods sold.

Beginning Balance (Inventory)	+	Transfers In (Purchases)	-	Ending Balance (Inventory)	=	Transfers Out (Cost of Goods Sold)
With fraud	$ 3,018,606,000	+	$ 9,024,821,000	-	$ 2,655,995,000	=	$ 9,387,432,000
Without fraud	$ 3,018,606,000	+	$ 9,024,821,000	-	$ 2,646,995,000	=	$ 9,396,432,000
Impact of fraud					$ 9,000,000 too high		$ 9,000,000 too low

By failing to record the inventory loss, **Rite Aid** overstated inventory (an asset) on the balance sheet by $9,000,000 and understated cost of goods sold (an expense) by $9,000,000 on the income statement. This ultimately increased profit by $9,000,000 because reported expenses were too low.

This inventory fraud was a relatively small part of the fraud allegedly committed by **Rite Aid** executives. In fact, **Rite Aid's** net income was restated downward by $1,600,000,000 in 2002. Several former executives pled guilty to conspiracy charges. The former chief executive, Martin Grass, was sentenced to

eight years in prison and the former chief financial officer, Franklyn Bergonzi, was sentenced to 28 months in prison. **Rite Aid's** stock fell from a high of $50 per share to $5 per share in 2003.

Sources: Securities and Exchange Commission, "Release 2002–92," news release, http://www.sec.gov; AP wires dated July 10, 2003, and May 27, 2004.

Manufacturing Versus Merchandising Income Statements

Question: Manufacturing companies clearly have more complex accounting systems to account for all the costs involved in producing products. However, the income statement for a manufacturing company is not all that much different than the income statement for a merchandising company. What are primary differences between manufacturing and merchandising company income statements?

Answer: The primary differences are as follows:

- Merchandising companies do not calculate the raw materials placed in production or cost of goods manufactured (shown in the top section of Figure 1.7 "Income Statement Schedules for Custom Furniture Company").
- Merchandisers purchase goods from suppliers instead of manufacturing goods. The cost of these purchases from suppliers is often called *net purchases* in the income statement, in contrast to *cost of goods manufactured* in a manufacturer's income statement. The net purchases line consists of purchases, purchases returns and allowances, purchases discounts, and freight in.
- Merchandisers do not use the schedule of cost of goods manufactured (and related schedule of raw materials placed in production).
- Merchandisers use an account called merchandise inventory, or simply inventory, instead of finished goods inventory. This reflects that merchandisers do not produce goods.

Table 1.5 "Income Statement Terminology in Manufacturing and Merchandising Companies" summarizes the differences in income statement terminology between manufacturing companies and merchandising companies.

Table 1.5 Income Statement Terminology in Manufacturing and Merchandising Companies

The following terms are used by manufacturing and merchandising companies: *sales*, *cost of goods available for sale*, *cost of goods sold*, *operating expenses*, *selling*, *general and administrative*, and *operating profit*.	
Finished goods inventory is used by manufacturing companies.	*Merchandise inventory* is used by merchandising companies.
Cost of goods manufactured is used by manufacturing companies.	*Net purchases* is used by merchandising companies.

Figure 1.9 "Merchandising Company Income Statement for Fashion, Inc." presents an income statement for Fashion, Inc., a retail company that sells clothing. Notice that the schedule of cost of goods manufactured (and related schedule of raw materials placed in production) is not needed for merchandising companies, and the terms *merchandise inventory* and *net purchases* are used instead of *finished goods inventory* and *cost of goods manufactured*. Also, the schedule of cost of goods sold is simply included in the income statement. Many companies prefer this approach because it means they do not have to prepare a separate schedule.

Figure 1.9 *Merchandising Company Income Statement for Fashion, Inc.*

Fashion, Inc.
Income Statement
Month Ended September 30

Sales		$450,000
Cost of goods sold:		
Merchandise inventory, beginning balance *(BB)*	$ 350,000	
Add net purchases *(TI)*	260,000	
Cost of goods available for sale	$ 610,000	
Less merchandise inventory, ending balance *(EB)*	$ 320,000	
Cost of goods sold		290,000
Gross profit		$ 160,000
Less operating expenses:		
Selling		90,000
General and administrative		40,000
Operating profit		$ 30,000

KEY TAKEAWAYS

- Three schedules are necessary to prepare an income statement for a manufacturing company, in the following order:
  - Schedule of raw materials placed in production, which shows cost of direct materials added to work-in-process inventory and cost of indirect materials added to manufacturing overhead
  - Schedule of cost of goods manufactured, which shows cost of goods completed and transferred out of work-in-process inventory into finished goods inventory
  - Schedule of cost of goods sold, which shows cost of goods sold and transferred out of finished goods inventory into cost of goods sold
- The income statements of merchandising companies differ from those of manufacturing companies in several areas. Merchandising companies do not use a schedule of raw materials placed in production or a schedule of cost of goods manufactured, and they use a merchandise inventory account instead of a finished goods inventory account. In addition, they use the term net purchases instead of cost of goods manufactured and often include the schedule of cost of goods sold in the income statement rather than presenting it separately.

REVIEW PROBLEM 1.8

Fine Cabinets, Inc., produces custom cabinets. The following inventory balances appeared on its balance sheet. (Note that the most current financial information is presented in the first column.)

	December 31, 2012	December 31, 2011
Raw materials inventory	$ 8,000	$ 10,000
Work-in-process inventory	600,000	550,000
Finished goods inventory	350,000	410,000

Fine Cabinets had $1,265,000 in sales for the year ended December 31, 2012. The company also had the following costs for the year:

Selling	$ 90,000
General and administrative	$240,000
Raw materials purchases	$100,000
Direct labor used in production	$125,000
Manufacturing overhead	$630,000

Of the total raw materials placed in production for the year, $12,000 was for indirect materials and must be deducted to find direct materials placed in production.

Required:

1. Prepare the schedules listed in the following for the year ended December 31, 2012. Use the format shown in Figure 1.7 "Income Statement Schedules for Custom Furniture Company". (Note that Figure 1.7 "Income Statement Schedules for Custom Furniture Company" shows information for a month and this review problem presents information for a year.)

    1. Schedule of raw materials placed in production
    2. Schedule of cost of goods manufactured
    3. Schedule of cost of goods sold

2. Prepare an income statement for the year ended December 31, 2012. Use the format shown in Figure 1.8 "Income Statement for Custom Furniture Company".
3. Assume Fine Cabinets, Inc., is a *merchandising* company that purchases its cabinets from a manufacturer. Use the information from the schedule of cost of goods sold prepared in requirement **1** and the income statement prepared in requirement **2** to prepare an income statement. Use the format shown in Figure 1.9 "Merchandising Company Income Statement for Fashion, Inc.".

Solution to Review Problem 1.8

1.

1.

Fine Cabinets, Inc.
Schedule of Raw Materials Placed in Production
Year Ended December 31, 2012

Raw materials inventory, beginning balance *(BB)*	$ 10,000
Add current period raw materials purchases *(TI)*	100,000
Raw materials available for production	$110,000
Less raw materials inventory, ending balance *(EB)*	8,000
Raw materials placed in production *(TO)*	$102,000
Less indirect materials included in manufacturing overhead	12,000
Direct materials placed in production	**$ 90,000**

2.

Fine Cabinets, Inc.
Schedule of Cost of Goods Manufactured
Year Ended December 31, 2012

WIP inventory, beginning balance *(BB)*		$ 550,000
Add current period manufacturing costs:		
Direct materials	$ 90,000*	
Direct labor	125,000	
Manufacturing overhead	630,000	
Total current period manufacturing costs *(TI)*		845,000
Total cost of work in process		$1,395,000
Less WIP inventory, ending balance *(EB)*		600,000
Cost of goods manufactured *(TO)*		$ **795,000**

$90,000 comes from the direct materials placed in production in part **1a.*

3.

Fine Cabinets, Inc.
Schedule of Cost of Goods Sold
Year Ended December 31, 2012

Finished goods inventory, beginning balance *(BB)*	$ 410,000
Add cost of goods manufactured *(TI)*	795,000*
Cost of goods available for sale	1,205,000
Less finished goods Inventory, ending balance *(EB)*	350,000
Cost of goods sold *(TO)*	$ **855,000**

$795,000 comes from the cost of goods manufactured (TO) in part **1b.*

4.

Fine Cabinets, Inc.
Income Statement
Year Ended December 31, 2012

Sales	$1,265,000
Cost of goods sold	855,000*
Gross profit	$ 410,000
Less operating (nonmanufacturing) expenses:	
Selling	90,000
General and administrative	240,000
Operating profit	$ 80,000

$855,000 comes from the cost of goods sold (TO) in part **1c.*

5.

Fine Cabinets, Inc.
Income Statement
Year Ended December 31, 2012

Sales		$ 1,265,000
Cost of goods sold:		
Merchandise inventory, beginning balance *(BB)*	$ 410,000	
Add net purchases *(TI)*	795,000	
Cost of goods available for sale	$ 1,205,000	
Less merchandise inventory, ending balance *(EB)*	350,000	
Cost of goods sold *(TO)*		855,000
Gross profit		$ 410,000
Less operating expenses:		
Selling		90,000
General and administrative		240,000
Operating profit		$ 80,000

END-OF-CHAPTER EXERCISES

Questions

1. Describe the characteristics of managerial accounting and financial accounting.
2. What are nonfinancial measures of performance? Provide several examples.

3. Which accountant (financial or managerial) would prepare each of the following reports:

    1. Income statement for the Chevrolet division of **General Motors**
    2. Balance sheet for **PepsiCo** prepared in accordance with U.S. GAAP
    3. **The Boston Symphony Orchestra's** budgeted income statement for next quarter
    4. Defect rate of computer chips produced by **Intel**
    5. Statement of cash flows for **Hewlett-Packard** prepared in accordance with U.S. GAAP

4. Describe the planning and control functions performed by most managers.
5. What is the controller's primary responsibility?
6. How do the treasurer's responsibilities differ from those of the controller?
7. Explain why ethical behavior is so important for finance and accounting personnel.
8. Briefly summarize the Institute of Management Accountants (IMA) *Statement of Ethical Professional Practice* shown in Figure 1.2 "IMA Statement of Ethical Professional Practice". What is the purpose of this statement?
9. Review Note 1.27 "Business in Action 1.3" Why would the company's former employees improperly record information as described here?
10. Review Note 1.28 "Business in Action 1.4" Why is improving ethics a top priority for businesses, such as **Home Depot** and **Hewlett-Packard**?
11. What is an enterprise resource planning system?
12. Why do manufacturing companies use product costing systems to track costs throughout the production process?
13. Describe manufacturing costs and nonmanufacturing costs. Provide examples of each.

14. Describe the difference between direct materials and direct labor versus indirect materials and indirect labor.
15. Why are the terms *product costs* and *period costs* used to describe manufacturing costs and nonmanufacturing costs?
16. How does the timing of recording expenses differ between product and period costs?
17. Review Note 1.43 "Business in Action 1.5" Why are items such as the hull, engine, transmission, carpet, and seats classified as direct materials and items such as glue, paint, and screws classified as indirect materials?
18. Review Note 1.48 "Business in Action 1.6" Provide two examples of selling costs and two examples of general and administrative costs at **PepsiCo**.
19. Describe the three inventory accounts used to record product costs.
20. What are the three categories of product costs that flow through the work-in-process inventory account? Describe each one.
21. When is the cost of goods sold account (often called *cost of sales*) used, and how is the dollar amount recorded in this account determined?
22. Review Note 1.57 "Business in Action 1.7" What are the names and dollar amounts of the inventory accounts appearing on the balance sheet? What is the total amount of product costs recorded as an expense on the income statement for the year ended December 31, 2010?
23. Describe the inventory cost flow equation and how it applies to the three schedules shown in Figure 1.7 "Income Statement Schedules for Custom Furniture Company".
24. How does a merchandising company income statement differ from a manufacturing company income statement?

Brief Exercises

25. **Accounting Information at Sportswear Company.** Refer to the dialogue between the president and accountant at Sportswear Company presented at the beginning of the chapter. Why can't the president find information for each product line (hats and jerseys) in the financial statements? Who within the company typically provides this type of information?
26. **Financial Versus Managerial Accounting.** Maria is the loan officer at a local bank that lends money to Old Town Market, a small grocery store. She requests several quarterly financial reports on an ongoing basis to assess the store's ability to repay the loan. Provide one example of a financial accounting report and two examples of managerial accounting reports that Maria might request.

27. **Planning and Control.** Two college graduates recently started a Web page design firm. The first month was just completed, and the owners are in the process of comparing budgeted revenues and expenses with actual revenues and expenses for the month. Would this be considered part of the planning function or the control function? Explain.

28. **Finance and Accounting Personnel.** Determine whether the chief financial officer, controller, treasurer, internal auditor, managerial accountant, financial accountant, or tax accountant would perform the following tasks. (Hint: Some job titles may be used more than once, and others may not be used at all.)

    a. Prepares annual reports for shareholders and creditors
    b. Provides a quarterly summary of financial results to the CEO and board of directors
    c. Provides profit and loss reports by product line
    d. Calculates estimated quarterly tax payments
    e. Oversees the treasurer and internal auditor
    f. Obtains sources of financing and manages short-term investments
    g. Verifies that annual report financial information is accurate

29. **Enterprise Resource Planning (ERP) System.** Enterprise resource planning (ERP) systems are designed to record and share information across functional and geographical areas on a real-time basis. However, these systems tend to be costly to purchase and maintain. Why do organizations continue to invest millions of dollars in ERP systems in spite of the cost?

30. **Manufacturing Cost Terms.** Indicate whether each of the following costs associated with production would be classified as direct materials, direct labor, or manufacturing overhead.

    1. Salaried supervisor responsible for several product lines
    2. Hourly workers assembling goods
    3. Grease used to maintain machines
    4. Maintenance personnel
    5. Bike frame used to build a racing bike
    6. Factory property taxes
    7. Glue used to assemble toys

31. **Manufacturing Cost Terms.** Indicate whether each of the following costs associated with production would be classified as direct materials, direct labor, or manufacturing overhead.

    1. Depreciation on production equipment
    2. Paint used to produce wagons
    3. Accounting staff performing tax services for a client
    4. Nails used to assemble cabinets
    5. Fiberglass used to produce a custom boat
    6. Hourly workers assembling goods
    7. Factory utilities

32. **Manufacturing and Nonmanufacturing Cost Terms.** Burns Company incurred costs for the following items.

    1. Salary of chief financial officer
    2. Factory insurance
    3. Salary for salespeople
    4. Raw materials used in production easily traced to the product
    5. Computer equipment depreciation for accounting department
    6. Insurance for headquarters building
    7. Production line workers
    8. Clerical support for production supervisors

    Required:

    a. Indicate whether each item should be categorized as a product or period cost.
    b. Indicate whether each item should be categorized as direct materials, direct labor, manufacturing overhead, selling, or general and administrative.

33. **Manufacturing and Nonmanufacturing Cost Terms.** Leighton, Inc., incurred costs for the following items.

    1. Janitorial services in the production facility
    2. Personnel department supplies
    3. Shipping costs for raw materials purchased from a supplier, easily traced to the product

4. Newspaper advertisements
5. Supervisor of several production lines
6. Insurance for factory equipment
7. Production line workers
8. Clerical support for sales staff

Required:

a. Indicate whether each item should be categorized as a product or period cost.
b. Indicate whether each item should be categorized as direct materials, direct labor, manufacturing overhead, selling, or general and administrative.

34. **Accounts Used to Record Product Costs.** Match each of the following accounts with the appropriate description that follows.

- _____ Raw materials inventory
- _____ Work-in-process inventory
- _____ Finished goods inventory
- _____ Cost of goods sold

1. Used to record product costs associated with goods that are sold
2. Used to record the cost of materials not yet put into production
3. Used to record product costs associated with goods that are complete and ready to sell
4. Used to record product costs associated with incomplete goods in the production process

35. **Income Statement Terminology: Manufacturing Versus Merchandising.** Match each of the following terms used in a manufacturing company's income statement with the equivalent term used in a merchandising company's income statement.

Manufacturing Company

- _____ Cost of goods manufactured

- _____ Work-in-process inventory
- _____ Finished goods inventory
- _____ Cost of goods sold

Merchandising Company

1. Merchandise inventory
2. Same term is used by a merchandising company
3. Net purchases
4. Not applicable for a merchandising company.

Exercises: Set A

36. **Financial Versus Managerial Accounting (Manufacturing).** The income statement from **Ford's** annual report appears as follows in summary form. (This information was obtained from the company's Web site, http://www.ford.com.)

Ford Motor Co.
Consolidated Income Statement
for the Years Ended December 31
(in millions)

	2010	2009
Revenue	$ 128,954	$ 116,283
Expenses		
Cost of goods sold	(104,451)	(98,866)
Selling, administrative, and other costs	(11,909)	(13,029)
Interest expense	(6,152)	(6,790)
Other income (expenses)	(181)	5,119
Net income	$ 6,261	$ 2,717

Required:

a. The financial information in the company's annual report was prepared primarily for shareholders and creditors in accordance with U.S. Generally Accepted Accounting Principles (U.S. GAAP). Does the income statement provide enough detailed information for managers at **Ford**? Explain.

b. Provide at least three additional detailed pieces of financial information that would help managers evaluate performance at **Ford**.
c. Provide at least two nonfinancial measures that would help managers evaluate performance at **Ford**.

37. **Organizational Structure.** The following list of personnel within organizations comes from Figure 1.2 "IMA Statement of Ethical Professional Practice".

1. Board of directors
2. Chief financial officer
3. Controller
4. Managerial accountant
5. Financial accountant
6. Tax accountant
7. Treasurer
8. Internal auditor

Required:

Match each previous item with the most accurate description as follows.

a. Assists in preparing information used for decision making within the organization
b. Assists in preparing tax reports for governmental agencies, including the Internal Revenue Service
c. Responsible for confirming that controls within the company are effective in ensuring accurate financial data, and serves as an independent link with the board of directors
d. Responsible for all finance and accounting functions within the organization and typically reports to the chief executive officer
e. Elected by the shareholders of the company
f. Oversees the managerial accountant, financial accountant, and tax accountant
g. Responsible for obtaining financing for the organization, projecting cash flow needs, and managing cash and short-term investments

h. Assists in preparing financial information, usually in accordance with U.S. GAAP, for those outside the company

38. **Schedule of Raw Materials Placed in Production.** The balance in Sedona Company's raw materials inventory account was $110,000 at the beginning of September and $135,000 at the end of September. Raw materials purchased during the month totaled $50,000. Sedona used $8,000 in indirect materials for the month.

Required:

Prepare a schedule of raw materials placed in production for the month of September.

39. **Schedule of Cost of Goods Manufactured.** The balance in Reid Company's work-in-process inventory account was $300,000 at the beginning of March and $320,000 at the end of March. Manufacturing costs for the month follow.

Direct materials (from the schedule of raw materials placed in production)	$ 40,000
Direct labor	$ 70,000
Manufacturing overhead	$200,000

Required:

Prepare a schedule of cost of goods manufactured for the month of March.

40. **Schedule of Cost of Goods Sold.** The balance in Blue Oak Company's finished goods inventory account was $25,000 at the beginning of September and $28,000 at the end of September. Cost of goods manufactured for the month totaled $17,000.

Required:

Prepare a schedule of cost of goods sold for the month of September.

41. **Income Statement.** Auto Products, Inc., had the following activity for the month of October.

Sales revenue	$1,100,000
Selling expenses	$ 300,000
General and administrative expenses	$ 230,000
Cost of goods sold	$ 475,000

Required:

Prepare an income statement for the month of October.

Exercises: Set B

42. **Financial Versus Managerial Accounting (Merchandising). Home Depot's** annual report appears as follows in summary form. (This information was obtained from the company's Web site, http://www.homedepot.com.)

Home Depot
Consolidated Income Statement
for the Years Ended January 30, 2011 and January 31, 2010
(in millions)

	2011	2010
Revenue	$ 67,997	$ 66,176
Expenses		
Cost of goods sold	(44,693)	(43,764)
Selling and administrative expenses	(15,849)	(15,902)
Income taxes and other expenses	(4,117)	(3,849)
Net income	$ 3,338	$ 2,661

Required:

a. The financial information in the company's annual report was prepared primarily for shareholders and creditors in accordance with U.S. GAAP. Does the income statement provide enough detailed information for managers at **Home Depot**? Explain.

b. Provide at least three additional detailed pieces of financial information that would help managers evaluate performance at **Home Depot**.
c. Provide at least two nonfinancial measures that would help managers evaluate performance at **Home Depot**.

43. **Organizational Structure.** The following list of personnel within organizations comes from Figure 1.2 "IMA Statement of Ethical Professional Practice".

1. Board of directors
2. Chief financial officer
3. Controller
4. Managerial accountant
5. Financial accountant
6. Tax accountant
7. Treasurer
8. Internal auditor

Required:

Match each previous item with the most accurate description as follows:

a. Responsible for hiring and overseeing the chief executive officer
b. Assists in preparing financial information for those outside the company, such as shareholders and bondholders
c. Responsible for reviewing internal controls within the company and ensuring accurate financial data
d. Responsible for controller, treasurer, and internal auditor functions within the organization
e. Responsible for projecting cash flow needs and managing cash and short-term investments
f. Oversees the managerial accountant, financial accountant, and tax accountant
g. Prepares profit information by product, which is used for decision making within the organization
h. Assists in establishing tax strategies for the organization

44. **Schedule of Raw Materials Placed in Production.** The balance in Clay Company's raw materials inventory account was $45,000 at the beginning of April and $38,000 at the end of April. Raw materials purchased during the month totaled $55,000. Clay used $14,000 in indirect materials for the month.

    Required:

    Prepare a schedule of raw materials placed in production for the month of April.

45. **Schedule of Cost of Goods Manufactured.** The balance in the work-in-process inventory account of Verdi Production, Inc., was $900,000 at the beginning of May and $750,000 at the end of May. Manufacturing costs for the month follow.

Direct materials (from the schedule of raw materials placed in production)	$340,000
Direct labor	$810,000
Manufacturing overhead	$660,000

    Required:

    Prepare a schedule of cost of goods manufactured for the month of May.

46. **Schedule of Cost of Goods Sold.** The balance in Posada Company's finished goods inventory account was $650,000 at the beginning of March and $625,000 at the end of March. Cost of goods manufactured for the month totaled $445,000.

    Required:

    Prepare a schedule of cost of goods sold for the month of March.

47. **Income Statement.** Game Products, Inc., had the following activity for the month of June.

Sales revenue	$800,000
Selling expenses	$100,000
General and administrative expenses	$200,000
Cost of goods sold	$360,000

Required:

Prepare an income statement for the month of June.

Problems

48. **Financial Versus Managerial Accounting (Service).** The income statement from the annual report of **United Parcel Service (UPS)** appears as follows in summary form. (This information was obtained from the company's Web site, http://www.ups.com.)

UPS
Consolidated Income Statement
for the Years Ended December 31
(in millions)

	2010	2009
Revenue	$ 49,545	$ 45,297
Expenses		
Compensation and benefits	(26,324)	(25,640)
Other expenses	(17,344)	(15,846)
Interest expense	(354)	(445)
Income taxes	(2,035)	(1,214)
Net income	$ 3,488	$ 2,152

Required:

a. The financial information in the company's annual report was prepared primarily for shareholders and creditors in accordance with U.S. GAAP. Does the income statement provide enough detailed information for managers at **UPS**? Explain.
b. Provide at least three additional detailed pieces of financial information that would help managers evaluate performance at **UPS**.

c. Provide at least two nonfinancial measures that would help managers evaluate performance at **UPS**.

49. **Income Statement and Supporting Schedules.** The following financial information is for Industrial Company. (Note that the most current financial information is presented in the first column.)

	December 31, 2011	December 31, 2010
Raw materials inventory	$ 24,000	$ 30,000
Work-in-process inventory	1,800,000	1,650,000
Finished goods inventory	1,050,000	1,230,000

Of the total raw materials placed in production for the year, $36,000 was for indirect materials. Industrial had $3,795,000 in sales for the year ended December 31, 2011. The company also had the following costs for the year:

Selling	$ 270,000
General and administrative	$ 720,000
Raw materials purchases	$ 300,000
Direct labor used in production	$ 375,000
Manufacturing overhead	$1,890,000

Required:

a. Prepare a schedule of raw materials placed in production for the year ended December 31, 2011.
b. Prepare a schedule of cost of goods manufactured for the year ended December 31, 2011.
c. Prepare a schedule of cost of goods sold for the year ended December 31, 2011.
d. Prepare an income statement for the year ended December 31, 2011.

e. Describe the three types of costs included in cost of goods sold on the income statement. (Dollar amounts are not necessary in your descriptions.)

50. **Income Statement and Supporting Schedules.** The following financial information is for Danville Company. (Note that the most current financial information is presented in the first column.)

	December 31, 2011	**December 31, 2010**
Raw materials inventory	$ 8,000	$ 10,000
Work-in-process inventory	600,000	550,000
Finished goods inventory	350,000	410,000

Of the total raw materials placed in production for the year, $12,000 was for indirect materials. Danville had $1,265,000 in sales for the year ended December 31, 2011. The company also had the following costs for the year:

Selling	$ 90,000
General and administrative	$240,000
Raw materials purchases	$100,000
Direct labor used in production	$125,000
Manufacturing overhead	$630,000

Required:

a. Prepare a schedule of raw materials placed in production for the year ended December 31, 2011.
b. Prepare a schedule of cost of goods manufactured for the year ended December 31, 2011.
c. Prepare a schedule of cost of goods sold for the year ended December 31, 2011.

d. Prepare an income statement for the year ended December 31, 2011.
e. Describe the three types of costs included in cost of goods manufactured. (Dollar amounts are not necessary in your descriptions.)

51. **Income Statement and Supporting Schedules.** The following information is for Ciena, Inc., for the year ended December 31, 2011.

Raw materials inventory beginning balance	$ 15,000
Raw materials inventory ending balance	$ 12,000
Work-in-process inventory beginning balance	$ 825,000
Work-in-process inventory ending balance	$ 900,000
Finished goods inventory beginning balance	$ 615,000
Finished goods inventory ending balance	$ 525,000
Raw material purchases	$ 150,000
Direct labor used in production	$ 187,500
Manufacturing overhead	$ 945,000
Selling costs	$ 135,000
General and administrative	$ 360,000
Sales revenue	$1,897,500

Of the total raw materials placed in production for the year, $18,000 was for indirect materials.

Required:

a. Prepare a schedule of raw materials placed in production for the year ended December 31, 2011.
b. Prepare a schedule of cost of goods manufactured for the year ended December 31, 2011.
c. Prepare a schedule of cost of goods sold for the year ended December 31, 2011.
d. Prepare an income statement for the year ending December 31, 2011.

52. **Income Statement and Supporting Schedules.** The following information is for Diablo, Inc., for the year ended December 31, 2011.

Raw materials inventory beginning balance	$ 60,000
Raw materials inventory ending balance	$ 48,000
Work-in-process inventory beginning balance	$3,300,000
Work-in-process inventory ending balance	$3,600,000
Finished goods inventory beginning balance	$2,460,000
Finished goods inventory ending balance	$2,100,000
Raw material purchases	$ 600,000
Direct labor used in production	$ 750,000
Manufacturing overhead	$3,780,000
Selling costs	$ 540,000
General and administrative	$1,440,000
Sales revenue	$7,590,000

Of the total raw materials placed in production for the year, $72,000 was for indirect materials.

Required:

a. Prepare a schedule of raw materials placed in production for the year ended December 31, 2011.
b. Prepare a schedule of cost of goods manufactured for the year ended December 31, 2011.
c. Prepare a schedule of cost of goods sold for the year ended December 31, 2011.
d. Prepare an income statement for the year ending December 31, 2011.

One Step Further: Skill-Building Cases

53. **Ethics: Accounting for Obsolete Inventory.** High Tech, Inc., is a public company that produces laser and ink jet printers. Jorge is an accounting staff member who works for the company's controller and is involved in preparing the annual report. One of High Tech's competitors developed a superior color laser jet printer using a less costly production process. Jorge realizes that High Tech's substantial inventory of color laser jet printers is effectively obsolete and will have to be written down to its net realizable value in accordance with U.S. GAAP. This means higher expenses and lower profits.

    Jorge's boss, the controller, is aware of the situation but the chief financial officer is not. In fact, the controller told the CFO that High Tech does not have any obsolete inventory. Both Jorge's boss and the CFO receive bonuses tied to the company's profits. The outside auditors are completing the audit and are unaware of the obsolete inventory.

    Required:

    How should Jorge handle this situation? Use the IMA's *Statement of Ethical Professional Practice* shown in Figure 1.2 "IMA Statement of Ethical Professional Practice" as a guide to answering this question.

54. **Internet Project: Institute of Management Accountants.** Go to the Web site of the Institute of Management Accountants (http://www.imanet.org). Review various parts of the site (e.g., *About IMA* or *Certification*) and write a one-page summary of your findings.
55. **Internet Project: American Institute of Certified Public Accountants.** Go to the Web site of the American Institute of Certified Public Accountants (AICPA; http://www.aicpa.org). Review various parts of the site (e.g., *About the AICPA* or *Professional Resources*) and write a one-page summary of your findings.
56. **Internet Project: Sarbanes-Oxley Act of 2002.** Go to the Securities and Exchange Commission's Web site (http://www.sec.gov) and click on *Laws and Regulations*. Click on the full text of the Sarbanes-Oxley Act of 2002.

    Required:

a. Go to section 302, *Corporate Responsibility for Financial Reports*, and summarize the six requirements in this section. Assume you are the chief financial officer of a public company. What concerns might you have about these requirements?
b. Go to section 404, subsection **a**, *Management Assessment of Internal Controls*. Assume you are an executive officer of a public company. What two items are you required to present in the annual report?

57. **Ethics: Companies Accused of Committing Fraud.** Using a source like *The Wall Street Journal*, *BusinessWeek*, or an Internet search engine, find an article about an organization accused of committing accounting fraud. Write a one-page summary of your findings. Include a copy of the article with your summary.
58. **Internet Project: Finding Company with Ethics Policy.** Using the Internet, find a company that has standards for ethical behavior. (Some companies refer to these standards as a "code of ethics"; others may use different terminology.) Write a one-page summary of your findings.
59. **Group Activity: Inventory Accounts for Manufacturing Company.** In groups of two to four students, use the Internet to find a manufacturing company that presents three inventory accounts on the balance sheet or in the notes to the financial statements. Include a printout of your findings, and explain what each account and related dollar amount represents.

Comprehensive Case

60. **Ethics: Accounting for Revenues and Expenses.** Equipment Group produces excavating equipment for contractors. Equipment Group is working on the annual financial statements for its shareholders, who are expecting profits of $200,000,000 for the year ending December 31. The controller (Jeff) and CFO (Kathy) will receive bonuses totaling 50 percent of their salaries if company profits exceed $200,000,000. Sarah is a staff accountant who works for the controller. One week before the end of the fiscal year, a customer decides to delay a significant purchase of equipment until March of the next year. As a result, Equipment Group's profits will decrease by $2,000,000 to $198,000,000 for the year.

Jeff, the controller, approaches Sarah and asks her to think of a way to increase profits by $2,500,000. He suggests looking at sales occurring in early January and perhaps moving them up to December. He also hints that some December expenses could be pushed back and recorded in January.

Required:

a. Is there a problem with the controller's request? Explain your answer.
b. How should Sarah handle this situation? There are many possible steps, as described in the IMA's *Statement of Ethical Professional Practice* shown in Figure 1.2 "IMA Statement of Ethical Professional Practice".
c. What are the potential consequences for Sarah if she agrees to do what Jeff suggests?

Chapter 2

How Is Job Costing Used to Track Production Costs?

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Dan Stevens recently started Custom Furniture Company, a manufacturing company that specializes in building custom wood tables for individuals and organizations. Each table is unique and built to customer specifications for use in homes (coffee tables and dining room tables) and offices (boardroom and meeting room tables). The sales price of each table varies significantly, from $1,000 to more than $30,000. (Note that this is the same company as the example in the last part of Chapter 1 "What Is Managerial Accounting?". Although not required, you may find it helpful to refer to the Chapter 1 "What Is Managerial Accounting?" discussion of Custom Furniture Company.)

When Dan received the company's income statement for May, he was surprised by the lack of profits. Because sales prices are based on a markup of estimated costs, Dan is questioning the accuracy of his estimates. He approaches Leslie, the full-time accountant for Custom Furniture Company, to get more information.

Dan:	*Leslie, last month's income statement shows we are struggling to make a decent profit. I'm not sure why this is happening, especially since we price our furniture 70 percent above estimated production costs.*
Leslie:	*Basing prices on estimated costs is a good approach, but it only works if your estimates are accurate. Have you compared the actual cost of each table with your original estimates?*
Dan:	*No, but I like the idea. Where do I start?*
Leslie:	*We use a job cost accounting system that tracks costs for each table you produce. I can pull together the information for you. How far back do you want to go?*
Dan:	*Let's start by looking at actual product costs for the three costliest tables produced in May. It would be helpful to break these costs out for direct materials, direct labor, and manufacturing overhead. I would also like to see the gross profit generated by each table.*
Leslie:	*No problem, I'll have the information for you by the end of the day.*

We use Custom Furniture Company as an example throughout the chapter to explain how a job costing system works and to provide information that will address Dan's concerns.

2.1 Differentiating Job Costing from Process Costing

LEARNING OBJECTIVE

1. Distinguish between job costing and process costing.

Question: Financial accounting classes cover how merchandising companies, such as Sears and Lowe's, account for the cost of the goods that they purchase from a supplier and later sell to a customer. These companies simply record the cost of the purchase in an inventory account and account for any returns and allowances, discounts, and shipping costs. Once the merchandise is sold, the related inventory costs are transferred to cost of goods sold. However, manufacturing companies are different. How do manufacturing companies account for inventory at different stages of production?

Answer: Manufacturing companies like Custom Furniture Company, **Ford**, and **IBM** don't have it quite as easy as merchandising companies. They must account for the materials, labor, and other manufacturing costs that go into building the product. The process of accounting for manufacturing costs depends on which costing system a company uses—job costing or process costing.

Job Costing

Question: We define a **job**[1] *as an activity that produces a unique product—one that can be easily distinguished from other products. For example, building a custom home is a job because the home is unique and easy to distinguish from other homes. An accounting firm's provision of tax services to a client is another example of a job. How does a job costing system help companies that produce unique products or jobs?*

Answer: A **job costing system**[2] records revenues and costs for each job. Because each job at Custom Furniture Company results in a unique product and has different material and labor requirements, the company uses a job costing system.

Tracking revenues and costs for each job is important for several reasons:

1. An activity that results in a unique product, one easily distinguished from other products.
2. A system that records revenues and costs for each job.

- Like Dan at Custom Furniture, managers want to assess the accuracy of cost estimates. This is particularly important when prices are based on estimated costs.
- Managers want to review actual revenues and costs for each job to see if the job is profitable.
- Managers want to compare actual costs with estimated costs throughout a project so they can identify unexpected changes as early in the project as possible. For example, if the cost of mahogany wood increases by 50 percent, Custom Furniture might renegotiate the price of a mahogany table with the customer. If it's too late to renegotiate the price of a current job, the cost increase could be built into the pricing of future jobs.

Process Costing

Question: Job costing may work for builders of custom furniture and tax professionals, but does job costing make sense for a company that produces soft drinks? Imagine trying to track costs for each can of soda produced. A job costing system would not be appropriate for this type of company. A different costing system, called process costing, would be a better fit. Which types of companies use this type of system?

Answer: Companies that produce identical units of product in batches using a consistent process track costs with a **process costing system**[3]. Table 2.1 "Job Costing Versus Process Costing" lists some products and services that require the use of process costing versus job costing, and Figure 2.1 "Examples of Job Costing and Process Costing" shows an example of each. This chapter focuses on job costing. We explore process costing further in Chapter 4 "How Is Process Costing Used to Track Production Costs?".

Table 2.1 Job Costing Versus Process Costing

Job Costing	Process Costing
Custom homes	Oil
Custom vans	Chemicals
House painting services	Paint
Movies	Lumber
Airplanes	Milk

3. A costing system used by companies that produce identical units of product in batches employing a consistent process.

Job Costing	Process Costing
Bridges	Pencils
Legal services	Paper

Figure 2.1 *Examples of Job Costing and Process Costing*

Builders of unique products, such as custom homes, use job costing to track costs.

Producers of identical products produced in batches, such as bottled drinks, use process costing to track costs.

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KEY TAKEAWAY

- Job costing systems record revenues and costs for unique products; ones that can be easily distinguished from other products. Process costing systems record revenues and costs for batches of identical units of product. When deciding whether to use a job costing or process costing system, we must understand a company's products and production processes.

REVIEW PROBLEM 2.1

Identify whether each company listed in the following would use job costing or process costing.

a. **Coca-Cola Company**
b. **Kelly Moore Paint**
c. **Volkswagen**—custom campers
d. **Universal Studios**—movie division
e. **Chevron Corporation**
f. **Michelin**
g. **Boeing Co.**
h. **Ernst & Young**—tax division

Solutions to Review Problem 2.1

a. Process costing
b. Process costing
c. Job costing
d. Job costing
e. Process costing
f. Process costing
g. Job costing
h. Job costing

2.2 How a Job Costing System Works

LEARNING OBJECTIVE

1. Understand how direct materials and direct labor costs are assigned to jobs.

Question: Now that we know a job costing system records revenues and costs for each unique job, we can determine whether this type of system would be appropriate at Custom Furniture Company. Recall that Custom Furniture produces high-quality custom wood tables that are sold for between $1,000 and $30,000. A job costing system is a perfect fit for this type of company. How would Custom Furniture Company use a job costing system to track production costs?

Answer: We use financial information for the month of May at Custom Furniture Company to illustrate how a job costing system works. Refer to Chapter 1 "What Is Managerial Accounting?", as needed, for a refresher on manufacturing cost terms and how the three different inventory accounts are used by manufacturing companies. Let's start our example with the purchase of raw materials.

Purchasing Raw Materials

Question: Recall from Chapter 1 "What Is Managerial Accounting?" that raw materials are the items necessary to build a product. For Custom Furniture Company, this includes items such as wood, brackets, screws, nails, glue, lacquer, and sandpaper. How do we record the purchase of raw materials?

Answer: The accountants at Custom Furniture record the cost of raw materials purchased in the raw materials inventory account. Assume Custom Furniture Company purchased $4,500 in raw materials on May 2. All purchases are on account. The journal entry to reflect this transaction is as follows:

May 2	Raw materials inventory	4,500	
	Accounts payable		4,500

This purchase of raw materials is further illustrated in the T-accounts shown in the following. Assume the beginning balance for raw material inventory is $25,000. Beginning balances are only provided for inventory accounts since the focus of this chapter is on manufacturing costs that flow through these accounts.

Introductory financial accounting texts discuss the rules for double-entry accounting in detail. Recall that the following account categories are *increased* with a *debit* (and are therefore decreased with a credit): assets, dividends, and expenses. Conversely, the following account categories are *increased* with a *credit* (and decreased with a debit): liabilities, stockholders' equity, and revenues. Also note that the individual transactions shown throughout this chapter represent one example of many similar transactions that occurred throughout the month of May. A summary of activity for the entire month of May is presented in Figure 2.7 "Custom Furniture Company's Journal Entries for May" and Figure 2.8 "Custom Furniture Company's T-Accounts".

Assigning Direct Material Costs to Jobs

Question: The next step is to move raw materials from the storeroom to production. How does the company track this information, and how is this transaction recorded in the general journal?

Answer: A **materials requisition form**[4] tracks materials taken out of raw materials inventory and placed in production. This form specifies the type, quantity, and cost of materials being requested, as well as the number of the job in which the materials will be used. Figure 2.2 "Materials Requisition Form for Custom Furniture

4. A form used to track materials taken out of raw materials inventory and placed into production.

Company" shows a materials requisition form that Custom Furniture Company used to transfer $370 in direct materials out of raw materials inventory into production.

Figure 2.2 *Materials Requisition Form for Custom Furniture Company*

Date May 3 Materials Requisition No. 205
Job Number Charged 50

Quantity	Item Number	Description	Total Cost
40 feet	C230	Cherry wood planks	$240
25 feet	M120	Mahogany trim	$130
Total			$370

Supervisor's Signature _____

The journal entry to reflect this transfer is as follows:

May 3	WIP inventory	370	
	Raw materials inventory		370

This flow of direct materials from one account to another is further illustrated in the T-accounts that follow. Assume the beginning balance for work-in-process inventory is $35,000.

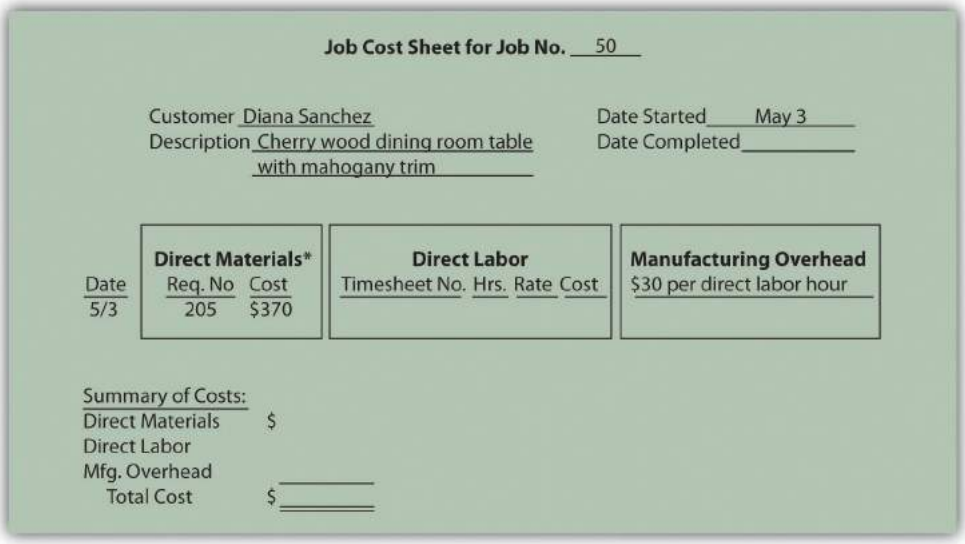
Raw Materials Inventory				WIP Inventory		
Beg. bal.	25,000			Beg. bal.	35,000	
(May 2)	4,500	370	(May 3) →	(May 3)	370	

Using a Job Cost Sheet

Question: The next step is to post the information shown on the materials requisition form to the appropriate job cost sheet. Because the work-in-process (WIP) inventory account tracks manufacturing costs in total, a separate subsidiary ledger is necessary to track manufacturing costs for each job. The total of all WIP inventory subsidiary ledgers matches the WIP inventory account shown on the balance sheet. What does a WIP inventory subsidiary ledger look like, and how is it used?

Answer: The WIP inventory subsidiary ledger typically comprises many individual *job cost sheets*. A **job cost sheet**[5] simply accumulates manufacturing costs incurred for each job. Figure 2.3 "Job Cost Sheet for Custom Furniture Company" shows a job cost sheet for Custom Furniture Company. Notice how the materials requisition in Figure 2.2 "Materials Requisition Form for Custom Furniture Company" is a line item in the job cost sheet for job 50.

Figure 2.3 *Job Cost Sheet for Custom Furniture Company*



**$370 comes from the total in Figure 2.2 "Materials Requisition Form for Custom Furniture Company".*

Assigning Direct Labor Costs to Jobs

Question: Recall from Chapter 1 "What Is Managerial Accounting?" that direct labor is defined as workers who convert materials into a finished product and whose time is easily traced to the product or job. Manufacturing companies, such as Custom Furniture Company, must keep track of the hours each worker spends on any given job. How do companies track this information, and how is this information recorded in the general journal?

5. A means of accumulating the manufacturing costs incurred for each job.

6. A document that workers use to track the hours spent on each job.

Answer: Workers use a **timesheet**[6] to track the hours spent on each job. The timesheet is often called a *time card*, *time ticket*, or *job ticket*. The worker is

responsible for completing the timesheet, including the date, job number, and hours worked on each job.

Figure 2.4 "Timesheet for Custom Furniture Company" provides an example of a timesheet used at Custom Furniture Company to track direct labor costs of $120 related to jobs 50 and 51 for Tim Wallace. The journal entry to reflect this is as follows:

May 4	WIP inventory	120	
	Wages payable		120

Recording these direct labor costs is further illustrated in the T-accounts that follow. Again, beginning balances are only provided for inventory accounts since the focus of this chapter is on manufacturing costs that flow through these accounts.

WIP Inventory			Wages Payable		
Beg. bal.	35,000			Beg. bal.	XX
(May 3)	370			120	(May 4)
(May 4)	120				

Figure 2.4 *Timesheet for Custom Furniture Company*

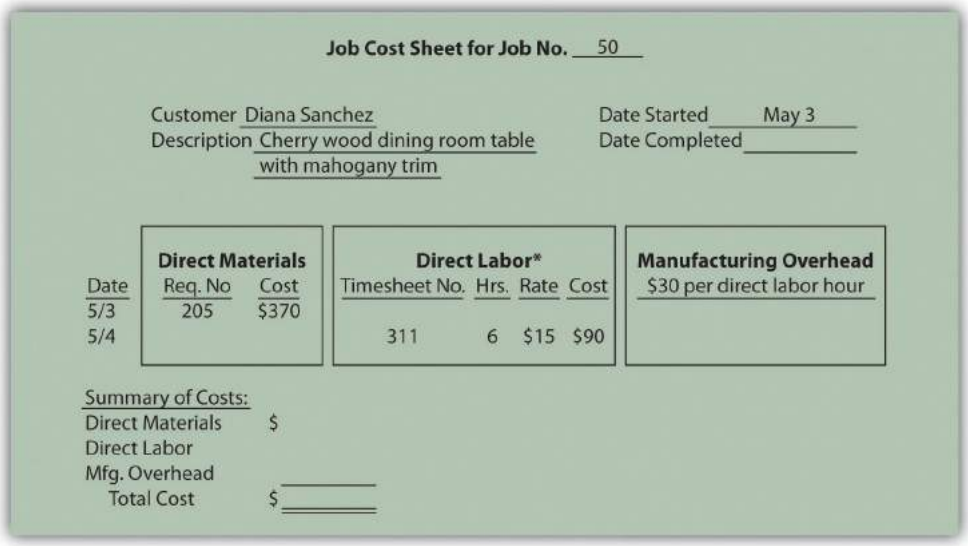
Name Tim Wallace Timesheet No. 311
Date May 4

Job Number	Hours	Rate	Total Cost
50	6	$15	$ 90
51	2	15	$ 30
Total			$120

Supervisor's Signature _____

The next step is to post the information shown on the timesheet to the appropriate job cost sheet, just as we did with direct materials. This is done for job 50 in Figure 2.5 "Direct Labor Costs for Custom Furniture Company's Job 50".

Figure 2.5 *Direct Labor Costs for Custom Furniture Company's Job 50*



Job Cost Sheet for Job No. 50

Customer Diana Sanchez
Description Cherry wood dining room table with mahogany trim

Date Started May 3
Date Completed

Date	Direct Materials Req. No	Direct Materials Cost	Direct Labor* Timesheet No.	Hrs.	Rate	Direct Labor* Cost	Manufacturing Overhead $30 per direct labor hour
5/3	205	$370					
5/4			311	6	$15	$90	

Summary of Costs:
Direct Materials $
Direct Labor
Mfg. Overhead
Total Cost $

*Direct labor information carried over from Figure 2.4 "Timesheet for Custom Furniture Company".

KEY TAKEAWAY

- A materials requisition form tracks materials taken out of raw materials inventory and placed in production. It identifies the job in which the materials will be used. A timesheet tracks the hours that workers spend on each job. The information from both the materials requisition forms and timesheets is recorded on each job cost sheet. A job cost sheet accumulates manufacturing costs for each job and serves as a subsidiary ledger for the work-in-process inventory account.

REVIEW PROBLEM 2.2

1. Provide the journal entry to record each of the following transactions:

    1. Raw materials totaling $40,000 are purchased on account.
    2. Direct materials totaling $5,000 are requisitioned and placed into production.
    3. Timesheets submitted by employees reflect direct labor costs of $2,000, to be paid the next week.

2. Which of the previously stated entries must also be recorded on the appropriate job cost sheet? Why?

Solutions to Review Problem 2.2

1.

1.

2.

3.

4. Entries **b** and **c** must be recorded on the appropriate job cost sheet. Direct materials (entry **b**) and direct labor (entry **c**) are by definition easily traceable to the job and therefore

must be recorded on the job cost sheet when the cost is incurred.

2.3 Assigning Manufacturing Overhead Costs to Jobs

LEARNING OBJECTIVE

1. Understand how manufacturing overhead costs are assigned to jobs.

Question: We have discussed how to assign direct material and direct labor costs to jobs using a materials requisition form, timesheet, and job cost sheet. The third manufacturing cost—manufacturing overhead—requires a little more work. How do companies assign manufacturing overhead costs, such as factory rent and factory utilities, to individual jobs?

Answer: Recall from Chapter 1 "What Is Managerial Accounting?" that manufacturing overhead consists of all costs related to the production process other than direct materials and direct labor. Because manufacturing overhead costs are difficult to trace to specific jobs, the amount allocated to each job is based on an estimate. The process of creating this estimate requires the calculation of a predetermined rate.

Using a Predetermined Overhead Rate

The goal is to allocate manufacturing overhead costs to jobs based on some common activity, such as direct labor hours, machine hours, or direct labor costs. The activity used to allocate manufacturing overhead costs to jobs is called an **allocation base**[7]. Once the allocation base is selected, a predetermined overhead rate can be established. The **predetermined overhead rate**[8] is calculated prior to the year in which it is used in allocating manufacturing overhead costs to jobs.

Calculating the Predetermined Overhead Rate

Question: How is the predetermined overhead rate calculated?

7. The activity used to allocate manufacturing overhead costs to jobs.

8. A rate established prior to the year in which it is used in allocating manufacturing overhead costs to jobs.

Answer: We calculate the predetermined overhead rate as follows, using estimates for the coming year:

Key Equation

$$\text{Predetermined overhead rate} = \frac{\text{Estimated overhead costs*}}{\text{Estimated activity in allocation base**}}$$

*The numerator requires an estimate of all overhead costs for the year, such as indirect materials, indirect labor, and other indirect costs associated with the factory. Custom Furniture Company estimates annual overhead costs to be $1,140,000 based on actual overhead costs last year.

**The denominator requires an estimate of activity in the allocation base for the year. Custom Furniture uses direct labor hours as the allocation base and expects its direct labor workforce to record 38,000 direct labor hours for the year.

The predetermined overhead rate calculation for Custom Furniture is as follows:

$$\begin{aligned}\text{Predetermined overhead rate} &= \frac{\$1{,}140{,}000 \text{ estimated overhead costs}}{38{,}000 \text{ estimated direct labor hours}} \\ &= \$30 \text{ per direct labor hour}\end{aligned}$$

Thus each job will be assigned $30 in overhead costs for every direct labor hour charged to the job. The assignment of overhead costs to jobs based on a predetermined overhead rate is called **overhead applied**[9]. Remember that overhead applied does *not* represent actual overhead costs incurred by the job—nor does it represent direct labor or direct material costs. Instead, overhead applied represents a portion of estimated overhead costs that is assigned to a particular job.

Question: Now that we know how to calculate the predetermined overhead rate, the next step is to use this rate to apply overhead to jobs. How do companies use the predetermined overhead rate to apply overhead to jobs, and how is this information recorded in the general journal?

9. The assignment of overhead costs to jobs based on a predetermined overhead rate.

Answer: As shown on the timesheet in Figure 2.4 "Timesheet for Custom Furniture Company", Tim Wallace charged six hours to job 50. Because manufacturing overhead is applied at a rate of $30 per direct labor hour, $180 (= $30 × 6 hours) in overhead is applied to job 50. The journal entry to reflect this is as follows:

May 4	WIP inventory	180	
	Manufacturing overhead		180

Recording the application of overhead costs to a job is further illustrated in the T-accounts that follow.

Manufacturing Overhead			WIP Inventory	
	180	(May 4)	Beg. bal.	35,000
			(May 3)	370
			(May 4)	120
			(May 4)	180

When this journal entry is recorded, we also record overhead applied on the appropriate job cost sheet, just as we did with direct materials and direct labor. Figure 2.6 "Overhead Applied for Custom Furniture Company's Job 50" shows the manufacturing overhead applied based on the six hours worked by Tim Wallace. Notice that total manufacturing costs as of May 4 for job 50 are summarized at the bottom of the job cost sheet.

Figure 2.6 *Overhead Applied for Custom Furniture Company's Job 50*

**$180 = $30 per direct labor hour × 6 direct labor hours.*

Selecting an Allocation Base

Question: Although we used direct labor hours as the allocation base for Custom Furniture Company's predetermined overhead rate, organizations use various other types of allocation bases. The most common allocation bases are direct labor hours, direct labor costs, and machine hours. What factors do companies consider when deciding on an allocation base?

Answer: Companies typically look at the following two items when determining which allocation base to use:

1. **Link to overhead costs.** The goal is to find an allocation base that drives overhead costs, often called a **cost driver**[10]. For example, if a company's production process is labor intensive (i.e., it requires a large labor force), overhead costs are likely driven by direct labor hours or direct labor costs. The more direct labor hours worked, the higher the overhead costs incurred. Thus direct labor hours or direct labor costs would be used as the allocation base.

10. The allocation base that drives overhead costs.

If a company's production process is highly mechanized (i.e., it relies on machinery more than on labor), overhead costs are likely driven by machine hours. The more machine hours used, the higher the overhead costs incurred. Thus machine hours would be used as the allocation base.

It may make more sense to use several allocation bases and several overhead rates to allocate overhead to jobs. This approach, called *activity-based costing*, is discussed in depth in Chapter 3 "How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?".

2. **Ease of measurement.** An allocation base should not only be linked to overhead costs; it should also be measurable. The three most common allocation bases—direct labor hours, direct labor costs, and machine hours—are relatively easy to measure. Direct labor hours and direct labor costs can be measured by using a timesheet, as discussed earlier, so using either of these as a base for allocating overhead is quite simple. Machine hours can also be easily measured by placing an hour meter on each machine if one does not already exist.

Why Use a Predetermined Overhead Rate?

Question: The use of a predetermined overhead rate rather than actual data to apply overhead to jobs is called **normal costing**[11]*. Most companies prefer normal costing over assigning actual overhead costs to jobs. Why do most companies prefer to use normal costing?*

Answer: Companies use normal costing for several reasons:

- Actual overhead costs can fluctuate from month to month, causing high amounts of overhead to be charged to jobs during high-cost periods. For example, utility costs might be higher during cold winter months and hot summer months than in the fall and spring seasons. Maintenance costs might be higher during slow periods. Normal costing averages these costs out over the course of a year.
- Actual overhead cost data are typically only available at the end of the month, quarter, or year. Managers prefer to know the cost of a job when it is completed—and in some cases during production—rather than waiting until the end of the period.
- The price charged to customers is often negotiated based on cost. A predetermined overhead rate is helpful when estimating costs.

11. A method of costing that uses a predetermined overhead rate to apply overhead to jobs.

- Bookkeeping is simplified by using a predetermined overhead rate. One rate is used to record overhead costs rather than tabulating actual overhead costs at the end of the reporting period and going back to assign the costs to jobs.

Using a Manufacturing Overhead Account

Question: Using a predetermined overhead rate to apply overhead costs to jobs requires the use of a manufacturing overhead account. How is the manufacturing overhead account used to record transactions?

Answer: The manufacturing overhead account tracks the following two pieces of information:

First, the manufacturing overhead account tracks actual overhead costs incurred. Recall that manufacturing overhead costs include all production costs other than direct labor and direct materials. The actual manufacturing overhead costs incurred in a period are recorded as debits in the manufacturing overhead account. For example, assume Custom Furniture Company places $4,200 in indirect materials into production on May 10. The journal entry to reflect this is as follows:

May 10	Manufacturing overhead	4,200	
	Raw materials inventory		4,200

Other examples of actual manufacturing overhead costs include factory utilities, machine maintenance, and factory supervisor salaries. All these costs are recorded as debits in the manufacturing overhead account when incurred.

Second, the manufacturing overhead account tracks overhead costs applied to jobs. The overhead costs applied to jobs using a predetermined overhead rate are recorded as credits in the manufacturing overhead account. You saw an example of this earlier when $180 in overhead was applied to job 50 for Custom Furniture Company. We repeat the entry here.

May 4	WIP inventory	180	
	Manufacturing overhead		180

The following T-account summarizes how overhead costs flow through the manufacturing overhead account:

Manufacturing Overhead	
(debit)	*(credit)*
Actual overhead costs incurred	Overhead costs applied to jobs

The manufacturing overhead account is classified as a **clearing account**[12]. A clearing account is used to hold financial data temporarily and is closed out at the end of the period before preparing financial statements.

Underapplied and Overapplied Overhead

Question: Because manufacturing overhead costs are applied to jobs based on an estimated predetermined overhead rate, overhead applied (credit side of manufacturing overhead) rarely equals actual overhead costs incurred (debit side of manufacturing overhead). What terms are used to describe the difference between actual overhead costs incurred during a period and overhead applied during a period?

Answer: Two terms are used to describe this difference—*underapplied overhead* and *overapplied overhead*.

Underapplied overhead[13] occurs when actual overhead costs (debits) are *higher* than overhead applied to jobs (credits). The T-account that follows provides an example of underapplied overhead. Note that the manufacturing overhead account has a *debit* balance when overhead is underapplied because fewer costs were applied to jobs than were actually incurred.

12. An account used to hold financial data temporarily until it is closed out at the end of the period.

13. Overhead costs applied to jobs that are less than actual overhead costs.

Manufacturing Overhead	
(debit) Actual overhead costs incurred	*(credit)* Overhead costs applied to jobs
$5,000	$3,000
$2,000 balance	

Overapplied overhead[14] occurs when actual overhead costs (debits) are *lower* than overhead applied to jobs (credits). The T-account that follows provides an example of overapplied overhead. Note that the manufacturing overhead account has a *credit* balance when overhead is overapplied because more costs were applied to jobs than were actually incurred.

Manufacturing Overhead	
(debit) Actual overhead costs incurred	*(credit)* Overhead costs applied to jobs
$6,000	$9,000
	$3,000 balance

14. Overhead costs applied to jobs that exceed actual overhead costs.

Business in Action 2.1

Source: Photo courtesy of prayitno, http://www.flickr.com/photos/34128007@N04/5293183651/.

Job Costing at **Boeing**

Boeing Company is the world's leading aerospace company and the largest manufacturer of commercial jetliners and military aircraft combined. **Boeing** provides products and services to customers in 150 countries and employs 165,000 people throughout the world.

Since most of **Boeing's** products are unique and costly, the company likely uses job costing to track costs associated with each product it manufactures. For example, the costly direct materials that go into each jetliner produced are tracked using a job cost sheet. Direct labor and manufacturing overhead costs (think huge production facilities!) are also assigned to each jetliner. This careful tracking of production costs for each jetliner provides management with important cost information that is used to assess production efficiency and profitability. Management can answer questions, such as "How much did direct materials cost?," "How much overhead was allocated to each jetliner?," or "What was the total production cost for each jetliner?" This is important information when it comes time to negotiate the sales price of a jetliner with a potential buyer like **United Airlines** or **Southwest Airlines**.

Source: **Boeing**, "Home Page," http://www.boeing.com.

Closing the Manufacturing Overhead Account

Question: Since the manufacturing overhead account is a clearing account, it must be closed at the end of the period. How do we close the manufacturing overhead account?

Answer: Most companies simply close the manufacturing overhead account balance to the cost of goods sold account. For example, if there is a $2,000 debit balance in manufacturing overhead at the end of the period, the journal entry to close the *underapplied* overhead is as follows:

If manufacturing overhead has a $3,000 credit balance at the end of the period, the journal entry to close the *overapplied* overhead is as follows:

Alternative Approach to Closing the Manufacturing Overhead Account

Question: Although most companies close the manufacturing overhead account to cost of goods sold, this is typically only done when the amount is immaterial (immaterial is a common accounting term used to describe an amount that is small relative to a company's size). The term material describes a relatively large amount. How do we close the manufacturing overhead account when the amount is material?

Answer: If the amount is material, it should be closed to three different accounts—work-in-process (WIP) inventory, finished goods inventory, and cost of goods sold—in proportion to the account balances in these accounts.

For example, suppose a company has $2,000 in underapplied overhead (debit balance in manufacturing overhead) and that the three account balances are as follows:

Account	Amount	Percent of Total
WIP inventory	$ 6,000	60%
Finished goods inventory	3,000	30%
Cost of goods sold	1,000	10%
Total	$10,000	100%

The $2,000 is closed to each of the three accounts based on their respective percentages. Thus $1,200 is apportioned to WIP inventory (= $2,000 × 60 percent), $600 goes to finished goods inventory (= $2,000 × 30 percent), and $200 goes to cost of goods sold (= $2,000 × 10 percent). The journal entry to close the $2,000 underapplied overhead debit balance in manufacturing overhead is as follows:

WIP inventory	1,200	
Finished goods inventory	600	
Cost of goods sold	200	
Manufacturing overhead		2,000

Although this approach is not as common as simply closing the manufacturing overhead account balance to cost of goods sold, companies do this when the amount is relatively significant.

KEY TAKEAWAYS

- Most companies use a normal costing system to track product costs. Normal costing tracks actual direct material costs and actual direct labor costs for each job and charges manufacturing overhead to jobs using a predetermined overhead rate. The predetermined overhead rate is calculated as follows:

$$\text{Predetermined overhead rate} = \frac{\text{Estimated overhead costs}}{\text{Estimated activity in allocation base}}$$

- A manufacturing overhead account is used to track actual overhead costs (debits) and applied overhead (credits). This account is typically closed to cost of goods sold at the end of the period.

REVIEW PROBLEM 2.3

1. Chan Company estimates that annual manufacturing overhead costs will be $500,000. Chan allocates overhead to jobs based on machine hours, and it expects that 100,000 machine hours will be required for the year. Calculate the predetermined overhead rate.
2. Why might Chan Company use machine hours as the overhead allocation base?
3. Chan Company received a bill totaling $3,700 for machine parts used in maintaining factory equipment. The bill will be paid next month. Make the journal entry to record this transaction.
4. Job 153 used a total of 2,000 machine hours. Make the journal entry to record manufacturing overhead applied to job 153. What other document will include this amount?

5. Assume Chan Company incurs actual manufacturing overhead costs of $470,000 and applies overhead of $510,000 for the year. Account balances are as follows: WIP inventory, $25,000; finished goods inventory, $25,000; and cost of goods sold, $50,000.

    1. Is overhead overapplied or underapplied? Explain your answer.
    2. Make the journal entry to close the manufacturing overhead account assuming the balance is immaterial.
    3. Make the journal entry to close the manufacturing overhead account assuming the balance is material.

Solutions to Review Problem 2.3

1. The predetermined overhead rate is calculated as follows:

$$\begin{aligned}\text{Predetermined overhead rate} &= \frac{\text{Estimated overhead costs}}{\text{Estimated activity in allocation ba}} \\ &= \frac{\$500{,}000 \text{ estimated overhead cost}}{100{,}000 \text{ machine hours}} \\ &= \$5 \text{ per machine hour}\end{aligned}$$

2. If Chan's production process is highly mechanized, overhead costs are likely driven by machine use. The more machine hours

used, the higher the overhead costs incurred. Thus there is a link between machine hours and overhead costs, and using machine hours as an allocation base is preferable.

Machine hours are also easily tracked, making implementation relatively simple.

3.

Manufacturing overhead	3,700	
Accounts payable		3,700

4. A total of $10,000 (= $5 per machine hour rate × 2,000 machine hours) will be applied to job 153 and recorded in the journal as follows:

WIP inventory	10,000	
Manufacturing overhead		10,000

This amount will also be recorded on the job cost sheet for Job 153.

5.

1. Overhead is *overapplied* because actual overhead costs are lower than overhead applied to jobs. Also, the manufacturing overhead account has a credit balance.

2.

Manufacturing overhead	40,000	
Cost of goods sold		40,000

3.

Manufacturing overhead	40,000	
WIP inventory		10,000*
Finished goods inventory		10,000*
Cost of goods sold		20,000*

**Amounts are calculated as follows. Allocation amount = percent of total × the overapplied balance of $40,000.*

Account	Account Balance	Percent of Total	Allocation Amount
WIP inventory	$ 25,000	25%	$ 10,000
Finished goods inventory	25,000	25%	10,000
Cost of goods sold	50,000	50%	20,000
Total	$100,000	100%	$ 40,000

2.4 Job Costing in Service Organizations

LEARNING OBJECTIVE

1. Apply job costing methods to service organizations.

Question: Although this chapter has focused on job costing in a manufacturing setting, many service organizations use job costing as well. Electricians, accountants, and auto mechanics are examples of service providers that use job costing. Electricians track costs by project (e.g., a new building or a kitchen remodel), accountants track costs by client (e.g., an individual or a corporation), and auto mechanics track costs by job (e.g., replacing a drive belt on a company truck). How does job costing work in a service company setting?

Answer: Job costing in service organizations is the same as in manufacturing organizations, except that service organizations tend to use fewer materials. There are also minor differences in the accounts that these types of organizations use, as shown in Table 2.2 "Accounts Used in Service Organizations and Manufacturing Organizations".

Table 2.2 Accounts Used in Service Organizations and Manufacturing Organizations

Manufacturing Organization Account Name	Service Organization Account Name	Financial Statement
Raw materials inventory	Parts inventory or supplies	Balance sheet (asset)
Work-in-process inventory	Work in process*	Balance sheet (asset)
Finished goods	(Not applicable)	Balance sheet (asset)
Cost of goods sold	Cost of services (or other expense accounts)	Income statement (expense)
***Some service companies do not use a work-in-process account but instead simply charge costs directly to expense accounts.**		

Manufacturing Organization Account Name	Service Organization Account Name	Financial Statement
Manufacturing overhead	Overhead (or service overhead)	None (clearing account)
***Some service companies do not use a work-in-process account but instead simply charge costs directly to expense accounts.**		

Service organizations use a job cost sheet like the one discussed earlier to track direct materials, direct labor, and overhead.

Direct Materials

Question: How do service organizations track direct materials using job costing?

Answer: Many service organizations do not track direct materials for each job because the cost of the materials is negligible. For example, accountants and attorneys use low-cost materials, such as binders and paper. These materials, often called supplies, are included in overhead rather than tracked by job.

Some service organizations track direct materials for each job because the cost of the materials is significant. Consider auto mechanics, who track the parts needed to perform repairs for each job, or electricians, who track the materials needed to wire a new building. Materials may be requisitioned from parts inventory or supplies, similar to raw materials inventory in a manufacturing setting, or may be purchased directly from a supplier, depending on the nature of the business. The process of recording this information in the journal and job cost sheet is exactly the same as for a manufacturing company (refer back to Figure 2.3 "Job Cost Sheet for Custom Furniture Company" for an example).

Direct Labor

Question: How do service organizations track direct labor using job costing?

Answer: Direct labor tends to be the most significant cost for service organizations. The process of tracking labor using a timesheet and recording labor costs in the

journal and job cost sheet is exactly the same as for a manufacturing company (refer back to Figure 2.4 "Timesheet for Custom Furniture Company" and Figure 2.5 "Direct Labor Costs for Custom Furniture Company's Job 50" for examples).

Overhead

Question: Like manufacturing companies, service organizations often use a predetermined overhead rate to apply overhead. What allocation bases are most commonly used by service organizations to apply overhead costs to jobs?

Answer: Because overhead is typically driven by direct labor hours in a service organization, direct labor hours or direct labor cost is the most common allocation base. Again, the process of recording this information in the journal and job cost sheet is exactly the same as for a manufacturing company (refer back to Figure 2.6 "Overhead Applied for Custom Furniture Company's Job 50" for an example).

Business in Action 2.2

Job Costing at Movie Studios

Studios that produce costly movies, such as **20th Century Fox**, **Universal Studios**, and **Warner Brothers**, incur a variety of costs that are tracked using a job costing system. For example, the production of a Harry Potter movie requires direct labor in the form of actors, directors, editors, and the film crew. The direct materials category includes costumes, extensive sets, and props. Overhead costs include items such as depreciation of film production equipment, utilities in the editing studio, and executive salaries for those overseeing the production of several films concurrently.

Determining the production costs of movies and related profitability is important for this industry since actors, directors, and others involved in the film are often compensated based on a percentage of profits. Disagreements sometimes arise between studios and actors regarding the accuracy of costs for movies, particularly in the area of overhead. Some studios have been accused of allocating too much overhead to individual films to drive down the reported profitability of each film, thereby reducing the amount owed to those receiving a portion of the profits.

KEY TAKEAWAY

- Job costing systems in service organizations are similar to those used by manufacturing companies. However, service organizations use fewer materials than manufacturing organizations, the account names they use are slightly different, and they often track costs by customer rather than by product.

REVIEW PROBLEM 2.4

Describe the similarities and differences in how service companies and manufacturing companies account for direct materials, direct labor, and overhead.

Solutions to Review Problem 2.4

The similarities and differences in how service companies and manufacturing companies account for direct materials, direct labor, and overhead are as follows:

- **Direct materials.** The cost of direct materials for many service companies, such as accounting and law firms, is insignificant. These companies therefore do not track direct materials for each job. However, service companies that use costly materials, such as an auto repair shop, do track direct materials for each job. Because direct materials tend to be costly for manufacturing firms, these firms typically track direct materials for each job.
- **Direct labor.** Because direct labor tends to be the most significant cost for service companies, these companies track costs by job using a timesheet and job cost sheet, just as manufacturing companies do.
- **Overhead.** Service and manufacturing firms track overhead costs in a similar way. Both often use a predetermined overhead rate to charge overhead costs to jobs. Because overhead is typically driven by direct labor hours in a service company, direct labor hours are often used as the allocation base. The process of recording overhead costs in the journal and job cost sheet is the same for both types of firms.

2.5 Chapter Wrap-Up: Summary of Cost Flows at Custom Furniture Company

LEARNING OBJECTIVE

1. Use a job costing system to track costs and evaluate profitability for each job.

Question: The goal of this section is to pull it all together for Custom Furniture Company. We begin by looking at revenue and cost information for May, including manufacturing and nonmanufacturing costs. Why is it important for companies like Custom Furniture Company to correctly classify and record costs such as direct materials (e.g., wood used for each table), salaries of administrative personnel, and rent on the factory?

Answer: Companies must be able to evaluate the profitability of each job and on a broader scale, evaluate the overall profitability of the company. This requires that all manufacturing and nonmanufacturing costs be classified and recorded correctly in the general journal. The following information shows how to accomplish this with transactions for the month of May at Custom Furniture Company.

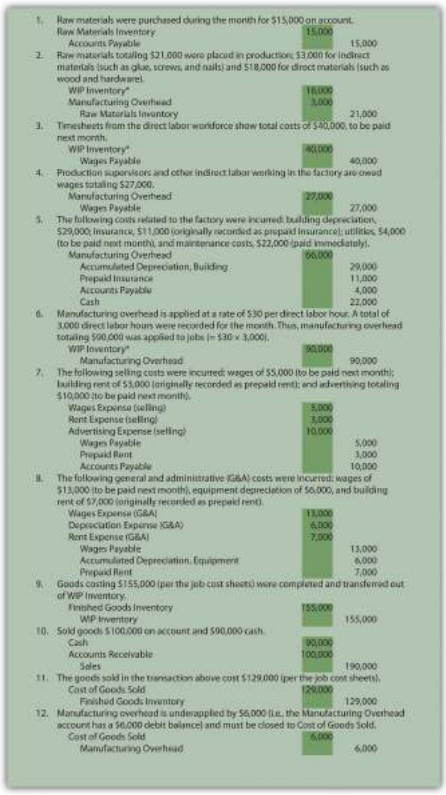
Revenue and Cost Information for Custom Furniture Company

Question: How are the typical transactions for a manufacturing company recorded in the general journal?

Answer: Figure 2.7 "Custom Furniture Company's Journal Entries for May" shows Custom Furniture Company's journal entries for May. Figure 2.8 "Custom Furniture Company's T-Accounts" presents the same information in T-account format. (Note that each entry shows the total dollar amount for the month rather than individual transaction amounts.) If you understand how to make an entry summarized in total, you know how to make each individual (perhaps daily) entry. Beginning balances for raw materials inventory ($25,000), work-in-process inventory ($35,000), and finished goods inventory ($90,000) are shown in the T-accounts in Figure 2.8

"Custom Furniture Company's T-Accounts". Although it is not necessary to refer back to Chapter 1 "What Is Managerial Accounting?" at this point, we should note that the beginning balance and transaction amounts used here for these three inventory accounts tie back to the three schedules presented in Chapter 1 "What Is Managerial Accounting?" (schedule of raw materials placed in production, schedule of cost of goods manufactured, and schedule of cost of goods sold).

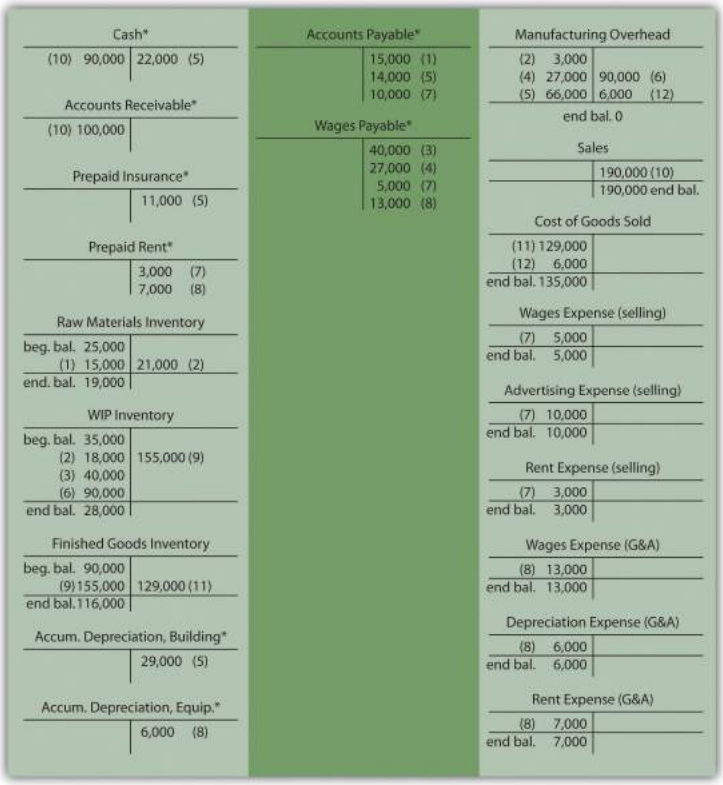
Figure 2.7 *Custom Furniture Company's Journal Entries for May*



1. Raw materials were purchased during the month for $15,000 on account.
   Raw Materials Inventory 15,000
   Accounts Payable 15,000
2. Raw materials totalling $21,000 were placed in production; $3,000 for indirect materials (such as glue, screws, and nails) and $18,000 for direct materials (such as wood and hardware).
   WIP Inventory* 18,000
   Manufacturing Overhead 3,000
   Raw Materials Inventory 21,000
3. Timesheets from the direct labor workforce show total costs of $40,000, to be paid next month.
   WIP Inventory* 40,000
   Wages Payable 40,000
4. Production supervisors and other indirect labor working in the factory are owed wages totaling $27,000.
   Manufacturing Overhead 27,000
   Wages Payable 27,000
5. The following costs related to the factory were incurred: building depreciation, $29,000; insurance, $11,000 (originally recorded as prepaid insurance); utilities, $4,000 (to be paid next month), and maintenance costs, $22,000 (paid immediately).
   Manufacturing Overhead 66,000
   Accumulated Depreciation, Building 29,000
   Prepaid Insurance 11,000
   Accounts Payable 4,000
   Cash 22,000
6. Manufacturing overhead is applied at a rate of $30 per direct labor hour. A total of 3,000 direct labor hours were recorded for the month. Thus, manufacturing overhead totaling $90,000 was applied to jobs (= $30 × 3,000).
   WIP Inventory* 90,000
   Manufacturing Overhead 90,000
7. The following selling costs were incurred: wages of $5,000 (to be paid next month); building rent of $3,000 (originally recorded as prepaid rent); and advertising totaling $10,000 (to be paid next month).
   Wages Expense (selling) 5,000
   Rent Expense (selling) 3,000
   Advertising Expense (selling) 10,000
   Wages Payable 5,000
   Prepaid Rent 3,000
   Accounts Payable 10,000
8. The following general and administrative (G&A) costs were incurred: wages of $13,000 (to be paid next month), equipment depreciation of $6,000, and building rent of $7,000 (originally recorded as prepaid rent).
   Wages Expense (G&A) 13,000
   Depreciation Expense (G&A) 6,000
   Rent Expense (G&A) 7,000
   Wages Payable 13,000
   Accumulated Depreciation, Equipment 6,000
   Prepaid Rent 7,000
9. Goods costing $155,000 (per the job cost sheets) were completed and transferred out of WIP Inventory.
   Finished Goods Inventory 155,000
   WIP Inventory 155,000
10. Sold goods $100,000 on account and $90,000 cash.
    Cash 90,000
    Accounts Receivable 100,000
    Sales 190,000
11. The goods sold in the transaction above cost $129,000 (per the job cost sheets).
    Cost of Goods Sold 129,000
    Finished Goods Inventory 129,000
12. Manufacturing overhead is underapplied by $6,000 (i.e., the Manufacturing Overhead account has a $6,000 debit balance) and must be closed to Cost of Goods Sold.
    Cost of Goods Sold 6,000
    Manufacturing Overhead 6,000

**All debit amounts to work-in-process inventory are also recorded on the appropriate job cost sheets.*

Figure 2.8 Custom Furniture Company's T-Accounts



**Beginning and ending balances are only provided for inventory accounts since the focus of this chapter is on manufacturing costs that flow through the inventory accounts.*

Question: Now that the information for the month of May has been recorded for Custom Furniture Company, we need to summarize this information to evaluate the profitability of the company and the profitability of jobs. How profitable was Custom Furniture for the month of May?

Answer: Custom Furniture Company's income statement for the month of May, shown in Figure 2.9 "Custom Furniture Company's Income Statement", indicates the company had operating profit of $11,000. This information comes directly from the T-accounts shown in Figure 2.8 "Custom Furniture Company's T-Accounts".

Figure 2.9 Custom Furniture Company's Income Statement

Custom Furniture Company
Income Statement
Month Ended May 31

Sales		$190,000
Cost of goods sold before adjustment for underapplied overhead	$129,000	
Adjustment for underapplied overhead*	6,000	
Cost of goods sold		135,000
Gross profit		$ 55,000
Less operating (nonmanufacturing) expenses:		
Selling		18,000
General and administrative		26,000
Operating profit		$ 11,000

*See entry **12** in Figure 2.7 "Custom Furniture Company's Journal Entries for May" and Figure 2.8 "Custom Furniture Company's T-Accounts" for this adjustment. This represents the amount of overhead underapplied to jobs and closed out to cost of goods sold at the end of May. An alternative presentation is to simply show the cost of goods sold amount of $135,000 directly under sales.*

Analysis of Job Profitability at Custom Furniture Company

Recall from the beginning of the chapter that Dan Stevens, the owner of Custom Furniture Company, is concerned about the company's profitability. Although Dan prices his furniture at 70 percent above estimated production costs, the company had only $11,000 in profits for the month of May, as shown in Figure 2.9 "Custom Furniture Company's Income Statement". Dan asked Leslie (the accountant) to look into the accuracy of his estimates by reviewing actual production costs for the three costliest tables produced in May. As you read Leslie's comments, be sure to look at the income statement in Figure 2.9 "Custom Furniture Company's Income Statement" and the job cost estimates and actual results in Figure 2.10 "Job Cost Estimates Versus Actual Results for Custom Furniture Company".

Figure 2.10 *Job Cost Estimates Versus Actual Results for Custom Furniture Company*

	Job 40		Job 44		Job 45	
	Estimate	Actual[a]	Estimate	Actual[a]	Estimate	Actual[a]
Sales price[b]	$ 18,360	$ 18,360	$ 27,030	$ 27,030	$ 13,260	$ 13,260
Direct materials	$ 1,500	$ 3,500	$ 2,800	$ 3,800	$ 1,100	$ 2,500
Direct labor	3,300	3,800	4,500	4,700	2,400	2,300
Manufacturing overhead	6,000	6,200	8,600	8,900	4,300	4,100
Total production costs	$ 10,800	$ 13,500	$ 15,900	$ 17,400	$ 7,800	$ 8,900
Gross profit	$ 7,560	$ 4,860	$ 11,130	$ 9,630	$ 5,460	$ 4,360
Gross profit as percent of total production cost[c]	70%	36%	70%	55%	70%	49%[d]

[a] *Product costs are from the job cost sheet, and the sales price is based on the original bid.*

[b] *Based on 70 percent markup of estimated total production costs. For example, job 40's sales price of $18,360 = $10,800 × 170 percent.*

[c] *Equals gross profit divided by total production costs. Company target is 70 percent.*

[d] *Rounded.*

Leslie:	*Dan, I have the production cost information you requested.*
Dan:	*Great! What did you find out?*
Leslie:	*Well, first I looked at the income statement for May. If you establish prices based on a 70 percent markup of production costs, then sales revenue should be 170 percent of cost of goods sold, and the resulting gross profit should be 70 percent of cost of goods sold.*
Dan:	*Sounds reasonable. Are we anywhere near these numbers?*
Leslie:	*Not really. Cost of goods sold for May total $135,000, so sales should be closer to $229,500 (that would be $135,000 times 170 percent), and gross profit should be closer to $94,500, which is $135,000 times 70 percent. As you can see on the income statement, we didn't get very close to these numbers.*
Dan:	*Do you have any idea why?*
Leslie:	*I pulled together production cost information from our job costing system for the three highest-cost tables produced in May as you requested.*
Dan:	*And?*

Leslie:	*I compared the job cost sheet information for each item with your original estimates, and here's what I found. It looks as if the problem is with direct materials. All three jobs show that direct material costs were significantly higher than you estimated. Direct labor and manufacturing overhead costs were pretty close.*
Dan:	*Wow, I'm surprised that direct material costs were so high. I'll have to check into this further. I do recall wood costs increasing over the last couple of months, but not to this extent.*
Leslie:	*There are lots of potential causes for the increase in direct materials. Perhaps materials were wasted as a result of machine problems or because of inexperienced employees.*
Dan:	*Let's try to nail down why my estimates are so far off so I can do a better job of estimating costs in the future.*
Leslie:	*Good idea—I'll look into the direct materials costs and get back to you later this week.*

Question: *Figure 2.10 "Job Cost Estimates Versus Actual Results for Custom Furniture Company"* *provides an in depth view of the costs associated with each job and the resulting profitability. How does this information help Custom Furniture Company plan for the future?*

Answer: This information helps managers assess the profitability of individual jobs. Custom Furniture Company was able to identify areas of concern by comparing information from job cost sheets with Dan's estimates. Dan and Leslie will have to do more research to find the cause of the high material costs. If changes cannot be made to the production process to reduce these costs, Dan may have to consider revising his estimates and raising prices on future jobs. The goal is to provide enough information for the company to make informed decisions about areas of concern, such as direct materials costs, and how much to charge for future jobs.

KEY TAKEAWAYS

- Job costing systems can do more than simply track the costs of each job. Companies also use these systems to track revenue and the resulting profit for each job.
- A job costing system can be used to identify areas of concern by comparing the cost estimate prepared before starting the job with information on the completed job cost sheet. This type of analysis often leads to changes in the production process and revised estimates for future jobs.

REVIEW PROBLEM 2.5

Farm Equipment, Inc., produces tractors and other farm machinery. Each piece of equipment is built to customer specifications. During May, its first month of operations, Farm Equipment, Inc., began working on three customer orders: jobs 1, 2, and 3. The following transactions occurred during May:

1. Purchased production materials on account totaling $450,000
2. Processed material requisitions for the following items:

Job 1 direct materials	$ 77,600
Job 2 direct materials	38,600
Job 3 direct materials	45,000
Indirect materials	87,000
Total	$ 248,200

3. Processed timesheets showing the following:

Job 1 direct labor (700 hours)	$ 14,800
Job 2 direct labor (550 hours)	11,800
Job 3 direct labor (300 hours)	6,500
Indirect labor	9,700
Total	$ 42,800

4. Applied overhead using a predetermined rate of 160 percent of direct labor cost
5. Completed job 1 and transferred it to finished goods
6. Delivered job 1 to the customer and billed her $140,000. (Hint: Two entries are required—one for the cost of the goods and another for the revenue.)

Required:

a. Calculate the production costs incurred in May for each of the three jobs.
b. Make the appropriate journal entry for each item described previously. Assume all payments will be made next month. (Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)
c. How much gross profit did Farm Equipment, Inc., earn from the sale of job 1?

d. Assuming selling costs totaled $4,000 and general and administrative costs totaled $11,000 in May, prepare an income statement for Farm Equipment, Inc., for the month. (Assume there is no adjustment to cost of goods sold for underapplied or overapplied overhead.)

Solutions to Review Problem 2.5

a.

	Job 1	Job 2	Job 3	Total
Direct materials	$ 77,600	$ 38,600	$ 45,000	$161,200
Direct labor	14,800	11,800	6,500	33,100
Manufacturing overhead (160% × direct labor cost)	23,680	18,880	10,400	52,960
Total cost	$116,080	$ 69,280	$ 61,900	$247,260

b.

Raw materials inventory	450,000	
Accounts payable		450,000

WIP inventory	161,200*	
Manufacturing overhead	87,000	
Raw materials inventory		248,200

$161,200 comes from the total for direct materials in part **a.*

WIP inventory	33,100*	
Manufacturing overhead	9,700	
Wages payable		42,800

$33,100 comes from the total for direct labor in part **a.*

WIP inventory	52,960*	
Manufacturing overhead		52,960

$52,960 comes from the total for manufacturing overhead in part **a.*

Finished goods inventory	116,080	
WIP inventory		116,080

Cost of goods sold	116,080	
Finished goods inventory		116,080

Accounts receivable	140,000	
Sales		140,000

c. Farm Equipment, Inc., made $23,920 in gross profit from the sale of job 1 ($23,920 = $140,000 revenue – $116,080 cost).

d.

Farm Equipment, Inc.
Income Statement
Month Ended May 31

Sales	$140,000
Cost of goods sold	116,080
Gross profit	$ 23,920
Less operating (nonmanufacturing) expenses:	
Selling	4,000
General and administrative	11,000
Operating profit	$ 8,920

END-OF-CHAPTER EXERCISES

Questions

1. Describe the characteristics of companies likely to use a job costing system. Explain how these characteristics differ from companies likely to use a process costing system.
2. What information is included on the materials requisition form?
3. What is the purpose of a job cost sheet? Describe the information typically included on a job cost sheet.
4. What information is included on a timesheet?
5. What is the purpose of using a predetermined overhead rate?
6. Review Note 2.23 "Business in Action 2.1" Explain why **Boeing** likely uses a job costing system. How does the information that comes from a job costing system help **Boeing** make better decisions?
7. What is a *normal costing system*, and why do companies tend to use a normal costing system to apply overhead to jobs rather than using actual overhead costs?
8. Describe the two important factors in selecting an overhead allocation base.
9. What cost information is recorded on the debit side of the manufacturing overhead account, and what information is recorded on the credit side?
10. When is manufacturing overhead underapplied? When is it overapplied?
11. What two options are available when closing the manufacturing overhead account at the end of the period, depending on the significance of the balance?
12. How might a job costing system used by a service organization differ from a job costing system used by a manufacturing organization?
13. Review Note 2.27 "Business in Action 2.2" Why is it important for movie studios to have accurate costs for each movie produced?
14. How does a job costing system help a company evaluate the profitability of jobs?

Brief Exercises

15. **Product Costs at Custom Furniture Company.** Refer to the dialogue between Dan and Leslie at Custom Furniture Company that appears at the beginning of the chapter. What is Dan concerned about, and how did Leslie propose to help?

16. **Job Costing Versus Process Costing.** Indicate whether each of the firms listed in the following would use job costing or process costing.

    1. Oil refinery
    2. Builder of pools
    3. Cereal producer
    4. Legal firm
    5. Upholstery repair shop
    6. Sport drink producer
    7. Toner cartridge producer
    8. Landscape design firm

17. **Job Costing Versus Process Costing.** Indicate whether each of the firms listed in the following would use job costing or process costing.

    1. Custom home builder
    2. Dairy farm
    3. Surgical unit of hospital
    4. Candy bar producer
    5. Auto body repair shop
    6. Producer of basketballs
    7. Producer of T-shirts
    8. Plumber

18. **Recording Purchase and Transfer of Raw Materials in T-Accounts.** The following transactions occurred during the month of October:

October 5	Raw materials totaling $15,000 were purchased on account.
October 8	Direct materials totaling $6,000 were placed in production.
October 10	Indirect materials totaling $1,000 were placed in production.

    Required:

a. Set up T-accounts for raw materials inventory, work-in-process inventory, manufacturing overhead, and accounts payable.
b. Use the T-accounts established in part **a** to record the transactions for October.

19. **Calculating Predetermined Overhead Rate.** Manufacturing overhead costs totaling $1,000,000 are expected for this coming year. The company also expects to use 20,000 in direct labor hours. Calculate the predetermined overhead rate and provide a one-sentence description of how the rate will be used in a job costing system.

20. **Service Organization Accounts.** Provide the account name commonly used by service companies for each of the following accounts used in a manufacturing environment.

    1. Raw materials inventory
    2. Work-in-process inventory
    3. Finished goods inventory
    4. Cost of goods sold
    5. Manufacturing overhead

21. **Evaluating Profitability of Jobs.** Refer to the job cost information in Figure 2.10 "Job Cost Estimates Versus Actual Results for Custom Furniture Company". Why is Custom Furniture Company comparing estimated product costs to actual product costs for each of the three jobs? Briefly summarize the results of this comparison.

Exercises: Set A

22. **Raw Materials Inventory Journal Entries.** The balance in Sedona Company's raw materials inventory account was $110,000 at the beginning of September. Raw materials purchased during the month totaled $50,000. Sedona used $17,000 in direct materials and $8,000 in indirect materials for the month.

    Required:

    a. Prepare separate journal entries to record the following items:

1. Raw materials purchased for the month, assuming all purchases were on account
2. The transfer of *direct* materials into production
3. The transfer of *indirect* materials into production

b. Prepare a T-account for raw materials inventory and include the beginning balance for September. Post the appropriate items from the journal entries in part **a** to this account, and calculate the ending balance in raw materials inventory.

23. **Work-in-Process Inventory Journal Entries.** The balance in Reid Company's work-in-process inventory account was $300,000 at the beginning of March. Manufacturing costs for the month are as follows:

Direct materials	$ 40,000
Direct labor	$ 70,000
Manufacturing overhead applied	$200,000
Cost of goods manufactured	$290,000

Required:

a. Prepare separate journal entries to record the following items. (Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)

1. Direct materials placed in production for the month
2. Direct labor used during the month, assuming employees will be paid next month
3. Manufacturing overhead applied for the month
4. Transfer of cost of goods manufactured to finished goods

b. Prepare a T-account for Work-in-process inventory and include the beginning balance for March. Post the appropriate items from the journal entries in part **a** to this

account, and calculate the ending balance in work-in-process inventory.

24. **Cost of Goods Sold Journal Entries.** The balance in Blue Oak Company's finished goods inventory account was $25,000 at the beginning of September. Cost of goods manufactured for the month totaled $17,000, and cost of goods sold totaled $14,000.

    Required:

    a. Prepare separate journal entries to record the following items. (Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)

        1. Cost of goods manufactured for the month
        2. Cost of goods sold for the month

    b. Prepare a T-account for finished goods inventory and include the beginning balance for September. Post the appropriate items from the journal entries in part **a** to this account, and calculate the ending balance in finished goods inventory.

25. **Income Statement (with cost of goods sold adjustment).** Rambler Company had the following activity for the year ended December 31.

Sales revenue	$2,050,000
Selling expenses	$ 575,000
General and administrative expenses	$ 330,000
Cost of goods sold (before adjustment)	$ 700,000
Underapplied overhead	$ 23,000

    Required:

    Prepare an income statement for year ended December 31.

26. **Manufacturing Overhead Allocation Base and Calculating the Cost of Jobs.** Pyramid Company expects to incur $3,000,000 in manufacturing overhead costs this year. During the year, it expects to use 40,000 direct labor hours at a cost of $600,000 and 80,000 machine hours.

    Required:

    a. Prepare a predetermined overhead rate based on direct labor hours, direct labor cost, and machine hours.
    b. Why might Pyramid Company prefer to use machine hours to allocate manufacturing overhead?
    c. Using each of the predetermined overhead rates calculated in part **a** and the data that follows for job 128, determine the cost of job 128.

Direct materials	$6,000
Direct labor	$4,000 (200 hours at $15 per hour) + (100 hours at $10 per hour)
Machine time	700 hours

Exercises: Set B

27. **Raw Materials Inventory Journal Entries.** The balance in Clay Company's raw materials inventory account was $45,000 at the beginning of April. Raw materials purchased during the month totaled $55,000. Clay used $48,000 in direct materials and $14,000 in indirect materials for the month.

    Required:

    a. Prepare separate journal entries to record the following items:

1. Raw materials purchased for the month, assuming all purchases were on account
2. The transfer of *direct* materials into production
3. The transfer of *indirect* materials into production

b. Prepare a T-account for raw materials inventory and include the beginning balance for April. Post the appropriate items from the journal entries in part **a** to this account, and calculate the ending balance in raw materials inventory.

28. **Work-in-Process Inventory Journal Entries.** The balance in the work-in-process inventory account of Verdi Production, Inc., was $900,000 at the beginning of May. Manufacturing costs for the month are as follows:

Direct materials	$ 340,000
Direct labor	$ 810,000
Manufacturing overhead applied	$ 660,000
Cost of goods manufactured	$1,960,000

Required:

a. Prepare separate journal entries to record the following items. (Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)

1. Direct materials placed in production for the month
2. Direct labor used during the month, assuming employees will be paid next month
3. Manufacturing overhead applied for the month
4. Transfer of cost of goods manufactured to finished goods

b. Prepare a T-account for work-in-process inventory and include the beginning balance for May. Post the appropriate items from the journal entries in part **a** to this account, and calculate the ending balance in work-in-process inventory.

29. **Cost of Goods Sold Journal Entries.** The balance in Posada Company's finished goods inventory account was $650,000 at the beginning of March. Cost of goods manufactured for the month totaled $445,000, and cost of goods sold totaled $470,000.

    Required:

    a. Prepare separate journal entries to record the following items. (Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)

        1. Cost of goods manufactured for the month
        2. Cost of goods sold for the month

    b. Prepare a T-account for finished goods inventory and include the beginning balance for March. Post the appropriate items from the journal entries in part **b** to this account, and calculate the ending balance in finished goods inventory.

30. **Income Statement (with cost of goods sold adjustment).** Statton Company had the following activity for the year ended December 31.

Sales revenue	$4,000,000
Selling expenses	$ 825,000
General and administrative expenses	$ 470,000
Cost of goods sold (before adjustment)	$1,900,000
Overapplied overhead	$ 109,000

    Required:

    Prepare an income statement for year ended December 31.

31. **Manufacturing Overhead Allocation Base and Calculating the Cost of Jobs.** Elko Company expects to incur $800,000 in manufacturing overhead costs this year. During the year, it

expects to use 10,000 direct labor hours at a cost of $200,000 and 4,000 machine hours.

Required:

a. Prepare a predetermined overhead rate based on direct labor hours, direct labor cost, and machine hours.
b. Why might Elko Company prefer to use direct labor hours or direct labor costs, rather than machine hours, to allocate manufacturing overhead?
c. Using each of the predetermined overhead rates for Elko Company calculated in part **a** and the data that follows for job 15B, determine the cost of job 15B.

Direct materials	$1,750
Direct labor	$860 (30 hours at $12 per hour) + (50 hours at $10 per hour)
Machine time	20 hours

Problems

32. **Actual and Applied Manufacturing Overhead.** Marine Products, Inc., incurred the following actual overhead costs for the month of June.

Indirect materials	$20,000
Indirect labor	$18,000
Rent	$ 3,000
Equipment depreciation	$ 6,500

Overhead is applied based on a predetermined rate of $12 per machine hour, and 5,100 machine hours were used during June.

Required:

a. Prepare a journal entry to record actual overhead costs for June. Assume that labor costs will be paid next month and that rent was prepaid.
b. Prepare a journal entry to record manufacturing overhead applied to jobs during June.
c. Create a T-account for manufacturing overhead, post the appropriate information from parts **a** and **b** to this account, and calculate the ending balance.
d. Is manufacturing overhead overapplied or underapplied? Using the balance in the manufacturing overhead account calculated in part **c**, prepare the journal entry to close manufacturing overhead to cost of goods sold.

33. **Actual and Applied Manufacturing Overhead.** Quincy Company incurred the following actual overhead costs for the month of February.

Indirect materials	$335,000
Indirect labor	$275,000
Factory depreciation	$ 18,000
Factory utilities	$ 9,500

Overhead is applied based on a predetermined rate of $2 per direct labor dollar (200 percent of direct labor cost), and direct labor costs were $300,000 for the month.

Required:

a. Prepare a journal entry to record actual overhead costs for February. Assume indirect labor costs and utilities will be paid next month.
b. Prepare a journal entry to record manufacturing overhead applied to jobs during February.
c. Create a T-account for manufacturing overhead, post the appropriate information from parts **a** and **b** to this account, and calculate the ending balance.
d. Is manufacturing overhead overapplied or underapplied? Using the balance in the manufacturing overhead account calculated in part **c**, prepare the journal entry to close manufacturing overhead to cost of goods sold.

34. **Calculating the Cost of Jobs, Making Journal Entries, and Preparing an Income Statement.** Racing Bikes, Inc., produces custom bicycles for professional racers. Each bike is built to customer specifications. During July, its first month of operations, Racing Bikes began production of four customer orders—jobs 1 through 4. The following transactions occurred during July.

    1. Purchased bike parts totaling $14,400

    2. Processed material requisitions for the following items:

Job 1, direct materials	$ 2,800
Job 2, direct materials	1,250
Job 3, direct materials	1,550
Job 4, direct materials	780
Indirect materials	1,075
Total	$ 7,455

    3. Processed timesheets showing the following:

Job 1, direct labor (30 hours)	$ 500
Job 2, direct labor (25 hours)	430
Job 3, direct labor (28 hours)	465
Job 4, direct labor (15 hours)	210
Indirect labor	985
Total	$ 2,590

    4. Applied overhead using a predetermined rate of $30 per direct labor hour
    5. Completed and transferred to finished goods jobs 1, 2, and 3
    6. Delivered jobs 1 and 2 to customers, billing them $6,000 for job 1 and $3,500 for job 2 (Hint: Two entries are required—one for the cost of the goods and another for the revenue.)

    Required:

    a. Calculate the production costs incurred in July for each of the four jobs.
    b. Make the appropriate journal entry for each transaction described previously (**1** through **6**). Assume all payments will

be made next month. (Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)

c. How much gross profit did Racing Bikes, Inc., earn from the sale of job 2?

d. Assume selling costs totaled $1,000 and that general and administrative costs totaled $2,200. Prepare an income statement for Racing Bikes for the month of July. (Assume there is no adjustment to cost of goods sold for underapplied or overapplied overhead.)

35. **Calculating the Cost of Jobs, Making Journal Entries, and Preparing an Income Statement.** Classic Boats, Inc., produces custom wood boats. Each boat is built to customer specifications. During April, its first month of operations, Classic Boats began production of three customer orders—jobs 1 through 3. The following transactions occurred during April.

1. Purchased production materials totaling $225,000

2. Processed material requisitions for the following items:

Job 1, direct materials	$ 38,800
Job 2, direct materials	19,300
Job 3, direct materials	22,500
Indirect materials	43,500
Total	$124,100

3. Processed timesheets showing the following:

Job 1, direct labor (350 hours)	$ 7,400
Job 2, direct labor (275 hours)	5,900
Job 3, direct labor (150 hours)	3,250
Indirect labor	4,850
Total	$ 21,400

4. Applied overhead using a predetermined rate of 160 percent of direct labor cost
5. Completed job 1 and transferred it to finished goods

6. Delivered job 1 to the customer and billed her $70,000. (Hint: Two entries are required—one for the cost of the goods and another for the revenue.)

Required:

a. Calculate the production costs incurred in April for each of the three jobs.
b. Make the appropriate journal entry for each of the six transactions described previously. Assume all payments will be made next month. (Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)
c. How much gross profit did Classic Boats earn from the sale of job 1?
d. Assume selling costs totaled $2,000 and general and administrative costs totaled $5,500. Prepare an income statement for Classic Boats for the month of April. (Assume there is no adjustment to cost of goods sold for underapplied or overapplied overhead.)

36. **Calculating the Cost of Jobs and Making Journal Entries for a Service Company.** Sampson & Associates provides accounting services. It began jobs 1 through 3 in the first week of January. The following transactions occurred that week.

1. Purchased supplies on account totaling $1,500
2. Used supplies totaling $800 for various jobs
3. Processed timesheets showing the following:

Job 1, direct labor (50 hours)	$ 1,500
Job 2, direct labor (60 hours)	1,700
Job 3, direct labor (10 hours)	400
Indirect labor	900
Total	$ 4,500

4. Applied overhead using a predetermined rate of $10 per direct labor hour.
5. Completed job 1 and billed the customer $3,000. (Hint: Two entries are required—one for the cost of services and another for revenue.)

Required:

a. Calculate the costs incurred in January for each of the three jobs.
b. Make the appropriate journal entry for each item described previously. Assume all payments will be made next month. (Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)
c. How much gross profit did Sampson & Associates earn from job 1?

37. **Calculating the Cost of Jobs and Making Journal Entries for a Service Company.** Management Consulting, Inc., provides consulting services and began operations on September 1. It began jobs 1 through 4 during the first half of September. The following transactions occurred during that time.

1. Purchased supplies on account totaling $6,000
2. Used supplies totaling $3,200 for various jobs
3. Processed timesheets showing the following:

Job 1, direct labor (200 hours)	$ 6,000
Job 2, direct labor (240 hours)	6,800
Job 3, direct labor (40 hours)	2,200
Job 4, direct labor (15 hours)	350
Indirect labor	3,600
Total	$ 18,950

4. Applied overhead using a predetermined rate of 120 percent of direct labor cost
5. Completed jobs 1 and 2 and billed the customers $20,000 and $21,000, respectively. (Hint: Two entries are required—one for the cost of services and another for revenue.)

Required:

a. Calculate the costs incurred in September for each of the four jobs.
b. Make the appropriate journal entry for each item described previously. Assume all payments will be made next month.

(Hint: Use Figure 2.7 "Custom Furniture Company's Journal Entries for May" as a guide.)

c. How much gross profit did Management Consulting, Inc., earn from job 1 and job 2?
d. What is the amount in work in process at the end of the first half of September?

38. **Closing Manufacturing Overhead: Two Approaches.** Olympia Company incurred actual manufacturing overhead costs of $630,000 during the year ended December 31, 2012. A total of $570,000 in overhead was applied to jobs. At December 31, 2012, work-in-process inventory totals $200,000, and finished goods inventory totals $400,000. Cost of goods sold before adjustments totals $1,400,000 for the year.

Required:

a. Is overhead underapplied or overapplied?
b. Close the manufacturing overhead account, assuming the balance is immaterial.
c. Close the manufacturing overhead account, assuming the amount is material.

39. **Closing Manufacturing Overhead: Two Approaches.** Placer Company incurred actual manufacturing overhead costs of $260,000 during the year ended December 31, 2012. A total of $350,000 in overhead was applied to jobs. At December 31, 2012, work-in-process inventory totals $100,000, and finished goods inventory totals $300,000. Cost of goods sold before adjustments totals $600,000 for the year.

Required:

a. Is overhead underapplied or overapplied?
b. Close the manufacturing overhead account, assuming the balance is immaterial.
c. Close the manufacturing overhead account, assuming the amount is material.

One Step Further: Skill-Building Cases

40. **Ethics: Shifting Hours Using Job Costing.** Shawney Accountancy Corporation provides accounting services. It uses a job costing system to track each client's revenues and costs. The firm is currently working on two jobs. The first job, preparing tax returns for Bantem Corporation, was bid at $25,000 and had budgeted costs of $18,000. The second job, performing a review of internal controls for Maxum Company, was bid at 50 percent above actual costs. The following conversation took place between Kelly (a manager) and Ron (senior staff working for Kelly).

Kelly:	*Ron, I just reviewed timesheets for the two jobs we're working on, and it appears we are quickly approaching the budget of $18,000 for the Bantem job.*
Ron:	*Yes, we're having trouble completing the Bantem job in the hours budgeted.*
Kelly:	*This is the first year on the Bantem job, and budgeting for first-year clients is always difficult.*
Ron:	*I'm sure we can retain this job next year with a little bump in the bid—perhaps to $29,000.*
Kelly:	*That's fine for next year, but I have to answer to my boss for this year's results. Why don't we take some of the pressure off by charging some time from the Bantem job to the internal control project we have with Maxum Company? We're under budget with the Maxum job, and they are paying us based on actual costs plus a 50 percent markup.*
Ron:	*Can we do that?*
Kelly:	*We don't do it often, but in cases like this, we have to get creative.*

Required:

a. Why is there an incentive to inflate the hours charged to the Maxum job?
b. What should Ron do? (You may want to refer to the IMA's ethical standards discussed in Chapter 1 "What Is Managerial Accounting?".)

41. **Internet Project: Automation and Overhead Allocation.** Over the past several decades, manufacturing companies have tended to move away from direct labor and more toward automation (i.e., using machinery rather than people to produce products).

    Required:

    a. Use the Internet to find several examples of companies that have made the shift toward an automated production environment. Write a one-page summary of your findings, and include specific information indicating what type of automation is being used.
    b. How might this shift to automation affect the allocation base used to allocate overhead to products?

42. **Group Project: Labor Costs at General Motors and Toyota.** Both **General Motors (GM)** and **Toyota** have production facilities in Texas. **GM's** plant was built in 1956 on a 249-acre site and has since undergone billions of dollars in renovations. **Toyota's** plant was built in 2006 on 2,000 acres. Each plant has a production capacity of 200,000 vehicles per year. **GM** averages close to 22 assembly labor hours per vehicle (no data on labor hours per vehicle are available for **Toyota**). The labor cost per vehicle is $1,800 for **GM**, which uses a unionized labor force, and $800 for **Toyota**, which uses nonunion labor. (Based on Lee Hawkins Jr. and Norihiko Shirouzu, "A Tale of Two Auto Plants," *Wall Street Journal*, May 24, 2006.)

    Required:

    Form groups of two to four students and respond to the following items:

    a. Provide at least two reasons for the significant difference in assembly labor cost per vehicle for **GM** and **Toyota**.
    b. What other production costs should be considered in evaluating the efficiency of each plant?

Comprehensive Cases

43. **Journal Entries, Closing Manufacturing Overhead, and Preparing an Income Statement.** Benning, Inc., is a defense contractor that uses job costing. Because the firm uses a perpetual inventory system, the three supporting schedules to the income statement (the schedule of raw materials placed in production, the schedule of cost of goods manufactured, and the schedule of cost of goods sold) are *not* necessary. Inventory account beginning balances at January 1, 2012, are listed as follows.

Raw materials inventory	$ 500,000
Work-in-process inventory	$ 700,000
Finished goods inventory	$1,800,000

You will be recording the following transactions, which summarize the activities that occurred during the year ended December 31, 2012:

1. Raw materials were purchased for $300,000 on account.
2. Raw materials totaling $420,000 were placed in production, $60,000 for indirect materials and $360,000 for direct materials.
3. The raw materials purchased in transaction **1** were paid for.
4. A total cost of $800,000 for direct labor, shown on the timesheets, was recorded as wages payable.
5. Production supervisors and other indirect labor working in the factory were owed $540,000, recorded as wages payable.
6. Wages owed, totaling $1,200,000, were paid. (These wages were previously recorded correctly as wages payable.)
7. The costs listed in the following related to the factory were incurred during the period. (Hint: Record these items in one entry with one debit to manufacturing overhead and four separate credits):

Building depreciation	$580,000
Insurance (prepaid during 2012, now expired)	$220,000

Utilities (on account)	$ 80,000
Maintenance (paid cash)	$440,000

8. Manufacturing overhead was applied at a rate of $20 per machine hour, and 90,000 machine hours were utilized during the year. (Hint: No need to calculate the predetermined overhead rate since it is already given to you here.)
9. Miscellaneous selling costs totaling $430,000 were paid. These costs were recorded in an account called selling expenses.
10. Miscellaneous general and administrative costs totaling $265,000 were paid. These costs were recorded in an account called G&A expenses.
11. Goods costing $2,030,000 (per the job cost sheets) were completed and transferred out of work-in-process inventory.
12. Goods were sold on account for $3,800,000.
13. The goods sold in transaction **12** had a cost of $2,570,000 (per the job cost sheets).
14. Payments totaling $3,300,000 from credit customers related to transaction **12** were received.

Required:

a. Prepare T-accounts for raw materials inventory, work-in-process inventory, finished goods inventory, manufacturing overhead, and cost of goods sold. Enter the beginning balances for the inventory accounts. (Manufacturing overhead and cost of goods sold are temporary accounts and thus do not have a beginning balance.)
b. Prepare a journal entry for each transaction from **1** through **14** in a format like the one in Figure 2.7 "Custom Furniture Company's Journal Entries for May", and where appropriate, post each entry to the T-accounts set up in requirement **a**. Note that these entries reflect the flow of costs through the inventory and cost of goods sold accounts for the year. Label each entry in the T-accounts by transaction number, include a short description (e.g., direct materials and manufacturing overhead applied), and total each T-account.

c. Based on the balance in the manufacturing overhead account prepared in requirement **b**, prepare a journal entry to close the manufacturing overhead account to cost of goods sold.
d. Prepare an income statement for the year ended December 31, 2012. Remember to adjust cost of goods sold for any underapplied or overapplied overhead.
e. Why is cost of goods sold adjusted upward on the income statement?

44. **Journal Entries, Closing Manufacturing Overhead, and Preparing an Income Statement.** Sierra Nursery Company grows a variety of plants and sells them to local nurseries. Raw materials consist of such items as seeds and the fertilizer required to grow plants from the seedling stage to a viable, saleable plant. Sierra Nursery uses a job costing system to track revenues and costs associated with customer orders. Because the firm uses a perpetual inventory system, the three supporting schedules to the income statement (the schedule of raw materials placed in production, the schedule of cost of goods manufactured, and the schedule of cost of goods sold) are *not* necessary. Inventory account beginning balances at January 1, 2012, are as follows:

Raw materials inventory	$50,000
Work-in-process inventory	$60,000
Finished goods inventory	$90,000

You will be recording the following transactions, which summarize the activities that occurred during the year ended December 31, 2012:

1. Raw materials were purchased for $30,000 on account.
2. Raw materials totaling $41,000 were placed in production, $5,000 for indirect materials and $36,000 for direct materials.
3. The raw materials purchased in transaction **1** were paid for.
4. A total cost of $140,000 for 9,000 hours of direct labor, shown on the timesheets, was recorded as wages payable.
5. Production supervisors and other indirect labor working in the nursery were owed $134,000, recorded as wages payable.

6. Wages owed totaling $180,000 were paid. (These wages were previously recorded correctly as wages payable.)

7. The costs listed in the following related to the nursery were incurred during the period. (Hint: Record these items in one entry with one debit to manufacturing overhead and four separate credits):

Equipment depreciation	$22,000
Rent (prepaid during 2012)	$36,000
Utilities (on account)	$33,000
Maintenance (paid cash)	$19,000

8. Manufacturing overhead was applied at a rate of $30 per direct labor hour. (Hint: No need to calculate the predetermined overhead rate since it is already given to you here.)
9. Miscellaneous selling costs totaling $63,000 were paid. These costs were recorded in an account called selling expenses.
10. Miscellaneous general and administrative costs totaling $18,000 were paid. These costs were recorded in an account called G&A expenses.
11. Goods costing $478,000 (per the job cost sheets) were completed and transferred out of work-in-process inventory.
12. Goods were sold on account for $780,000.
13. The goods sold in transaction **12** had a cost of $415,000 (per the job cost sheets).
14. Payments totaling $380,000 from credit customers related to transaction **12** were received.

Required:

a. Prepare T-accounts for raw materials inventory, work-in-process inventory, finished goods inventory, manufacturing overhead, and cost of goods sold. Enter the beginning balances for the inventory accounts. (Manufacturing overhead and cost of goods sold are temporary accounts and thus do not have a beginning balance.)
b. Prepare a journal entry for each transaction from **1** through **14** in a format like the one in Figure 2.7 "Custom Furniture

Company's Journal Entries for May", and where appropriate, post each entry to the T-accounts set up in requirement **a**. Note that these entries reflect the flow of costs through the inventory and cost of goods sold accounts for the year. Label each entry in the T-accounts by transaction number, include a short description (e.g., direct materials and manufacturing overhead applied), and total each T-account.

c. Based on the balance in the manufacturing overhead account prepared in requirement **b**, prepare a journal entry to close the manufacturing overhead account to cost of goods sold.
d. Prepare an income statement for the year ended December 31, 2012. Remember to adjust cost of goods sold for any underapplied or overapplied overhead.
e. Why is cost of goods sold adjusted downward on the income statement?

Chapter 3

How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?

Cindy Hall is the owner and chief executive officer of SailRite Company. SailRite builds two models of sailboats that are sold at hundreds of retail boat showrooms throughout the world. At its inception several years ago, the company produced only the Basic model, which is 12 feet long and designed for two sailors. Very few options are available for this model, and the production process is relatively simple. Because many owners of the Basic model wanted to move to a bigger, more sophisticated boat, SailRite developed the Deluxe model two years ago. The Deluxe model is 14 feet long and designed for three sailors. Many additional features are available for this model, and the production process is more complex than for the Basic model. Last year, SailRite sold 5,000 units of the Basic and 1,000 units of the Deluxe.

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Although sales of both models increased last year over the year before, company profits have steadily declined. Cindy, the CEO, is concerned about this trend and discusses her concerns with John Lester, the company's accountant; Mary McCann, the vice president of marketing; and Bob Schuler, the vice president of production.

Cindy (CEO):	*Ever since we introduced the Deluxe model our profits have taken a beating. I need some input on what we should do to get this turned around.*
Mary (Marketing Vice President):	*I'm not sure you can blame our salespeople. We've asked them to push the Deluxe model because of the high profit margins, and our sales force has really responded. Sales have steadily increased over the last couple of years, and customers seem to love our sailboats.*
Bob (Production Vice President):	*I don't think the problem is with our products, and using our current costing system, we make $320 in profit for each Basic model and $850 for each Deluxe model. We need to take a close look at how the cost of each boat is determined. Overhead costs have increased significantly*

	since we started producing the Deluxe boat—to about 45 percent of total production costs—and yet we use only one overhead rate based on direct labor hours to allocate these costs. I don't see how this can lead to an accurate cost, and I assume we set the price based on the cost of each boat.
Cindy:	*We certainly considered the cost in our pricing structure. Are you telling me the cost information I have isn't accurate?*
John (Accountant):	*No, the cost information you have is fine for financial reporting, but not for pricing products. When we were producing only the Basic model, overhead allocation wasn't an issue. All overhead costs were simply assigned to the one product. Now that we have two products, overhead is allocated based on direct labor hours as Bob stated. We are required to allocate overhead for financial reporting purposes, but I wouldn't use this cost information for internal pricing purposes.*
Bob:	*I can tell you that the production process for the Deluxe model is much more complicated than the one for the Basic model, so I would expect to see significantly higher costs attached to the Deluxe boat.*
John:	*What I'm hearing is that we need better cost information. I think it's time we move to a more sophisticated costing system called activity-based costing. Give me time to do some research. Let's meet next week.*

This dialogue between the accountant and top management emphasizes the importance of having accurate cost information for decision-making purposes. Very few costing systems provide "perfect" product cost information. Overhead (indirect manufacturing costs) can be allocated in a number of different ways and result in a number of different costs for the same product. The goal is to find a system of allocation that best approximates the amount of overhead costs caused by each product. Sophisticated costing systems are expensive, however. Organizations like SailRite must continually ask the question: Will the benefits of having improved cost information outweigh the costs of obtaining the information?

Several options are available to allocate overhead costs. Before we discuss these options, it is important to understand why overhead costs are allocated at all.

3.1 Why Allocate Overhead Costs?

LEARNING OBJECTIVE

1. Understand why organizations allocate overhead costs to products.

Question: Recall that costs for direct labor and direct materials are easily traced to products. When SailRite produces a sailboat, the direct materials include items such as fiberglass to build the hull, mast, sails, and rope. Direct labor includes the employees building the boat. Accounting for these costs is fairly simple. Indirect manufacturing costs (also called manufacturing overhead or overhead) include electricity to run the factory, rent for the factory building, and factory maintenance. These costs are not easily traced to products and pose a much more complicated challenge for SailRite. Accounting for indirect manufacturing costs typically requires allocating overhead using predetermined overhead rates. Why do managers insist on allocating overhead costs to products?

Answer: Three important reasons that managers allocate overhead costs to products are described in the following:

- **Provide information for decision making.** Setting prices for products is one example of a decision that must be made by management. Prices are often established based on the cost of products. It is not enough to simply include direct materials and direct labor. Overhead must be considered as well.
- **Promote efficient use of resources.** Several different activities are performed to produce a product, such as purchasing raw materials, setting up production machinery, inspecting the final product, and repairing defective products. All of these activities consume resources (consuming resources is another way of stating that a cost is associated with each of these activities). If products are charged for the use of these activities, managers will have an incentive to be efficient in utilizing the activities.
- **Comply with U.S. Generally Accepted Accounting Principles (U.S. GAAP).** U.S. GAAP requires that all manufacturing costs—direct materials, direct labor, and overhead—be assigned to products for inventory costing purposes. This requires the allocation of overhead costs to products.

KEY TAKEAWAY

- Overhead costs are allocated to products to provide information for internal decision making, to promote the efficient use of resources, and to comply with U.S. Generally Accepted Accounting Principles.

REVIEW PROBLEM 3.1

For each scenario listed as follows, identify which of the three important reasons presented in this section best explains why managers choose to allocate overhead costs to products.

a. Financial statements are prepared for the annual report that is provided to shareholders.
b. Management is considering the addition of a new product line.
c. The production manager decides to decrease the frequency of raw materials purchases to reduce the allocated portion of the purchasing department's costs.
d. Profits are calculated for each product so management can decide which products to promote.
e. Quality control inspections are reduced to cut down on the allocated portion of the quality control department's costs.
f. Financial statements are prepared for the company's bondholders.
g. Management asks for cost information to assist in bidding for a contract.

Solutions to Review Problem 3.1

a. Comply with U.S. GAAP
b. Provide information for decision making
c. Promote efficient use of resources
d. Provide information for decision making
e. Promote efficient use of resources
f. Comply with U.S. GAAP
g. Provide information for decision making

3.2 Approaches to Allocating Overhead Costs

LEARNING OBJECTIVE

1. Compare and contrast allocating overhead costs using a plantwide rate, department rates, and activity-based costing.

Question: Managers at companies such as Hewlett-Packard often look for better ways to figure out the cost of their products. When Hewlett-Packard produces printers, the company has three possible methods that can be used to allocate overhead costs to products—plantwide allocation, department allocation, and activity-based allocation (called activity-based costing). How do managers decide which allocation method to use?

Answer: The choice of an allocation method depends on how managers decide to group overhead costs and the desired accuracy of product cost information. Groups of overhead costs are called **cost pools**[1]. For example, **Hewlett Packard's** printer production division may choose to collect all factory overhead costs in one cost pool and allocate those costs from the cost pool to each product using one predetermined overhead rate. Or **Hewlett Packard** may choose to have several cost pools (perhaps for each department, such as assembly, packaging, and quality control) and allocate overhead costs from each department cost pool to products using a separate predetermined overhead rate for each department. In general, the more cost pools used, the more accurate the allocation process.

Plantwide Allocation

Question: Let's look at SailRite Company, which was presented at the beginning of the chapter. The managers at SailRite like the idea of using the plantwide allocation method to allocate overhead to the two sailboat models produced by the company. How would SailRite implement the plantwide allocation method?

1. A collection of overhead costs, typically organized by department or activity.

2. A method of allocating costs that uses one cost pool, and therefore one predetermined overhead rate, to allocate overhead costs.

Answer: The **plantwide allocation**[2] method uses one predetermined overhead rate to allocate overhead costs.Regardless of the approach used to allocate overhead, a predetermined overhead rate is established for each cost pool. The predetermined

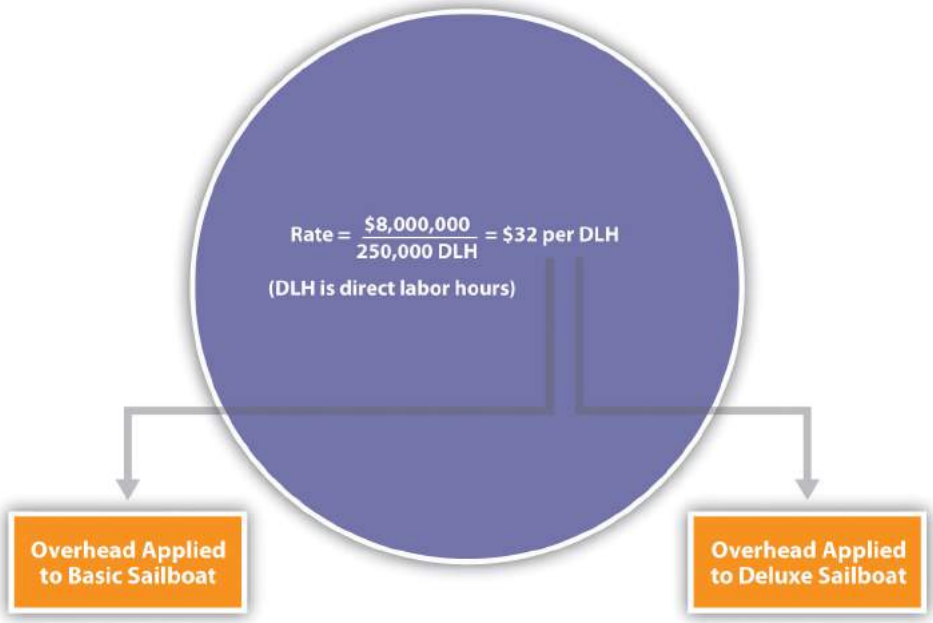
overhead rate is calculated as follows (from Chapter 2 "How Is Job Costing Used to Track Production Costs?"):

$$\text{Predetermined overhead rate} = \frac{\text{Estimated overhead costs}}{\text{Estimated activity in allocation base}}$$

When activity-based costing is used, the denominator can also be called *estimated cost driver activity*. One cost pool accounts for all overhead costs, and therefore one predetermined overhead rate is used to apply overhead costs to products. You learned about this approach in Chapter 2 "How Is Job Costing Used to Track Production Costs?" where one predetermined rate—typically based on direct labor hours, direct labor costs, or machine hours—was used to allocate overhead costs. (Remember, the focus here is on the allocation of overhead costs. Direct materials and direct labor are easily traced to the product and therefore are not a part of the overhead allocation process.)

Using SailRite Company as an example, assume annual overhead costs are estimated to be $8,000,000 and direct labor hours are used for the plantwide allocation base. Management estimates that a total of 250,000 direct labor hours are worked annually. These estimates are based on the previous year's overhead costs and direct labor hours and are adjusted for expected increases in demand the coming year. The predetermined overhead rate is $32 per direct labor hour (= $8,000,000 ÷ 250,000 direct labor hours). Thus, as shown in Figure 3.1 "Using One Plantwide Rate to Allocate SailRite Company's Overhead", products are charged $32 in overhead costs for each direct labor hour worked.

Figure 3.1 *Using One Plantwide Rate to Allocate SailRite Company's Overhead*



Product Costs Using the Plantwide Allocation Approach at SailRite

Question: Assume SailRite uses one plantwide rate to allocate overhead based on direct labor hours. What is SailRite's product cost per unit and resulting profit using the plantwide approach to allocate overhead?

Answer: The calculation of a product's cost involves three components—direct materials, direct labor, and manufacturing overhead. Assume direct materials cost $1,000 for one unit of the Basic sailboat and $1,300 for the Deluxe. Direct labor costs are $600 for one unit of the Basic sailboat and $750 for the Deluxe. This information, combined with the overhead cost per unit, gives us what we need to determine the product cost per unit for each model.

Given the predetermined overhead rate of $32 per direct labor hour calculated in the previous section, and assuming it takes 40 hours of direct labor to build one Basic sailboat and 50 hours to build one Deluxe sailboat, we can calculate the manufacturing overhead cost per unit. Manufacturing overhead cost per unit is $1,280 (= $32 × 40 direct labor hours) for the Basic boat and $1,600 (= $32 × 50 direct labor hours) for the Deluxe boat. Combine the manufacturing overhead with direct materials and direct labor, as shown in Figure 3.2 "SailRite Company Product Costs

Using One Plantwide Rate Based on Direct Labor Hours", and we are able to calculate the product cost per unit.

Figure 3.2 *SailRite Company Product Costs Using One Plantwide Rate Based on Direct Labor Hours*

	Basic Sailboat (cost per unit)	Deluxe Sailboat (cost per unit)
Direct materials	$ 1,000	$ 1,300
Direct labor	600	750
Overhead	1,280*	1,600**
Total product cost per unit	$ 2,880	$ 3,650

**$1,280 = 40 direct labor hours per unit × $32 rate.*

***$1,600 = 50 direct labor hours per unit × $32 rate.*

The average sales price is $3,200 for the Basic model and $4,500 for the Deluxe. Using the product cost information in Figure 3.2 "SailRite Company Product Costs Using One Plantwide Rate Based on Direct Labor Hours", the profit per unit is $320 (= $3,200 price – $2,880 cost) for the Basic model and $850 (= $4,500 price – $3,650 cost) for the Deluxe. Recall from the opening dialogue that SailRite's overall profit has declined ever since it introduced the Deluxe model even though the data shows both products are profitable.

Question: The managers at SailRite like the idea of using the plantwide allocation approach, but they are concerned that this approach will not provide accurate product cost information. Although the plantwide allocation method is the simplest and least expensive approach, it also tends to be the least accurate. In spite of this weakness, why do some organizations prefer to use one plantwide overhead rate to allocate overhead to products?

Answer: Organizations that use a plantwide allocation approach typically have simple operations with a few similar products. Management may not want more accurate product cost information or may not have the resources to implement a more complex accounting system. As we move on to more complex costing systems, remember that these systems are more expensive to implement. Thus the benefits

of having improved cost information must outweigh the costs of obtaining the information.

Department Allocation

Question: Assume the managers at SailRite Company prefer a more accurate approach to allocating overhead costs to its two products. As a result, they are considering using the department allocation approach. How would SailRite form cost pools for the department allocation approach?

Answer: The **department allocation**[3] approach is similar to the plantwide approach except that cost pools are formed for each department rather than for the entire plant, and a separate predetermined overhead rate is established for each department. Remember, total estimated overhead costs will not change. Instead, they will be broken out into various department cost pools. This approach allows for the use of different allocation bases for different departments depending on what drives overhead costs for each department. For example, the Hull Fabrication department at SailRite Company may find that overhead costs are driven more by the use of machinery than by labor, and therefore decides to use machine hours as the allocation base. The Assembly department may find that overhead costs are driven more by labor activity than by machine use and therefore decides to use labor hours or labor costs as the allocation base.

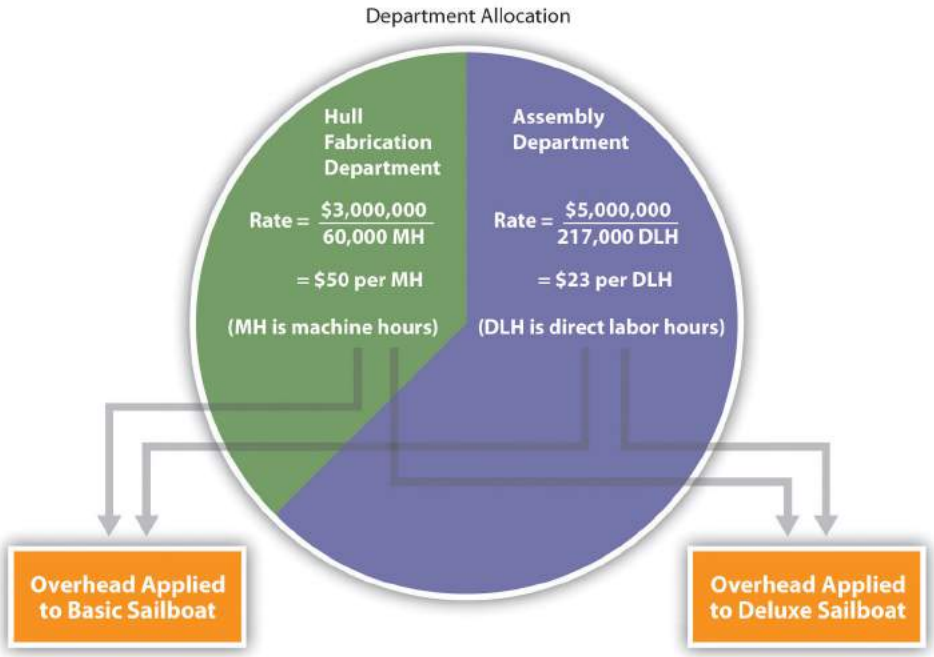
Assume that SailRite is considering using the department approach rather than the plantwide approach for allocating overhead. The cost pool in the Hull Fabrication department is estimated to be $3,000,000 for the year, and the cost pool in the Assembly department is estimated at $5,000,000. Note that total estimated overhead cost is still $8,000,000 (= $3,000,000 + $5,000,000). Machine hours (estimated at 60,000 hours) will be used as the allocation base for Hull Fabrication, and direct labor hours (estimated at 217,000 hours) will be used as the allocation base for Assembly. Thus two rates are used to allocate overhead (rounded to the nearest dollar) as follows:

1. Hull Fabrication department rate: $50 per machine hour (= $3,000,000 ÷ 60,000 hours)
2. Assembly department rate: $23 per direct labor hour (= $5,000,000 ÷ 217,000 hours)

3. A method of allocating costs that uses a separate cost pool, and therefore a separate predetermined overhead rate, for each department.

As shown in Figure 3.3 "Using Department Rates to Allocate SailRite Company's Overhead", products going through the Hull Fabrication department are charged $50 in overhead costs for each *machine hour* used. Products going through the Assembly department are charged $23 in overhead costs for each *direct labor hour* used.

Figure 3.3 *Using Department Rates to Allocate SailRite Company's Overhead*



The department allocation approach allows cost pools to be formed for each department and provides for flexibility in the selection of an allocation base. Although Figure 3.3 "Using Department Rates to Allocate SailRite Company's Overhead" shows just two rates, many companies have more than two departments and therefore more than two rates. Organizations that use this approach tend to have simple operations within each department but different activities across departments. One department may use machinery, while another department may use labor, as is the case with SailRite's two departments. This approach typically provides more accurate cost information than simply using one plantwide rate but still relies on the assumption that overhead costs are driven by direct labor hours, direct labor costs, or machine hours. This assumption of a causal relationship is increasingly less realistic as production processes become more complex.

The plantwide and department allocation methods are "traditional" approaches because both typically use direct labor hours, direct labor costs, or machine hours

as the allocation base, and both were used prior to the creation of activity-based costing in the 1980s.

KEY TAKEAWAY

- Regardless of the approach used to allocate overhead, a predetermined overhead rate is established for each cost pool. The plantwide allocation approach uses one cost pool to collect and apply overhead costs and therefore uses one predetermined overhead rate for the entire company. The department allocation approach uses several cost pools (one for each department) and therefore uses several predetermined overhead rates.

REVIEW PROBLEM 3.2

Kline Company expects to incur $800,000 in overhead costs this coming year—$200,000 in the Cut and Polish department and $600,000 in the Quality Control department. Total annual direct labor costs are expected to be $160,000. The Cut and Polish department expects to use 25,000 machine hours, and the Quality Control department plans to utilize 50,000 hours of direct labor time for the year.

Required:

1. Assume Kline Company allocates overhead costs with the plantwide approach, and direct labor cost is the allocation base. Calculate the rate used by the company to allocate overhead costs.
2. Assume Kline Company allocates overhead costs with the department approach. Calculate the rate used by each department to allocate overhead costs.

Solutions to Review Problem 3.2

1. The plantwide rate is calculated as follows:

$$\text{Predetermined overhead rate} = \frac{\text{Estimated overhead costs}}{\text{Estimated activity in allocation ba}}$$

$$= \frac{\$800,000}{\$160,000}$$

$$= \$5 \text{ per } \$1 \text{ in direct labor cost (or 5}$$

2. The department rates are calculated using the same formula as the plantwide rate. However, overhead costs and activity levels are estimated for each department rather than for the entire company, and two separate rates are calculated:

$$\text{Cut and Polish department} = \frac{\$200,000}{25,000 \text{ machine hours}} = \$8 \text{ per mac}$$

$$\text{Quality Control department} = \frac{\$600,000}{50,000 \text{ direct labor hours}} = \$12 \text{ per}$$

3.3 Using Activity-Based Costing to Allocate Overhead Costs

LEARNING OBJECTIVE

1. Understand how to use the five steps of activity-based costing to determine product costs.

Question: Suppose the managers at SailRite Company decide that the benefits of implementing an activity-based costing system would exceed the cost, and thus the company should use activity-based costing to allocate overhead. What are the five steps of activity-based costing, and how would this method work for SailRite?

Answer: **Activity-based costing (ABC)**[4] uses several cost pools, organized by *activity*, to allocate overhead costs. (Remember that plantwide allocation uses one cost pool for the whole plant, and department allocation uses one cost pool for each department.) The idea is that activities are required to produce products—activities such as purchasing materials, setting up machinery, assembling products, and inspecting finished products. These activities can be costly. Thus the cost of activities should be allocated to products based on the products' use of the activities.

ABC in Action at SailRite Company

Five steps are required to implement activity-based costing. As you work through the example for SailRite Company, once again note that total estimated overhead costs remain at $8,000,000. However, the total is broken out into different *activities* rather than *departments*, and an overhead rate is established for each activity. The five steps are as follows:

4. A method of costing that uses several cost pools, and therefore several predetermined overhead rates, organized by activity to allocate overhead costs.
5. Any process or procedure that consumes overhead resources.

Step 1. Identify costly activities required to complete products.

An **activity**[5] is any process or procedure that consumes overhead resources. The goal is to understand all the activities required to make the company's products.

This requires interviewing and meeting with personnel throughout the organization. Companies that use activity-based costing, such as **Hewlett Packard** and **IBM**, may identify hundreds of activities required to make their products. The most challenging part of this step is narrowing down the activities to those that have the biggest impact on overhead costs.

After meeting with personnel throughout the company, SailRite's accountant identified the following activities as having the biggest impact on overhead costs:

- Purchasing materials
- Setting up machines
- Running machines
- Assembling products
- Inspecting finished products

Step 2. Assign overhead costs to the activities identified in step 1.

This step requires that overhead costs associated with each activity be assigned to the activity (i.e., a cost pool is formed for each activity). For SailRite, the cost pool for the purchasing materials activity will include costs for items such as salaries of purchasing personnel, rent for purchasing department office space, and depreciation of purchasing office equipment.

The accountant at SailRite developed the following allocations after careful review of all overhead costs (remember, these are *overhead* costs, not direct materials or direct labor costs):

Activity	Estimated Annual Overhead Cost
Purchasing materials	$1,200,000
Setting up machines	1,600,000
Running machines	2,700,000
Assembling products*	1,500,000
Inspecting finished products	1,000,000
Total	$8,000,000

**We should note that this is not the direct labor cost. Instead, this represents overhead costs associated with assembling products, such as supplies and the factory space being used for assembly.*

At this point, we have identified the most important and costly activities required to make products, and we have assigned overhead costs to each of these activities. The next step is to find an allocation base that drives the cost of each activity.

Step 3. Identify the cost driver for each activity.

A **cost driver**[6] is the action that causes (or "drives") the costs associated with the activity. Identifying cost drivers requires gathering information and interviewing key personnel in various areas of the organization, such as purchasing, production, quality control, and accounting. After careful scrutiny of the process required for each activity, SailRite established the following cost drivers:

Activity	Cost Driver	Estimated Annual Cost Driver Activity
Purchasing materials	Purchase requisitions	10,000 requisitions
Setting up machines	Machine setups	2,000 setups
Running machines	Machine hours	90,000 hours
Assembling products	Direct labor hours	250,000 hours
Inspecting finished products	Inspection hours	20,000 hours

Notice that this information includes an estimate of the level of activity for each cost driver, which is needed to calculate a predetermined rate for each activity in step 4.

Step 4. Calculate a predetermined overhead rate for each activity.

This is done by dividing the estimated overhead costs (from step 2) by the estimated level of cost driver activity (from step 3). Figure 3.4 "Predetermined Overhead Rates for SailRite Company" provides the overhead rate calculations for SailRite Company based on the information shown in the previous three steps. It shows that products will be charged $120 in overhead costs for each purchase requisition processed,

6. The action that causes the costs associated with an activity.

$800 for each machine setup, $30 for each machine hour used, $6 for each direct labor hour worked, and $50 for each hour of inspection time.

Figure 3.4 *Predetermined Overhead Rates for SailRite Company*

Activity	Cost Driver	(a) Estimated Overhead Costs	(b) Estimated Cost Driver Activity	(a) ÷ (b) Predetermined Overhead Rate
Purchasing materials	Purchase requisitions	$1,200,000	10,000	$120 per requisition
Setting up machines	Machine setups	1,600,000	2,000	800 per setup
Running machines	Machine hours	2,700,000	90,000	30 per machine hour
Assembling products	Direct labor hours	1,500,000	250,000	6 per direct labor hour
Inspecting finished products	Inspection hours	1,000,000	20,000	50 per inspection hour
Total		$8,000,000		

Step 5. Allocate overhead costs to products.

Overhead costs are allocated to products by multiplying the predetermined overhead rate for each activity (calculated in step 4) by the level of cost driver activity used by the product. The term *applied overhead* is often used to describe this process.

Assume the following annual cost driver activity takes place at SailRite for the Basic and Deluxe sailboats:Notice that the total activity levels presented here match the estimated activity levels presented in step 4. This was done to avoid complicating the example with overapplied and underapplied overhead. However, a more realistic scenario would provide *actual* activity levels that are different than *estimated* activity levels, thereby creating overapplied and underapplied overhead for each activity. We described the disposition of overapplied and underapplied overhead in Chapter 2 "How Is Job Costing Used to Track Production Costs?".

Activity	Basic Sailboat	Deluxe Sailboat	Total
Purchasing materials	7,000 requisitions	3,000 requisitions	10,000 requisitions
Setting up machines	1,100 setups	900 setups	2,000 setups
Running machines	50,000 hours	40,000 hours	90,000 machine hours

Assembling products	200,000 hours	50,000 hours	250,000 direct labor hours
Inspecting finished products	12,000 hours	8,000 hours	20,000 inspection hours

Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company" shows the allocation of overhead using the cost driver activity just presented and the overhead rates calculated in Figure 3.4 "Predetermined Overhead Rates for SailRite Company". Notice that allocated overhead costs total $8,000,000. This is the same cost figure used for the plantwide and department allocation methods we discussed earlier. Activity-based costing simply provides a more refined way to allocate the same overhead costs to products.

Figure 3.5 *Allocation of Overhead Costs to Products at SailRite Company*

		Basic Sailboat		Deluxe Sailboat	
Activity	Predetermined Overhead Rate	Cost Driver Activity	Overhead Allocated*	Cost Driver Activity	Overhead Allocated*
Purchasing materials	$120 per requisition	7,000	$ 840,000	3,000	$ 360,000
Setting up machines	800 per setup	1,100	880,000	900	720,000
Running machines	30 per machine hour	50,000	1,500,000	40,000	1,200,000
Assembling products	6 per direct labor hour	200,000	1,200,000	50,000	300,000
Inspecting finished products	50 per inspection hour	12,000	600,000	8,000	400,000
Total overhead costs allocated			$ 5,020,000		$ 2,980,000
Total companywide overhead costs				$ 8,000,000	
Overhead cost per unit for each product**			$ 1,004		$ 2,980

**Overhead allocated equals the predetermined overhead rate times the cost driver activity.*

***Overhead cost per unit for the Basic model equals $5,020,000 (overhead allocated) ÷ 5,000 units produced, and for the Deluxe model, it equals $2,980,000 ÷ 1,000 units produced.*

The bottom of Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company" shows the *overhead* cost per unit for each product assuming SailRite produces 5,000 units of the Basic sailboat and 1,000 units of the Deluxe sailboat. This information is needed to calculate the *product* cost for each unit of product, which we discuss next.

Product Costs Using the Activity-Based Costing Approach at SailRite

Question: As shown in Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company", SailRite knows the overhead cost per unit using activity-based costing is $1,004

for the Basic model and $2,980 for the Deluxe. Now that SailRite has the overhead cost per unit, how will the company find the total product cost per unit and resulting profit?

Answer: Recall from our discussion earlier that the calculation of a product's cost involves three components—direct materials, direct labor, and manufacturing overhead. Assume direct materials cost $1,000 for the Basic sailboat and $1,300 for the Deluxe. Direct labor costs are $600 for the Basic sailboat and $750 for the Deluxe. This information, combined with the overhead cost per unit calculated at the bottom of Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company", gives us what we need to determine the product cost per unit for each model, which is presented in Figure 3.6 "SailRite Company Product Costs Using Activity-Based Costing". The average sales price is $3,200 for the Basic model and $4,500 for the Deluxe. Using the product cost information in Figure 3.6 "SailRite Company Product Costs Using Activity-Based Costing", the Basic model yields a profit of $596 (= $3,200 price – $2,604 cost) per unit and the Deluxe model yields a *loss* of $530 (= $4,500 price – $5,030 cost) per unit.

Figure 3.6 SailRite Company Product Costs Using Activity-Based Costing

	Basic Sailboat (cost per unit)	Deluxe Sailboat (cost per unit)
Direct materials	$ 1,000	$ 1,300
Direct labor	600	750
Overhead	1,004	2,980
Total product cost per unit	$ 2,604	$ 5,030

As you can see in Figure 3.6 "SailRite Company Product Costs Using Activity-Based Costing", overhead is a significant component of total product costs. This explains the need for a refined overhead allocation system such as activity-based costing.

Comparison of ABC to Plantwide Costing at SailRite

After going through the process of allocating overhead using activity-based costing, John Lester (the company accountant) called a meeting with the same management group introduced at the beginning of the chapter: Cindy Hall (CEO), Mary McCann (vice president of marketing), and Bob Schuler (vice president of production). As you read the following dialogue, refer to Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company", which summarizes John's findings.

Cindy:	*What do you have for us, John?*
John:	*I think you'll find the results of our most recent costing analysis very interesting. We used an approach called activity-based costing to allocate overhead to products.*
Bob:	*I recall being interviewed last week about the activities involved in the production process.*
John:	*Yes, here's what we found. The old allocation approach indicates that the Basic boat costs $2,880 to build and the Deluxe boat costs $3,650 to build. Our average sales price for the Basic is $3,200 and $4,500 for the Deluxe. You can see why we pushed sales of the Deluxe boat—it has a profit of $850 per boat.*
Cindy:	*John, from your analysis, it looks as if we were wrong about the Deluxe boat being the most profitable.*
John:	*We do have some startling results. Using activity-based costing, an approach I think is much more accurate, the Deluxe boat is not profitable at all. In fact, we lose $530 for each Deluxe boat sold, and the profits from the Basic boat are much higher than we thought at $596 per unit.*
Cindy:	*I see direct materials and direct labor are the same no matter which costing system we use. Why is there such a large variation in overhead costs?*
John:	*Good question! When we used our old approach of one plantwide rate based on direct labor hours, the Deluxe process consumed 20 percent of all direct labor hours worked—that is, 50,000 Deluxe hours divided by 250,000 total hours. Therefore the Deluxe model was allocated 20 percent of all overhead costs. Using activity-based costing, we identified five key activities and assigned overhead costs based on the use of these activities. The Deluxe process consumed more than 20 percent of the resources provided for every activity. For example, running machines is one of the most costly activities, and the Deluxe model used about 44 percent of the resources provided by this activity. This is significantly higher than the 20 percent allocated using direct labor hours under the old approach.*
Bob:	*This certainly makes sense! Each Deluxe boat takes a whole lot more machine hours to produce than the Basic boat.*
Cindy:	*Thanks for this analysis, John. Now we know why company profits have been declining even though sales have increased. Either the Deluxe sales price must go up or costs must go down—or a combination of both!*

Figure 3.7 Activity-Based Costing Versus Plantwide Costing at SailRite Company

Plantwide Costing
(direct labor hours as allocation base)

	Basic Sailboat	Deluxe Sailboat
Direct materials	$ 1,000	$ 1,300
Direct labor	600	750
Overhead*	1,280	1,600
Total product cost per unit (a)	$ 2,880	$ 3,650
Sales price (b)	$ 3,200	$ 4,500
Profit = (b) – (a)	**$ 320**	**$ 850**

Activity-Based Costing
(several different allocation bases)

	Basic Sailboat	Deluxe Sailboat
Direct materials	$ 1,000	$ 1,300
Direct labor	600	750
Overhead**	1,004	2,980
Total product cost per unit (c)	$ 2,604	$ 5,030
Sales price (d)	$ 3,200	$ 4,500
Profit (loss) = (d) – (c)	**$ 596**	**$ (530)**

*From Figure 3.2 "SailRite Company Product Costs Using One Plantwide Rate Based on Direct Labor Hours".

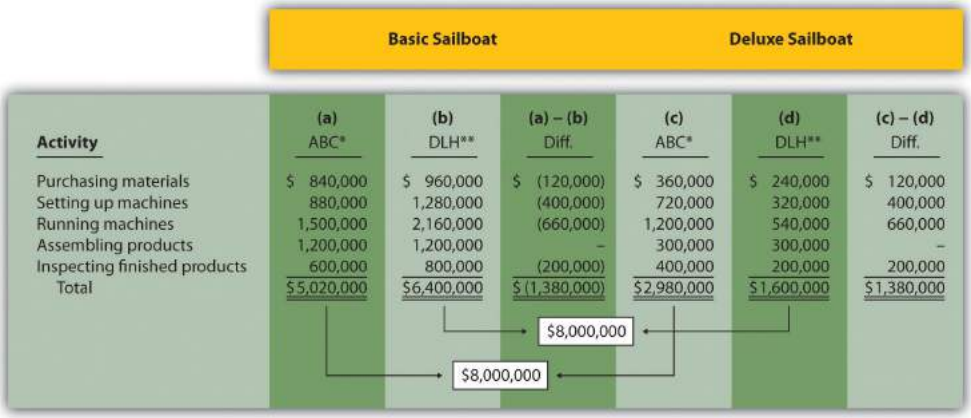
**From Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company".

Question: SailRite has more accurate product cost information using activity-based costing to allocate overhead. Why is the overhead cost per unit so different using activity-based costing?

Answer: Figure 3.8 "Detailed Analysis of Overhead Allocations at SailRite Company" provides a more thorough look at how the Deluxe product consumes a significant share of overhead resources—much higher than the 20 percent that was being allocated based on direct labor hours. Let's look at Figure 3.8 "Detailed Analysis of Overhead Allocations at SailRite Company" in detail:

- The ABC column represents overhead costs allocated using the activity-based costing shown back in Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company".
- The DLH (direct labor hours) column represents overhead costs allocated using direct labor hours as the allocation base where 80 percent was allocated to the Basic boat (= 200,000 hours ÷ 250,000 total hours) and 20 percent allocated to the Deluxe boat (= 50,000 hours ÷ 250,000 total hours).
- The Diff. (difference) column shows the difference between one allocation method and the other. Notice the shift in the allocation of overhead costs using activity-based costing. A total of $1,380,000 in overhead costs shifts to the Deluxe sailboat, which amounts to $1,380 per boat (= $1,380,000 ÷ 1,000 boats).

Figure 3.8 *Detailed Analysis of Overhead Allocations at SailRite Company*



**Amounts in this column come from Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company".*

***Amounts in this column are calculated by multiplying 80 percent for the Basic boat (20 percent for the Deluxe) by the total overhead cost for the activity. For example, the total overhead cost for purchasing materials is $1,200,000 (see Figure 3.4 "Predetermined Overhead Rates for SailRite Company") and $1,200,000 × 80 percent = $960,000. Using the plantwide approach (one plantwide rate based on direct labor hours), $960,000 is the amount allocated to the Basic sailboat for this activity, and $240,000 is the amount allocated to the Deluxe boat.*

The primary reason that using activity-based costing shifted overhead costs to the Deluxe sailboat is that producing each Deluxe boat requires more resources than the Basic boat. For example, the Basic boat requires 50,000 machine hours to produce 5,000 boats, and the Deluxe boat requires 40,000 machine hours to produce 1,000 boats. The number of machine hours required per boat produced is as follows:

	Basic	Deluxe
Total machine hours (a)	50,000	40,000
Total boats produced (b)	÷ 5,000	÷ 1,000
Machine hours per boat (a) ÷ (b)	10	40

You can see from this analysis that the Deluxe boat consumes four times the machine hours of the Basic boat. At a rate of $30 per machine hour, the Deluxe boat is assigned $1,200 per boat for this activity ($30 rate × 40 machine hours) while the Basic boat is assigned $300 per boat ($30 rate × 10 machine hours).

Advantages and Disadvantages of ABC

Question: Activity-based costing undoubtedly provides better cost information than most traditional costing methods, such as plantwide and department allocation methods. However, ABC has its limitations. What are the advantages and disadvantages of using activity-based costing?

Answer: The advantages and disadvantages of ABC are as follows:

Advantages

More accurate cost information leads to better decisions. The cost information provided by ABC is generally regarded as more accurate than the information provided by most traditional costing methods. This allows management to make better decisions in areas such as product pricing, product line changes (adding products or eliminating products), and product mix decisions (how much of each product to produce and sell).

Increased knowledge of production activities leads to process improvements and reduced costs. ABC requires identifying the activities involved in the production process (step 1) and assigning costs to these activities (step 2). This provides management with a better view of the detailed activities involved (purchasing materials, machine setups, inspections, and so forth) and the cost of each activity. Managers are more likely to focus on improving efficiency in the most costly activities, thereby reducing costs.

Disadvantages

ABC systems can be costly to implement. ABC systems require teamwork across the organization and therefore require employees to take time out from their day-to-day activities to assist in the ABC process (e.g., to identify costly activities). Assigning costs to activities takes time, as does identifying and tracking cost drivers. And assigning costs to products requires a significant amount of time in the accounting department. Imagine having 15 cost pools (activities), each with a predetermined overhead rate used to assign overhead costs to the company's 80 products—not an unrealistic example for a large company. The accounting costs incurred to maintain such a system can be prohibitively high.

Unitizing fixed costs can be misleading. Product costing involves allocating costs from activity centers to products and calculating a product cost per unit. The problem with this approach is that fixed costs are often a large part of the overhead costs being allocated (e.g., building and machinery depreciation and supervisor salaries). Recall that fixed costs are costs that *do not change in total* with changes in activity.

Looking back to the SailRite example using activity-based costing, the Deluxe sailboat cost $5,030 per unit to produce based on production of 1,000 units (as shown in Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company"). If SailRite produces 2,000 units of the Deluxe boat, will the unit cost remain at $5,030? Probably not. A significant portion of overhead costs are fixed and will be spread out over more units, thereby reducing the cost per unit. We address this issue at length in later chapters. The point here is that managers must beware of using per unit cost information blindly for decision making, particularly if a significant change in the level of production is anticipated.

The benefits may not outweigh the costs. Companies with one or two products that require very little variation in production may not benefit from an ABC system. Suppose a company produces one product. The overhead costs can be divided into as many cost pools as you like, but all overhead costs will still be assigned to the one product. (We should mention, however, that management would benefit from understanding the activities involved in the process and the costs associated with each activity. It's the allocation to the one product—steps 4 and 5 of ABC—that would provide little useful information in this scenario.)

Companies that produce several different products may believe that the benefits of implementing ABC will outweigh the costs. However, management must be willing to use the ABC information to benefit the company. Companies like **Chrysler Group LLC** have been known to try ABC, only to meet resistance from their managers.

Until managers are willing to use the ABC information to make improvements in the organization, there is no point in implementing such a system.

Business in Action 3.1

Characteristics of Companies That Use Activity-Based Costing

A survey of 130 U.S. manufacturing companies yielded some interesting results. The companies that used activity-based costing (ABC) had higher overhead costs as a percent of total product costs than companies that used traditional costing. Those using ABC also had a higher level of automation. The complexity of production processes and products tended to be higher for those using ABC, and ABC companies operated at capacity more frequently.

It is important to note that the differences between companies using ABC and companies using traditional costing systems in all these areas—overhead costs, automation, complexity of production, and frequency of capacity—were relatively small. However, users of ABC indicated their systems were more adequate than traditional systems in providing useful information for performance evaluation and cost reduction.

Source: Susan B. Hughes and Kathy A. Paulson Gjerde, "Do Different Cost Systems Make a Difference?" *Management Accounting Quarterly*, Fall 2003.

ABC Cost Flows

Question: How are overhead costs recorded when using activity-based costing?

Answer: We presented the flow of costs for a job costing system in Chapter 2 "How Is Job Costing Used to Track Production Costs?", including how to track actual overhead costs and how to track overhead applied using a separate manufacturing overhead account. The cost flows are the same for an activity-based costing system, with one exception. Instead of using one plantwide overhead rate to allocate (or apply) overhead to products, an ABC system uses several overhead rates to allocate overhead. The entry to record this allocation—whether it involves one rate or

multiple rates—is the same as the entry in Chapter 2 "How Is Job Costing Used to Track Production Costs?". Simply debit work-in-process inventory and credit manufacturing overhead for the amount of overhead applied. (Some companies use separate work-in-process inventory and manufacturing overhead accounts for each activity. For the sake of simplicity, we do not use separate accounts.)

For example, assume production of SailRite's Basic sailboats has the following cost driver activity for one week of operations:

(a) Activity for the Week	(b) Rate*	(a) × (b) Amount of Overhead Applied
10 purchase requisitions	$120 per requisition	$ 1,200
15 machine setups	800 per setup	12,000
35 machine hours	30 per machine hour	1,050
150 direct labor hours	6 per direct labor hour	900
60 inspection hours	50 per inspection hour	3,000
Total overhead applied to the Basic Sailboat		$ 18,150

*From *Figure 3.4 "Predetermined Overhead Rates for SailRite Company"*.

The entry to record overhead applied to the Basic sailboats for the week is as follows:

Dr. WIP Inventory	18,150	
Cr. Manufacturing overhead		18,150

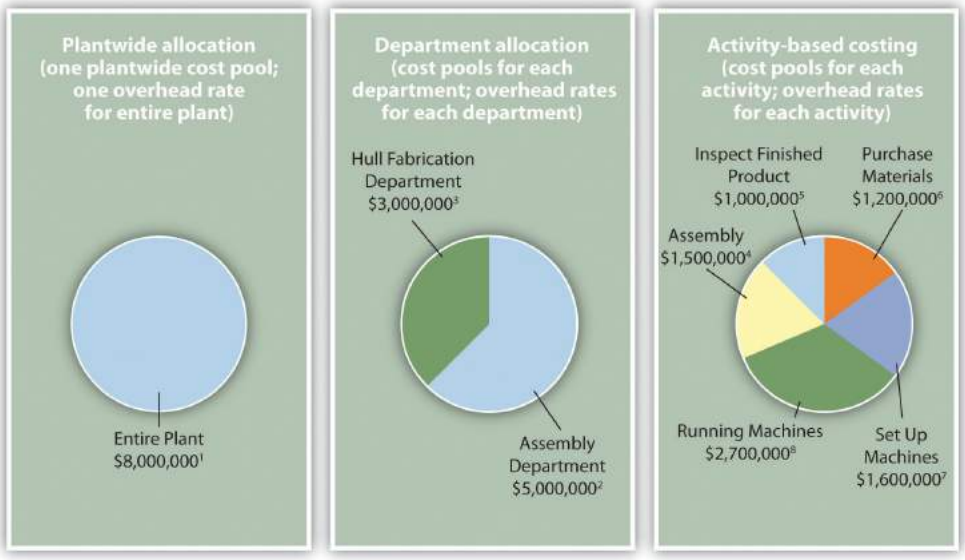
Recall from Chapter 2 "How Is Job Costing Used to Track Production Costs?" that the manufacturing overhead account is closed to cost of goods sold at the end of the period. If actual overhead costs are higher than applied overhead, the resulting *underapplied* overhead is closed with a debit to cost of goods sold and a credit to manufacturing overhead. If actual overhead costs are lower than applied overhead, the resulting *overapplied* overhead is closed with a debit to manufacturing overhead and a credit to cost of goods sold.

Recap of Three Allocation Methods

We have discussed three different methods of allocating overhead to products—plantwide allocation, department allocation, and activity-based costing. Remember, total overhead costs will not change in the short run, but the way total overhead costs are allocated to products will change depending on the method used.

Figure 3.9 "The Three Methods of Overhead Allocation" presents the three allocation methods, using SailRite as an example. Notice that the three pie charts in the illustration are of equal size, representing the $8,000,000 total overhead costs incurred by SailRite.

Figure 3.9 *The Three Methods of Overhead Allocation*



Overhead Rates:

[1] *Allocated based on direct labor hours (DLH): $8,000,000 ÷ 250,000 DLH = $32 per DLH.*

[2] *Allocated based on direct labor hours (DLH): $5,000,000 ÷ 217,000 DLH = $23 per DLH.*

[3] *Allocated based on machine hours (MH): $3,000,000 ÷ 60,000 MH = $50 per MH.*

[4] *Allocated based on direct labor hours (DLH): $1,500,000 ÷ 250,000 DLH = $6 per DLH.*

[5] *Allocated based on inspection hours (IH): $1,000,000 ÷ 20,000 IH = $50 per IH.*

[6] *Allocated based on purchase requisitions (PR): $1,200,000 ÷ 10,000 PR = $120 per PR.*

[7] *Allocated based on machine setups (MS): $1,600,000 ÷ 2,000 MS = $800 per MS.*

[8] *Allocated based on machine hours (MH): $2,700,000 ÷ 90,000 MH = $30 per MH.*

KEY TAKEAWAY

- Activity-based costing focuses on identifying the activities required to make products, on forming cost pools for each activity, and on allocating overhead costs to the products based on their use of each activity. ABC systems and traditional systems often result in vastly different product costs. But even if the resulting product costs are not much different, ABC provides managers with a better understanding of the production activities required for each activity and the associated costs, which often leads to improved efficiency and reduced costs.

Business in Action 3.2

Using Activity-Based Costing to Argue Predatory Pricing

BuyGasCo Corporation, a privately owned chain of gas stations based in Florida, was taken to court for selling regular grade gasoline below cost, and an injunction was issued. Florida law prohibits selling gasoline below refinery cost if doing so injures competition. Using a plantwide approach of allocating costs to products, the plaintiff's costing expert was able to support the allegation of predatory pricing. The defendant's expert witness, an accounting professor, used activity-based costing to dispute the allegation.

Both costing experts had to allocate costs to each of the three grades of gasoline (regular, plus, and premium) to determine a total cost per grade of fuel and a cost per gallon for each grade. Sales of regular grade fuel were significantly higher (63 percent of total sales) than the other two grades. Using the plantwide approach, the plaintiff's expert allocated all costs based on gallons of gas sold. Using the activity-based costing approach, the defendant's expert formed three activity cost pools—labor, kiosk, and gas dispensing. The first two cost pools allocated costs using gallons of gas sold and therefore were allocated as they would be with the plantwide approach (63 percent for regular grade, 20 percent for plus, and 17 percent for premium). The third cost pool (gas dispensing) allocated costs equally to each grade of fuel (i.e., one-third of costs to each grade of fuel). The gas dispensing pool included costs for storage tanks, all of which were the same size, as well as gas pumps and signs.

Compared with the plantwide approach, activity-based costing showed a lower cost per gallon for regular gas and a higher cost per gallon for the other two grades of fuel. Once the ABC information was presented, the case was settled, and the initial injunction was lifted.

Sources: Thomas L. Barton and John B. MacArthur, "Activity-Based Costing and Predatory Pricing: The Case of the Petroleum Retail Industry," *Management Accounting*, Spring 2003; All Business, "Home Page," http://www.allbusiness.com.

REVIEW PROBLEM 3.3

Parker Company produces an inkjet printer that sells for $150 and a laser printer that sells for $350. Last year, total overhead costs of $1,050,000 were allocated based on direct labor hours. A total of 15,000 direct labor hours were required last year to build 12,000 inkjet printers (1.25 hours per unit), and 10,000 direct labor hours were required to build 4,000 laser printers (2.50 hours per unit). Total direct labor and direct materials costs for the year were as follows:

	Inkjet Printer	Laser Printer
Direct materials	$540,000	$320,000
Direct labor	$600,000	$400,000

The management of Parker Company would like to use activity-based costing to allocate overhead rather than use one plantwide rate based on direct labor hours. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

			Estimated Cost Driver Activity		
Activity	Cost Driver	Estimated Overhead Costs	Inkjet	Laser	Total
Production runs	Number of production runs	$ 400,000	40	10	50
Quality inspections	Inspection hours	250,000	1,200	2,800	4,000
Packaging and shipping	Number of units shipped	400,000	12,000	4,000	16,000
Total		$1,050,000			

Required:

1. Calculate the direct materials cost per unit and direct labor cost per unit for each product.

2.

    1. Using the plantwide allocation method, calculate the predetermined overhead rate and determine the overhead cost per unit for the inkjet and laser products.
    2. What is the cost per unit for the inkjet and laser products?

3.

1. Using the activity-based costing allocation method, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.)
2. Using the activity-based costing allocation method, allocate overhead to each product. (Hint: This is step 5 in the activity-based costing process.) Determine the overhead cost per unit. Round amounts to the nearest dollar.
3. What is the product cost per unit for the inkjet and laser products?

4. Calculate the per unit profit for each product using the plantwide approach and the activity-based costing approach. Comment on the differences between the results of the two approaches.

Solutions to Review Problem 3.3

1. The cost per unit for direct materials is as follows:

	Inkjet Printer	Laser Printer
Total direct material costs (a)	$ 540,000	$ 320,000
Units produced (b)	12,000 units	4,000 units
Direct material cost per unit (a) ÷ (b)	$ 45 per unit	$ 80 per unit

The cost per unit for direct labor is as follows:

	Inkjet Printer	Laser Printer
Total direct labor costs (c)	$ 600,000	$ 400,000
Units produced (d)	12,000 units	4,000 units
Direct labor cost per unit (c) ÷ (d)	$ 50 per unit	$ 100 per unit

2.

1. The plantwide allocation used by Parker Company is based on direct labor hours. The predetermined overhead rate is calculated as follows:

$$\frac{\text{Estimated overhead cost}}{\text{Estimated activity in allocation base}} = \frac{\$1{,}050{,}000}{25{,}000 \text{ hours}}$$

$$= \$42 \text{ per direct labor}$$

Because the inkjet printer requires 1.25 direct labor hours to build and the laser printer takes 2.50 direct labor hours to build (both figures are provided in the problem data), $52.50 in overhead is allocated to 1 unit of the inkjet product (= $42 rate × 1.25 hours) and $105 in overhead is allocated to 1 unit of the laser product ($42 rate × 2.50 direct labor hours).

2. Per unit product costs are as follows:

	Inkjet Printer	Laser Printer
Direct materials	$ 45.00	$ 80.00
Direct labor	50.00	100.00
Overhead	52.50*	105.00**
Total product cost per unit	$147.50	$285.00

Direct materials and direct labor determined from Question 1.

**\$52.50 = 1.25 direct labor hours per unit × \$42 rate.*

***\$105 = 2.50 direct labor hours per unit × \$42 rate.*

3.

1. Predetermined overhead rates are calculated for each activity as follows:

Activity	Cost Driver	(a) Estimated Overhead Costs	(b) Estimated Cost Driver Activity	(a) ÷ (b) Predetermined Overhead Rate
Production runs	Number of production runs	$ 400,000	50 runs	$ 8,000.00 per run
Quality inspections	Inspection hours	250,000	4,000 hours	62.50 per inspection hr.
Packaging and shipping	Number of units shipped	400,000	16,000 units	25.00 per unit shipped
Total		$1,050,000		

2. Overhead costs are allocated as follows:

			Inkjet Printer		Laser Printer	
Activity	Predetermined Overhead Rate	Cost Driver Activity	Overhead Allocated*	Cost Driver Activity	Overhead Allocated*
Production runs	$8,000.00 per run	40	$ 320,000	10	$ 80,000
Quality inspections	62.50 per inspection	1,200	75,000	2,800	175,000
Packaging and shipping	25.00 per unit shipped	12,000	300,000	4,000	100,000
Total overhead costs allocated			$ 695,000		$ 355,000
Total companywide overhead costs				$ 1,050,000	
Overhead cost per unit for each product**			$ 58		$ 89

**Overhead allocated equals the predetermined overhead rate times the cost driver activity.*

***Overhead cost per unit for the inkjet printer equals $695,000 (overhead allocated) ÷ 12,000 units produced, and for the laser printer, $355,000 ÷ 4,000 units produced. Amounts are rounded to the nearest dollar.*

3. Per unit product costs are as follows:

	Inkjet Printer	Laser Printer
Direct materials	$ 45	$ 80
Direct labor	50	100
Overhead	58	89
Total product cost per unit	$ 153	$ 269

Direct materials and direct labor determined from Question 1. Overhead determined from Question 3b.

4.

Plantwide Allocation
(direct labor hours as the allocation base)

	Inkjet Printer	Laser Printer
Direct materials	$ 45.00	$ 80.00
Direct labor	50.00	100.00
Overhead	52.50	105.00
Total product cost per unit (a)	$147.50	$285.00
Sales price (b)	$150.00	$350.00
Profit = (b) – (a)	**$ 2.50**	**$ 65.00**

Activity-Based Costing
(several different allocation bases)

	Inkjet Printer	Laser Printer
Direct materials	$ 45.00	$ 80.00
Direct labor	50.00	100.00
Overhead	58.00	89.00
Total product cost per unit (c)	$153.00	$269.00
Sales price (d)	$150.00	$350.00
Profit (loss) = (d) – (c)	**$ (3.00)**	**$ 81.00**

Although unit product costs do not change significantly for the inkjet printer when activity-based costing is used (from $147.50 to $153), the cost increases enough to result in a $3 loss for each unit. Conversely, the laser printer costs decrease significantly from $285 to $269 per unit when using activity-based costing, resulting in a profit of $81 per unit.

The shift in overhead costs to the inkjet printer is primarily a result of the inkjet printer using 80 percent of the production run resources and thus being assigned 80 percent of the overhead costs associated with production runs. The plantwide rate approach only assigned 60 percent of all overhead costs to the inkjet printer, including those related to production runs (60 percent = 15,000 inkjet direct labor hours ÷ 25,000 total direct labor hours).

3.4 Using Activity-Based Management to Improve Operations

LEARNING OBJECTIVE

1. Understand the concept of activity-based management.

Question: Activity-based costing is helpful in providing relatively accurate product cost information. However, the value of activity-based costing information goes beyond accurate product costing. When activity-based costing is used in conjunction with activity-based management, organizations are often able to make dramatic improvements to operations. How does activity-based management help an organization reduce costs and become more efficient?

Answer: **Activity-based management (ABM)**[7] provides three steps for managers to use that lead to improved efficiency and profitability of operations.

Step 1. Identify activities required to complete products.

This involves interviewing personnel throughout the company. Recall that activity-based costing also requires the identification of key activities. However, ABM allows for a more detailed analysis because the estimation of costs and related overhead rates are not required when using ABM.

Step 2. Determine whether activities are value-added or non-value-added.

Activities that add to the product's quality and performance are called **value-added activities**[8]. Activities that do not add to the product's quality and performance are called **non-value-added activities**[9]. Examples of value-added activities at SailRite include using materials and machines to produce hulls and assembling each

7. A management tool that uses cost information obtained from an ABC system to improve the efficiency and profitability of operations.
8. Activities that add to a product's quality and performance.
9. Activities that do not add to a product's quality and performance.

sailboat. Examples of non-value-added activities include storing parts in a warehouse and letting machinery sit idle.

Step 3. Continuously improve the value-added activities and minimize or eliminate the non-value-added activities.

Even if an activity is identified as value-added, ABM requires the continuous improvement of the activity. For example, SailRite's assembly process (a value-added activity) may require workers to shift back and forth between Basic and Deluxe sailboats throughout the day, each of which uses different parts and requires different tools. Perhaps the efficiency of this process could be improved by assembling the boats in batches—one day working on Basic boats, another day working on Deluxe boats.

Activities that are non-value-added should be minimized or eliminated. For example, storing parts in a warehouse at SailRite (a non-value-added activity) might be minimized by moving to a just-in-time system that requires suppliers to deliver parts immediately before they are needed for production.

The next time you visit a fast-food restaurant, go to a clothing store, or stand in line at a college bookstore, try to identify value-added and non-value-added activities. Think about ways the organization can eliminate non-value-added activities and improve value-added activities.

KEY TAKEAWAY

- Activity-based management provides a three step process that shows management how to use the cost information obtained from an activity-based costing system to improve the efficiency and profitability of operations.

Business in Action 3.3

Why Use Activity-Based Costing (ABC) and Activity-Based Management (ABM)?

A survey of 296 users of activity-based costing and activity-based management showed that the top four objectives of using ABC and ABM were as follows:

1. To provide product costing (58 percent)
2. To analyze processes (51 percent)
3. To evaluate performance (49 percent)
4. To assess profitability (38 percent)

All these objectives are important to most organizations and can be achieved with the help of ABC and ABM systems.

Source: Mohan Nair, "Activity-Based Costing: Who's Using It and Why?" *Management Accounting Quarterly*, Spring 2000.

REVIEW PROBLEM 3.4

Label each of the following activities as value-added or non-value-added:

a. Placing customers who call to order a pizza on hold
b. Assembling desks to be sold to customers
c. Storing raw materials to be used in production the next month
d. Designing a car to maximize comfort
e. Scrapping defective production materials
f. Waiting for a phone call from a customer
g. Moving raw materials from one end of a factory to the other

Solutions to Review Problem 3.4

a. Non-value-added activity
b. Value-added activity
c. Non-value-added activity
d. Value-added activity
e. Non-value-added activity
f. Non-value-added activity
g. Non-value-added activity

3.5 Using Activity-Based Costing (ABC) and Activity-Based Management (ABM) in Service Organizations

LEARNING OBJECTIVE

1. Apply activity-based costing and activity-based management to service organizations.

*Question: To this point, we have presented ABC and ABM examples in a manufacturing setting. However, service organizations, such as banks, hospitals, airlines, and government agencies, also use ABC and ABM.*Some specialists refer to activity-based costing and activity-based management as *activity-based costing and management*, or *ABCM.In fact, a recent survey indicates that 75 percent of companies that use ABC are in the public sector, a service industry, or a consulting industry.*Mohan Nair, "Activity-Based Costing: Who's Using It and Why?" *Management Accounting Quarterly*, Spring 2000, 29–33.*How can ABC help service organizations get better product cost information?*

Answer: The same five steps used in manufacturing organizations can also be used in service organizations. To understand how ABC could be used in a service organization, let's look at how ABC can be used to determine the cost of loan products at a financial institution.

Service Organization Example of ABC

Imagine you are the chief financial officer of Five Star Bank. You are interested in implementing an activity-based costing system to evaluate the cost of different loan products, such as auto loans and home equity loans, offered by the bank. The five steps of activity-based costing we presented earlier still apply. Let's look at how these steps might work when evaluating the cost of bank loans.

Step 1. Identify costly activities.

Processing loans includes activities such as meeting with customers, reviewing customer applications, and running credit reports.

Step 2. Assign overhead costs to the activities identified in step 1.

Costs assigned to the activity of *reviewing customer applications* include items such as wages of personnel reviewing applications, depreciation of computer equipment used to review online applications, and supplies needed for the review process.

Step 3. Identify the cost driver for each activity.

Activity cost drivers are shown as follows:

Activity	**Cost Driver**
Meeting with customers	Hours of meeting time
Reviewing customer applications	Number of applications reviewed
Running credit reports	Number of credit reports run

Step 4. Calculate a predetermined overhead rate for each activity.

This is done by dividing estimated overhead costs for each activity by the estimated cost driver activity. For the activity *meeting with customers*, this calculation results in a rate per hour of meeting time. For the activity *reviewing customer applications*, the calculation results in a rate per application reviewed, and for *running credit reports*, a rate per credit report run.

Step 5. Allocate overhead costs to products.

Overhead is allocated, or *applied*, to products (auto loans and home equity loans in this example) based on the use of each activity's cost driver. If a loan officer reviews 30 auto loan applications, an amount equal to the *rate per application reviewed* times *30 applications* is allocated to the auto loans product.

Service Organization Example of ABM

Question: Managers at Five Star Bank are not only interested in product cost information; they would also like to scrutinize the activities involved in processing loans and make the process more efficient. How can the management of Five Star Bank use activity-based management to become more efficient?

Answer: Managers and accountants can apply the three steps of activity-based management to Five Star Bank as follows:

1. **Identify activities required to complete the product.** This involves interviewing personnel throughout the company to capture all the activities involved in processing loans.
2. **Determine whether activities are value-added or non-value-added.** An example of a value-added activity is the quick approval of a loan. An example of a non-value-added activity is time spent waiting for credit reports.
3. **Continuously improve the value-added activities and minimize, or eliminate, the non-value-added activities.** Five Star Bank should continually strive to improve its ability to approve loans quickly (a value-added activity). While waiting for credit reports (a non-value-added activity), perhaps the bank can find other value-added activities that bank personnel can perform (e.g., responding to customer questions or processing other loan applications).

Business in Action 3.4

Activity-Based Costing at **Blue Cross and Blue Shield of Florida (BCBSF)**

Management at **Blue Cross and Blue Shield of Florida** realized it needed more sophisticated cost information to make better decisions. Given the highly competitive nature of the health care insurance industry and the need to minimize costs, **BCBSF's** management decided to implement an activity-based costing system. Management's primary concern was how to allocate administrative costs totaling $588,000,000 (21 percent of revenue) to the products and services the organization provides.

The benefits of implementing an activity-based costing and management system at **BCBSF** are as follows:

- Product pricing is improved as a result of having better cost information (prices are based on cost).
- Regional management is able to identify the cost of services provided by headquarters and make more efficient use of costly services.
- Product managers use the cost information to design products in a way that is most cost-effective.

As stated by the product director and cost accounting manager at **BCBSF**, "The goal is to provide the right information at the right time to the right people in a cost-efficient way."

Source: Kenneth L. Thurston, Dennis M. Kelemen, and John B. MacArthur, "Cost for Pricing at Blue Cross and Blue Shield of Florida," *Management Accounting Quarterly*, Spring 2000.

KEY TAKEAWAY

- Activity-based costing and activity-based management techniques are not limited to manufacturing companies. Virtually all organizations—including service, nonprofit, retail, and governmental—can benefit from implementing some form of ABC and ABM.

REVIEW PROBLEM 3.5

Menzies and Associates provides two products to its clients—tax services and audit services. Last year, total overhead costs of $1,000,000 were allocated based on direct labor hours. A total of 10,000 direct labor hours were required last year for tax clients at a cost of $350,000, and 30,000 direct labor hours were required for audit clients at a cost of $1,200,000. Direct materials used were negligible and are included in overhead costs. Sales revenue totaled $720,000 for tax services and $2,200,000 for audit services.

Management of Menzies and Associates would like to use activity-based costing to allocate overhead rather than use one plantwide rate based on direct labor hours (perhaps the term "officewide" rate would be more appropriate here). The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

			Estimated Cost Driver Activity		
Activity	Cost Driver	Estimated Overhead Costs	Tax	Audit	Total
Scheduling and data entry	Number of clients	$ 400,000	150	100	250
Advertising in journals	Number of ads	100,000	45	5	50
Computer usage	Computer hours	500,000	2,500	2,500	5,000
Total		$1,000,000			

Required:

1.

    1. Using the plantwide allocation method, calculate the total cost for each product. (Hint: Product costs for this company include overhead and direct labor.)
    2. Calculate the profit for each product using this approach. Also calculate profit as a percent of sales revenue for each product.

2.

    1. Using activity-based costing, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.)

2. Using activity-based costing, calculate the amount of overhead assigned to each product. (Hint: This is step 5 in the activity-based costing process.)
3. Calculate the profit for each product using this approach. Also calculate profit as a percent of sales revenue for each product.

3. Comment on the results of using activity-based costing compared to plantwide allocation.

Solutions to Review Problem 3.5

1.

1. The plantwide allocation used by Menzies and Associates is based on direct labor hours. The rate is calculated as follows:

$$\frac{\text{Estimated overhead cost}}{\text{Estimated activity in allocation base}} = \frac{\$1{,}000{,}000}{40{,}000 \text{ hours}}$$

$$= \$25 \text{ per direct labo}$$

Total product costs are as follows:

	Tax	Audit
Direct labor (given)	$350,000	$1,200,000
Overhead	250,000*	750,000**
Total product cost	$600,000	$1,950,000

**$250,000 = 10,000 direct labor hours × $25 rate.*

***$750,000 = 30,000 direct labor hours per unit × $25 rate.*

2.

	Tax	Audit
Direct labor	$ 350,000	$1,200,000
Overhead	250,000	750,000
Total product cost (a)	$ 600,000	$1,950,000
Sales revenue (b)	720,000	2,200,000
Profit (c) = (b) – (a)	120,000	250,000
Profit as percent of revenue (c) ÷ (b)	17% (rounded)	11% (rounded)

2.

1. Predetermined overhead rates are calculated for each activity as follows:

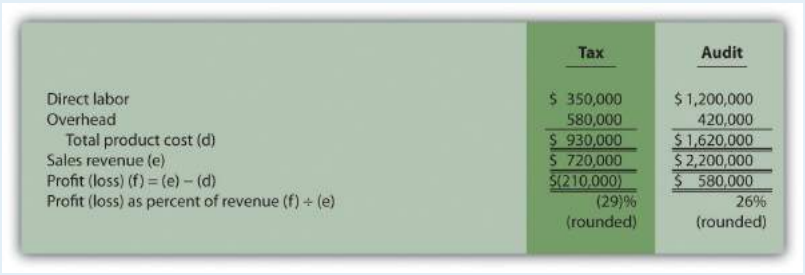
Activity	Cost Driver	(a) Estimated Overhead Costs	(b) Estimated Cost Driver Activity	(a) ÷ (b) Predetermined Overhead Rate
Scheduling and data entry	Number of clients	$ 400,000	250 clients	$ 1,600 per client
Advertising in journals	Inspection ads	100,000	50 ads	2,000 per ad
Computer usage	Computer hours	500,000	5,000 hours	100 per hour
Total		$1,000,000		

2. Overhead costs are allocated as follows:

		Tax		Audit	
Activity	Predetermined Overhead Rate	Cost Driver Activity	Overhead Allocated*	Cost Driver Activity	Overhead Allocated*
Scheduling and data entry	$ 1,600 per client	150	$ 240,000	100	$ 160,000
Advertising in journals	2,000 per ad	45	90,000	5	10,000
Computer usage	100 per hour	2,500	250,000	2,500	250,000
Total overhead costs allocated			$ 580,000		$ 420,000
Total companywide overhead costs				$ 1,000,000	

**Overhead allocated equals the predetermined overhead rate times the cost driver activity.*

3. The profit and profit as a percent of sales revenue are calculated as follows:



	Tax	Audit
Direct labor	$ 350,000	$ 1,200,000
Overhead	580,000	420,000
Total product cost (d)	$ 930,000	$ 1,620,000
Sales revenue (e)	$ 720,000	$ 2,200,000
Profit (loss) (f) = (e) – (d)	$(210,000)	$ 580,000
Profit (loss) as percent of revenue (f) ÷ (e)	(29)% (rounded)	26% (rounded)

3. Activity-based costing results in a significant increase of overhead costs allocated to the tax product and a decrease of overhead costs allocated to the audit product. The plantwide allocation approach allocates overhead based on direct labor hours, which results in 25 percent of all overhead costs being allocated to tax (= 10,000 direct labor hours in tax ÷ 40,000 total direct labor hours) and 75 percent to audit. However, ABC shows that tax uses 60 percent of scheduling and data entry resources (= 150 tax clients ÷ 250 total clients), 90 percent of advertising resources (= 45 tax ads ÷ 50 total ads), and 50 percent of computer resources (= 2,500 tax computer hours ÷ 5,000 total computer hours). Thus tax is allocated more overhead costs using ABC than using one plantwide rate based on direct labor hours. Note that total profit of $370,000 is the same regardless of the overhead cost allocation approach used. Using the plantwide allocation approach, $370,000 = $120,000 + $250,000. Using the ABC approach, $370,000 = ($210,000) + $580,000.

   Management must use this information to make improvements to the company's operations. It would probably be unwise to eliminate tax services because of the connection they have with audit services (i.e., audit clients may appreciate the convenience of also having tax services available to them). However, management can look for ways to make the process more efficient by focusing on costly activities identified in the ABC analysis.

   Note that when calculating product costs for service organizations, it is difficult, if not impossible, to calculate a product cost *per unit*. Most service organizations do not have an easily defined unit of measure because services vary so much from one customer to another. One alternative is to calculate

total profit as a percent of total sales revenue. This allows for a comparison of profitability between different types of services, similar to comparing the profitability for units of product.

3.6 Variations of Activity-Based Costing (ABC)

LEARNING OBJECTIVE

1. Expand the use of activity-based costing.

Question: The primary focus of activity-based costing thus far has been on allocating manufacturing overhead costs to products. Although this is important for external reporting purposes, we can expand ABC to include costs beyond manufacturing overhead. Also, we can organize costs in different ways to help managers evaluate performance. What different approaches can be used to organize cost data in a way that helps managers make better decisions?

Answer: Cost data can be organized in a number of ways to help managers make decisions. Four common approaches are addressed in this section:

1. Expanding ABC to include nonmanufacturing costs
2. Allocating service department costs to production departments
3. Using the hierarchy of costs to organize cost information
4. Measuring the costs of controlling and failing to control quality

External Reporting and Internal Decision Making

Question: U.S. Generally Accepted Accounting Principles require the allocation of all manufacturing costs to products for inventory costing purposes. The choice of an allocation method is not critical to this process. Companies that use direct labor hours, machine hours, activity-based costing, or some other method to allocate overhead costs to products are likely to be in compliance with U.S. GAAP. Throughout this chapter, we have illustrated how ABC is used to allocate manufacturing overhead costs. However, organizations often use ABC for purposes that go beyond allocating costs solely for external reporting. How might ABC be used to help companies in areas other than external reporting?

Answer: Commissions paid to sales people for the sale of specific products (often called *selling, general, and administrative*) are included as an operating expense in financial reports prepared for external users as required by U.S. GAAP. However, many organizations may assign commission costs to specific products for internal decision-making purposes. This treatment is not in compliance with U.S. GAAP, but it is perfectly acceptable for internal reporting purposes and may be done using activity-based costing. It is important to understand that managers have ultimate control over which costs should be allocated to products for internal reporting purposes, and this allocation often involves going beyond overhead costs.

Table 3.1 "Examples of Costs Allocated to Products" provides examples of costs that could be allocated to products. It also includes cost categories—product, selling, and general and administrative (G&A)—and indicates whether the cost allocation complies with U.S. GAAP for *external* reporting. As you can see in the far right column, all costs can be allocated to products for *internal* reporting purposes.

Table 3.1 Examples of Costs Allocated to Products

Cost	Cost Category*	OK to Allocate to Products for External Reporting (U.S. GAAP)?	OK to Allocate to Products for Internal Reporting?
Direct materials	Product	Yes	Yes
Direct labor	Product	Yes	Yes
Manufacturing overhead**	Product	Yes	Yes
Sales commissions	Selling	No	Yes
Shipping products to customers	Selling	No	Yes

*See Chapter 2 "How Is Job Costing Used to Track Production Costs?" for information about category definitions.

**Includes all manufacturing costs other than direct labor and direct materials, such as factory related costs for supervisors, building rent, machine maintenance, utilities, and indirect materials. See Chapter 2 "How Is Job Costing Used to Track Production Costs?" for more detail.

Cost	Cost Category*	OK to Allocate to Products for External Reporting (U.S. GAAP)?	OK to Allocate to Products for Internal Reporting?
Product advertising	Selling	No	Yes
Legal costs for product lawsuit	G&A	No	Yes
Processing payroll for production personnel	G&A	No	Yes
Company president's salary	G&A	No	Yes
Costs of implementing ABC	G&A	No	Yes

*See Chapter 2 "How Is Job Costing Used to Track Production Costs?" for information about category definitions.

**Includes all manufacturing costs other than direct labor and direct materials, such as factory related costs for supervisors, building rent, machine maintenance, utilities, and indirect materials. See Chapter 2 "How Is Job Costing Used to Track Production Costs?" for more detail.

Allocating Service Department Costs Using the Direct Method

Question: Most companies have departments that are classified as either service departments or production departments. **Service departments**[10] *provide services to other departments within the company and include such functions as accounting, human resources, legal, maintenance, and computer support.* **Production departments**[11] *are directly involved with producing goods or providing services for customers and include such functions as ordering materials, assembling products, and performing quality inspections. Why do companies often allocate a share of service department costs to production departments for internal reporting purposes even though U.S. GAAP generally does not allow it for external reporting?*

10. Departments that provide services to other departments within a company.

11. Departments directly involved with producing goods or providing services for customers.

Answer: Companies allocate service department costs to production departments for several reasons:

- The services provided by departments within a company are not free, and they should be used as efficiently as possible. Managers of production departments that use these services thus have an incentive to minimize their use.
- To minimize costs, **Hewlett Packard** and other large companies often "outsource" services like building maintenance and legal support (i.e., they have other companies provide the services for them). This creates an incentive for the company's service departments to provide services at a reasonable cost.
- Organizations often include service department costs when determining product costs for internal decision-making purposes, as described earlier (refer to Table 3.1 "Examples of Costs Allocated to Products" for examples).

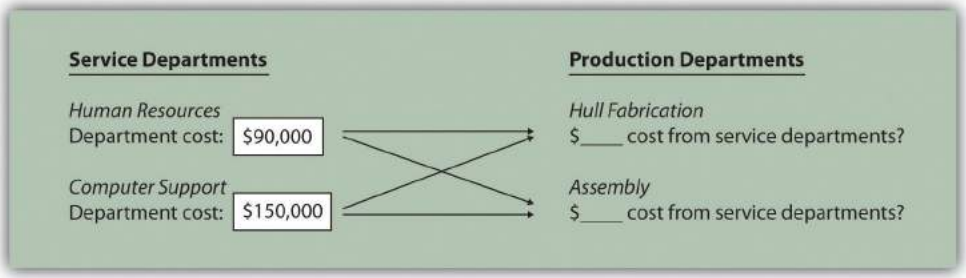
Question: How do companies allocate service department costs to production departments and how might this be done at SailRite?

Answer: Several methods of allocating service department costs to production departments are available. We introduce the simplest approach—the *direct method*—here (complex approaches are presented in more advanced cost accounting texts). The **direct method**[12] allocates service department costs directly to production departments but not to other service departments.

For example, assume that SailRite Company has two service departments—Human Resources and Computer Support. Costs associated with Human Resources and Computer Support total $90,000 and $150,000, respectively. Recall that SailRite has two production departments—Hull Fabrication and Assembly. The goal is to allocate service department costs to the two production departments, as shown in Figure 3.10 "Allocating Service Department Costs to Production Departments at SailRite Company: Direct Method (Before Allocations)".

12. A method of allocating costs that allocates service department costs directly to production departments but not to other service departments.

Figure 3.10 *Allocating Service Department Costs to Production Departments at SailRite Company: Direct Method (Before Allocations)*



SailRite would like to allocate service department costs using an allocation base that drives these costs. Assume management decides to use the *number of employees* as the allocation base to allocate Human Resources costs, and the *number of computers* as the allocation base to allocate Computer Support costs. Allocation base activity for each production department is as follows:

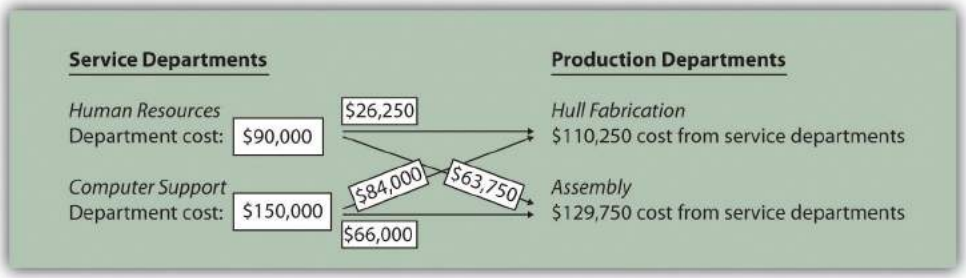
	Hull Fabrication	Assembly	Total
Number of employees	35	85	120
Number of computers	42	33	75

The allocation rate for human resource services is $750 per employee (= $90,000 department costs ÷ 120 employees). The allocation rate for computer support services is $2,000 per computer (= $150,000 ÷ 75 computers). Thus the Hull Fabrication department receives an allocation of $26,250 in human resource costs (= 35 employees × $750 rate) and $84,000 in computer support costs (= 42 computers × $2,000 rate). The Assembly department receives an allocation of $63,750 in human resource costs (= 85 employees × $750 rate) and $66,000 in computer support costs (= 33 computers × $2,000 rate).

The allocations to production departments are shown in Figure 3.11 "Allocating Service Department Costs to SailRite's Production Departments: Direct Method (After Allocations)". If management chooses to allocate service department costs to production departments as described here, there must be some benefit to going through the process. Should these costs be assigned to activity cost pools for the purpose of costing products (activity-based costing)? Should production department managers be evaluated based on the use of these services? Should actual service department usage be compared to budgeted usage for each production department? The answers to these questions vary from one

organization to the next. However, one point is certain—the benefits of implementing this allocation system must outweigh the costs!

Figure 3.11 *Allocating Service Department Costs to SailRite's Production Departments: Direct Method (After Allocations)*



The Hierarchy of Costs

Question: Some organizations group activities into four cost categories, called the hierarchy of costs, to help managers form cost pools for activity-based costing purposes. The **cost hierarchy**[13]Credit for developing the cost hierarchy is generally given to R. Cooper and R. S. Kaplan, "Profit Priorities from Activity-Based Costing," *Harvard Business Review*, May 1991, 130–35.*groups costs based on whether the activity is at the facility level, product or customer level, batch level, or unit level. What is the difference between each of these categories, and how does this information help managers?*

Answer: Each category within the cost hierarchy is described as follows:

- **Facility-level activities**[14] (or costs) are required to sustain facility operations and include items such as building rent and management of the factory. These costs are generally changed over long time horizons and are incurred regardless of how many product-, batch-, or unit-level activities take place.
- **Product-level activities**[15] (or customer-level activities) are required to develop, produce, and sell specific types of products. This category includes items such as product development and product advertising. These costs can be changed over a shorter time horizon than facility-level activities and are incurred regardless of the number of batches run or units produced.
- **Batch-level activities**[16] are required to produce batches (or groups) of products and include items such as machine setups and quality

13. A method of costing that groups costs based on whether the activity is at the facility level, product or customer level, batch level, or unit level.
14. Activities required to sustain facility operations and include items such as building rent and management of the factory.
15. Activities required to develop, produce, and sell specific types of products.
16. Activities required to produce batches (or groups) of products.

inspections. These costs can be changed over a shorter time horizon than product- and facility-level activities and are driven by the number of batches run rather than the number of units produced. For example, a batch can consist of producing 5 units or 10,000 units. The costs in this category are driven by the number of batches, not the number of units in each batch.

- **Unit-level activities**[17] are required to produce individual units of product and include items such as energy to run machines, direct labor, and direct materials. These costs can be changed over a short time horizon based on how many units management chooses to produce.

The cost hierarchy serves as a framework for managers to establish cost pools and determine what drives the change in costs for each cost pool. It also provides a sense of how quickly (or slowly) costs change based on decisions made by management. Examples of activities often identified by companies using activity-based costing, and how these activities fit in the cost hierarchy, appear in Table 3.2 "Cost Hierarchy Examples".

Table 3.2 Cost Hierarchy Examples

Cost Hierarchy Category	Activity/Cost
Facility-level	Plant depreciation
	Building rent
	Management of facility
Product/customer-level	New product development
	Product engineering
	Product marketing and advertising
	Maintaining customer records
Batch-level	Machine setups
	Processing purchase orders
	Batch quality inspections
Unit-level	Energy to run production machines
	Direct labor
	Direct materials

17. Activities required to produce individual units of product, such as direct materials and direct labor.

Measuring the Costs of Controlling and Improving Quality

Question: The hierarchy of costs is not the only approach organizations use to group costs. Managers are also concerned about measuring the costs associated with quality. Quality-related costs can be organized into four categories. The first two categories—prevention and appraisal—are costs incurred to control and improve quality. The final two categories—internal failure and external failure—are costs incurred as a result of failing to control and improve quality. What is the difference between these cost categories, and how does this information help managers improve quality?

- **Prevention costs**[18] are costs incurred to prevent defects in products and services. Examples include designing production processes that minimize defects, providing quality training to employees, and inspecting raw materials before they are placed in production.
- **Appraisal costs**[19] (often called *detection costs*) are costs incurred to detect defective products before they are delivered to customers. The cost of finished goods inspections falls in this category.
- **Internal failure costs**[20] are the costs incurred as a result of detecting defective products before they are delivered to customers. Examples include the reworking of defective products, the scrapping of defective products, and the machine downtime resulting from process problems that cause defects.
- **External failure costs**[21] are the costs incurred as a result of delivering defective products to customers. Examples include warranty repairs, warranty replacements, and product liability resulting from unsafe defective products.

Companies that measure these costs of quality typically calculate the costs in each category as a percent of total revenue. The goal is to steadily shift costs toward the prevention and appraisal categories and away from the internal and external failure categories. As organizations concentrate more on preventing defects, total quality costs as a percent of revenue tends to decline and product quality improves. Table 3.3 "Summary of Quality Costs" provides a summary of the four classifications of quality-related costs.

18. Costs for activities that prevent defects in products and services.
19. Costs for activities that detect defective products before they are delivered to customers.
20. Costs incurred as a result of detecting defective products before they are delivered to customers.
21. Costs for activities that result from delivering defective products to customers.

Table 3.3 Summary of Quality Costs

Quality Cost Category	Description
Prevention cost	Cost of activities that prevent defects in products, such as quality training and raw materials inspections

Quality Cost Category	Description
Appraisal cost	Cost of activities that detect defective products before they are delivered to customers, such as finished goods inspections and field inspections
Internal failure cost	Cost of activities that result from detecting defective products before they are delivered to customers, such as rework and scrap
External failure cost	Cost of activities that result from delivering defective products to customers, such as warranty repairs and warranty replacements

KEY TAKEAWAY

- Activity-based costing is not simply used to allocate manufacturing overhead costs to products for external reporting purposes; it is also often used to allocate selling, general, and administrative costs to products for internal decision-making purposes. A number of methods can be used to assist in the cost allocation process. For example, the cost of service departments can be allocated to production departments using the direct method. Also the cost hierarchy can be used to help establish cost pools and identify cost drivers used to allocate costs. Organizations are also concerned with measuring and reducing the cost of quality by categorizing quality costs into four categories—prevention, appraisal, internal failure, and external failure.

REVIEW PROBLEM 3.6

Fill in the following table to identify if the cost item can be included in the cost of products for external reporting purposes and/or internal reporting purposes. The first item is completed for you.

Cost	OK to Allocate to Products for External Reporting (U.S. GAAP)?	OK to Allocate to Products for Internal Reporting?
Direct materials	Yes	Yes
Salaries of sales people		
Indirect materials used in production		
Rent for headquarters building		
Product promotions		
Direct labor		
Legal costs for patent applications		
Processing payroll for human resource personnel		
Depreciation of factory equipment		
Marketing vice president's salary		
Depreciation of administrative department equipment		

Solution to Review Problem 3.6

Cost	OK to Allocate to Products for External Reporting (U.S. GAAP)?	OK to Allocate to Products for Internal Reporting?
Direct materials	Yes	Yes

Salaries of sales people	No	Yes
Indirect materials used in production	Yes	Yes
Rent for headquarters building	No	Yes
Product promotions	No	Yes
Direct labor	Yes	Yes
Legal costs for patent applications	No	Yes
Processing payroll for human resource personnel	No	Yes
Depreciation of factory equipment	Yes	Yes
Marketing vice president's salary	No	Yes
Depreciation of administrative department equipment	No	Yes

END-OF-CHAPTER EXERCISES

Questions

1. Why do managers allocate overhead costs to products?
2. Describe the three methods of allocating overhead costs.
3. What is a cost pool, and how does it relate to allocating overhead to products?
4. What is the difference between an activity and a cost driver?
5. How do cost flows using activity-based costing differ from cost flows using one plantwide rate?
6. Describe the five steps required to implement activity-based costing.
7. What are some advantages of using an activity-based costing system?
8. What are some disadvantages of using an activity-based costing system?
9. Review Note 3.14 "Business in Action 3.1" What were the two common characteristics of the 130 U.S. manufacturing companies that used activity-based costing?
10. Explain how to record the application of overhead to products using activity-based costing.
11. Describe the three steps required to implement activity-based management.
12. How does activity-based management differ from activity-based costing?
13. What is the difference between a value-added activity and a non-value-added activity? Provide two examples of non-value-added activities for each of the following:
    1. Fast-food restaurant
    2. Clothing store
    3. College bookstore
14. Review Note 3.16 "Business in Action 3.2" How did activity-based costing help **BuyGasCo Corporation** settle its predatory pricing case?
15. Review Note 3.23 "Business in Action 3.3" What did the survey of 296 users of ABC and ABM show were the top two objectives in using these systems?
16. Review Note 3.26 "Business in Action 3.4" What was management's primary concern in deciding to implement an activity-based costing system?
17. What selling costs and general and administrative costs might be allocated to products using activity-based costing? Why do some managers prefer allocating these costs to products?

18. What are service departments? Why do some managers allocate service department costs to production departments?
19. Describe the four categories included in the hierarchy of costs.
20. What is the difference between a facility-level cost and a unit-level cost?
21. How does the hierarchy of costs help managers allocate overhead costs?
22. Describe the four categories related to the costs of quality. How might the allocation of quality costs to these four categories help managers?

Brief Exercises

23. **Product Costing at SailRite.** Refer to the dialogue presented at the beginning of the chapter and the follow-up dialogue before Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company".

    Required:

    a. In the opening dialogue, why was the owner concerned about the product costs for each of the company's boats?
    b. In the follow-up dialogue before Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company", what did the company's accountant discover about the profitability of each boat using activity-based costing? (Refer to Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company" as you prepare your answer.)

24. **Calculating Plantwide Predetermined Overhead Rate.** Manufacturing overhead costs totaling $5,000,000 are expected for this coming year. The company also expects to use 50,000 direct labor hours and 20,000 machine hours.

    Required:

    a. Calculate the plantwide predetermined overhead rate using direct labor hours as the base. Provide a one-sentence description of how the rate will be used to allocate overhead costs to products.
    b. Calculate the plantwide predetermined overhead rate using machine hours as the base. Provide a one-sentence description of how the rate will be used to allocate overhead costs to products.

25. **Calculating Department Predetermined Overhead Rates.** Manufacturing overhead costs totaling $1,000,000 are expected for this coming year—$400,000 in the Assembly department and $600,000 in the Finishing department. The Assembly department expects to use 4,000 machine hours, and the Finishing department expects to use 30,000 direct labor hours.

    Required:

    a. Assume this company uses the department approach for allocating overhead costs. Calculate the predetermined overhead rate for each department, and explain how these rates will be used to allocate overhead costs to products.
    b. Why do different departments use different allocation bases (e.g., direct labor hours or machine hours)?

26. **Identifying Cost Drivers.** Ehrman Company identified the activities listed in the following as being most important (step 1 and step 2 of activity-based costing), and it formed cost pools for each activity.

    1. Purchasing raw materials
    2. Inspecting raw materials
    3. Storing raw materials
    4. Maintaining production equipment
    5. Setting up machines to produce batches of product
    6. Testing finished products

    Required:

    Perform step 3 of the activity-based costing process by identifying a possible cost driver for each activity.

27. **Identifying Cost Drivers: Service Company.** McHale Architects, Inc., designs, engineers, and supervises the construction of custom homes. The following activities were identified as being most important (step 1 and step 2 of activity-based costing), and cost pools were formed for each activity.

    1. Meeting with customers
    2. Coordinating inspections with the building department

3. Consulting with contractors
4. Maintaining office equipment
5. Processing customer billings (invoices)

Required:

Perform step 3 of the activity-based costing process by identifying a possible cost driver for each activity.

28. **Value-Added and Non-Value-Added Activities.** Novak Corporation manufactures custom-made kayaks and accessories. The company performs the following activities.

    1. Storing parts and materials
    2. Queuing orders before beginning production
    3. Assembling kayaks
    4. Waiting for materials to arrive to continue production
    5. Painting kayaks
    6. Designing kayaks to maximize comfort
    7. Scrapping defective materials

    Required:

    Label each activity as value-added or non-value-added.

29. **Allocation Base for Service Departments.** Valencia Company has 15 production departments and produces hundreds of products. Service department costs are allocated to production departments using the direct method. Five service departments provide the following services to the production departments.

    1. The Computer Technology department provides computer support.
    2. The Personnel department posts job openings, hires employees, and coordinates employee benefits.
    3. The Accounting department processes accounting data, provides financial reports, and performs general accounting duties.
    4. The Maintenance department maintains buildings and equipment.
    5. The Legal department provides legal services.

Required:

a. For each service department, provide a possible allocation base. Explain why the base you chose for each service department is reasonable.
b. Does the direct method provide for allocations from one service department to another? Explain.

Exercises: Set A

30. **Plantwide Versus Department Allocations of Overhead.** San Juan Company expects to incur $600,000 in overhead costs this coming year—$100,000 in the Cutting department, $300,000 in the Assembly department, and $200,000 in the Finishing department. Direct labor hours worked in all departments are expected to total 40,000 (used for the plantwide rate). The Cutting department expects to use 20,000 machine hours, the Assembly department expects to use 25,000 direct labor hours, and the Finishing department expects to incur $100,000 in direct labor costs (this information will be used for department rates).

    Required:

    a. Assume San Juan Company uses the plantwide approach for allocating overhead costs and direct labor hours as the allocation base. Calculate the predetermined overhead rate, and explain how this rate will be used to allocate overhead costs.
    b. Assume San Juan Company uses the department approach for allocating overhead costs. Calculate the predetermined overhead rate for each department, and explain how these rates will be used to allocate overhead costs.

31. **Computing Product Costs Using Activity-Based Costing.** Stillwater Company identified the following activities, estimated costs for each activity, and identified cost drivers for each activity for this coming year. (These are the first three steps of activity-based costing.)

Activity	Cost Driver	Estimated Annual Overhead Costs	Estimated Annual Cost Driver Activity
Ordering parts	Number of purchase requisitions	$ 400,000	5,000 purchase requisitions
Tracking inventory of parts	Number of parts purchased	560,000	80,000 parts purchased
Running machines	Machine hours	350,000	7,000 machine hours
Inspecting finished products	Inspections hours	200,000	1,000 inspection hours
Total		$1,510,000	

The company produces three products, Z1, Z2, and Z3. Information about these products for the month of January follows:

	Z1	Z2	Z3
Direct materials cost per unit	$100	$ 75	$200
Direct labor cost per unit	35	25	70
Overhead cost per unit	?	?	?
Product cost per unit	$?	$?	$?
Units produced	250 units	500 units	700 units

Actual cost driver activity levels for the month of January are as follows:

	Z1	Z2	Z3
Number of purchase requisitions	50	70	100
Number of parts purchased	4,000	3,300	3,600
Machine hours	330	240	310
Inspections hours	10	50	30

Required:

a. Using the estimates for the year, compute the predetermined overhead rate for each activity (this is step 4 of the activity-based costing process).
b. Using the activity rates calculated in requirement **a** and the actual cost driver activity levels shown for January, allocate overhead to the three products for the month of January (this is step 5 of the activity-based costing process).
c. For each product, calculate the overhead cost per unit for the month of January. Round results to the nearest cent.
d. For each product, calculate the product cost per unit for the month of January. Round results to the nearest cent.

32. **Journal Entry to Apply Overhead.** Caspian Company is deciding which of three approaches it should use to apply overhead to products. Information for each approach is provided in the following.

    - **One plantwide rate.** The predetermined overhead rate is 150 percent of direct labor cost.
    - **Department rates.** The Machining department uses a rate of $55 per machine hour, and the Assembly department uses a rate of $35 per direct labor hour.
    - **Activity-based costing rates.** Three activities were identified and rates were calculated for each activity.

Purchase requisitions	$15 per requisition processed
Production setup	$50 per setup
Quality control	$70 per inspection

    Required:

    a. Direct labor costs for the year totaled $80,000. Using the plantwide method, calculate the amount of overhead applied to products and make the appropriate journal entry.
    b. During the year, the Machining department used 1,000 machine hours, and the Assembly department used 1,200 direct labor hours. Using the department method, calculate the amount of overhead applied to products and make the appropriate journal entry.
    c. During the year, 900 purchase requisitions were processed, 1,300 production setups were performed, and 400 products were inspected. Using the activity-based costing approach, calculate the amount of overhead applied to products, and make the appropriate journal entry.

33. **Allocating Service Department Costs.** Crandall Company has two production departments (P1 and P2) and three service departments (S1, S2, and S3). Service department costs are allocated to production departments using the direct method. The $400,000 costs of department S1 are allocated based on the

number of employees in each production department. The $600,000 costs of department S2 are allocated based on the square footage of space occupied by each production department. The $300,000 costs of department S3 are allocated based on hours of computer support used by each production department. Information for each production department follows.

Production Department	Number of Employees	Square Feet Occupied	Computer Support Hours
P1	20	3,000	10,000
P2	80	6,000	15,000
Total	100	9,000	25,000

Required:

a. Calculate the service department costs allocated to each production department.
b. In general, do U.S. Generally Accepted Accounting Principles allow for the allocation of service department costs to production departments for the purpose of valuing inventory?

34. **Cost Hierarchy.** The following activities and costs are for Tanaka Company.

1. Direct materials used by workers to assemble products
2. Purchase requisitions issued for raw materials
3. Machines set up to produce groups of products
4. New product research and development
5. Maintenance performed on the factory building
6. Direct labor assembling products
7. Product designed for a specific customer
8. Factory building rent

Required:

a. Determine whether each item is a facility-level, product- or customer-level, batch-level, or unit-level cost.

b. Provide one example of an appropriate allocation base for each item. (For instance, an appropriate allocation base for item **1** is the quantity of direct materials used.)

Exercises: Set B

35. **Plantwide Versus Department Allocations of Overhead: Service Company.** Chan and Associates provides wetlands design and maintenance services for its customers, most of whom are developers. Billing is based on costs plus a 30 percent markup. Thus costs are allocated to customers rather than to products.

    Total overhead costs this coming year are expected to be $2,000,000 ($600,000 in the Design department and $1,400,000 in the Wetlands Maintenance department). Direct labor costs are expected to total $800,000 (used for the plantwide rate). The Design department expects to incur direct labor costs of $500,000, and the Wetlands Maintenance department expects to work 30,000 direct labor hours (this information is used for the department rates).

    Required:

    a. Assume Chan and Associates uses the plantwide approach to allocating overhead costs and direct labor costs as the allocation base. Calculate the predetermined overhead rate, and explain how this rate will be used to allocate overhead costs. Round results to the nearest cent.
    b. Assume Chan and Associates uses the department approach for allocating overhead costs. Calculate the predetermined overhead rate for each department, and explain how these rates will be used to allocate overhead costs. Round results to the nearest cent.
    c. What are two possible interpretations of the term *costs* in the following statement? “Customers are billed based on costs plus a 30 percent markup.”

36. **Computing Product Costs Using Activity-Based Costing.** Petrov Company identified the following activities, estimated costs for each activity, and identified cost drivers for each

activity for this coming year. (These are the first three steps of activity-based costing.)

Activity	Cost Driver	Estimated Annual Overhead Costs	Estimated Annual Cost Driver Activity
Production setup	Number of production runs	$ 60,000	100 production runs
Materials handling	Yards of material purchased	140,000	10,000 yards purchased
Quality control	Number of inspections	80,000	800 inspections
Total		$ 280,000	

The company produces two products, MX1 and MX2. Information about these products for the month of March follows:

	MX1	MX2
Direct materials cost per unit	$ 20	$ 30
Direct labor cost per unit	15	45
Overhead cost per unit	?	?
Product cost per unit	$?	$?
Units produced	1,000 units	700 units

Actual cost driver activity levels for the month of March are as follows:

	MX1	MX2
Number of production runs	3	6
Yards of material purchased	550	230
Number of inspections	40	10

Required:

a. Using the estimates for the year, compute the predetermined overhead rate for each activity (this is step 4 of the activity-based costing process).
b. Using the activity rates calculated in requirement **a** and the actual cost driver activity levels shown for March, allocate overhead to the three products for the month of March (this is step 5 of the activity-based costing process).
c. For each product, calculate the overhead cost per unit for the month of March. Round results to the nearest cent.
d. For each product, calculate the product cost per unit for the month of March. Round results to the nearest cent.

37. **Journal Entry to Apply Overhead, Closing Overhead Account.** Premium Products, Inc., is deciding which of three approaches it should use to apply overhead to products. Information for each approach is provided as follows.

    - **One plantwide rate.** The predetermined overhead rate is $130 per direct labor hour.
    - **Department rates.** The Cutting department uses a rate of 200 percent of direct labor cost, and the Finishing department uses a rate of $50 per machine hour.
    - **Activity-based costing rates.** Three activities were identified, and rates were calculated for each activity.

Materials handling	$8 per pound of material purchased
Production setup	$60 per setup
Quality control	$110 per batch inspected

    Required:

    a. Direct labor hours totaled 2,000 for the year. Using the plantwide method, calculate the amount of overhead applied to products, and make the appropriate journal entry.
    b. During the year, the Cutting department incurred $80,000 in direct labor costs, and the Finishing department used 1,800 machine hours. Using the department method, calculate the amount of overhead applied to products, and make the appropriate journal entry.
    c. During the year, 6,000 pounds of material were purchased, 1,600 production setups were performed, and 1,300 batches of products were inspected. Using the activity-based costing approach, calculate the amount of overhead applied to products, and make the appropriate journal entry.
    d. Premium Products, Inc., closes overapplied or underapplied overhead to the cost of goods sold account at the end of each year. Prepare the journal entry to close the manufacturing overhead account at

the end of the year for each of the following independent scenarios assuming the company made the journal entry to apply overhead in requirement **c**.

1. The company recorded $302,500 in actual overhead costs for the year.
2. The company recorded $243,000 in actual overhead costs for the year.

38. **Allocating Service Department Costs.** Southwest, Inc., has two production departments (P1 and P2) and three service departments (S1, S2, and S3). Service department costs are allocated to production departments using the direct method. The $800,000 costs of department S1 are allocated based on the number of employees in each production department. The $300,000 costs of department S2 are allocated based on the square footage of space occupied by each production department. The $600,000 costs of department S3 are allocated based on hours of computer support used by each production department. Information for each production department follows.

Production Department	Number of Employees	Square Feet Occupied	Computer Support Hours
P1	40	3,000	30,000
P2	160	9,000	70,000
Total	200	12,000	100,000

Required:

a. Calculate the service department costs allocated to each production department.
b. In general, do U.S. Generally Accepted Accounting Principles allow for the allocation of service department costs to production departments for the purpose of valuing inventory?

39. **Cost Hierarchy.** The following activities and costs are for Rios Corporation.

1. Salary of a supervisor responsible for one product line
2. Moving groups of products to the finished goods warehouse upon completion
3. New product design
4. Factory building depreciation
5. Direct materials used by workers to assemble products
6. Machines set up to produce groups of products
7. Product designed for a specific customer
8. Maintenance performed on the factory building

Required:

a. Determine whether each item is a facility-level, product- or customer-level, batch-level, or unit-level cost.
b. Provide one example of an appropriate allocation base for each item.

Problems

40. **Activity-Based Costing Versus Traditional Approach.** Techno Company produces a regular computer monitor that sells for $175 and a flat panel computer monitor that sells for $300. Last year, total overhead costs of $3,675,000 were allocated based on direct labor hours. A total of 63,000 direct labor hours were required last year to build 36,000 regular monitors (1.75 hours per unit), and 42,000 direct labor hours were required to build 12,000 flat panel monitors (3.50 hours per unit). Total direct labor and direct materials costs for last year were as follows:

	Regular Monitor	**Flat Panel Monitor**
Direct materials	$1,908,000	$ 900,000
Direct labor	$1,728,000	$1,200,000

The management of Techno Company would like to use activity-based costing to allocate overhead rather than one plantwide rate based on direct labor hours. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

			Estimated Cost Driver Activity		
Activity	Cost Driver	Estimated Overhead Costs	Regular	Flat Panel	Total
Purchase orders	Number of purchase orders	$1,200,000	400	600	1,000
Production setups	Number of setups	1,125,000	120	30	150
Quality inspections	Inspection hours	750,000	3,600	8,400	12,000
Packaging and shipping	Number of units shipped	$ 600,000	36,000	12,000	48,000
Total		$3,675,000			

Required:

a. Calculate the direct materials cost per unit and direct labor cost per unit for each product.

b.

1. Using the plantwide allocation method, calculate the predetermined overhead rate and determine the overhead cost per unit allocated to the regular and flat panel products.
2. Using the plantwide allocation method, calculate the product cost per unit for the regular and flat panel products. Round results to the nearest cent.

c.

1. Using the activity-based costing allocation method, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.)
2. Using the activity-based costing allocation method, allocate overhead to each product. (Hint: This is step 5 in the activity-based costing process.) Determine the overhead cost per unit. Round results to the nearest cent.
3. What is the product cost per unit for the regular and flat panel products?

d. Calculate the per unit profit for each product using the plantwide approach and the activity-based costing approach.

e. How much did the profit per unit change for each product when moving from the plantwide approach to the activity-based costing approach? What caused this change?

41. **Activity-Based Costing Versus Traditional Approach, Activity-Based Management.** Quality Furniture, Inc., produces a wood desk that sells for $500 and a wood table that sells for $900. Last year, total overhead costs of $6,000,000 were allocated based on direct labor costs. Direct labor costs totaled $2,000,000 last year, and Quality Furniture produced 15,000 desks and 5,000 tables. Total direct labor and direct materials costs by product for last year were as follows:

	Desk	Table
Direct materials	$1,575,000	$950,000
Direct labor	$1,200,000	$800,000

The management of Quality Furniture would like to use activity-based costing to allocate overhead rather than one plantwide rate based on direct labor costs. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

			Estimated Cost Driver Activity		
Activity	Cost Driver	Estimated Overhead Costs	Desk	Table	Total
Purchase orders	Number of purchase orders	$ 800,000	900	100	1,000
Machine setups	Number of setups	1,600,000	240	260	500
Machine maintenance	Machine hours	2,400,000	42,000	18,000	60,000
Quality inspections	Number of inspections	1,200,000	15,000	5,000	20,000
Total		$6,000,000			

Required:

a. Calculate the direct materials cost per unit and direct labor cost per unit for each product.

b.

1. Using the plantwide allocation method, calculate the predetermined overhead rate and determine the overhead cost per unit allocated to the desk and table products.
2. Using the plantwide allocation method, calculate the product cost per unit for the desk and table products. Round results to the nearest cent.

c.

1. Using the activity-based costing allocation method, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.)
2. Using the activity-based costing allocation method, allocate overhead to each product. (Hint: This is step 5 in the activity-based costing process.) Determine the overhead cost per unit. Round results to the nearest cent.
3. What is the product cost per unit for the desk and table products?

d. Calculate the per unit profit for each product using the plantwide approach and the activity-based costing approach. How much did the per unit profit change when moving from one approach to the other?
e. Refer to the estimated cost driver activity provided. Calculate the percent of each activity consumed by each product (e.g., the desk product issued 900 of the 1,000 purchase orders issued in total and therefore consumes 90 percent of this activity). These percentages represent the amount of overhead costs allocated to each product using activity-based costing. Using the plantwide approach, 60 percent of all overhead costs are allocated to the desk and 40 percent to the table. Compare the activity-based costing percentages to the percentage of overhead allocated to each product using the plantwide approach. Use this information to explain what caused the shift in overhead costs to the desk product using activity-based costing.

42. **Calculating and Recording Overhead Applied.** Assume Quality Furniture, Inc., discussed in Problem 41, uses activity-based costing.

Required:

a. Using the data presented at the beginning of Problem 41, calculate the predetermined overhead rate for each activity.

b. The following activity associated with the desk product was reported for the month of March.

Number of purchase orders processed	40
Number of machine setups	22
Number of machine hours	2,425
Number of quality inspections	890

Using the predetermined overhead rates calculated in requirement **a**, determine the amount of overhead applied to the desk product for the month of March.

c. Make the journal entry to record overhead applied to the desk product for the month of March.

d. Assume you are the manager of the desk product line and would like to reduce the amount of overhead costs being applied to your products. Which activity would you focus on first? Why?

43. **Computing Product Costs Using Activity-Based Costing, Service Company.** Roseville Community Bank uses activity-based costing to assign overhead costs to two different loan products—student loans and auto loans. The bank identified the following activities, estimated costs for each activity, and identified cost drivers for each activity for this coming year. (These are the first three steps of activity-based costing.)

Activity	Cost Driver	Estimated Annual Overhead Costs	Estimated Annual Cost Driver Activity
Meeting with customers	Hours of meeting time	$400,000	20,000 hours
Reviewing applications	Number of applications reviewed	120,000	8,000 applications
Running credit reports	Number of credit reports run	420,000	6,000 credit reports
Total		$940,000	

The following information for the two loan products offered by Roseville Community Bank is for the month of July:

	Student Loans	Auto Loans
Direct labor cost per loan	$250	$150
Overhead cost per loan	?	?
Total cost per loan	$?	$?
Loans approved	100 loans	300 loans

Actual cost driver activity levels for the month of July are as follows:

	Student Loans	Auto Loans
Hours of meeting time	400	350
Number of applications reviewed	175	700
Number of credit reports run	150	550

Required:

a. Using the estimates for the year, compute the predetermined overhead rate for each activity (this is step 4 of the activity-based costing process).
b. Using the activity rates calculated in requirement **a** and the actual cost driver activity levels shown for July, allocate overhead to the two products for the month of July.
c. For each loan product, calculate the overhead cost per loan approved for the month of July. Round results to the nearest cent.
d. For each loan product, calculate the total cost per loan approved for the month of July. Round results to the nearest cent.
e. Assume you are the manager of the auto loans product line and would like to reduce the amount of overhead costs being

applied to your products. Which activity would you focus on first? Why?

44. **Activity-Based Costing Versus Traditional Approach: Service Company, Activity-Based Management.** Hodges and Associates is a small firm that provides structural engineering services for its clients. The company performs structural engineering services for both residential and commercial buildings. Last year, total overhead costs of $330,000 were allocated based on direct labor costs. A total of $300,000 in direct labor costs were incurred in the following areas: $120,000 in the residential segment and $180,000 in the commercial segment. Direct materials used were negligible and are included in overhead costs. Sales revenue totaled $450,000 for residential services and $330,000 for commercial services.

    The management of Hodges and Associates would like to use activity-based costing to allocate overhead rather than a plantwide rate based on direct labor costs. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

			Estimated Cost Driver Activity		
Activity	Cost Driver	Estimated Overhead Costs	Residential	Commercial	Total
Scheduling and data entry	Direct labor hours	$100,000	4,500	3,500	8,000
Computer maintenance	Number of computer hours	70,000	8,000	12,000	20,000
Processing permit applications	Number of applications	160,000	400	400	800
Total		$330,000			

Required:

a.

1. Using the plantwide allocation method, calculate the total cost for each product. (Hint: Product costs for this company include overhead and direct labor.)
2. Using the plantwide approach, calculate the profit for each product. Also calculate profit as a

percent of sales revenue for each product (round to the nearest tenth of a percent).

b.

1. Using activity-based costing, calculate the predetermined overhead rate for each activity. (Hint: Step 1 through step 3 in the activity-based costing process have already been done for you; this is step 4.) Round results to the nearest cent.
2. Using activity-based costing, calculate the amount of overhead assigned to each product. (Hint: This is step 5 in the activity-based costing process.)
3. Using activity-based costing, calculate the profit for each product. Also calculate profit as a percent of sales revenue for each product (round to the nearest tenth of a percent).

c. What caused the shift of overhead costs to the residential product using activity-based costing? How might management use this information to make improvements within the company?

45. **Calculating and Recording Overhead Applied: Service Company.** Assume Hodges and Associates, discussed in Problem 44, uses activity-based costing.

Required:

a. Using the data presented at the beginning of Problem 44, calculate the predetermined overhead rate for each activity. Round results to the nearest cent.

b. The following activity associated with the commercial product was reported for the month of September.

Number of direct labor hours	350
Number of computer hours	960

Number of applications	50

Using the predetermined overhead rates calculated in requirement **a**, determine the amount of overhead applied to the commercial product for the month of September.

c. Make the journal entry to record overhead applied to the commercial product for the month of September.
d. Assume you are manager of the commercial product line and would like to reduce the amount of overhead costs being applied to your products. Which activity would you focus on first? Why?

46. **Allocating Service Department Costs.** Szabo Industries has two production departments (Finishing and Painting) and three service departments (Maintenance, Computer Support, and Personnel). Service department costs are allocated to production departments using the direct method. Maintenance allocates costs totaling $3,000,000 based on the square footage of space occupied by each production department. Computer Support allocates costs totaling $4,000,000 based on hours of computer support used by each production department. Personnel allocates costs totaling $2,500,000 based on number of employees in each production department. Information for each production department follows.

Production Department	Square Feet Occupied	Computer Support Hours	Number of Employees
Finishing	10,000	21,000	70
Painting	30,000	39,000	180
Total	40,000	60,000	250

Required:

a. Calculate the service department costs allocated to each production department.
b. Why do companies allocate service department costs to production departments?

47. **Selecting an Allocation Base for Service Costs.** Winstead, Inc., is looking for an appropriate allocation base to allocate personnel costs totaling $5,000,000. Service department costs are allocated to three production departments: Assembly, Sanding, and Finishing. Management is considering two allocation bases.

Possible Allocation Base	Assembly	Sanding	Finishing
Number of employees	30	20	50
Square feet of space occupied	25,000	15,000	10,000

Required:

a. Calculate the amount of personnel department costs allocated to production departments using each allocation base.
b. Which allocation base do you think is most reasonable? Why?

One Step Further: Skill-Building Cases

48. **Overhead Allocation.** Do you agree with the following statement? Explain your answer.

Total estimated overhead costs will vary depending on whether we use the plantwide method, department method, or activity-based costing to allocate overhead.

49. **Cost Allocation Issues.** Assume you rent a house with two friends. The total monthly rent is $1,500. Your bedroom is the smallest of the three bedrooms, and each of the others has a bathroom attached. You and your friends are trying to decide how to divide up the rent. Two possibilities are being discussed.

1. Share the cost equally among the three of you.
2. Determine rent based on square feet occupied (the attached bathrooms would be part of the square footage measurement).

Required:

a. Which approach do you think is most fair for all involved? Why?
b. Which approach is easiest? Why?
c. Suggest another approach to dividing up the cost of rent.

50. **Activity-Based Costing and Activity-Based Management.** A colleague states, "We produce one product, and our operations are relatively simple. Activity-based costing and activity-based management would be a waste of time for our company!" Do you agree with this statement? Explain.
51. **Product Costs.** The company president makes the following statement: "Product costs are straightforward. Whatever costs are incurred to produce a product are assigned to that product." Do you agree with this statement? Explain.

52. **Changing Plantwide Allocation Rate at SailRite.** Recall from the chapter discussion that SailRite uses one plantwide rate based on direct labor hours to allocate manufacturing overhead costs to the company's two sailboat products—Basic and Deluxe. Management was concerned about the inaccuracy of overhead costs being assigned to each product and decided to calculate product costs using activity-based costing. Product cost and profit results are summarized in the following for the plantwide allocation approach (based on direct labor hours) and activity-based costing approach. This information was presented in the chapter in Figure 3.7 "Activity-Based Costing Versus Plantwide Costing at SailRite Company".

Plantwide Allocation
(direct labor hours as allocation base)

	Basic Sailboat	Deluxe Sailboat
Direct materials	$ 1,000	$ 1,300
Direct labor	600	750
Overhead*	1,280	1,600
Total product cost per unit (a)	$ 2,880	$ 3,650
Sales price (b)	$ 3,200	$ 4,500
Profit = (b) – (a)	**$ 320**	**$ 850**

Activity-Based Costing
(several different allocation bases)

	Basic Sailboat	Deluxe Sailboat
Direct materials	$ 1,000	$ 1,300
Direct labor	600	750
Overhead**	1,004	2,980
Total product cost per unit (c)	$ 2,604	$ 5,030
Sales price (d)	$ 3,200	$ 4,500
Profit (loss) = (d) – (c)	**$ 596**	**$ (530)**

**Overhead taken from Figure 3.2 "SailRite Company Product Costs Using One Plantwide Rate Based on Direct Labor Hours".*

***Overhead taken from Figure 3.5 "Allocation of Overhead Costs to Products at SailRite Company".*

Although management of SailRite prefers the accuracy of activity-based costing, the cost of maintaining such an accounting system for the long term is prohibitive. John, the accountant, has proposed going back to using one plantwide rate, but he would like to allocate overhead costs using machine hours rather than direct labor hours.

Recall that overhead costs totaled $8,000,000. A total of 90,000 machine hours were used for the period: 50,000 for Basic sailboats and 40,000 for Deluxe sailboats. The company produced 5,000 units of the Basic model and 1,000 units of the Deluxe model. Thus the Basic model uses 10 machine hours per unit (= 50,000 machine hours ÷ 5,000 units) and the Deluxe model uses 40 machine hours per unit (= 40,000 machine hours ÷ 1,000 units).

Required:

a. Calculate the predetermined overhead rate using machine hours as the allocation base, and determine the overhead cost per unit allocated to the Basic and Deluxe sailboats. Round results to the nearest cent.
b. For each product, calculate the unit product cost and profit using the same format presented previously. Round results to the nearest cent.
c. Compare your results in requirement **b** to the results using direct labor hours as the allocation base and activity-based costing.
d. Provide at least two reasons why management might prefer machine hours as the overhead allocation base rather than direct labor hours or activity-based costing.

53. **Service Department Cost Allocation.** Biotech, Inc., recently began providing cafeteria services to its employees. Because revenue from the sale of food at the cafeteria does not fully cover cafeteria expenses, Biotech must pay for the shortfall. These costs are allocated to production departments based on employee usage. That is, the company tracks which employees use the cafeteria and allocates costs to production departments accordingly.

    Sarah Kolster, manager of the quality testing department, is not happy with receiving cafeteria cost allocations. She is evaluated based on meeting a cost budget established at the beginning of the fiscal year, which does not include the cafeteria allocation, and she clearly has an incentive to minimize costs.

    When Sarah met with the company's accountant, Dan, regarding this issue, she said, "Dan, I like the idea of providing cafeteria service to our employees, but the costs allocated to my department are killing my budget. Last month alone, I was allocated $3,000 in costs related to the new cafeteria. I have no choice but to require my employees to go elsewhere for food."

    Dan responded, "I understand your concern, Sarah. Management's intent was to provide a service to our employees that would improve productivity and reward employees for their hard work. If you tell your employees to stop using the cafeteria, more costs will be allocated to other departments, and the other

departments might also stop using the cafeteria. My belief is that the cafeteria will be self-sufficient within a year if more employees are encouraged to use it. This translates into no more cost allocations to departments within a year. I'll discuss your concerns with top management later this week."

Required:

a. Why does Biotech, Inc., allocate cafeteria costs to departments?
b. What recommendations would you make to top management regarding the way cafeteria costs are allocated to departments?

Comprehensive Case

54. **Activity-Based Costing, Journal Entries, T-Accounts, and Preparing an Income Statement.** This problem is an adaptation of the example presented at the end of Chapter 2 "How Is Job Costing Used to Track Production Costs?" for Custom Furniture Company. The only difference is that this problem uses activity-based costing to allocate overhead costs rather than one plantwide rate. Recall that inventory beginning balances were $25,000 for raw materials inventory, $35,000 for work-in-process inventory, and $90,000 for finished goods inventory.

Management of Custom Furniture Company would like to use activity-based costing to allocate overhead costs totaling $1,140,000 rather than one plantwide rate based on direct labor hours. The following estimates are for the activities and related cost drivers identified as having the greatest impact on overhead costs.

Activity	Cost Driver	Estimated Annual Overhead Costs	Estimated Annual Cost Driver Activity
Purchase orders	Number of purchase orders	$ 260,000	800 orders
Machine setups	Number of setups	360,000	1,000 setups
Machine maintenance	Machine hours	140,000	20,000 machine hours
Misc. production activities	Direct labor hours	380,000	38,000 direct labor hours
Total		$1,140,000	

Transactions for the month of May are shown as follows:

1. Raw materials were purchased during the month for $15,000 on account.
2. Raw materials totaling $21,000 were placed in production: $3,000 for indirect materials (glue, screws, nails, and the like) and $18,000 for direct materials (wood planks, hardware, etc.).
3. Timesheets from the direct labor workforce show total costs of $40,000, to be paid the next month.
4. Production supervisors and other indirect labor working in the factory are owed wages totaling $27,000.
5. The following costs were incurred related to the factory: building depreciation of $29,000, insurance of $11,000 (originally recorded as prepaid insurance), utilities of $4,000 (to be paid the next month), and maintenance costs of $22,000 (paid immediately).
6. Manufacturing overhead is applied to products based on the following cost driver activity for the month:

Number of purchase orders	75
Number of machine setups	120
Machine hours	1,850
Direct labor hours	3,240

7. The following selling costs were incurred: wages of $5,000 (to be paid the next month), building rent of $3,000 (originally recorded as prepaid rent), and advertising totaling $10,000 (to be paid the next month).
8. The following general and administrative (G&A) costs were incurred: wages of $13,000 (to be paid the next month), equipment depreciation of $6,000, and building rent of $7,000 (originally recorded as prepaid rent).
9. Completed goods costing $155,000 were transferred out of work-in-process inventory.
10. Sold goods for $100,000 on account and $90,000 cash.
11. The goods sold in the previous transaction had a cost of $129,000.

12. Closed the manufacturing overhead account to cost of goods sold.

Required:

a. Calculate the predetermined overhead rate for each activity.
b. Prepare T-accounts for the following accounts: cash, accounts receivable, prepaid insurance, prepaid rent, raw materials inventory, work-in-process inventory, finished goods inventory, accumulated depreciation (building and equipment), accounts payable, wages payable, manufacturing overhead, sales, cost of goods sold, advertising expense (selling), rent expense (selling), wages expense (selling), depreciation expense (G&A), rent expense (G&A), and wages expense (G&A). Enter beginning balances in T-accounts for the inventory accounts (raw materials, work in process, and finished goods).
c. Prepare a journal entry for each of the transactions **1** through **11**, and post each entry to the T-accounts set up in requirement **b**. Label each entry in the T-accounts by transaction number, and total each T-account.
d. Is overhead underapplied or overapplied for the month of May? Based on the balance in the manufacturing overhead T-account prepared in requirement **c**, prepare a journal entry for transaction **12**.
e. Prepare an income statement for the month of May. (Hint: Be sure to include the adjustment made to cost of goods sold in requirement **d**.)

Chapter 4

How Is Process Costing Used to Track Production Costs?

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Ann Watkins owns and operates a company that mass produces wood desks used in classrooms throughout the world. Ann's company, Desk Products, Inc., maintains an advantage over its competitors by producing one desk in large quantities—4,000 to 8,000 desks per month—using a universally accepted design. This enables the company to buy materials in bulk, often leading to volume price discounts from suppliers. Because the exact same desk is produced for all customers, Desk Products purchases precut wood materials from suppliers. As a result, Desk Products can limit the production process to two processing departments—Assembly and Finishing. The Assembly department requisitions precut materials and hardware from the raw materials storeroom, assembles each desk, and moves the assembled desks to the Finishing department. The Finishing department sands and paints each desk and moves completed desks to the finished goods warehouse.

A new competitor recently began producing a similar desk, and Ann is concerned about whether Desk Products' production costs are reasonable. In particular, Ann is concerned about the costs in the Assembly department since this department is responsible for the majority of the company's production costs. Ann talks with the accountant at Desk Products, John Fuller, to investigate.

Ann:	*John, as you know, we have a new competitor that is aggressively going after our customers. It looks as if we will have to focus on keeping costs low to compete. The Assembly department is my biggest concern, and it would help if I knew the cost of each desk that goes through this department.*
John:	*Although we don't track production costs for each desk individually, we do use a process costing system that assigns costs to each batch of desks produced. This system enables us to calculate a cost per unit as the products move through the Assembly department.*
Ann:	*Excellent! Can you get me the cost information for the Assembly department for last month?*
John:	*Sure, I'll put together a production cost report for you by the end of the week.*

We return to Desk Products, Inc., throughout the chapter to explain how process costing systems work.

4.1 Comparison of Job Costing with Process Costing

LEARNING OBJECTIVE

1. Compare and contrast job costing and process costing.

Question: A **process costing system**[1] *is used by companies that produce similar or identical units of product in batches employing a consistent process. Examples of companies that use process costing include Chevron Corporation (petroleum products), the Wrigley Company (chewing gum), and Pittsburgh Paints (paint). A* **job costing system**[2] *is used by companies that produce unique products or jobs. Examples of companies that use job costing systems include Boeing (airplanes), Lockheed Martin (advanced technology systems), and Deloitte & Touche (accounting). What are the similarities and differences between job costing and process costing systems?*

Answer: Although these systems have marked differences, they are also similar in many ways. (As you read through this section, refer to Chapter 1 "What Is Managerial Accounting?" for a review of important terms if necessary.) Recall the three inventory accounts that accountants use to track product cost information—raw materials inventory, work-in-process inventory, and finished goods inventory. These three inventory accounts are used to record product cost information for both process costing and job costing systems. However, several work-in-process inventory accounts are typically used in a process costing system to track the flow of product costs through each production *department*. Thus each department has its own work-in-process inventory account. (For the purposes of this chapter, assume each department represents a production *process*. This explains the term *process costing* because we are tracking costs by process.) The sum of all work-in-process inventory accounts represents total work in process for the company.

1. A system of assigning costs used by companies that produce similar or identical units of product in batches employing a consistent process.
2. A system of assigning costs used by companies that produce unique products or jobs.

Recall the three components of product costs—direct materials, direct labor, and manufacturing overhead. Assigning these product costs to individual products remains an important goal for process costing, just as with job costing. However, instead of assigning product costs to individual *jobs* (shown on a job cost sheet), process costing assigns these costs to departments (shown on a departmental production cost report).

Figure 4.1 "A Comparison of Cost Flows for Job Costing and Process Costing" shows how product costs flow through accounts for job costing and process costing systems. Table 4.1 "A Comparison of Process Costing and Job Costing" outlines the similarities and differences between these two costing systems. Review these illustrations carefully before moving on to the next section.

Figure 4.1 *A Comparison of Cost Flows for Job Costing and Process Costing*

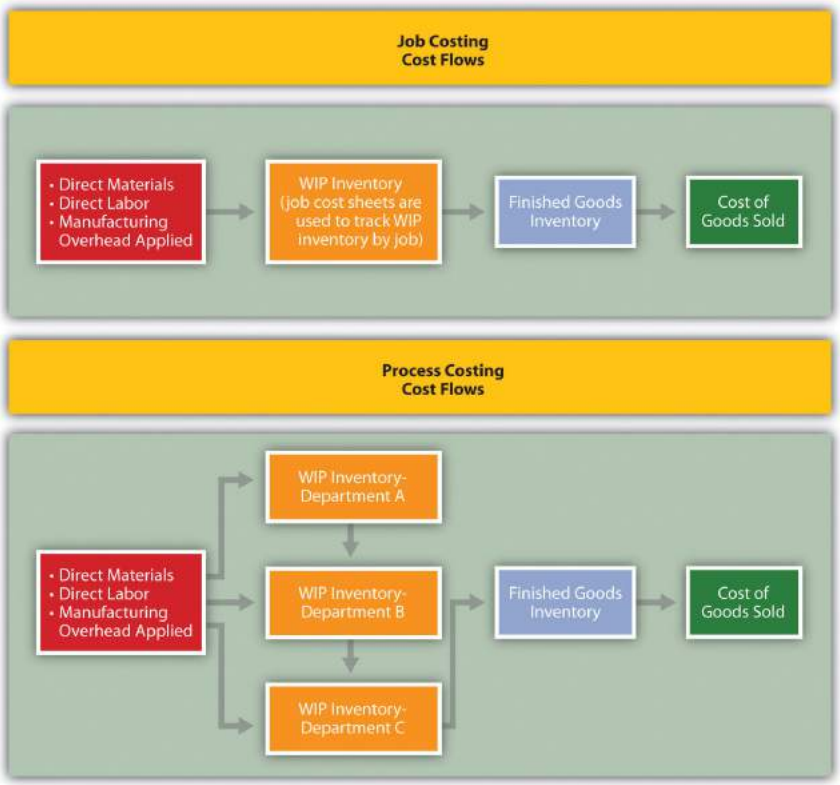


Table 4.1 A Comparison of Process Costing and Job Costing

Product Costs		
Similarities	Product costs consist of direct materials, direct labor, and manufacturing overhead.	
Differences	*Process Costing*	*Job Costing*
	Product costs are assigned to departments (or processes).	Product costs are assigned to jobs.
Unit Cost Information		
Similarities	Unit cost information is needed by management for decision-making purposes.	

Differences	*Process Costing*	*Job Costing*
	Unit cost information comes from the departmental production cost report.	Unit cost information comes from the job cost sheet.
Inventory Accounts		
Similarities	Inventory accounts include raw materials inventory, work-in-process inventory, and finished goods inventory.	
Differences	*Process Costing*	*Job Costing*
	Several different work-in-process inventory accounts are used—one for each department (or process).	One work-in-process inventory account is used—job cost sheets track costs assigned to each job.

Business in Action 4.1

Source: Photo courtesy of Simon Berry, http://www.flickr.com/photos/bezznet/3105213435/.

The Production Process at **Coca-Cola**

The Coca-Cola Company is one of the world's largest producers of nonalcoholic beverages. According to the company, more than 11,000 of its soft drinks are consumed every second of every day.

In the first stage of production, **Coca-Cola** mixes direct materials—water, refined sugar, and secret ingredients—to make the liquid for its beverages. The second stage includes filling cleaned and sanitized bottles before placing a cap on each bottle. In the third stage, filled bottles are inspected, labeled, and packaged.

Work in process begins with the first stage of production (mixing and blending), continues with the second stage (bottling), and ends with the third stage (inspecting, labeling, and packaging). When products have gone through all three stages of production, they are shipped to a warehouse, and the costs are entered into finished goods inventory. Once products are delivered to retail

stores, product costs are transferred from finished goods inventory to cost of goods sold.

Source: **Coca-Cola Company**, "Home Page," http://www2.coca-cola.com/ourcompany/bottlingtoday.

KEY TAKEAWAY

- A process costing system is used by companies that produce similar or identical units of product in batches employing a consistent process. A job costing system is used by companies that produce unique products or jobs. Process costing systems track costs by processing department, whereas job costing systems track costs by job.

REVIEW PROBLEM 4.1

Identify whether each business listed in the following would use job costing or process costing.

a. Trash bag manufacturer
b. Custom furniture manufacturer
c. Shampoo manufacturer
d. Automobile repair shop
e. Sports drink manufacturer
f. Antique boat restorer

Solution to Review Problem 4.1

a. Process costing
b. Job costing
c. Process costing
d. Job costing
e. Process costing
f. Job costing

4.2 Product Cost Flows in a Process Costing System

LEARNING OBJECTIVE

1. Identify how product costs flow through accounts using process costing.

As products physically move through the production process, the product costs associated with these products move through several important accounts as shown back in Figure 4.1 "A Comparison of Cost Flows for Job Costing and Process Costing". In this section, we present a detailed look at how product costs flow through accounts using a process costing system. Later in the chapter, we explain how dollar amounts are established for product costs that flow through the accounts. As you review each of the following cost flows for a process costing system, remember that product costs are now tracked by *department* rather than by *job*.

Direct Materials

Question: In a process costing setting, direct materials are often used by several production departments. How do we record direct materials costs for each production department?

Answer: When direct materials are requisitioned from the raw materials storeroom, a journal entry is made to reduce the raw materials inventory account and increase the appropriate work-in-process inventory account. For example, assume the Assembly department of Desk Products, Inc., requisitions direct materials to be used in production. The journal entry to reflect this is as follows:

1.a.	WIP inventory—*assembly*	XXX	
	Raw materials inventory		XXX

The use of direct materials is not limited to one production department. Suppose the Finishing department requisitions direct materials for production. The journal entry to reflect this is as follows:

Notice that two different work-in-process inventory accounts are used to track production costs—one for each department.

Direct Labor

Question: Each production department typically has a direct labor work force. How do we record direct labor costs for each production department?

Answer: Direct labor costs are recorded directly in the production department's work-in-process inventory account. Assume direct labor costs are incurred by the Assembly department. The journal entry to reflect this is as follows:

As with direct materials, the use of direct labor is not limited to one production department. Suppose direct labor costs are incurred by the Finishing department. The journal entry to reflect this is as follows:

Manufacturing Overhead

Question: Manufacturing overhead costs are typically assigned to products using a predetermined overhead rate using a normal costing system as discussed in Chapter 2 "How Is Job Costing Used to Track Production Costs?" (job costing) and Chapter 3 "How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?" (activity-based costing). How do we record manufacturing overhead costs for each department?

Answer: Assume manufacturing overhead costs (often simply called *overhead* costs) are being applied to products going through the Assembly department. The journal entry to reflect this is as follows:

3.a.	WIP inventory—*assembly*	XXX	
	Manufacturing overhead		XXX

The journal entry to reflect manufacturing overhead costs being applied to products going through the Finishing department is as follows:

3.b.	WIP inventory—*finishing*	XXX	
	Manufacturing overhead		XXX

Transferred-In Costs

Question: At this point, we have discussed how to record product costs (direct materials, direct labor, and manufacturing overhead) related to each production department. As you review Figure 4.1 "A Comparison of Cost Flows for Job Costing and Process Costing", notice that products often flow from one production department to the next. **Transferred-in costs**[3] *are the costs associated with products moving from one department to another. How do we record transferred-in costs for each department?*

Answer: Assume the Assembly department at Desk Products, Inc., completes a batch of desks and moves the desks to the Finishing department. The costs associated with these desks must be transferred from the work-in-process inventory account for the Assembly department to the work-in-process inventory account for the Finishing department. Thus these costs are being *transferred in* to the Finishing department. The journal entry to reflect this is as follows:

4.	WIP inventory—*finishing*	XXX	
	WIP inventory—*assembly*		XXX

3. Costs associated with products moving from one department to another.

Finished Goods

Question: Goods are completed and ready to sell once they have gone through the final production department. The final production department at Desk Products, Inc., is the Finishing department. How do we record production costs for products moved from the final production department to the finished goods warehouse?

Answer: When goods go through the final production department and are completed, the related costs are moved to the finished goods inventory account. The journal entry to reflect this is as follows:

5.	Finished goods inventory	XXX	
	WIP inventory—*finishing*		XXX

Cost of Goods Sold

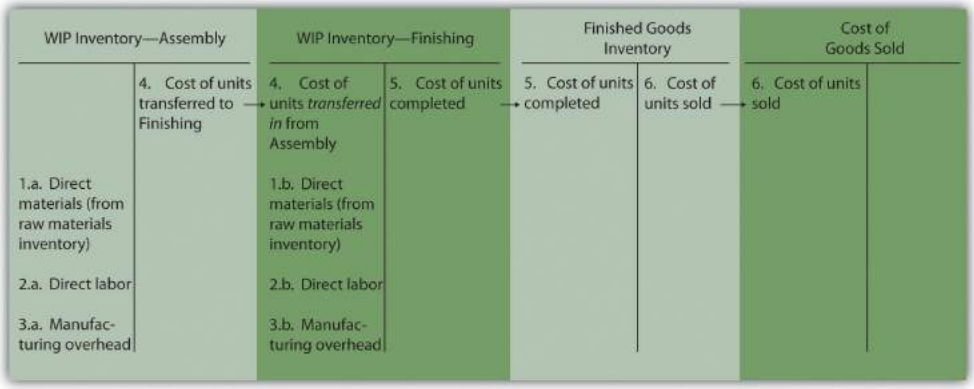
Question: How do we record production costs for goods that have been sold?

Answer: Once the completed goods are sold, the related costs are moved out of the finished goods inventory account and into the cost of goods sold account. The journal entry to reflect this is as follows:

6.	Cost of goods sold	XXX	
	Finished goods inventory		XXX

Figure 4.2 "Flow of Product Costs in a Process Costing System" summarizes the flow of product costs through T-accounts for each of the journal entries presented in this section. Note that when goods are sold and production costs are moved from finished goods inventory to cost of goods sold, an additional entry is made to record the revenue associated with this transaction. We do not show this entry because the focus of this section is on the flow of production costs rather than revenues.

Figure 4.2 *Flow of Product Costs in a Process Costing System*



Business in Action 4.2

Source: Photo courtesy of Mykl Roventine, http://www.flickr.com/photos/myklroventine/3471836813/.

The Production Process for **Wrigley's** Gum

The **Wrigley Company** has 14 factories located in various parts of the world, including North America, Europe, Africa, India, and the Asia/Pacific region. The gum produced by these factories is sold in 150 countries. According to **Wrigley Company**, 50 percent of Americans chew gum, and on average, each person consumes 190 sticks per year. The number drops to 130 sticks per person in the United Kingdom and to 100 sticks per person in Taiwan.

The production process at **Wrigley** involves six sequential stages:

1. **Melting.** The gum base, which comes in small round balls, is melted and purified.
2. **Mixing.** The melted base is poured into a mixer, to which sweeteners and flavors are added.
3. **Rolling.** A large "loaf" of gum is sent through a series of rollers, thereby reducing thickness to the desired size.
4. **Scoring.** The gum is cut into the shape of sticks or pellets.

5. **Conditioning.** The gum is cooled and "conditioned" to ensure the right consistency before being packaged.
6. **Packaging.** The gum is packaged and made ready for shipping.

Because **Wrigley** produces identical units of product in batches employing a consistent process, it likely uses a process costing system. With such a system, **Wrigley** would need a separate work-in-process inventory account to track costs for each stage of the production process.

Source: **Wrigley's**, "Home Page," http://www.wrigley.com.

KEY TAKEAWAY

- The cost flows in a process costing system are similar to the cost flows in a job costing system. The primary difference between the two costing methods is that a process costing system assigns product costs—direct materials, direct labor, and manufacturing overhead—to each production department (or process) rather than to each job. Each production department has its own work-in-process inventory account when using process costing.

REVIEW PROBLEM 4.2

Chewy Gum Corporation produces bubble gum in large batches and uses a process costing system. Three departments—Mixing, Rolling, and Packaging—are involved in the production process. Chewy Gum has the following transactions:

a. Direct materials totaling $20,000—$6,000 for the Mixing department, $5,000 for the Rolling department, and $9,000 for the Packaging department—are requisitioned and placed in production.

b. Each production department incurs the following direct labor costs (wages payable):

Mixing	$2,500
Rolling	$4,600
Packaging	$2,200

c. Manufacturing overhead costs are applied to each department as follows:

Mixing	$10,000
Rolling	$ 7,000
Packaging	$ 7,500

d. Products with a cost of $5,500 are transferred from the Mixing department to the Rolling department.
e. Products with a cost of $6,400 are transferred from the Rolling department to the Packaging department.
f. Products with a cost of $9,100 are completed and transferred from the Packaging department to the finished goods warehouse.
g. Products with a cost of $8,300 are sold to customers.

Perform the following steps for each transaction:

1. Prepare a journal entry to record the transaction.
2. Summarize the flow of costs through T-accounts. Use the format presented in Figure 4.2 "Flow of Product Costs in a Process Costing System" (no need to include T-accounts for raw materials inventory, wages payable, or manufacturing overhead). Assume there are no

beginning balances in the work-in-process inventory, finished goods inventory, and cost of goods sold accounts.

Solution to Review Problem 4.2

1.

1.

WIP inventory—mixing	6,000	
WIP inventory—rolling	5,000	
WIP inventoryy—packaging	9,000	
Raw materials inventory		20,000

2.

WIP inventory—mixing	2,500	
WIP inventory—rolling	4,600	
WIP inventoryy—packaging	2,200	
Wages payable		9,300

3.

WIP inventory—mixing	10,000	
WIP inventory—rolling	7,000	
WIP inventory—packaging	7,500	
Manufacturing overhead		24,500

4.

WIP inventory—rolling	5,500	
WIP inventory—mixing		5,500

5.

WIP inventory—packaging	6,400	
WIP inventory—rolling		6,400

6.

Finished goods inventory	9,100	
WIP inventory—packaging		9,100

7.

Cost of goods sold	8,300	
Finished goods inventory		8,300

8.

4.3 Determining Equivalent Units

LEARNING OBJECTIVE

1. Understand the concept of an equivalent unit.

Question: The beginning of this chapter describes process costing and the flow of costs through accounts used in a process costing system. The challenge is determining the unit cost of products being transferred out of each departmental work-in-process inventory account. We start the process of determining unit cost information with an important concept, the concept of equivalent units. What are equivalent units, and how are equivalent units calculated?

Answer: Units of product in work-in-process inventory are assumed to be *partially* completed; otherwise, the units would not be in work-in-process inventory. Process costing requires *partially* completed units in ending work-in-process inventory to be converted to the equivalent *completed* units (called *equivalent units*). **Equivalent units**[4] are calculated by multiplying the number of physical (or actual) units on hand by the percentage of completion of the units. If the physical units are 100 percent complete, equivalent units will be the same as the physical units. However, if the physical units are not 100 percent complete, the equivalent units will be less than the physical units.

For example, if four physical units of product are 50 percent complete at the end of the period, an equivalent of two units has been completed (2 equivalent units = 4 physical units × 50 percent). The formula used to calculate equivalent units is as follows:

Equivalent units = Number of physical units × Percentage of completion

Figure 4.3 "Concept of Equivalent Units" provides an example of the equivalent unit concept in which four desks, 50 percent complete, are the equivalent of two completed desks.

4. Partially completed units converted to the equivalent completed units; calculated by multiplying the number of physical units on hand by the percentage of completion of the physical units.

Figure 4.3 Concept of Equivalent Units

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Question: With the concept of equivalent units now in hand, we can calculate equivalent units for the three product costs—direct materials, direct labor, and manufacturing overhead. Why do we calculate equivalent units separately for direct materials, direct labor, and manufacturing overhead?

Answer: Equivalent units in work in process are often different for direct materials, direct labor, and manufacturing overhead because these three components of production may enter the process at varying stages. For example, in the Assembly department at Desk Products, Inc., direct materials enter production early in the process while direct labor and overhead are used throughout the process. (Imagine asking workers to assemble desks without materials!) Thus equivalent units must be calculated for each of the three production costs. (Note that direct labor and manufacturing overhead are sometimes combined in a category called *conversion costs*, which assumes both are added to the process at the same time. In this text, we keep direct labor and manufacturing overhead separate.) The next section presents how we use the equivalent unit concept for product costing purposes. Be sure you understand the concept of equivalent units before moving on.

Business in Action 4.3

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Calculating Full-Time Equivalent Students

The concept of an equivalent unit can be applied to determine the number of *full-time equivalent students (FTES)* at a school. Colleges use FTES data to plan and make decisions about course offerings, staffing, and facility needs. Although having information about the number of students enrolled (the *headcount*) is helpful, headcount data do not provide an indication of whether the students are full time or part time. Clearly, full-time students take more classes each term and generally use more resources than part-time students. Thus administrators often prefer to convert enrollment data to FTES.

Using a simple example to explain this concept, assume 30 students attend school and each takes half a full load of classes. The headcount is 30. However, this is the equivalent of 15 full-time students, or 15 FTES.

To apply this to the real world, let's look at the enrollment data for **Sierra College**, a community college located near Sacramento, California. During a recent semester, the student headcount in a specific department at **Sierra College** was 8,190. Because a large number of students in the department were part time, the full-time equivalent number of students totaled 3,240.

Source: Based on enrollment data from Sierra College.

KEY TAKEAWAYS

- When units of work-in-process (WIP) inventory exist at the end of the reporting period, process costing requires that these partially completed units be converted to the equivalent completed units (called equivalent units). The equation used to calculate equivalent completed units is as follows:

  Equivalent units = Number of physical units × Percentage of completion

- Because direct materials, direct labor, and manufacturing overhead typically enter the production process at different stages, equivalent units must be calculated separately for each of these production costs.

REVIEW PROBLEM 4.3

Soap Production Company's Mixing department shows the following information for the 1,000 units of product remaining in work in process at the end of the period. Assume there was no beginning inventory.

Direct materials	90 percent complete
Direct labor	30 percent complete
Overhead	60 percent complete

Calculate the equivalent units for each of the three product costs—direct materials, direct labor, and overhead.

Solution to Review Problem 4.3

The formula used to calculate equivalent units is as follows:

Equivalent units = Number of partially completed units × Percentage of completion

Materials	900 equivalent units = 1,000 partially completed units × 90 percent
Labor	300 equivalent units = 1,000 partially completed units × 30 percent
Overhead	600 equivalent units = 1,000 partially completed units × 60 percent

4.4 The Weighted Average Method

LEARNING OBJECTIVE

1. Use four steps to assign costs to products using the weighted average method.

Most companies use either the *weighted average* or *first-in-first-out (FIFO)* method to assign costs to inventory in a process costing environment. The **weighted average method**[5] includes costs in beginning inventory and current period costs to establish an average cost per unit. The **first-in-first-out (FIFO)**[6] method keeps beginning inventory costs separate from current period costs and assumes that beginning inventory units are completed and transferred out *before* the units started during the current period are completed and transferred out. We focus on the weighted average approach here and leave the discussion of the FIFO method to more advanced cost accounting textbooks.

Question: The primary goal stated in Chapter 2 "How Is Job Costing Used to Track Production Costs?" and Chapter 3 "How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?", and continued in this chapter, is to assign product costs to products. In a process costing system, **cost per equivalent unit**[7] *is the term used to describe the average unit cost for each product. How is the concept of cost per equivalent unit used to assign costs to (1) completed units transferred out and (2) units still in work-in-process (WIP) inventory at the end of the period?*

5. A method of process costing that includes costs in beginning inventory and current period costs to establish an average cost per unit.
6. A method of accounting for product costs that assumes that the first units completed within a processing department are the first units transferred out; beginning inventory costs are maintained separately from current period costs.
7. The average unit cost for each product.

Answer: Costs are assigned to completed units transferred out and units in ending WIP inventory using a four-step process. We list the four steps in the following and then explain them in detail. Review these steps carefully.

Step 1. Summarize the physical flow of units and compute the equivalent units for direct materials, direct labor, and overhead.

Step 2. Summarize the costs to be accounted for (separated into direct materials, direct labor, and overhead).

Step 3. Calculate the cost per equivalent unit.

Step 4. Use the cost per equivalent unit to assign costs to (1) completed units transferred out and (2) units in ending WIP inventory.

The Four Key Steps of Assigning Costs

Recall that Desk Products, Inc., has two departments—Assembly and Finishing. Although this chapter focuses on the Assembly department, the Finishing department would also use the four steps to determine product costs for completed units transferred out and ending WIP inventory. Table 4.2 "Production Information for Desk Products' Assembly Department" presents information for the Assembly department at Desk Products for the month of May. Review this information carefully as it will be used to illustrate the four key steps.

Table 4.2 Production Information for Desk Products' Assembly Department

Assembly Department—Month of May
• The company had 3,000 units in beginning WIP inventory; all were completed and transferred out during May.
• During May, 6,000 units were started. Of the 6,000 units started: ◦ 1,000 units were completed and transferred out to the Finishing department (100 percent complete with respect to direct materials, direct labor, and overhead); thus 1,000 units were *started and completed* during May. ◦ 5,000 units were partially completed and remained in ending WIP inventory on May 31 (60 percent complete for direct materials, 30 percent complete for direct labor, and 30 percent complete for overhead, which is applied based on direct labor hours).

Assembly Department—Month of May
• Costs in beginning WIP inventory totaled $161,000 (= $95,000 in direct materials + $40,000 in direct labor + $26,000 in overhead).
• Costs incurred during May totaled $225,000 (= $115,000 in direct materials + $70,000 in direct labor + $40,000 in overhead).

Question: Costs for the Assembly department totaled $386,000 for the month of May ($386,000 = $161,000 in beginning WIP inventory + $225,000 incurred during May). How much of the $386,000 should be assigned to (1) completed units transferred out to the Finishing department and (2) units remaining in the Assembly department ending WIP inventory?

Answer: Let's use the four key steps as follows to answer this question.

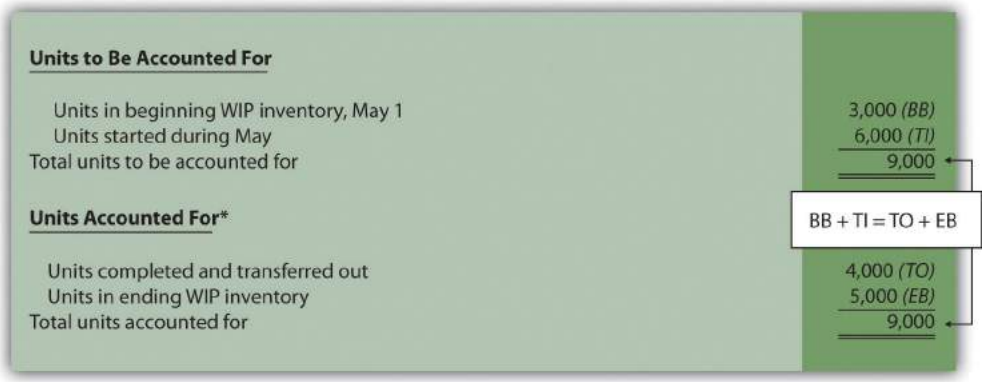
Step 1. Summarize the physical flow of units and compute the equivalent units for direct materials, direct labor, and overhead.

This step uses the basic cost flow equation presented in Chapter 2 "How Is Job Costing Used to Track Production Costs?" to identify the physical flow of units (the basic cost flow equation applies to *costs* and to *units*):

$$\underbrace{\text{Beginning balance} + \text{Transfers in}}_{\substack{(BB) + (TI) \\ \textit{Units to be accounted for}}} = \underbrace{\text{Transfers out} + \text{Ending balance}}_{\substack{(TO) + (EB) \\ \textit{Units accounted for}}}$$

Question: What are the two categories used to summarize the physical flow of units?

Answer: The first category, *units to be accounted for*, includes the beginning balance *(BB)* and transfers in *(TI)*. The second category, *units accounted for*, includes the ending balance *(EB)* and transfers out *(TO)*. As you can see from the previous equation, *units to be accounted for* must equal *units accounted for*. Here is how it looks for the Assembly department for the month of May:



**This information is used in the physical units column of Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department".*

This step shows that 3,000 units were in WIP inventory on May 1 and 6,000 units were started during May. Thus 9,000 units must be accounted for. These 9,000 units will end up in one of two places, either completed and transferred out (to the Finishing department) or not completed and therefore in ending WIP inventory. The previous schedule shows that 4,000 units were completed and transferred out (3,000 from beginning WIP inventory and 1,000 from the units started and completed during the month), and 5,000 units remain in ending WIP inventory.

Question: Based on the previous information for Desk Products, Inc., we now know that 4,000 units were completed and transferred out, and 5,000 units were in ending WIP inventory at the end of May. How do we convert this information into equivalent units?

Answer: The *units accounted for* (4,000 transferred out and 5,000 in ending WIP inventory) must be converted into equivalent units for direct materials, direct labor, and overhead, as shown in Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department". The 4,000 units transferred

out are 100 percent complete for direct materials, direct labor, and overhead (otherwise, they would not be transferred out), which results in equivalent units matching the physical units. However, the 5,000 units in ending WIP inventory are at varying levels of completion for direct materials, direct labor, and overhead, and must be converted into equivalent units using the following formula (as described earlier in the chapter):

Equivalent units = Number of physical units × Percentage of completion

Later in step 3, we will use equivalent unit information for the Assembly department to calculate the cost per equivalent unit.

Figure 4.4 *Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department*

		Equivalent Units		
Units Accounted For	**Physical Units[a]**	**Direct Materials**	**Direct Labor**	**Overhead**
Units completed and transferred out	4,000	4,000[b]	4,000[b]	4,000[b]
Units in ending WIP inventory	5,000	3,000[c]	1,500[c]	1,500[c]
Total units accounted for	9,000	7,000	5,500	5,500

[a] *This column represents actual physical units accounted for before converting to equivalent units.*

[b] *Equivalent units = Number of physical units × Percentage of completion. Units completed and transferred out are 100 percent complete. Thus equivalent units are the same as the physical units. (Information is from Table 4.2 "Production Information for Desk Products' Assembly Department".)*

[c] *Equivalent units = Number of physical units × Percentage of completion. For direct materials, 3,000 equivalent units = 5,000 physical units × 60 percent complete; for direct labor and overhead, 1,500 equivalent units = 5,000 physical units × 30 percent complete. (Information is from Table 4.2 "Production Information for Desk Products' Assembly Department".)*

Step 2. Summarize the costs to be accounted for (separated into direct materials, direct labor, and overhead).

Question: How do we summarize the costs that are used to calculate the cost per equivalent unit?

Answer: The total costs to be accounted for include the costs in beginning WIP inventory and the costs incurred during the period. Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department" shows these costs for the Assembly department. Notice that the costs are separated into direct materials, direct labor, and overhead.

Figure 4.5 *Summary of Costs to Be Accounted for in Desk Products' Assembly Department*

Costs to Be Accounted For	Direct Materials	Direct Labor	Overhead	Total
Costs in beginning WIP inventory[a]	$ 95,000	$ 40,000	$ 26,000	$161,000
Costs incurred during May[a]	115,000	70,000	40,000	225,000
Total costs to be accounted for	$210,000	$110,000	$ 66,000	$386,000

[a] *Information is from Table 4.2 "Production Information for Desk Products' Assembly Department".*

Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department" shows that costs totaling $386,000 must be assigned to (1) completed units transferred out and (2) units in ending WIP inventory.

Step 3. Calculate the cost per equivalent unit.

Question: We now have the costs (Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department") and equivalent units (Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department") needed to determine the cost per equivalent unit for direct materials, direct labor, and overhead. How do we use this information to calculate the cost per equivalent unit?

Answer: The formula to calculate the cost per equivalent unit using the weighted average method is as follows:

Key Equation

$$\text{Cost per equivalent unit} = \frac{\text{Costs in beginning WIP} + \text{C}}{\text{Equivalent units completed and transferred ou}}$$

In summary, the same formula is as follows:

$$\text{Cost per equivalent unit} = \frac{\text{Total costs to be accounted for*}}{\text{Total equivalent units accounted for**}}$$

*From the bottom of Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department".

**From the bottom of Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department".

Figure 4.6 "Calculation of the Cost per Equivalent Unit for Desk Products' Assembly Department" presents the cost per equivalent unit calculation for Desk Products' Assembly department.

Figure 4.6 *Calculation of the Cost per Equivalent Unit for Desk Products' Assembly Department*

	Direct Materials	Direct Labor	Overhead	Total
Total costs to be accounted for[a]	$210,000	$110,000	$ 66,000	
Total equivalent units accounted for[b]	÷ 7,000	÷ 5,500	÷ 5,500	
Cost per equivalent unit	$ 30	$ 20	$ 12	$ 62

[a] *Information is from Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department".*

[b] *Information is from Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department".*

The cost per equivalent unit is calculated for direct materials, direct labor, and overhead. Simply divide *total costs to be accounted for* by *total equivalent units accounted for*. It is important to note that the information shown in Figure 4.6 "Calculation of the Cost per Equivalent Unit for Desk Products' Assembly Department" allows managers to carefully assess the unit cost information in the Assembly department for direct materials, direct labor, and overhead. We discuss this further later in the chapter.

Step 4. Use the cost per equivalent unit to assign costs to (1) completed units transferred out and (2) units in ending WIP inventory.

Question: Recall our primary goal of assigning costs to completed units transferred out and to units in ending WIP inventory. How do we accomplish this goal?

Answer: Costs are assigned by multiplying the cost per equivalent unit (shown in Figure 4.6 "Calculation of the Cost per Equivalent Unit for Desk Products' Assembly Department") by the number of equivalent units (shown in Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department") for direct materials, direct labor, and overhead. Figure 4.7 "Assigning Costs to Products in Desk Products' Assembly Department" shows how this is done.

Figure 4.7 *Assigning Costs to Products in Desk Products' Assembly Department*

	Direct Materials	Direct Labor	Overhead	Total
Costs assigned to units transferred out	$120,000[a]	$ 80,000[a]	$ 48,000[a]	$ 248,000
Costs assigned to ending WIP inventory	90,000[b]	30,000[b]	18,000[b]	138,000
Total costs accounted for				$386,000[c]

[a] *The total cost assigned to units transferred out equals the cost per equivalent unit times the number of equivalent units. For example, the cost assigned to direct materials of $120,000 = 4,000 equivalents units (Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department") × $30 per equivalent unit (Figure 4.6 "Calculation of the Cost per Equivalent Unit for Desk Products' Assembly Department").*

[b] *The total cost assigned to units in ending inventory equals the cost per equivalent unit times the number of equivalent units. For example, the cost assigned to direct materials of $90,000 = 3,000 equivalent units (Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department") × $30 per equivalent unit (Figure 4.6 "Calculation of the Cost per Equivalent Unit for Desk Products' Assembly Department").*

[c] *This must match total costs to be accounted for shown in Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department". Although not an issue in this example, rounding the cost per equivalent unit may cause minor differences between the two amounts.*

Figure 4.7 "Assigning Costs to Products in Desk Products' Assembly Department" shows that total costs of $248,000 are assigned to units completed and transferred out and that $138,000 in costs are assigned to ending WIP inventory.

On completion of step 4, it is important to reconcile the total costs to be accounted for shown at the bottom of Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department" with the total costs accounted for shown at the bottom of Figure 4.7 "Assigning Costs to Products in Desk Products' Assembly Department". The two balances must match (note that small discrepancies may exist due to rounding the cost per equivalent unit). This reconciliation relates back to the basic cost flow equation as follows:

$$\underbrace{\text{Beginning balance} + \text{Transfers in}}_{(BB) + (TI)} = \underbrace{\text{Transfers out} + \text{Ending balance}}_{(TO) + (EB)}$$

Costs to be accounted for ($386,000*)

Costs accounted for ($386,000**)

**From Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department".

***From Figure 4.7 "Assigning Costs to Products in Desk Products' Assembly Department".

Although the examples in this chapter have been created in a way that minimizes rounding errors, always round the cost per equivalent unit calculations in step 3 to the nearest thousandth (e.g., if the cost per equivalent unit is $2.3739, round this to $2.374 rather than to $2). Although rounding differences still may occur, this will minimize the size of rounding errors when attempting to reconcile costs to be accounted for (step 2) with costs accounted for (step 4).

Journalizing Costs Assigned to Units Completed and Transferred

Question: Once the four-step process is complete, a journal entry must be made to record the transfer of costs out of the Assembly department and into the Finishing department. How do we record the costs associated with units completed and transferred out?

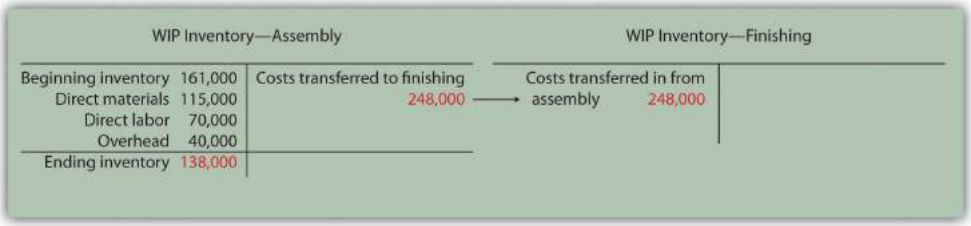
Answer: At Desk Products, Inc., 4,000 units were transferred from the Assembly department to the Finishing department. Costs totaling $248,000 were assigned to these units as shown in Figure 4.7 "Assigning Costs to Products in Desk Products' Assembly Department". The journal entry to record this at the end of May is as follows:

WIP inventory—*finishing*	248,000	
WIP inventory—*assembly*		248,000

(Note that this was journal entry number four, presented without dollar amounts earlier in the chapter.)

Figure 4.8 "Flow of Costs through the Work-in-Process Inventory T-Account of Desk Products' Assembly Department" shows the flow of costs through the work-in-process inventory T-account for the Assembly department. Note that four key steps were performed for the Assembly department to determine the costs assigned to (1) completed units transferred out to the Finishing department ($248,000) and (2) units in Assembly's WIP inventory ($138,000). Both amounts are highlighted.

Figure 4.8 *Flow of Costs through the Work-in-Process Inventory T-Account of Desk Products' Assembly Department*



Business in Action 4.4

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The Production Process for **Hershey's** Chocolate

Hershey Foods Corp. is best known for its chocolate products, including brands like Almond Joy, **Hershey's** Kisses, and Reese's. **Hershey's** products are sold in more than 90 countries worldwide. According to **Hershey**, more than 80 million Kiss-shaped products are made every day!

Several sequential stages of production are required to produce chocolate at **Hershey**:

1. **Fermentation.** Cocoa beans are placed in large heaps for one week to allow the cocoa flavor to develop.
2. **Roasting.** The cocoa beans are roasted at very high temperatures.
3. **Hulling.** A hulling machine separates the shell from the inside of the bean (called the *nib*).
4. **Milling.** The nibs are ground into chocolate liquor (a liquid with a pure chocolate flavor that contains no alcohol).
5. **Mixing.** The chocolate liquor is mixed with cocoa butter, sugar, and milk. This mixture is dried into a brown powder, called *chocolate crumb*, and processed into chocolate paste.

6. **Molding.** Machines are used to fill more than 1,000 molds per minute with chocolate. The chocolate is then chilled to form solid candy.
7. **Packaging.** The candy is wrapped, packaged, and ready to be shipped.

Hershey likely uses a process costing system since it produces identical units of product in batches employing a consistent process. Process costing systems require the use of work-in-process inventory accounts for each process. Thus **Hershey** would track production costs using separate work-in-process inventory accounts for each stage of production.

Source: **Hershey's**, "Home Page," http://www.hersheys.com.

KEY TAKEAWAYS

- Four steps are used to assign product costs to (1) completed units transferred out and (2) units in work-in-process inventory at the end of the period.
- The four-step process must be performed for each processing department and results in a journal entry to record the costs assigned to units transferred out.

REVIEW PROBLEM 4.4

Kelley Paint Company uses the weighted average method to account for costs of production. Kelley manufactures base paint in two separate departments—Mixing and Packaging. The following information is for the Mixing department for the month of March.

- A total of 40,000 units (measured in gallons) were in beginning WIP inventory. All were completed and transferred out during March.
- A total of 70,000 units were started during March. Of the 70,000 units started,
  - 20,000 units were completed and transferred out to the Packaging department (100 percent complete with respect to direct materials, direct labor, and overhead), and
  - 50,000 units were partially completed and remained in ending WIP inventory on March 31 (90 percent complete for direct materials, 70 percent complete for direct labor, and 30 percent complete for overhead, which is applied based on machine hours).
- Costs in beginning WIP inventory totaled $229,000 (= $98,000 in direct materials + $41,000 in direct labor + $90,000 in overhead).
- Costs incurred during March totaled $165,000 (= $70,000 in direct materials + $35,000 in direct labor + $60,000 in overhead).

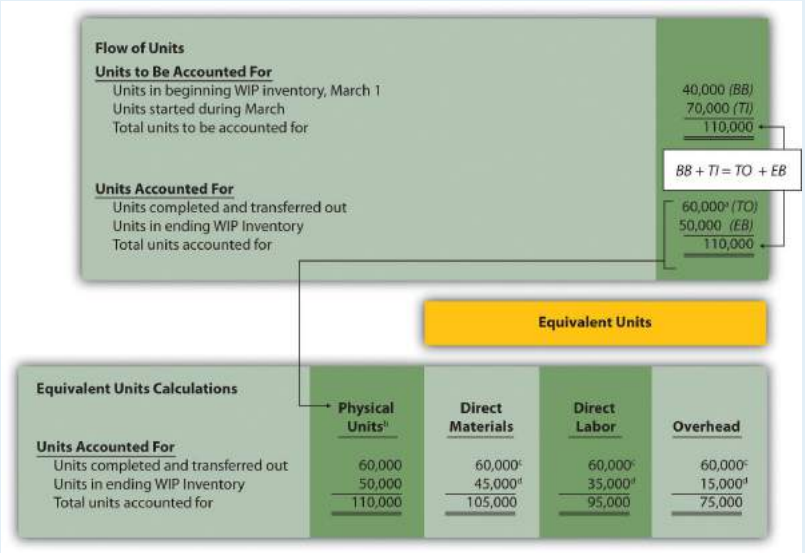
Required:

a. Use the four key steps to assign costs to units completed and transferred out and to units in ending WIP inventory for the Mixing department.
b. Prepare the journal entry necessary at the end of March to record the transfer of costs associated with units completed and transferred to the Packaging department.

Solution to Review Problem 4.4

a. The four steps are as follows:

Step 1. Summarize the physical flow of units and compute the equivalent units for direct materials, direct labor, and overhead.



[a] *60,000 units = 40,000 from beginning WIP inventory + 20,000 started and completed in March.*

[b] *This column represents actual physical units accounted for before converting to equivalent units.*

[c] *Equivalent units = number of physical units × percentage of completion. Units completed and transferred out are 100 percent complete. Thus equivalent units are the same as the physical units.*

[d] *Equivalent units = number of physical units × percentage of completion. For direct materials, 45,000 equivalent units = 50,000 physical units × 90 percent complete; for direct labor, 35,000 equivalent units = 50,000 physical units × 70 percent complete; for overhead, 15,000 equivalent units = 50,000 physical units × 30 percent complete.*

Step 2. Summarize the costs to be accounted for (separated into direct materials, direct labor, and overhead).

Costs to Be Accounted For	Direct Materials	Direct Labor	Overhead	Total
Costs in beginning WIP inventory[e]	$ 98,000	$ 41,000	$ 90,000	$ 229,000
Costs incurred during May[e]	70,000	35,000	60,000	165,000
Total costs to be accounted for	$ 168,000	$ 76,000	$ 150,000	$ 394,000

[e] *Information is given.*

Step 3. Calculate the cost per equivalent unit.

	Direct Materials	Direct Labor	Overhead	Total
Total costs to be accounted for (step 2)	$168,000	$ 76,000	$ 150,000	
Total equivalent units accounted for (step 1)	÷ 105,000	÷ 95,000	÷ 75,000	
Cost per equivalent unit	$ 1.60	$ 0.80	$ 2.00	$ 4.40

Step 4. Use the cost per equivalent unit to assign costs to (1) completed units transferred out and (2) units in ending WIP inventory.

	Direct Materials	Direct Labor	Overhead	Total
Costs assigned to units transferred out	$ 96,000[f]	$ 48,000[f]	$ 120,000[f]	$ 264,000
Costs assigned to ending WIP Inventory	72,000[g]	28,000[g]	30,000[g]	130,000
Total costs accounted for				$ 394,000[h]

[f] *Total costs assigned to units transferred out equals the cost per equivalent unit times the number of equivalent units. For example, costs assigned for direct materials of $96,000 = 60,000 equivalents units (from step 1) × $1.60 per equivalent unit (from step 3).*

[g] *Total costs assigned to ending WIP inventory equals the cost per equivalent unit times the number of equivalent units. For example, costs assigned for direct materials of $72,000 = 45,000 equivalent units (from step 1) × $1.60 per equivalent unit (from step 3).*

[h] *This must match total costs to be accounted for in step 2, as shown in the following:*

$$\underset{(BB)}{\text{Beginning balance}} + \underset{(TI)}{\text{Transfers in}} = \underset{(TO)}{\text{Transfers out}} + \underset{(EB)}{\text{Ending b}}$$

$$\underset{\text{Costs to be accounted for}}{(BB) + (TI)} = \underset{\text{Costs accounted for}}{(TO) + (EB)}$$

$$(394{,}000 \textit{ from step } 2) \qquad (\$394{,}000 \textit{ from step } 4)$$

b. As shown in step 4, $264,000 in total costs are assigned to units completed and transferred out. The entry to record this is as follows:

4.5 Preparing a Production Cost Report

LEARNING OBJECTIVE

1. Prepare a production cost report for a processing department.

Question: The results of the four key steps are typically presented in a production cost report. The **production cost report**[8] *summarizes the production and cost activity within a department for a reporting period. It is simply a formal summary of the four steps performed to assign costs to units transferred out and units in ending work-in-process (WIP) inventory. What does the production cost report look like for the Assembly department at Desk Products, Inc.?*

Answer: The production cost report for the month of May for the Assembly department appears in Figure 4.9 "Production Cost Report for Desk Products' Assembly Department". Notice that each section of this report corresponds with one of the four steps described earlier. We provide references to the following illustrations so you can review the detail supporting calculations.

8. A report that summarizes the production and cost activity within a department for a reporting period.

Figure 4.9 Production Cost Report for Desk Products' Assembly Department

Desk Products, Inc.
Assembly Department Production Cost Report: Weighted Average Method
Month Ended May 31

Step 1: Summary of physical units and equivalent unit calculations	Physical Units			
Units to Be Accounted For[b]				
Units in beginning WIP inventory	3,000			
Units started during May	6,000			
Total units to be accounted for	9,000			
		Equivalent Units		
Units Accounted For[c]	Physical Units	Direct Materials	Direct Labor	Overhead
Units completed and transferred out	4,000	4,000	4,000	4,000
Units in ending WIP inventory	5,000	3,000	1,500	1,500
Total units accounted for	9,000	7,000	5,500	5,500

Step 2: Summary of costs to be accounted for	Direct Materials	Direct Labor	Overhead	Total
Costs to Be Accounted For[d]				
Costs in beginning WIP inventory	$ 95,000	$ 40,000	$ 26,000	$ 161,000
Costs incurred during May	115,000	70,000	40,000	225,000
Total costs to be accounted for	$ 210,000	$ 110,000	$ 66,000	$ 386,000[a]

Step 3: Calculation of cost per equivalent unit[e]	Direct Materials	Direct Labor	Overhead	Total
Total costs to be accounted for	$ 210,000	$ 110,000	$ 66,000	
Total equivalent units accounted for	÷ 7,000	÷ 5,500	÷ 5,500	
Cost per equivalent unit	$ 30	$ 20	$ 12	$ 62

Step 4: Assign costs to units transferred out and units in ending WIP inventory.[f]	Direct Materials	Direct Labor	Overhead	Total
Costs assigned to units transferred out	$ 120,000	$ 80,000	$ 48,000	$ 248,000
Costs assigned to ending WIP inventory	90,000	30,000	18,000	138,000
Total costs accounted for				$ 386,000[a]

[a] *Total costs to be accounted for (step 2) must equal total costs accounted for (step 4).*

[b] *Data are given.*

[c] *This section comes from Figure 4.4 "Flow of Units and Equivalent Unit Calculations for Desk Products' Assembly Department".*

[d] *This section comes from Figure 4.5 "Summary of Costs to Be Accounted for in Desk Products' Assembly Department".*

[e] *This section comes from Figure 4.6 "Calculation of the Cost per Equivalent Unit for Desk Products' Assembly Department".*

[f] *This section comes from Figure 4.7 "Assigning Costs to Products in Desk Products' Assembly Department".*

How Do Managers Use Production Cost Report Information?

Question: Although the production cost report provides information needed to transfer costs from one account to another, managers also use this report for decision-making purposes. What important questions can be answered using the production cost report?

Answer: A production cost report helps managers answer several important questions:

- How much does it cost to produce each unit of product for each department?
- Which production cost is the highest—direct materials, direct labor, or overhead?
- Where are we having difficulties in the production process? In any particular departments?
- Are we seeing any significant changes in unit costs for direct materials, direct labor, or overhead? If so, why?
- How many units flow through each processing department each month?
- Are improvements in the production process being reflected in the cost per unit from one month to the next?

Beware of Fixed Costs

Question: Why might the per unit cost data provided in the production cost report be misleading?

Answer: When using information from the production cost report, managers must be careful not to assume that all production costs are variable costs. The CEO of Desk Products, Inc., Ann Watkins, was told that the Assembly department cost for each desk totaled $62 for the month of May (from Figure 4.9 "Production Cost Report for Desk Products' Assembly Department", step 3). However, if the company produces more or fewer units than were produced in May, the unit cost will change. This is because the $62 unit cost includes both variable and fixed costs (see Chapter 5 "How Do Organizations Identify Cost Behavior Patterns?" for a detailed discussion of fixed and variable costs).

Assume direct materials and direct labor are variable costs. In the Assembly department, the variable costs per unit associated with direct materials and direct labor of $50 (= $30 direct materials + $20 direct labor) will remain the same regardless of the level of production, within the relevant range. However, the remaining unit product cost of $12 associated with overhead must be analyzed further to determine the amount that is variable (e.g., indirect materials) and the amount that is fixed (e.g., factory rent). Managers must understand that fixed costs *per unit* will change depending on the level of production. More specifically, Ann Watkins must understand that the $62 unit cost in the Assembly department provided in the production cost report will change depending on the level of production. Chapter 5 "How Do Organizations Identify Cost Behavior Patterns?" provides a detailed presentation of how cost information can be separated into fixed and variable components for the purpose of providing managers with more useful information.

KEY TAKEAWAY

- The four key steps of assigning costs to units transferred out and units in ending WIP inventory are formally presented in a production cost report. The production cost report summarizes the production and cost activity within a processing department for a reporting period. A separate report is prepared for each processing department. Rounding the cost per equivalent unit to the nearest thousandth will minimize rounding differences when reconciling costs to be accounted for in step 2 with costs accounted for in step 4.

Computer Application

Using Excel to Prepare a Production Cost Report

Managers typically use computer software to prepare production cost reports. They do so for several reasons:

- Once the format is established, the template can be used from one period to the next.
- Formulas underlie all calculations, thereby minimizing the potential for math errors and speeding up the process.
- Changes can be made easily without having to redo the entire report.
- Reports can be easily combined to provide a side-by-side analysis from one period to the next.

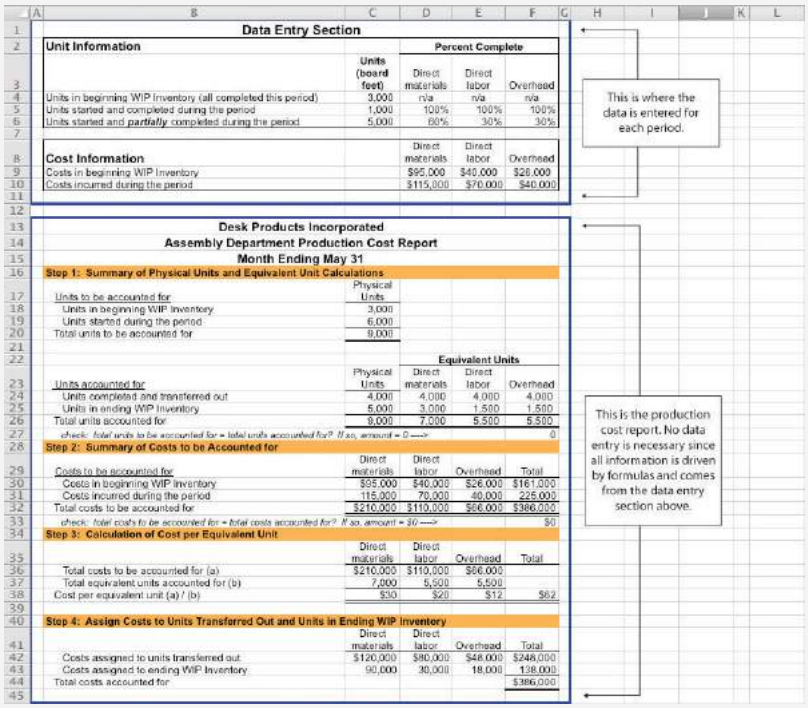
Review Figure 4.9 "Production Cost Report for Desk Products' Assembly Department" and then ask yourself: "How can I use Excel to help prepare this report?" Answers will vary widely depending on your experience with Excel. However, Excel has a few basic features that can make the job of creating a production cost report easier. For example, you can use formulas to sum numbers in a column (note that each of the four steps presented in Figure 4.9 "Production Cost Report for Desk Products' Assembly Department" has column totals) and to calculate the cost per equivalent unit. Also you can establish a separate line to double-check that

- the *units to be accounted for* match the *units accounted for*; and
- the *total costs to be accounted for* match the *total costs accounted for*.

For those who want to add more complex features, the basic data (e.g., the data in Table 4.2 "Production Information for Desk Products' Assembly Department") can be entered at the top of the spreadsheet and pulled down to the production cost report where necessary.

An example of how to use Excel to prepare a production cost report follows. Notice that the basic data are at the top of the spreadsheet, and the rest of the report is driven by formulas. Each month, the data at the top are changed to

reflect the current month's activity, and the production cost report takes care of itself.



Data Entry Section

Unit Information	Units (board feet)	Percent Complete: Direct materials	Direct labor	Overhead
Units in beginning WIP Inventory (all completed this period)	3,000	n/a	n/a	n/a
Units started and completed during the period	1,000	100%	100%	100%
Units started and *partially* completed during the period	5,000	60%	30%	30%

Cost Information	Direct materials	Direct labor	Overhead
Costs in beginning WIP Inventory	$95,000	$40,000	$26,000
Costs incurred during the period	$115,000	$70,000	$40,000

This is where the data is entered for each period.

Desk Products Incorporated
Assembly Department Production Cost Report
Month Ending May 31

Step 1: Summary of Physical Units and Equivalent Unit Calculations

Units to be accounted for	Physical Units
Units in beginning WIP Inventory	3,000
Units started during the period	6,000
Total units to be accounted for	9,000

		Equivalent Units		
Units accounted for	Physical Units	Direct materials	Direct labor	Overhead
Units completed and transferred out	4,000	4,000	4,000	4,000
Units in ending WIP Inventory	5,000	3,000	1,500	1,500
Total units accounted for	9,000	7,000	5,500	5,500

check: total units to be accounted for = total units accounted for? If so, amount = 0 ----> 0

Step 2: Summary of Costs to be Accounted for

Costs to be accounted for	Direct materials	Direct labor	Overhead	Total
Costs in beginning WIP Inventory	$95,000	$40,000	$26,000	$161,000
Costs incurred during the period	115,000	70,000	40,000	225,000
Total costs to be accounted for	$210,000	$110,000	$66,000	$386,000

check: total costs to be accounted for = total costs accounted for? If so, amount = $0 ----> $0

Step 3: Calculation of Cost per Equivalent Unit

	Direct materials	Direct labor	Overhead	Total
Total costs to be accounted for (a)	$210,000	$110,000	$66,000	
Total equivalent units accounted for (b)	7,000	5,500	5,500	
Cost per equivalent unit (a) / (b)	$30	$20	$12	$62

Step 4: Assign Costs to Units Transferred Out and Units in Ending WIP Inventory

	Direct materials	Direct labor	Overhead	Total
Costs assigned to units transferred out	$120,000	$80,000	$48,000	$248,000
Costs assigned to ending WIP Inventory	90,000	30,000	18,000	138,000
Total costs accounted for				$386,000

This is the production cost report. No data entry is necessary since all information is driven by formulas and comes from the data entry section above.

REVIEW PROBLEM 4.5

Using the information in Note 4.24 "Review Problem 4.4", prepare a production cost report for the Mixing department of Kelley Paint Company for the month ended March 31. (Hint: You have already completed the four key steps in Note 4.24 "Review Problem 4.4". Simply summarize the information in a production cost report as shown in Figure 4.9 "Production Cost Report for Desk Products' Assembly Department".)

Solution to Review Problem 4.5

(See solutions to Note 4.24 "Review Problem 4.4" for detailed calculations.)

Kelley Paint Company
Mixing Department Production Cost Report: Weighted Average Method
Month Ended March 31

Step 1: Summary of physical units and equivalent unit calculations

Units to Be Accounted For	Physical Units
Units in beginning WIP inventory	40,000
Units started during March	70,000
Total units to be accounted for	110,000

		Equivalent Units		
Units Accounted For	Physical Units	Direct Materials	Direct Labor	Overhead
Units completed and transferred out	60,000	60,000	60,000	60,000
Units in ending WIP inventory	50,000	45,000	35,000	15,000
Total units accounted for	110,000	105,000	95,000	75,000

Step 2: Summary of costs to be accounted for

Costs to Be Accounted For	Direct Materials	Direct Labor	Overhead	Total
Costs in beginning WIP inventory	$ 98,000	$ 41,000	$ 90,000	$229,000
Costs incurred during March	70,000	35,000	60,000	165,000
Total costs to be accounted for	$168,000	$ 76,000	$150,000	$394,000

Step 3: Calculation of cost per equivalent unit

	Direct Materials	Direct Labor	Overhead	Total
Total costs to be accounted for	$168,000	$ 76,000	$150,000	
Total equivalent units accounted for	÷ 105,000	÷ 95,000	÷ 75,000	
Cost per equivalent unit	$ 1.60	$ 0.80	$ 2.00	$ 4.40

Step 4: Assign costs to units transferred out and units in ending WIP inventory.

	Direct Materials	Direct Labor	Overhead	Total
Costs assigned to units transferred out	$ 96,000	$ 48,000	$120,000	$264,000
Costs assigned to ending WIP inventory	72,000	28,000	30,000	130,000
Total costs accounted for				$394,000

Amounts must match (unless rounding differences occur).

END-OF-CHAPTER EXERCISES

Questions

1. Which types of companies use a process costing system to account for product costs? Provide at least three examples of products that would require the use of a process costing system.
2. Describe the similarities between a process costing system and a job costing system.
3. Describe the differences between a process costing system and a job costing system.
4. Review Note 4.4 "Business in Action 4.1" What are the three stages of production at **Coca-Cola**, and what account is used to track production costs for each stage?
5. What are *transferred-in costs*?
6. Review Note 4.9 "Business in Action 4.2" Why is it likely that **Wrigley** uses a process costing system rather than a job costing system?
7. Explain the difference between *physical units* and *equivalent units*.
8. Explain the concept of equivalent units assuming the weighted average method is used.
9. Explain why direct materials, direct labor, and overhead might be at different stages of completion at the end of a reporting period.
10. Review Note 4.14 "Business in Action 4.3" Why do colleges convert the actual number of students attending school to a full-time equivalent number of students?
11. Describe the four key steps shown in a production cost report assuming the weighted average method is used.
12. What two important amounts are determined in step 4 of the production cost report?
13. Describe the basic cost flow equation and explain how it is used to reconcile units to be accounted for with units accounted for.
14. Describe the basic cost flow equation and explain how it is used to reconcile costs to be accounted for with costs accounted for.
15. Review Note 4.22 "Business in Action 4.4" Describe the last two stages of the production process at **Hershey**.
16. How does a company determine the number of production cost reports to be prepared for each reporting period?
17. What is a production cost report, and how is it used by management?
18. Explain how the cost per equivalent unit might be misleading to managers, particularly when a significant change in production is anticipated.

Brief Exercises

19. **Product Costing at Desk Products, Inc.** Refer to the dialogue presented at the beginning of the chapter.

    Required:

    a. Why was the owner of Desk Products, Inc., concerned about the Assembly department product cost of each desk?
    b. What did the accountant, John Fuller, promise by the end of the week?

20. **Job Costing Versus Process Costing.** For each firm listed in the following, identify whether it would use job costing or process costing.

    1. Chewing gum manufacturer
    2. Custom automobile restorer
    3. Facial tissue manufacturer
    4. Accounting services provider
    5. Electrical services provider
    6. Pool builder
    7. Cereal producer
    8. Architectural design provider

21. **Process Costing Journal Entries.** Assume a company has two processing departments—Molding and Packaging. Transactions for the month are shown as follows.

    1. The Molding department requisitioned direct materials totaling $2,000 to be used in production.
    2. Direct labor costs totaling $3,500 were incurred in the Molding department, to be paid the next month.
    3. Manufacturing overhead costs applied to products in the Molding department totaled $2,500.
    4. The cost of goods transferred from the Molding department to the Packaging department totaled $10,000.
    5. Manufacturing overhead costs applied to products in the Packaging department totaled $1,800.

    Required:

Prepare journal entries to record transactions **1** through **5**.

22. **Calculating Equivalent Units.** Complete the requirements for each item in the following.

    1. A university has 500 students enrolled in classes. Each student attends school on a part-time basis. On average, each student takes three-quarters of a full load of classes. Calculate the number of full-time equivalent students (i.e., calculate the number of equivalent units).
    2. A total of 10,000 units of product remain in the Assembly department at the end of the year. Direct materials are 80 percent complete and direct labor is 40 percent complete. Calculate the equivalent units in the Assembly department for direct materials and direct labor.
    3. A local hospital has 60 nurses working on a part-time basis. On average, each nurse works two-thirds of a full load. Calculate the number of full-time equivalent nurses (i.e., calculate the number of equivalent units).
    4. A total of 6,000 units of product remain in the Quality Testing department at the end of the year. Direct materials are 75 percent complete and direct labor is 20 percent complete. Calculate the equivalent units in the Quality Testing department for direct materials and direct labor.

23. **Calculating Cost per Equivalent Unit.** The following information pertains to the Finishing department for the month of June.

	Direct Materials	**Direct Labor**	**Overhead**
Total costs to be accounted for	$100,000	$200,000	$300,000
Total equivalent units accounted for	10,000 units	8,000 units	8,000 units

    Required:

    Calculate the cost per equivalent unit for direct materials, direct labor, overhead, and in total. Show your calculations.

24. **Assigning Costs to Completed Units and to Units in Ending WIP Inventory.** The following information is for the Painting department for the month of January.

	Direct Materials	Direct Labor	Overhead
Cost per equivalent unit	$2.10	$1.50	$3.80
Equivalent units completed and transferred out	3,000 units	3,000 units	3,000 units
Equivalent units in ending WIP inventory	1,000 units	1,200 units	1,200 units

Required:

a. Calculate the costs assigned to units completed and transferred out of the Painting department for direct materials, direct labor, overhead, and in total.
b. Calculate the costs assigned to ending WIP inventory for the Painting department for direct materials, direct labor, overhead, and in total.

Exercises: Set A

25. **Assigning Costs to Products: Weighted Average Method.** Sydney, Inc., uses the weighted average method for its process costing system. The Assembly department at Sydney, Inc., began April with 6,000 units in work-in-process inventory, all of which were completed and transferred out during April. An additional 8,000 units were started during the month, 3,000 of which were completed and transferred out during April. A total of 5,000 units remained in work-in-process inventory at the end of April and were at varying levels of completion, as shown in the following.

Direct materials	40 percent complete
Direct labor	30 percent complete
Overhead	50 percent complete

The following cost information is for the Assembly department at Sydney, Inc., for the month of April.

	Direct Materials	Direct Labor	Overhead	Total
Beginning WIP inventory	$300,000	$350,000	$250,000	$900,000
Incurred during the month	$180,000	$200,000	$170,000	$550,000

Required:

a. Determine the units to be accounted for and units accounted for; then calculate the equivalent units for direct materials, direct labor, and overhead. (Hint: This requires performing step 1 of the four-step process.)
b. Calculate the cost per equivalent unit for direct materials, direct labor, and overhead. (Hint: This requires performing step 2 and step 3 of the four-step process.)
c. Assign costs to units transferred out and to units in ending WIP inventory. (Hint: This requires performing step 4 of the four-step process.)
d. Confirm that total costs to be accounted for (from step 2) equals total costs accounted for (from step 4). Note that minor differences may occur due to rounding the cost per equivalent unit in step 3.
e. Explain the meaning of equivalent units.

26. **Production Cost Report: Weighted Average Method.** Refer to Exercise 25. Prepare a production cost report for Sydney, Inc., for the month of April using the format shown in Figure 4.9 "Production Cost Report for Desk Products' Assembly Department".

27. **Process Costing Journal Entries.** Silva Piping Company produces PVC piping in two processing departments—Fabrication and Packaging. Transactions for the month of July are shown as follows.

1. Direct materials totaling $15,000 are requisitioned and placed into production—$7,000 for the Fabrication department and $8,000 for the Packaging department.

2. Direct labor costs (wages payable) are incurred by each department as follows:

Fabrication	$4,500
Packaging	$6,700

3. Manufacturing overhead costs are applied to each department as follows:

Fabrication	$20,000
Packaging	$14,000

4. Products with a cost of $22,000 are transferred from the Fabrication department to the Packaging department.
5. Products with a cost of $35,000 are completed and transferred from the Packaging department to the finished goods warehouse.
6. Products with a cost of $31,000 are sold to customers.

Required:

1. Prepare journal entries to record each of the previous transactions.
2. In general, how does the process costing system used here differ from a job costing system?

Exercises: Set B

28. **Assigning Costs to Products: Weighted Average Method.** Varian Company uses the weighted average method for its process costing system. The Molding department at Varian began the month of January with 80,000 units in work-in-process inventory, all of which were completed and transferred out during January. An additional 90,000 units were started during the month, 30,000 of which were completed and transferred out during January. A total of 60,000 units remained in work-in-

process inventory at the end of January and were at varying levels of completion, as shown in the following.

Direct materials	80 percent complete
Direct labor	90 percent complete
Overhead	90 percent complete

The following cost information is for the Molding department at Varian Company for the month of January.

	Direct Materials	Direct Labor	Overhead	Total
Beginning WIP inventory	$1,400,000	$1,100,000	$1,700,000	$4,200,000
Incurred during the month	$1,210,000	$ 980,000	$1,450,000	$3,640,000

Required:

a. Determine the units to be accounted for and units accounted for; then calculate the equivalent units for direct materials, direct labor, and overhead. (Hint: This requires performing step 1 of the four-step process.)
b. Calculate the cost per equivalent unit for direct materials, direct labor, and overhead. (Hint: This requires performing step 2 and step 3 of the four-step process.)
c. Assign costs to units transferred out and to units in ending WIP inventory. (Hint: This requires performing step 4 of the four-step process.)
d. Confirm that total costs to be accounted for (from step 2) equals total costs accounted for (from step 4). Note that minor differences may occur due to rounding the cost per equivalent unit in step 3.
e. Explain the meaning of *equivalent units*.

29. **Production Cost Report: Weighted Average Method.** Refer to Exercise 28. Prepare a production cost report for Varian Company for the month of January using the format shown in Figure 4.9 "Production Cost Report for Desk Products' Assembly Department".

30. **Process Costing Journal Entries.** Westside Chemicals produces paint thinner in three processing departments—Mixing, Testing, and Packaging. Transactions for the month of September are shown as follows.

    1. Direct materials totaling $80,000 are requisitioned and placed into production—$60,000 for the Mixing department, $11,000 for the Testing department, and $9,000 for the Packaging department.

    2. Direct labor costs (wages payable) incurred by each department are as follows:

Mixing	$35,000
Testing	$25,000
Packaging	$18,000

    3. Manufacturing overhead costs are applied to each department as follows:

Mixing	$17,500
Testing	$12,500
Packaging	$ 6,000

    4. Products with a cost of $55,000 are transferred from the Mixing department to the Testing department.
    5. Products with a cost of $86,000 are transferred from the Testing department to the Packaging department.
    6. Products with a cost of $100,000 are completed and transferred from the Packaging department to the finished goods warehouse.
    7. Products with a cost of $81,000 are sold to customers.

    Required:

    a. Prepare journal entries to record each of the previous transactions.
    b. In general, how does the process costing system used here differ from a job costing system?

Problems

31. **Production Cost Report: Weighted Average Method.** Calvin Chemical Company produces a chemical used in the production of silicon wafers. Calvin Chemical uses the weighted average method for its process costing system. The Mixing department at Calvin Chemical began the month of June with 5,000 units (gallons) in work-in-process inventory, all of which were completed and transferred out during June. An additional 15,000 units were started during the month, 11,000 of which were completed and transferred out during June. A total of 4,000 units remained in work-in-process inventory at the end of June and were at varying levels of completion, as shown in the following.

Direct materials	60 percent complete
Direct labor	40 percent complete
Overhead	40 percent complete

The cost information is as follows:

Costs in beginning work-in-process inventory

Direct materials	$8,000
Direct labor	$3,000
Overhead	$2,800

Costs incurred during the month

Direct materials	$21,000
Direct labor	$ 8,500
Overhead	$ 7,200

Required:

a. Prepare a production cost report for the Mixing department at Calvin Chemical Company for the month of June.
b. Confirm that total costs to be accounted for (from step 2) equals total costs accounted for (from step 4). Note that minor differences may occur due to rounding the cost per equivalent unit in step 3.
c. According to the production cost report, what is the total cost per equivalent unit for the work performed in the Mixing department? Which of the three product cost components is the highest, and what percent of the total does this product cost represent?

32. **Production Cost Report: Weighted Average Method.** Quality Confections Company manufactures chocolate bars in two processing departments, Mixing and Packaging, and uses the weighted average method for its process costing system. The table that follows shows information for the Mixing department for the month of March.

Unit Information (Measured in Pounds)	**Mixing**
Beginning work-in-process inventory	8,000
Started or transferred in during the month	230,000
Ending work-in-process inventory: 80 percent materials, 70 percent labor, and 60 percent overhead	6,000
Cost Information	
Beginning Work-in-Process Inventory	
Direct materials	$ 3,000
Direct labor	$ 1,500
Overhead	$ 2,200
Costs Incurred during the Period	
Direct materials	$103,000
Direct labor	$ 55,000
Overhead	$ 81,000

Required:

a. Prepare a production cost report for the Mixing department for the month of March.
b. Confirm that total costs to be accounted for (from step 2) equals total costs accounted for (from step 4); minor differences may occur due to rounding the cost per equivalent unit in step 3.
c. According to the production cost report, what is the total cost per equivalent unit for the work performed in the Mixing department? Which of the three product cost components is the highest, and what percent of the total does this product cost represent?

33. **Production Cost Report and Journal Entries: Weighted Average Method.** Wood Products, Inc., manufactures plywood in two processing departments, Milling and Sanding, and uses the weighted average method for its process costing system. The table that follows shows information for the Milling department for the month of April.

Unit Information (Measured in Feet)	**Milling**
Beginning work-in-process inventory	24,000
Started or transferred in during the month	110,000
Ending work-in-process inventory: 80 percent materials, 70 percent labor, and 60 percent overhead	32,000
Cost Information	
Beginning Work-in-Process Inventory	
Direct materials	$ 9,000
Direct labor	$ 3,000
Overhead	$ 3,200
Costs Incurred during the Period	
Direct materials	$45,000
Direct labor	$14,000
Overhead	$16,000

Required:

a. Prepare a production cost report for the Milling department for the month of April.
b. Confirm that total costs to be accounted for (from step 2) equals total costs accounted for (from step 4); minor differences may occur due to rounding the cost per equivalent unit in step 3.

c. For the Milling department at Wood Products, Inc., prepare journal entries to record:

1. The cost of direct materials placed into production during the month (from step 2).
2. Direct labor costs incurred during the month but not yet paid (from step 2).
3. The application of overhead costs during the month (from step 2).
4. The transfer of costs from the Milling department to the Sanding department (from step 4).

One Step Further: Skill-Building Cases

34. **Internet Project: Production Company Plant Tour.** Using the Internet, find a company that provides a virtual tour of its production processes. Document your findings by completing the following requirements.

Required:

a. Summarize each step in the production process.
b. Which type of costing system (job or process) would you expect the company to use? Why?

35. **Process Costing at Coca-Cola.** Refer to Note 4.4 "Business in Action 4.1".

Required:

a. What type of costing system does **Coca-Cola** use? Explain.

b. What is the purpose of preparing a production cost report? What information results from preparing a production cost report for the mixing and blending department at **Coca-Cola**?
c. Based on the information provided, what is the minimum number of production cost reports that **Coca-Cola** prepares each reporting period? Explain.

36. **Process Costing at Wrigley.** Refer to Note 4.9 "Business in Action 4.2".

Required:

a. What type of costing system does **Wrigley** use? Explain.
b. What is the purpose of preparing a production cost report? What information results from preparing a production cost report for **Wrigley's** Packaging department?
c. Based on the information provided, what is the minimum number of production cost reports that **Wrigley** prepares each reporting period? Explain.

37. **Group Activity: Job or Process Costing?** Form groups of two to four students. Each group should determine whether a process costing or job costing system is most likely used to calculate product costs for each item listed in the following and should be prepared to explain its answers.

1. Jetliners produced by **Boeing**
2. Gasoline produced by **Shell Oil Company**
3. Audit of **Intel** by **Ernst & Young**
4. Oreo cookies produced by **Nabisco Brands, Inc.**
5. Frosted Mini-Wheats produced by **Kellogg Co.**
6. Construction of suspension bridge in Puget Sound, Washington, by **Bechtel Group, Inc.**
7. Aluminum foil produced by **Alcoa, Inc.**
8. Potato chips produced by **Frito-Lay, Inc.**

Comprehensive Cases

38. **Ethics: Manipulating Percentage of Completion Estimates.** Computer Tech Corporation produces computer keyboards, and its fiscal year ends on December 31. The weighted average method is used for the company's process costing system. As the controller of Computer Tech, you present December's production cost report for the Assembly department to the president of the company. The Assembly department is the last processing department before goods are transferred to finished goods inventory. All 160,000 units completed and transferred out during the month were sold by December 31.

    The board of directors at Computer Tech established a compensation incentive plan that includes a substantial bonus for the president of the company if annual net income before taxes exceeds $2,000,000. Preliminary figures show current year net income before taxes totaling $1,970,000, which is short of the target by $30,000. The president approaches you and asks you to increase the percentage of completion for the 40,000 units in ending WIP inventory to 90 percent for direct materials and to 95 percent for direct labor and overhead. Even though you are confident in the percentages used to prepare the production cost report, which appears as follows, the president insists that his change is minor and will have little impact on how investors and creditors view the company.

Data Entry Section					
Unit Information			**Percent Complete**		
	Units	Direct materials	Direct labor	Overhead	
Units in beginning WIP Inventory (all completed this period)	50,000	n/a	n/a	n/a	
Units started and completed during the period	110,000	100%	100%	100%	
Units started and ***partially*** completed during the period	40,000	60%	40%	40%	
Cost Information		Direct materials	Direct labor	Overhead	
Costs in beginning WIP Inventory		$80,000	$30,000	$28,000	
Costs incurred during the period		$210,000	$85,000	$72,000	
Computer Tech Company					
Assembly Department Production Cost Report					
Month Ending December 31					
Step 1: Summary of Physical Units and Equivalent Unit Calculations					
	Physical Units				
Units to be accounted for					
Units in beginning WIP Inventory	50,000				
Units started during the period	150,000				
Total units to be accounted for	200,000				
		Equivalent Units			
	Physical Units	Direct materials	Direct labor	Overhead	
Units accounted for					
Units completed and transferred out	160,000	160,000	160,000	160,000	
Units in ending WIP Inventory	40,000	24,000	16,000	16,000	
Total units accounted for	200,000	184,000	176,000	176,000	
check: total units to be accounted for = total units accounted for? If so, amount = 0 ----->					0
Step 2: Summary of Costs to be Accounted for					
	Direct materials	Direct labor	Overhead	Total	
Costs to be accounted for					
Costs in beginning WIP Inventory	$80,000	$30,000	$28,000	$138,000	
Costs incurred during the period	210,000	85,000	72,000	367,000	
Total costs to be accounted for	$290,000	$115,000	$100,000	$505,000	
check: total costs to be accounted for = total costs accounted for? If so, amount = $0 ----->					$0
Step 3: Calculation of Cost per Equivalent Unit					
	Direct materials	Direct labor	Overhead	Total	
Total costs to be accounted for (a)	$290,000	$115,000	$100,000		
Total equivalent units accounted for (b)	184,000	176,000	176,000		
Cost per equivalent unit (a) / (b)	$1.5761	$0.6534	$0.5682	$2.7977	
Step 4: Assign Costs to Units Transferred Out and Units in Ending WIP Inventory					
	Direct materials	Direct labor	Overhead	Total	
Costs assigned to units transferred out	$252,176	$104,544	$90,912	$447,632	
Costs assigned to ending WIP Inventory	37,826	10,454	9,091	57,372	
Rounding difference				(4)	
Total costs accounted for				$505,000	

Required:

a. Why is the president asking you to increase the percentage of completion estimates?
b. Prepare another production cost report for Computer Tech Company that includes the president's revisions. Indicate what impact the president's request will have on cost of goods sold and on net income (ignore income taxes in your calculations).
c. As the controller of the company, how would you handle the president's request? (If necessary, review the presentation of ethics in Chapter 1 "What Is Managerial Accounting?" for additional information.)

39. **Ethics: Increasing Production to Boost Profits.** Pacific Siding, Inc., produces synthetic wood siding used in the construction of residential and commercial buildings. Pacific Siding's fiscal year ends on March 31, and the weighted average method is used for the company's process costing system.

Financial results for the first 11 months of the current fiscal year (through February 28) are well below expectations of management, owners, and creditors. Halfway through the month of March, the chief executive officer and chief financial officer asked the controller to estimate the production results for the month of March in the form of a production cost report (the company only has one production department). This report is shown as follows.

Data Entry Section

Unit Information	Units (board feet)	Percent Complete: Direct materials	Direct labor	Overhead
Units in beginning WIP Inventory (all completed this period)	250,000	n/a	n/a	n/a
Units started and completed during the period	140,000	100%	100%	100%
Units started and ***partially*** completed during the period	70,000	40%	60%	30%

Cost Information	Direct materials	Direct labor	Overhead
Costs in beginning WIP Inventory	$76,000	$90,000	$150,000
Costs incurred during the period	$55,000	$75,000	$135,000

Pacific Siding Incorporated
***Preliminary* Production Cost Report**
Month Ending March 31

Step 1: Summary of Physical Units and Equivalent Unit Calculations

Units to be accounted for	Physical Units
Units in beginning WIP Inventory	250,000
Units started during the period	210,000
Total units to be accounted for	460,000

		Equivalent Units		
Units accounted for	Physical Units	Direct materials	Direct labor	Overhead
Units completed and transferred out	390,000	390,000	390,000	390,000
Units in ending WIP Inventory	70,000	28,000	42,000	21,000
Total units accounted for	460,000	418,000	432,000	411,000

check: total units to be accounted for = total units accounted for? If so, amount = 0 -----> 0

Step 2: Summary of Costs to be Accounted for

Costs to be accounted for	Direct materials	Direct labor	Overhead	Total
Costs in beginning WIP Inventory	$76,000	$90,000	$150,000	$316,000
Costs incurred during the period	55,000	75,000	135,000	265,000
Total costs to be accounted for	$131,000	$165,000	$285,000	$581,000

check: total costs to be accounted for = total costs accounted for? If so, amount = $0 -----> $0

Step 3: Calculation of Cost per Equivalent Unit

	Direct materials	Direct labor	Overhead	Total
Total costs to be accounted for (a)	$131,000	$165,000	$285,000	
Total equivalent units accounted for (b)	418,000	432,000	411,000	
Cost per equivalent unit (a) / (b)	$0.3134	$0.3819	$0.6934	$1.3888

Step 4: Assign Costs to Units Transferred Out and Units in Ending WIP Inventory

	Direct materials	Direct labor	Overhead	Total
Costs assigned to units transferred out	$122,226	$148,941	$270,426	$541,593
Costs assigned to ending WIP Inventory	8,775	16,040	14,561	39,376
Rounding difference				31
Total costs accounted for				$581,000

Armed with the preliminary production cost report for March, and knowing that the company's production is well below capacity, the CEO and CFO decide to produce as many units as possible for the last half of March even though sales are *not* expected to increase any time soon. The production manager is told to push his employees to get as far as possible with production, thereby increasing the percentage of completion for ending WIP inventory. However, since the production process takes three weeks to complete, all the units produced in the last half of March will be in WIP inventory at the end of March.

Required:

a. Explain how the CEO and CFO expect to increase profit (net income) for the year by boosting production at the end of March.

b. Using the following assumptions, prepare a revised estimate of production results in the form of a production cost report for the month of March.

Assumptions based on the CEO and CFO's request to boost production

1. Units started and partially completed during the period will increase to 225,000 (from the initial estimate of 70,000). This is the projected ending WIP inventory at March 31.
2. Percentage of completion estimates for units in ending WIP inventory will increase to 80 percent for direct materials, 85 percent for direct labor, and 90 percent for overhead.
3. Costs incurred during the period will increase to $95,000 for direct materials, $102,000 for direct labor, and $150,000 for overhead (most overhead costs are fixed).
4. All units completed and transferred out during March are sold by March 31.

c. Compare your new production cost report with the one prepared by the controller. How much do you expect profit to increase as a result of increasing production during the last half of March? (Ignore income taxes in your calculations.)

d. Is the request made by the CEO and CFO ethical? Explain your answer.

Chapter 5

How Do Organizations Identify Cost Behavior Patterns?

Eric Mendez is the chief financial officer (CFO) of Bikes Unlimited, a company that produces mountain bikes and sells them to retail bicycle stores. Bikes Unlimited obtains the bulk of its parts from outside suppliers and assembles them into the mountain bikes prior to shipment. Last month (June), Bikes Unlimited sold 5,000 mountain bikes for $100 each. Last month's income statement shows total revenue of $500,000 and operating profit of $50,000:

© Thinkstock

Bikes Unlimited
Income Statement
Month Ended June 30

		Percent of Sales
Sales	$500,000	100%
Cost of goods sold	290,000	58
Gross margin	$210,000	42%
Selling and administrative expenses	160,000	32
Operating profit	$ 50,000	10%

Susan Wesley is Bikes Unlimited's cost accountant. Planning for July was completed during June. Senior management is now planning for next month (August) and has asked Eric, the CFO, to obtain some vital financial information for budgeting purposes. Eric arranged a meeting with Susan to discuss the August budget.

Eric:	*As you know, we are in the middle of our planning for next month. The senior management group asked me to make some projections based on expected changes to our sales next month.*
Susan:	*Where do you think sales are headed?*
Eric:	*We expect unit sales to increase 10 percent, perhaps 20 percent if all goes well.*
Susan:	*If sales increase 10 percent, I would expect profit to increase by more than 10 percent since some costs are fixed.*
Eric:	*Sounds reasonable. What's the next step to get a reasonable estimate of profit?*
Susan:	*First, we have to identify how costs behave with changes in sales and production—whether the costs are variable, fixed, or some other type. Then we can set up the income statement in a contribution margin format and determine if the numbers are within the relevant range.*
Eric:	*Perhaps you and your staff can discuss this and get me some accurate estimates.*
Susan:	*I'll meet with them tomorrow and should have some information for you within a few days.*

5.1 Cost Behavior Patterns

LEARNING OBJECTIVE

1. Identify typical cost behavior patterns.

Question: To predict what will happen to profit in the future at Bikes Unlimited, we must understand how costs behave with changes in the number of units sold (sales volume). Some costs will not change at all with a change in sales volume (e.g., monthly rent for the production facility). Some costs will change with a change in sales volume (e.g., materials for the mountain bikes). What are the three cost behavior patterns that help organizations identify which costs will change and which will remain the same with changes in sales volume?

Answer: The three basic cost behavior patterns are known as variable, fixed, and mixed. Each of these cost patterns is described next.

Variable Costs

Question: We know that some costs vary with changes in activity. What do we call this type of cost behavior?

Answer: This cost behavior pattern is called a variable cost. A **variable cost**[1] describes a cost that *varies in total* with changes in volume of activity. The activity in this example is the number of bikes produced and sold. However, the activity can take many different forms depending on the organization. The two most common variable costs are direct materials and direct labor. Other examples include indirect materials and energy costs.

Assume the cost of direct materials (wheels, seats, frames, and so forth) for each bike at Bikes Unlimited is $40. If Bikes Unlimited produces one bike, *total* variable cost for direct materials amounts to $40. If Bikes Unlimited doubles its production to two bikes, total variable cost for direct materials also doubles to $80. Variable

1. A cost that varies in total with changes in activity and remains constant on a per unit basis with changes in activity.

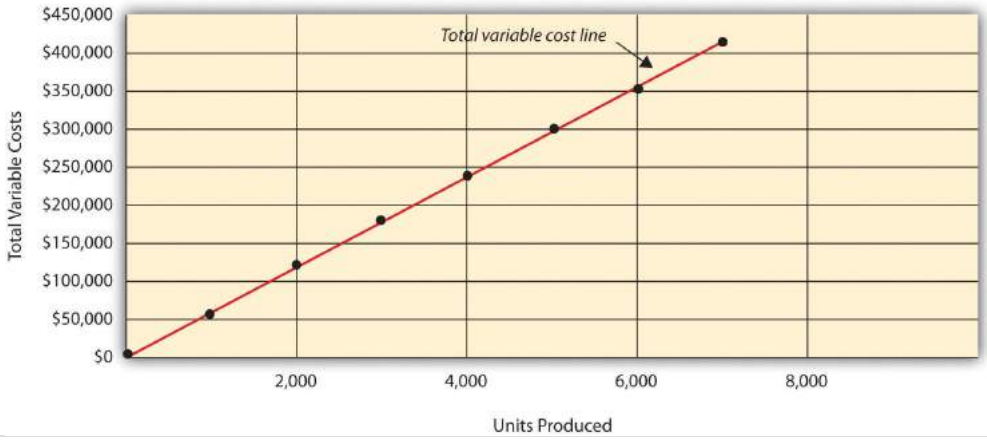
costs typically change in proportion to changes in volume of activity. If volume of activity doubles, total variable costs also double, while the cost per unit remains the same. It is important to note that the term *variable* refers to what happens to *total costs* with changes in activity, not to the cost per unit.

Taking it one step further for Bikes Unlimited, let's consider all variable costs related to production. Assume direct materials, direct labor, and all other variable production costs amount to $60 per unit. Table 5.1 "Variable Cost Behavior for Bikes Unlimited" provides the total and per unit variable costs at three different levels of production, and Figure 5.1 "Total Variable Production Costs for Bikes Unlimited" graphs the relation of total variable costs (*y*-axis) to units produced (*x*-axis). Note that the slope of the line represents the variable cost per unit of $60 (slope = change in variable cost ÷ change in units produced).

Table 5.1 Variable Cost Behavior for Bikes Unlimited

Units Produced	Total Variable Costs	Per Unit Variable Cost
1	$ 60	$60
2,000	120,000	60
4,000	240,000	60

Figure 5.1 *Total Variable Production Costs for Bikes Unlimited*



Using Different Activities to Measure Variable Costs

Question: At Bikes Unlimited, it is reasonable to assume that the activity, number of units produced, will affect total variable costs for direct materials and direct labor. However,

companies often use a different activity to estimate total variable costs. What types of activities might be used to estimate variable costs?

Answer: The type of activity used to estimate variable costs depends on the cost. For example, a law firm might use the *number of labor hours* to estimate labor costs. An airline such as **American Airlines** might use *hours of flying time* to estimate fuel costs. A mail delivery service such as **UPS** might use the *number of packages processed* to estimate labor costs associated with sorting packages. A retail store such as **Best Buy** might use *sales dollars* to estimate cost of goods sold.

Variable costs are affected by different activities depending on the organization. The goal is to find the activity that causes the variable cost so that accurate cost estimates can be made.

Fixed Costs

Question: Costs that vary in total with changes in activity are called variable costs. What do we call costs that remain the same in total with changes in activity?

Answer: This cost behavior pattern is called a fixed cost. A **fixed cost**[2] describes a cost that is *fixed (does not change) in total* with changes in volume of activity. Assuming the activity is the number of bikes produced and sold, examples of fixed costs include salaried personnel, building rent, and insurance.

Assume Bikes Unlimited pays $8,000 per month in rent for its production facility. In addition, insurance for the same building is $2,000 per month and salaried production personnel are paid $6,000 per month. All other fixed production costs total $4,000. Thus Bikes Unlimited has total fixed costs of $20,000 per month related to its production facility (= $8,000 + $2,000 + $6,000 + $4,000). If only one bike is produced, Bikes Unlimited still must pay $20,000 per month. If 5,000 bikes are produced, Bikes Unlimited still pays $20,000 per month. The fixed costs remain unchanged in total as the level of activity changes.

2. A cost that remains constant in total with changes in activity and varies on a per unit basis with changes in activity.

Question: What happens to fixed costs on a per unit basis as production levels change?

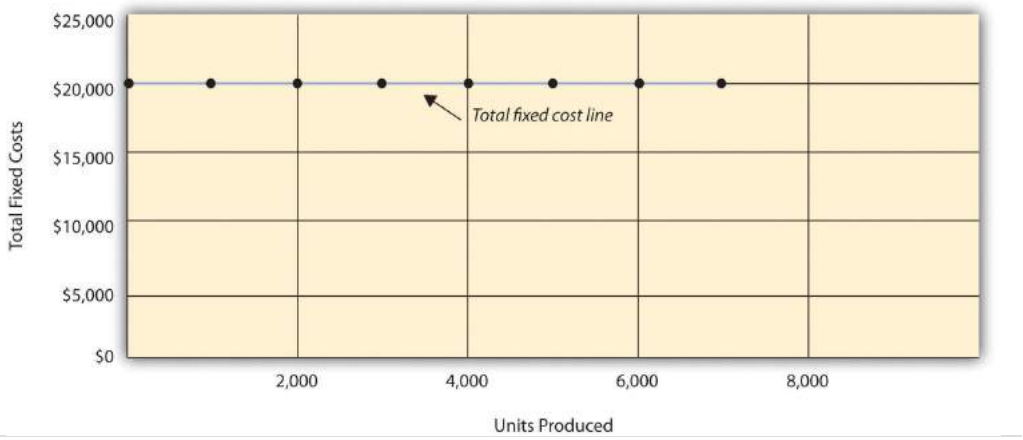
Answer: If Bikes Unlimited only produces one bike, the fixed cost *per unit* would amount to $20,000 (= $20,000 total fixed costs ÷ 1 bike). If Bikes Unlimited produces two bikes, the fixed cost per unit would be $10,000 (= $20,000 ÷ 2 bikes). As activity increases, the fixed costs are spread out over more units, which results in a lower cost per unit.

Table 5.2 "Fixed Cost Behavior for Bikes Unlimited" provides the total and per unit fixed costs at three different levels of production, and Figure 5.2 "Total Fixed Production Costs for Bikes Unlimited" graphs the relation of total fixed costs (*y*-axis) to units produced (*x*-axis). Note that regardless of the activity level, *total* fixed costs remain the same.

Table 5.2 Fixed Cost Behavior for Bikes Unlimited

Units Produced	Total Fixed Costs	Per Unit Fixed Cost
1	$20,000	$20,000
2,000	20,000	10
4,000	20,000	5

Figure 5.2 *Total Fixed Production Costs for Bikes Unlimited*



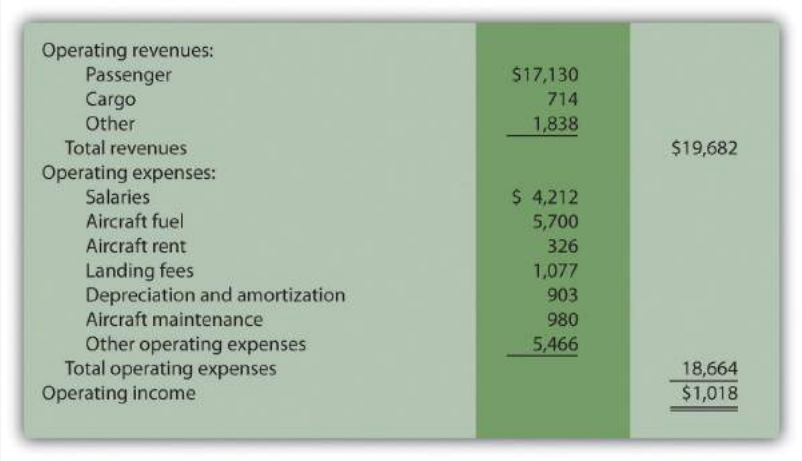
Business in Action 5.1

Source: Photo courtesy of Simon_sees, http://www.flickr.com/photos/39551170@N02/3696524201/.

United Airlines Struggles to Control Costs

United Airlines is the second largest air carrier in the world. It has hubs in Chicago, Denver, Los Angeles, San Francisco, and New York and flies to 109 destinations in 23 countries. Destinations include Tokyo, London, and Frankfurt.

Back in 2002, **United** filed for bankruptcy. Industry analysts reported that **United** had relatively high fixed costs, making it difficult for the company to cut costs quickly in line with its reduction in revenue. A few years later, **United** emerged from bankruptcy, and in 2010 merged with **Continental Airlines**. Although financial information was presented separately for each company (**United** and **Continental**) in 2010, both companies are now owned by **United Continental Holdings, Inc.** The following financial information for **United Airlines** is from the company's income statement for the year ended December 31, 2010 (amounts are in millions). Review this information carefully. Which costs are likely to be fixed?



Operating revenues:		
Passenger	$17,130	
Cargo	714	
Other	1,838	
Total revenues		$19,682
Operating expenses:		
Salaries	$ 4,212	
Aircraft fuel	5,700	
Aircraft rent	326	
Landing fees	1,077	
Depreciation and amortization	903	
Aircraft maintenance	980	
Other operating expenses	5,466	
Total operating expenses		18,664
Operating income		$1,018

Although we cannot identify all fixed costs with certainty, several costs likely fall into this category: salaries (for union employees, such as pilots, flight crews, and mechanics); aircraft fuel (assuming flights are not easily canceled); aircraft rent; and depreciation. These costs total $11.1 billion, or 60 percent of total operating expenses (rounded). Fixed costs are clearly a large component of total operating expenses, which makes it difficult for airline companies like **United Airlines** to make short-term cuts in expenses when revenue declines.

Source: **United Continental, Inc.**, form 10K for 2010.

Committed Versus Discretionary Fixed Costs

Question: Organizations often view fixed costs as either committed or discretionary. What is the difference between these two types of fixed costs?

Answer: A **committed fixed cost**[3] is a fixed cost that cannot easily be changed in the short run without having a significant impact on the organization. For example, assume Bikes Unlimited has a five-year lease on the company's production facility, which costs $8,000 per month. This is a committed fixed cost because the lease cannot easily be broken, and the company is committed to using this facility for years to come. Other examples of committed fixed costs include salaried employees with long-term contracts, depreciation on buildings, and insurance.

3. A fixed cost that cannot easily be changed in the short run without having a significant impact on the organization.

A **discretionary fixed cost**[4] is a fixed cost that can be changed in the short run without having a significant impact on the organization. For example, assume Bikes Unlimited contributes $10,000 each year toward charitable organizations. Management has the option of changing this amount in the short run without causing a significant impact on the organization. Other examples of discretionary fixed costs include advertising, research and development, and training programs (although an argument can be made that reducing these expenditures could have a significant impact on the company depending on the amount of the cuts).

In general, management looks to cut discretionary fixed costs when sales and profits are declining, since cuts in this area tend not to have as significant an impact on the organization as cutting committed fixed costs. Difficulties arise when struggling organizations go beyond cutting discretionary fixed costs and begin looking at cutting committed fixed costs.

Mixed Costs

Question: We have now learned about two types of cost behavior patterns—variable costs and fixed costs. However, there is a third type of cost that behaves differently in that both total and per unit costs change with changes in activity. What do we call this type of cost?

Answer: This cost behavior pattern is called a mixed cost. The term **mixed cost**[5] describes a cost that has a mix of fixed and variable costs. For example, assume sales personnel at Bikes Unlimited are paid a total of $10,000 in monthly salary plus a commission of $7 for every bike sold. This is a mixed cost because it has a fixed component of $10,000 per month and a variable component of $7 per unit.

Table 5.3 "Mixed Cost Behavior for Bikes Unlimited" provides the total and per unit fixed costs at three different levels of production, and Figure 5.3 "Total Mixed Sales Compensation Costs for Bikes Unlimited" graphs the relation of total mixed costs (*y*-axis) to units produced (*x*-axis). The point at which the line intersects the *y*-axis represents the total fixed cost ($10,000), and the slope of the line represents the variable cost per unit ($7).

Table 5.3 Mixed Cost Behavior for Bikes Unlimited

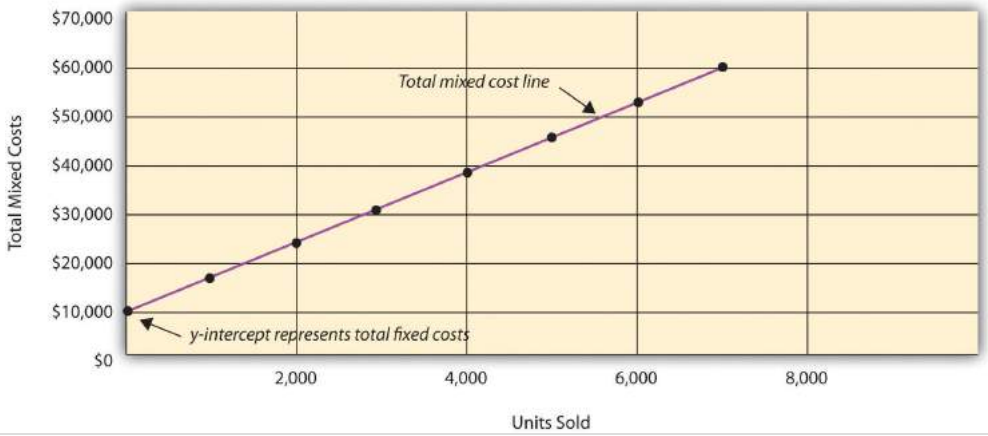
Units Sold	Total Mixed Costs	Per Unit Mixed Cost
1	$10,007	$10,007.00

4. A fixed cost that can be changed in the short run without having a significant impact on the organization.

5. A cost that has a combination of fixed and variable costs.

Units Sold	Total Mixed Costs	Per Unit Mixed Cost
2,000	24,000	12.00
4,000	38,000	9.50

Figure 5.3 Total Mixed Sales Compensation Costs for Bikes Unlimited



Because this cost is depicted with a straight line, we can use the equation for a straight line to describe a mixed cost:

Key Equation

Total mixed cost = Total fixed cost + (Unit variable cost × Number of units)

or

$Y = f + vX$

where

Y = total mixed costs (this is the *y*-axis in Figure 5.3 "Total Mixed Sales Compensation Costs for Bikes Unlimited")

f = total fixed costs

v = variable cost per unit

X = level of activity (this is the *x*-axis in Figure 5.3 "Total Mixed Sales Compensation Costs for Bikes Unlimited")

For Bikes Unlimited, the mixed cost equation is Y = $10,000 + $7X. If Bikes Unlimited sells 4,000 bikes (X) in one month, the total mixed cost (Y) for sales personnel compensation would be $38,000 [= $10,000 + ($7 × 4,000 units)].

Short Term Versus Long Term and the Relevant Range

We now introduce two important concepts that must be considered when estimating costs: short term versus long term, and the relevant range.

Short Term Versus Long Term

Question: When identifying cost behavior patterns, we assume that management is using the cost information to make short-term decisions. Why is this short-term decision making assumption so important?

Answer: Variable, fixed, and mixed cost concepts are useful for short-term decision making and therefore apply to a specific period of time. This short-term period will

vary depending on the company's current production capacity and the time required to change capacity. In the long term, all cost behavior patterns will likely change.

For example, suppose Bikes Unlimited's production capacity is 8,000 units per month, and management plans to expand capacity in two years by renting a new production facility and hiring additional personnel. This is a long-term decision that will change the cost behavior patterns identified earlier. Variable production costs will no longer be $60 per unit, fixed production costs will no longer be $20,000 per month, and mixed sales compensation costs will also change. All these costs will change because the estimates are accurate only in the short term.

The Relevant Range

Question: Another important concept we use when estimating costs is called the relevant range. What is the relevant range and why is it so important when estimating costs?

Answer: The **relevant range**[6] is the range of activity for which cost behavior patterns are likely to be accurate. The variable, fixed, and mixed costs identified for Bikes Unlimited will only be accurate within a certain range of activity. Once the firm goes outside that range, cost estimates are not necessarily accurate and often must be reevaluated and recalculated.

For example, assume Bikes Unlimited's mixed sales compensation costs of $10,000 per month plus $7 per unit is only valid up to 4,000 units per month. If unit sales increase beyond 4,000 units, management will hire additional salespeople and the total monthly base salary will increase beyond $10,000. Thus the relevant range for this mixed cost is from zero to 4,000 units. Once the company exceeds sales of 4,000 units per month, it is out of the relevant range, and the mixed cost must be recalculated.

We discuss the relevant range concept in more detail later in the chapter. For now, remember that the accuracy of cost behavior patterns is limited to a certain range of activity called the relevant range.

6. The range of activity for which the cost behavior patterns are likely to be accurate.

Computer Application

Using Excel to Create Charts

Managers typically use computer applications on a daily basis to perform a variety of functions. For example, they often use Excel to generate tables, graphs, and charts. You could use Excel to create the charts shown in Figure 5.1 "Total Variable Production Costs for Bikes Unlimited", Figure 5.2 "Total Fixed Production Costs for Bikes Unlimited", and Figure 5.3 "Total Mixed Sales Compensation Costs for Bikes Unlimited". Here's how:

1. **Enter the data.** Open a new Excel document and enter the data in two columns: one column for the *x*-axis (horizontal axis), and one column for the *y*-axis (vertical axis). Let's suppose you want to create the chart shown in Figure 5.1 "Total Variable Production Costs for Bikes Unlimited". In that case, the *x*-axis represents units produced, and the *y*-axis represents total variable costs. An excerpt from your Excel document would appear as follows:

	A	B	C	D
1		Units Produced	Total Variable Costs	
2		0	$ -	
3		1,000	$ 60,000	
4		2,000	$ 120,000	
5		3,000	$ 180,000	
6		4,000	$ 240,000	
7		5,000	$ 300,000	
8		6,000	$ 360,000	
9		7,000	$ 420,000	
10				

2. **Create the chart.** After you have entered the data, highlight the appropriate data cells (including headings and labels) and click on *Insert*, *Chart*, *Scatter*. Choose *Scatter with Smooth Lines and Markers*. The chart that results is linked to your data points. If you change the data, the chart changes, too. (In earlier versions of Excel, the

chart wizard walks you through the steps necessary to create the chart.)

3. **Format the chart.** Now that you have created the chart, select it and use Chart Tools to format it with background shading, text inserts, font size, chart size, and other more advanced features. If you want to display the chart within some other document (e.g., a Word document), you can copy it (highlight the chart and select *Edit*, *Copy* from the menu bar) and paste it into the document (select *Edit*, *Paste* or *Paste Special*).

The Excel document created by following these three steps would look like the one shown in Figure 5.1 "Total Variable Production Costs for Bikes Unlimited".

How Cost Behavior Patterns Are Used

Question: How do managers use cost behavior patterns to make better decisions?

Answer: Accurately predicting what costs will be in the future can help managers answer several important questions. For example, managers at Bikes Unlimited might ask the following:

- We expect to see a 5 percent increase in unit sales next year. How will this affect revenues and costs?
- We are applying for a loan with a bank, and bank managers think our sales estimates are high. What happens to our revenues and costs if we lower estimates by 20 percent?
- What happens to revenues and costs if we add a racing bike to our product line?
- How will costs behave in the future if we increase automation in the production process?

The only way to accurately predict costs is to understand how costs behave given changes in activity. To make good decisions, managers must know how costs are structured (fixed, variable, or mixed). The next section explains how to estimate fixed and variable costs, and how to identify the fixed and variable components of mixed costs.

Business in Action 5.2

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Budget Cuts at an Elementary School District

A school district outside Sacramento, California, was faced with making budget cuts because of a reduction in state funding. To reduce costs, the school district's administration decided to consider closing one of the smaller elementary schools in the district. According to an initial estimate, closing this school would reduce costs by $500,000 to $1,000,000 per year. However, further analysis identified only $100,000 to $150,000 in cost savings.

Why did the analysis yield lower savings than the initial estimate? Most of the costs were committed fixed costs (e.g., teachers' salaries and benefits) and could not be eliminated in the short term. In fact, teachers and students at the school being considered for closure were to be moved to other schools in the

district, and so no savings on teachers' salaries and benefits would result. The only real short-term cost savings would be in not having to maintain the classrooms, computer lab, and library (nonunion employees would be let go) and in utilities (heat and air conditioning would be turned off).

The school district ultimately decided not to close the school because of the large committed fixed costs involved, as well as a lack of community support, and budget cuts were made in other areas throughout the district.

REVIEW PROBLEM 5.1

Sierra Company is trying to identify the behavior of the three costs shown in the following table. The following cost information is provided for six months. Calculate the cost per unit, and then identify how each cost behaves (fixed, variable, or mixed). Explain your answers.

		Cost 1		Cost 2		Cost 3	
Month	**Units Produced**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**
1	50	$100	$2.00	$100	$2.00	$100	$2.00
2	100	200	2.00	100	1.00	150	1.50
3	150	300	_____	100	_____	200	_____
4	200	400	_____	100	_____	250	_____
5	250	500	_____	100	_____	300	_____
6	300	600	_____	100	_____	350	_____

Solution to Review Problem 5.1

As shown in the following table, cost 1 is a variable cost because as the number of units produced changes, total costs change (in proportion to changes in activity) and per unit cost remains the same. Cost 2 is a fixed cost because as the number of units produced changes, total costs remain the same and per unit costs change. Cost 3 is a mixed cost because as the number of units produced changes, total cost changes (but not in proportion to changes in activity) and per unit cost changes.

		Cost 1		Cost 2		Cost 3	
Month	**Units Produced**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit***	**Total Costs**	**Cost per Unit***
1	50	$100	$2.00	$100	$2.00	$100	$2.00
2	100	200	2.00	100	1.00	150	1.50
3	150	300	2.00	100	0.67	200	1.33
							***Rounded.**

		Cost 1		Cost 2		Cost 3	
4	200	400	2.00	100	0.50	250	1.25
5	250	500	2.00	100	0.40	300	1.20
6	300	600	2.00	100	0.33	350	1.17
							***Rounded.**

5.2 Cost Estimation Methods

LEARNING OBJECTIVE

1. Estimate costs using account analysis, the high-low method, the scattergraph method, and regression analysis.

Question: Recall the conversation that Eric (CFO) and Susan (cost accountant) had about Bikes Unlimited's budget for the next month, which is August. The company expects to increase sales by 10 to 20 percent, and Susan has been asked to estimate profit for August given this expected increase. Although examples of variable and fixed costs were provided in the previous sections, companies typically do not know exactly how much of their costs are fixed and how much are variable. (Financial accounting systems do not normally sort costs as fixed or variable.) Thus organizations must estimate their fixed and variable costs. What methods do organizations use to estimate fixed and variable costs?

Answer: Four common approaches are used to estimate fixed and variable costs:

- Account analysis
- High-low method
- Scattergraph method
- Regression analysis

All four methods are described next. The goal of each cost estimation method is to estimate fixed and variable costs and to describe this estimate in the form of $Y = f + vX$. That is, Total mixed cost = Total fixed cost + (Unit variable cost × Number of units). Note that the estimates presented next for Bikes Unlimited may differ from the dollar amounts used previously, which were for illustrative purposes only.

Account Analysis

7. A method of cost analysis that requires a review of accounts by an experienced employee or group of employees to determine whether the costs in each account are fixed or variable.

Question: The **account analysis**[7] *approach is perhaps the most common starting point for estimating fixed and variable costs. How is the account analysis approach used to estimate fixed and variable costs?*

Answer: This approach requires that an experienced employee or group of employees review the appropriate accounts and determine whether the costs in each account are fixed or variable. Totaling all costs identified as fixed provides the estimate of total fixed costs. To determine the variable cost per unit, all costs identified as variable are totaled and divided by the measure of activity (*units produced* is the measure of activity for Bikes Unlimited).

Let's look at the account analysis approach using Bikes Unlimited as an example. Susan (the cost accountant) asked the financial accounting department to provide cost information for the production department for the month of June (July information is not yet available). Because the financial accounting department tracks information by department, it is able to produce this information. The production department information for June is as follows:

Units produced and sold	5,000
Materials used in production	$180,000
Labor used in production (assembly and supervisors)	80,000
Production facility costs (rent, insurance, utilities, etc.)	30,000
Total production cost	$290,000

Susan reviewed this cost information with the production manager, Indira Bingham, who has worked as production manager at Bikes Unlimited for several years. After careful review, Indira and Susan came up with the following breakdown of variable and fixed costs for June:

	Total (=)	Variable (+)	Fixed
Materials used in production	$180,000	$180,000	$ 0
Labor used in production (assembly and supervisors)	80,000	65,000	15,000
Production facility costs (rent, insurance, utilities, etc.)	30,000	15,000	15,000
Total production cost	$290,000	$260,000	$30,000

Total fixed cost is estimated to be $30,000, and variable cost per unit is estimated to be $52 (= $260,000 ÷ 5,000 units produced). *Remember, the goal is to describe the mixed costs in the equation form $Y = f + vX$.* Thus the mixed cost equation used to estimate future production costs is

$$Y = \$30{,}000 + \$52X$$

Now Susan can estimate monthly production costs (Y) if she knows how many units Bikes Unlimited plans to produce (X). For example, if Bikes Unlimited plans to produce 6,000 units for a particular month (a 20 percent increase over June) and this level of activity is within the relevant range, total production costs should be approximately $342,000 [= $30,000 + ($52 × 6,000 units)].

Question: Why should Susan be careful using historical data for one month (June) to estimate future costs?

Answer: June may not be a typical month for Bikes Unlimited. For example, utility costs may be low relative to those in the winter months, and production costs may be relatively high as the company prepares for increased demand in July and August. This might result in a lower materials cost per unit from quantity discounts offered by suppliers. To smooth out these fluctuations, companies often use data from the past quarter or past year to estimate costs.

REVIEW PROBLEM 5.2

Alta Production, Inc., is using the account analysis approach to identify the behavior of production costs for a month in which it produced 350 units. The production manager was asked to review these costs and provide her best guess as to how they should be categorized. She responded with the following information:

	Total (=)	Variable (+)	Fixed
Materials used in production	$270,000	$270,000	$ 0
Labor used in production	134,000	130,000	4,000
Production facility costs	103,000	100,000	3,000
Total production cost	$507,000	$500,000	$7,000

1. Describe the production costs in the equation form Y = *f* + *v*X.
2. Assume Alta intends to produce 400 units next month. Calculate total production costs for the month.

Solution to Review Problem 5.2

1. Because *f* represents total fixed costs, and *v* represents variable cost per unit, the cost equation is: Y = $7,000 + $1,428.57X. (Variable cost per unit of $1,428.57 = $500,000 ÷ 350 units.)

2. Using the previous equation, simply substitute 400 units for X, as follows:

$$\begin{aligned} Y &= \$7{,}000 + (\$1{,}428.57 \times 400 \text{ units}) \\ Y &= \$7{,}000 + \$571{,}428 \\ Y &= \$578{,}428 \end{aligned}$$

Thus total production costs are expected to be $578,428 for next month.

High-Low Method

Question: Another approach to identifying fixed and variable costs for cost estimation purposes is the **high-low method**[8]*. Accountants who use this approach are looking for a quick and easy way to estimate costs, and will follow up their analysis with other more accurate techniques. How is the high-low method used to estimate fixed and variable costs?*

8. A method of cost analysis that uses the high and low activity data points to estimate fixed and variable costs.

Answer: The high-low method uses historical information from several reporting periods to estimate costs. Assume Susan Wesley obtains monthly production cost information from the financial accounting department for the last 12 months. This information appears in Table 5.4 "Monthly Production Costs for Bikes Unlimited".

Table 5.4 Monthly Production Costs for Bikes Unlimited

Reporting Period (Month)	Total Production Costs	Level of Activity (Units Produced)
July	$230,000	3,500
August	250,000	3,750
September	260,000	3,800
October	220,000	3,400
November	340,000	5,800
December	330,000	5,500
January	*200,000*	*2,900*
February	210,000	3,300
March	240,000	3,600
April	*380,000*	*5,900*
May	350,000	5,600
June	290,000	5,000

All of the data points from Table 5.4 "Monthly Production Costs for Bikes Unlimited" are plotted on the graph shown in Figure 5.4 "Estimated Total Mixed Production Costs for Bikes Unlimited: High-Low Method". Although a graph is not required using the high-low method, it is a helpful visual tool. Susan then draws a straight line using the high (April) and low (January) *activity levels* from these data. The goal of the high-low method is to describe this line mathematically in the form of an equation stated as $Y = f + vX$, which requires calculating both the total fixed costs amount (f) and per unit variable cost amount (v). Four steps are required to achieve this using the high-low method:

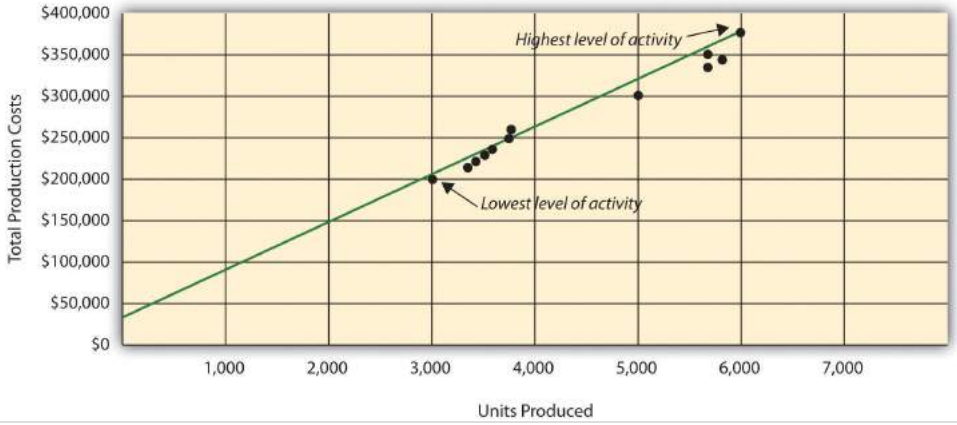
Step 1. Identify the high and low activity levels from the data set.

Step 2. Calculate the variable cost per unit (*v*).

Step 3. Calculate the total fixed cost (*f*).

Step 4. State the results in equation form Y = *f* + *v*X.

Figure 5.4 *Estimated Total Mixed Production Costs for Bikes Unlimited: High-Low Method*



Question: How are the four steps of the high-low method used to estimate total fixed costs and per unit variable cost?

Answer: Each of the four steps is described next.

Step 1. Identify the high and low activity levels from the data set.

The highest level of activity (level of production) occurred in the month of April (5,900 units; $380,000 production costs), and the lowest level of activity occurred in the month of January (2,900 units; $200,000 production costs). Note that we are identifying the high and low *activity* levels rather than the high and low *dollar* levels—choosing the high and low dollar levels can result in incorrect high and low points.

Step 2. Calculate the variable cost per unit (*v*).

Because the slope of the line shown in Figure 5.4 "Estimated Total Mixed Production Costs for Bikes Unlimited: High-Low Method" represents the variable cost per unit, the goal here is to calculate the slope of the line using the high and low points identified in step 1 (the slope calculation is often referred to as "rise over run" in math courses). The calculation of the variable cost per unit for Bikes Unlimited is shown as follows:

$$\begin{aligned}\text{Unit variable cost } (v) &= \frac{\text{Cost at highest level} - \text{Cost at lowest level}}{\text{Highest activity level} - \text{Lowest activity level}} \\ &= \frac{\$380{,}000 - \$200{,}000}{5{,}900 \text{ units} - 2{,}900 \text{ units}} \\ &= \frac{\$180{,}000}{3{,}000 \text{ units}} \\ &= \$60\end{aligned}$$

Step 3. Calculate the total fixed cost (*f*).

After completing step 2, the equation to describe the line is partially complete and stated as Y = *f* + $60X. The goal of step 3 is to calculate a value for total fixed cost (*f*). Simply select either the high or low activity level, and fill in the data to solve for *f* (total fixed costs), as shown.

Using the low activity level of 2,900 units and $200,000,

$$\begin{aligned} Y &= f + vX \\ \$200{,}000 &= f + (\$60 \times 2{,}900 \text{ units}) \\ f &= \$200{,}000 - (\$60 \times 2{,}900 \text{ units}) \\ f &= \$200{,}000 - \$174{,}000 \\ f &= \$26{,}000 \end{aligned}$$

Thus total fixed costs total $26,000. (Try this using the high activity level of 5,900 units and $380,000. You will get the same result as long as the per unit variable cost is not rounded.)

Step 4. State the results in equation form Y = *f* + *v*X.

We know from step 2 that the variable cost per unit is $60, and from step 3 that total fixed cost is $26,000. Thus we can state the equation used to estimate total costs as

Y = $26,000 + $60X

Now it is possible to estimate total production costs given a certain level of production (X). For example, if Bikes Unlimited expects to produce 6,000 units during August, total production costs are estimated to be $386,000:

$$\begin{aligned} Y &= \$26{,}000 + (\$60 \times 6{,}000 \text{ units}) \\ Y &= \$26{,}000 + \$360{,}000 \\ Y &= \$386{,}000 \end{aligned}$$

Question: Although the high-low method is relatively simple, it does have a potentially significant weakness. What is the potential weakness in using the high-low method?

Answer: In reviewing Figure 5.4 "Estimated Total Mixed Production Costs for Bikes Unlimited: High-Low Method", you will notice that this approach only considers the

high and low activity levels in establishing an estimate of fixed and variable costs. The high and low data points may not represent the data set as a whole, and using these points can result in distorted estimates.

For example, the $380,000 in production costs incurred in April may be higher than normal because several production machines broke down resulting in costly repairs. Or perhaps several key employees left the company, resulting in higher than normal labor costs for the month because the remaining employees were paid overtime. Cost accountants will often throw out the high and low points for this reason and use the next highest and lowest points to perform this analysis. While the high-low method is most often used as a quick and easy way to estimate fixed and variable costs, other more sophisticated methods are most often used to refine the estimates developed from the high-low method.

REVIEW PROBLEM 5.3

Alta Production, Inc., reported the following production costs for the 12 months January through December. (This is the same company featured in Note 5.15 "Review Problem 5.2".)

Reporting Period (Month)	Total Production Costs	Level of Activity (Units Produced)
January	$460,000	300
February	300,000	220
March	480,000	330
April	550,000	390
May	570,000	410
June	310,000	240
July	440,000	290
August	455,000	320
September	530,000	380
October	250,000	150
November	700,000	450
December	490,000	350

1. Using this information, perform the four steps of the high-low method to estimate costs and state your results in cost equation form $Y = f + vX$.
2. Assume Alta Production, Inc., will produce 400 units next month. Calculate total production costs for the month.
3. What is the potential weakness in using this approach to estimate costs?

Solution to Review Problem 5.3

1. The four steps are as follows:

Step 1. Identify the high and low activity levels from the data set.

The highest level of activity occurred in November (450 units; $700,000 production costs), and the lowest level of activity occurred in October (150 units; $250,000 production costs).

Step 2. Calculate the variable cost per unit (*v*).

$$\begin{aligned}\text{Unit variable cost} &= \text{Change in cost} \div \text{Change in activity} \\ &= (\$700{,}000 - \$250{,}000) \div (450 \text{ units} - 150 \\ &= \$1{,}500\end{aligned}$$

Step 3. Calculate the total fixed cost (*f*).

After completing step 2, the equation to describe the line is partially complete and stated as Y = *f* + $1,500X. To calculate total fixed costs, simply select either the high or low activity level, and fill in the data to solve for *f* (total fixed costs), as shown.

Using the high activity level,

$$\begin{aligned}Y &= f + vX \\ \$700{,}000 &= f + (\$1{,}500 \times 450 \text{ units}) \\ f &= (\$1{,}500 \times 450 \text{ units}) \\ f &= \$700{,}000 - \$675{,}000 \\ f &= \$25{,}000\end{aligned}$$

Thus total fixed cost is $25,000.

Step 4. State the results in equation form Y = *f* + *v*X.

We know from step 2 that the variable cost per unit is $1,500, and from step 3 that total fixed costs are $25,000. Thus the equation used to estimate total production costs is

$$Y = \$25{,}000 + \$1{,}500X$$

2. Using the equation from part 1, simply substitute 400 units for X, as follows:

$$\begin{aligned} Y &= \$25{,}000 + (\$1{,}500 \times 400 \text{ units}) \\ Y &= \$25{,}000 + \$600{,}000 \\ Y &= \$625{,}000 \end{aligned}$$

Thus total production costs are expected to be $625,000 for next month.

3. This approach only considers the high and low activity levels in establishing an estimate of fixed and variable costs. The high and low data points may not represent the data set as a whole, and using these points can result in distorted estimates. In reviewing the set of data points for January through December, it appears that October and November are relatively extreme points when compared to the other 10 months. Because the cost equation is based solely on these two points, the resulting estimate of production costs for 400 units of production (in part 2) may not be accurate.

Scattergraph Method

Question: Many organizations prefer to use the **scattergraph method**[9] *to estimate costs. Accountants who use this approach are looking for an approach that does not simply use the highest and lowest data points. How is the scattergraph method used to estimate fixed and variable costs?*

Answer: The scattergraph method considers all data points, not just the highest and lowest levels of activity. Again, the goal is to develop an estimate of fixed and variable costs stated in equation form $Y = f + vX$. Using the same data for Bikes Unlimited shown in Table 5.4 "Monthly Production Costs for Bikes Unlimited", we will follow the five steps associated with the scattergraph method:

9. A method of cost analysis that uses a set of data points to estimate fixed and variable costs.

Step 1. Plot the data points for each period on a graph.

Step 2. Visually fit a line to the data points and be sure the line touches one data point.

Step 3. Estimate the total fixed costs (*f*).

Step 4. Calculate the variable cost per unit (*v*).

Step 5. State the results in equation form Y = *f* + *v*X.

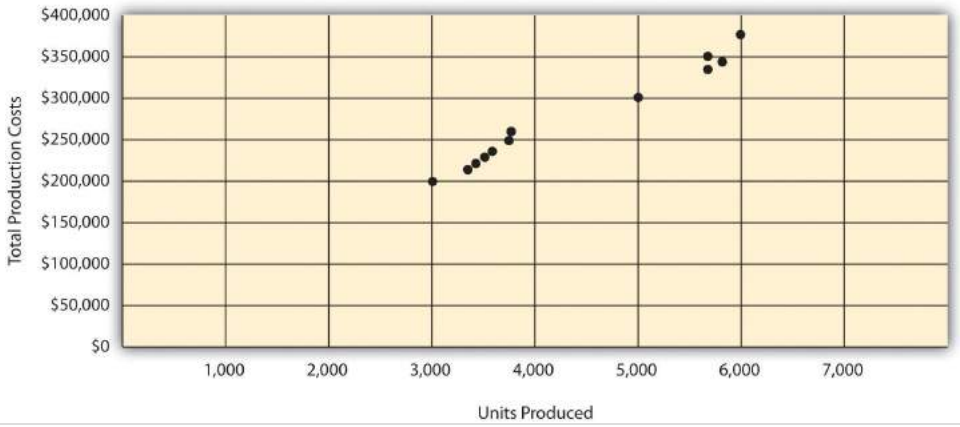
Question: How are the five steps of the scattergraph method used to estimate total fixed costs and per unit variable cost?

Answer: Each of the five steps is described next.

Step 1. Plot the data points for each period on a graph.

This step requires that each data point be plotted on a graph. The *x*-axis (horizontal axis) reflects the level of activity (units produced in this example), and the *y*-axis (vertical axis) reflects the total production cost. Figure 5.5 "Scattergraph of Total Mixed Production Costs for Bikes Unlimited" shows a scattergraph for Bikes Unlimited using the data points for 12 months, July through June.

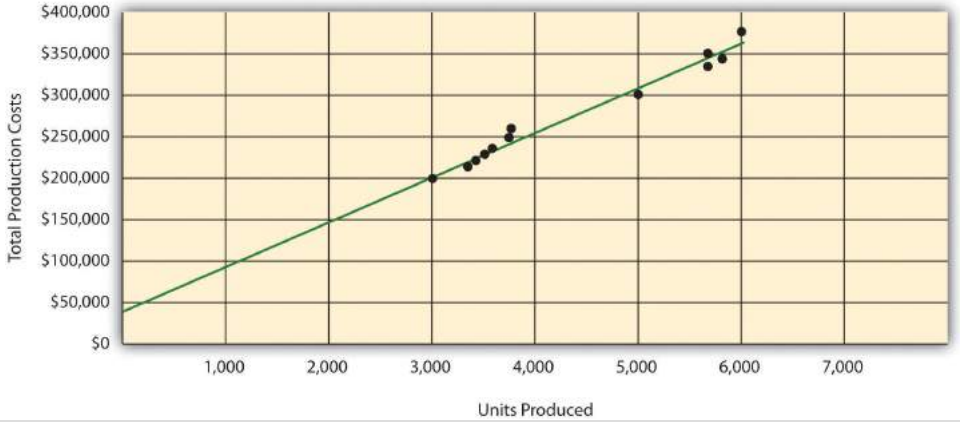
Figure 5.5 *Scattergraph of Total Mixed Production Costs for Bikes Unlimited*



Step 2. Visually fit a line to the data points and be sure the line touches one data point.

Once the data points are plotted as described in step 1, draw a line through the points touching one data point and extending to the *y*-axis. The goal here is to minimize the distance from the data points to the line (i.e., to make the line as close to the data points as possible). Figure 5.6 "Estimated Total Mixed Production Costs for Bikes Unlimited: Scattergraph Method" shows the line through the data points. Notice that the line hits the data point for July (3,500 units produced and $230,000 total cost).

Figure 5.6 *Estimated Total Mixed Production Costs for Bikes Unlimited: Scattergraph Method*



Step 3. Estimate the total fixed costs (*f*).

The total fixed costs are simply the point at which the line drawn in step 2 meets the *y*-axis. This is often called the *y*-intercept. Remember, the line meets the *y*-axis when the activity level (units produced in this example) is zero. Fixed costs remain the same in total regardless of level of production, and variable costs change in total with changes in levels of production. Since variable costs are zero when no units are produced, the costs reflected on the graph at the *y*-intercept must represent total fixed costs. The graph in Figure 5.6 "Estimated Total Mixed Production Costs for Bikes Unlimited: Scattergraph Method" indicates total fixed costs of approximately $45,000. (Note that the *y*-intercept will always be an approximation.)

Step 4. Calculate the variable cost per unit (*v*).

After completing step 3, the equation to describe the line is partially complete and stated as Y = $45,000 + *v*X. The goal of step 4 is to calculate a value for variable cost per unit (*v*). Simply use the data point the line intersects (July: 3,500 units produced and $230,000 total cost), and fill in the data to solve for *v* (variable cost per unit) as follows:

$$\begin{aligned} \text{Y} &= f + v\text{X} \\ \$230{,}000 &= \$45{,}000 + \left(v \times 3{,}500\right) \\ \$230{,}000 - \$45{,}000 &= v \times 3{,}500 \\ \$185{,}000 &= v \times 3{,}500 \\ v &= \$185{,}000 \div 3{,}500 \\ v &= \$52.86 \left(\text{rounded}\right) \end{aligned}$$

Thus variable cost per unit is $52.86.

Step 5. State the results in equation form Y = *f* + *v*X.

We know from step 3 that the total fixed costs are $45,000, and from step 4 that the variable cost per unit is $52.86. Thus the equation used to estimate total costs looks like this:

Y = $45,000 + $52.86X

Now it is possible to estimate total production costs given a certain level of production (X). For example, if Bikes Unlimited expects to produce 6,000 units during August, total production costs are estimated to be $362,160:

$$\begin{aligned} Y &= \$45{,}000 + \left(\$52.86 \times 6{,}000 \text{ units}\right) \\ Y &= \$45{,}000 + \$317{,}160 \\ Y &= \$362{,}160 \end{aligned}$$

Question: Remember that the key weakness of the high-low method discussed previously is that it considers only two data points in estimating fixed and variable costs. How does the scattergraph method mitigate this weakness?

Answer: The scattergraph method mitigates this weakness by considering all data points in estimating fixed and variable costs. The scattergraph method gives us an opportunity to review all data points in the data set when we plot these data points in a graph in step 1. If certain data points seem unusual (statistics books often call these points *outliers*), we can exclude them from the data set when drawing the best-fitting line. In fact, many organizations use a scattergraph to identify outliers and then use *regression analysis* to estimate the cost equation $Y = f + vX$. We discuss regression analysis in the next section.

Although the scattergraph method tends to yield more accurate results than the high-low method, the final cost equation is still based on estimates. The line is drawn using our best judgment and a bit of guesswork, and the resulting *y*-intercept (fixed cost estimate) is based on this line. This approach is not an exact science! However, the next approach to estimating fixed and variable costs—regression analysis—uses mathematical equations to find the best-fitting line.

REVIEW PROBLEM 5.4

Alta Production, Inc., reported the following production costs for the 12 months January through December. (These are the same data presented in Note 5.17 "Review Problem 5.3".)

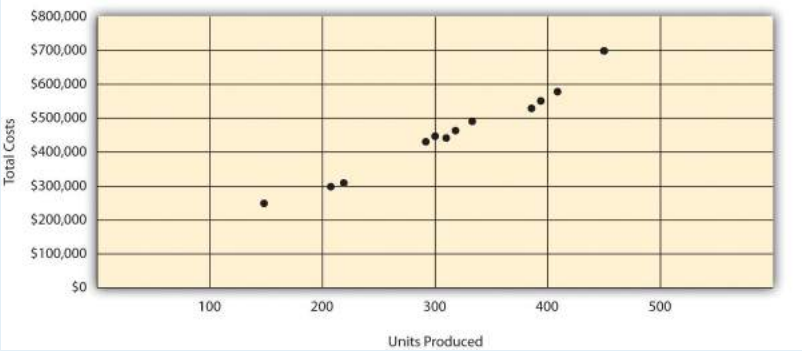
Reporting Period (Month)	Total Production Costs	Level of Activity (Units Produced)
January	$460,000	300
February	300,000	220
March	480,000	330
April	550,000	390
May	570,000	410
June	310,000	240
July	440,000	290
August	455,000	320
September	530,000	380
October	250,000	150
November	700,000	450
December	490,000	350

1. Using the information, perform the five steps of the scattergraph method to estimate costs and state your results in cost equation form $Y = f + vX$.
2. Assume Alta Production, Inc., will produce 400 units next month. Calculate total production costs for the month.
3. When is this approach likely to yield more accurate results than the high-low method?

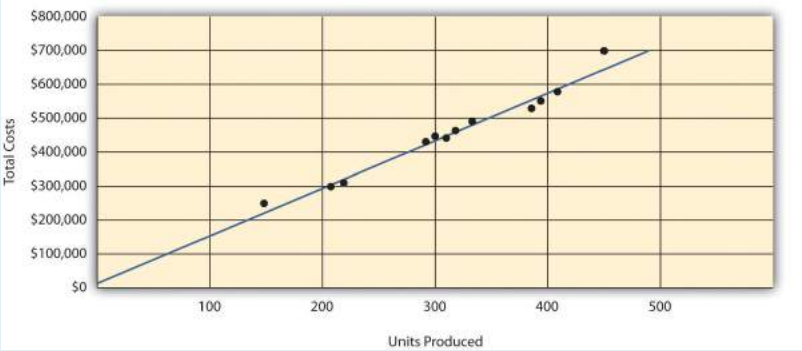
Solution to Review Problem 5.4

1. The five steps are as follows:

Step 1. Plot the data points for each period on a graph.



Step 2. Visually fit a line to the data points, and be sure the line touches one data point.



Step 3. Estimate the total fixed costs (*f*).

The *y*-intercept represents total fixed costs. This is where the line meets the *y*-axis. Total fixed costs in the graph appear to be approximately $5,000. You will likely get a different answer because the answer depends on the line that you visually fit to the data points. Remember you must draw the line through one data point. The line intersects the data point for March ($480,000 production costs; 330 units produced). This will be used in step 4.

Step 4. Calculate the variable cost per unit (v).

After completing step 3, the equation to describe the line is partially complete and stated as Y = $5,000 + vX. The goal of this step is to calculate a value for variable cost per unit (v). Use the data point the line intersects (for March, 330 units produced and $480,000 total costs), and fill in the data to solve for v (variable cost per unit):

$$\begin{aligned} \text{Y} &= f + v\text{X} \\ \$480{,}000 &= \$5{,}000 + (v \times 330) \\ \$480{,}000 - \$5{,}000 &= v \times 330 \\ \$475{,}000 &= v \times 330 \\ v &= \$475{,}000 \div 330 \\ v &= \$1{,}439.39 \ (\text{rounded}) \end{aligned}$$

Step 5. State the results in equation form Y = f + vX.

We know from step 3 that the total fixed costs are $5,000, and from step 4 that variable cost per unit is $1,439.39. Thus the equation used to estimate total production costs is stated as:

$$\text{Y} = \$5{,}000 + \$1{,}439.39\text{X}$$

It is evident from this information that this company has very little in fixed costs and relatively high variable costs. This is indicative of a company that uses a high level of labor and materials (both variable costs) and a low level of machinery (typically a fixed cost through depreciation or lease costs).

2. Using the equation, simply substitute 400 units for X, as follows:

$$\begin{aligned} Y &= \$5{,}000 + (\$1{,}439.39 \times 400 \text{ units}) \\ Y &= \$5{,}000 + \$575{,}756 \\ Y &= \$580{,}756 \end{aligned}$$

Thus total production costs are expected to be $580,756 for next month.

3. This approach is likely to yield more accurate results than the high-low method when the high and low points are not representative of the entire set of data. Notice that fixed costs are much lower using the scattergraph method ($5,000) than the high-low method ($25,000).

Regression Analysis

Question: Regression analysis is similar to the scattergraph approach in that both fit a straight line to a set of data points to estimate fixed and variable costs. How does regression analysis differ from the scattergraph method for estimating costs?

Answer: **Regression analysis**[10] uses a series of mathematical equations to find the best possible fit of the line to the data points and thus tends to provide more accurate results than the scattergraph approach. Rather than running these computations by hand, most companies use computer software, such as Excel, to perform regression analysis. Using the data for Bikes Unlimited shown back in Table 5.4 "Monthly Production Costs for Bikes Unlimited", regression analysis in Excel provides the following output. (This is a small excerpt of the output; see the appendix to this chapter for an explanation of how to use Excel to perform regression analysis.)

	Coefficients
y-intercept	43,276
x variable	53.42

Thus the equation used to estimate total production costs for Bikes Unlimited looks like this:

Y = $43,276 + $53.42X

10. A method of cost analysis that uses a series of mathematical equations to estimate fixed and variable costs; typically done using computer software.

Now it is possible to estimate total production costs given a certain level of production (X). For example, if Bikes Unlimited expects to produce 6,000 units during August, total production costs are estimated to be $363,796:

$$\begin{aligned} Y &= \$43{,}276 + \left(\$53.42 \times 6{,}000 \text{ units}\right) \\ Y &= \$43{,}276 + \$320{,}520 \\ Y &= \$363{,}796 \end{aligned}$$

Regression analysis tends to yield the most accurate estimate of fixed and variable costs, assuming there are no unusual data points in the data set. It is important to review the data set first—perhaps in the form of a scattergraph—to confirm that no outliers exist.

REVIEW PROBLEM 5.5

Alta Production, Inc., reported the following production costs for the 12 months January through December. (These are the same data that appear in Note 5.17 "Review Problem 5.3" and Note 5.19 "Review Problem 5.4".)

Reporting Period (Month)	Total Production Cost	Level of Activity (Units Produced)
January	$460,000	300
February	300,000	220
March	480,000	330
April	550,000	390
May	570,000	410
June	310,000	240
July	440,000	290
August	455,000	320
September	530,000	380
October	250,000	150
November	700,000	450
December	490,000	350

Regression analysis performed using Excel resulted in the following output:

	Coefficients
y-intercept	703
x variable	1,442.97

1. Using this information, create the cost equation in the form $Y = f + vX$.
2. Assume Alta Production, Inc., will produce 400 units next month. Calculate total production costs for the month.

Solution to Review Problem 5.5

1. The cost equation using the data from regression analysis is:

$$Y = \$703 + \$1{,}442.97X$$

2. Using the equation, simply substitute 400 units for X, as follows:

$$\begin{aligned} Y &= \$703 + (\$1{,}442.97 \times 400 \text{ units}) \\ Y &= \$703 + \$577{,}188 \\ Y &= \$577{,}891 \end{aligned}$$

Thus total production costs are expected to be $577,891 for next month.

Summary of Four Cost Estimation Methods

Question: You are now able to create the cost equation Y = f + vX to estimate costs using four approaches. What does the cost equation look like for each approach at Bikes Unlimited?

Answer: The results of these four approaches for Bikes Unlimited are summarized as follows:

- Account analysis: Y = $30,000 + $52.00X
- High-low method: Y = $26,000 + $60.00X
- Scattergraph method: Y = $45,000 + $52.86X
- Regression analysis: Y = $43,276 + $53.42X

Question: We have seen that different methods yield different results, so which method should be used?

Answer: Regression analysis tends to be most accurate because it provides a cost equation that best fits the line to the data points. However, the goal of most companies is to get close—the results do not need to be perfect. Some could

reasonably argue that the account analysis approach is best because it relies on the knowledge of those who are familiar with the costs involved.

At Bikes Unlimited, Eric (CFO) and Susan (cost accountant) met several days later. After consulting with her staff, Susan agreed that regression analysis was the best approach to use in estimating total production costs (keep in mind nothing has been done yet with selling and administrative expenses). Account analysis was ruled out because no one on the accounting staff had been with the company long enough to review the accounts and determine which costs were variable, fixed, or mixed. The high-low method was ruled out because it only uses two data points and Eric would prefer a more accurate estimate. Susan did request that her staff prepare a scattergraph and review it for any unusual data points before performing regression analysis. Based on the scattergraph prepared, all agreed that the data was relatively uniform and no outlying data points were identified.

Susan:	*My staff has been working hard to determine what will happen to profit if sales volume increases. So far, we've been able to identify cost behavior patterns for production costs, and we're currently working on the cost behavior patterns for selling and administrative expenses.*
Eric:	*What do you have for production costs?*
Susan:	*The portion of production costs that are fixed—that won't change with changes in production and sales—totals $43,276. The portion of production costs that are variable—that vary with changes in production and sales—totals $53.42 per unit.*
Eric:	*When do you expect to have further information for the selling and administrative costs?*
Susan:	*We should have those results by the end of the day tomorrow. At that point, I'll put together an income statement projecting profit for August.*
Eric:	*Sounds good. Let's meet when you have the information ready.*

KEY TAKEAWAYS

- Account analysis requires that a knowledgeable employee (or group of employees) determine whether costs are fixed, variable, or mixed. If employees do not have enough experience to accurately estimate these costs, another method should be used.
- Table 5.1 "Variable Cost Behavior for Bikes Unlimited" and Figure 5.1 "Total Variable Production Costs for Bikes Unlimited" show that total variable costs change with changes in activity, but per unit variable cost does not change with changes in activity. Table 5.2 "Fixed Cost Behavior for Bikes Unlimited" and Figure 5.2 "Total Fixed Production Costs for Bikes Unlimited" show that total fixed costs do not change with changes in activity, but per unit fixed costs do change with changes in activity. Table 5.3 "Mixed Cost Behavior for Bikes Unlimited" and Figure 5.3 "Total Mixed Sales Compensation Costs for Bikes Unlimited" show that total mixed costs change with changes in activity, and per unit mixed cost also changes with changes in activity.
- The high-low method starts with the highest and lowest activity levels and uses four steps to estimate fixed and variable costs.
- The scattergraph method has five steps and starts with plotting all points on a graph and fitting a line through the points. This line represents costs throughout a range of activity levels and is used to estimate fixed and variable costs. The scattergraph is also used to identify any outlying or unusual data points.
- Regression analysis forms a mathematically determined line that best fits the data points. Software packages like Excel are available to perform regression analysis. As with the account analysis, high-low, and scattergraph methods, this line is described in the equation form $Y = f + vX$. This equation is used to estimate future costs.
- Four methods can be used to estimate fixed and variable costs. Each method has its advantages and disadvantages, and the choice of a method will depend on the situation at hand. Experienced employees may be able to effectively estimate fixed and variable costs by using the account analysis approach. If a quick estimate is needed, the high-low method may be appropriate. The scattergraph method helps with identifying any unusual data points, which can be thrown out when estimating costs. Finally, regression analysis can be run using computer software such as Excel and generally provides for more accurate cost estimates.

REVIEW PROBLEM 5.6

Use the solutions you prepared for Note 5.15 "Review Problem 5.2", Note 5.17 "Review Problem 5.3", Note 5.19 "Review Problem 5.4", and Note 5.21 "Review Problem 5.5" to do the following:

1. Show the four cost equations created for Alta Production, Inc., using account analysis (Note 5.15 "Review Problem 5.2"), the high-low method (Note 5.17 "Review Problem 5.3"), the scattergraph method (Note 5.19 "Review Problem 5.4"), and regression analysis (Note 5.21 "Review Problem 5.5").
2. Using the four equations listed in your answer to 1, calculate total production costs assuming Alta Production, Inc., will produce 400 units next month. Comment on your results.

Solution to Review Problem 5.6

1. The cost equations for each of the four methods used in Note 5.15 "Review Problem 5.2", Note 5.17 "Review Problem 5.3", Note 5.19 "Review Problem 5.4", and Note 5.21 "Review Problem 5.5" are shown here. Each of these cost equations was created using the same historical production cost data for Alta Production, Inc. The goal for you as a student is to understand how to develop a cost equation that will help in estimating costs for the future (based on past information).

    1. Account analysis: Y = $7,000 + $1,428.57X
    2. High-low method: Y = $25,000 + $1,500.00X
    3. Scattergraph method: Y = $5,000 + $1,439.39X
    4. Regression analysis: Y = $703 + $1,442.97X

2. Total production costs assuming 400 units will be produced are calculated for each method given. Note that the equations presented previously are used for these calculations.

Account analysis

$$\begin{aligned} Y &= \$7{,}000 + (\$1{,}428.57 \times 400 \text{ units}) \\ Y &= \$7{,}000 + \$571{,}428 \\ Y &= \$578{,}428 \end{aligned}$$

High-low method

$$\begin{aligned} Y &= \$25{,}000 + (\$1{,}500 \times 400 \text{ units}) \\ Y &= \$25{,}000 + \$600{,}000 \\ Y &= \$625{,}000 \end{aligned}$$

Scattergraph method

$$\begin{aligned} Y &= \$5{,}000 + (\$1{,}439.39 \times 400 \text{ units}) \\ Y &= \$5{,}000 + \$575{,}756 \\ Y &= \$580{,}756 \end{aligned}$$

Regression analysis

$$\begin{aligned} Y &= \$703 + (\$1{,}442.97 \times 400 \text{ units}) \\ Y &= \$703 + \$577{,}188 \\ Y &= \$577{,}891 \end{aligned}$$

The account analysis ($578,428), scattergraph method ($580,756), and regression analysis ($577,891) all yield similar estimated production costs. The high-low method varies significantly from the other three approaches, likely because only two data points are used to estimate unit variable cost and total fixed costs.

5.3 The Contribution Margin Income Statement

LEARNING OBJECTIVE

1. Prepare a contribution margin income statement.

After further work with her staff, Susan was able to break down the selling and administrative costs into their variable and fixed components. (This process is the same as the one we discussed earlier for production costs.) Susan then established the cost equations shown in Table 5.5 "Cost Equations for Bikes Unlimited".

Table 5.5 Cost Equations for Bikes Unlimited

Production costs	Y = $43,276 + $53.42X
Selling and administrative costs	Y = $110,000 + $9.00X

Question: The challenge now is to organize this information in a way that is helpful to management—specifically, to Eric Mendez. The traditional income statement format used for external financial reporting simply breaks costs down by functional area: cost of goods sold and selling and administrative costs. It does not show fixed and variable costs. Panel A of Figure 5.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited" illustrates the traditional format. (We defer consideration of income taxes to the end of Chapter 6 "How Is Cost-Volume-Profit Analysis Used for Decision Making?".) How can this information be presented in an income statement that shows fixed and variable costs separately?

Answer: Another income statement format, called the **contribution margin income statement**[11], shows the fixed and variable components of cost information. This type of statement appears in panel B of Figure 5.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited". Note that operating profit is the same in both statements, but the organization of data differs. The contribution margin income statement organizes the data in a way that makes it easier for management to assess how changes in production and sales will affect operating profit. The **contribution margin**[12] represents sales revenue left over after deducting variable costs from sales. It is the amount remaining that will

11. An income statement used for internal reporting that shows fixed and variable cost information.

12. Sales revenue left over after deducting variable costs from sales.

contribute to covering fixed costs and to operating profit (hence, the name *contribution margin*).

Eric indicated that sales volume in August could increase by 20 percent over sales in June of 5,000 units, which would increase unit sales to 6,000 units [= 5,000 units + (5,000 × 20 percent)], and he asked Susan to come up with projected profit for August. Eric also mentioned that the sales price would remain the same at $100 per unit. Using this information and the cost estimate equations in Table 5.5 "Cost Equations for Bikes Unlimited", Susan prepared the contribution margin income statement in panel B of Figure 5.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited". Assume for now that 6,000 units is just within the relevant range for Bikes Unlimited. (We will discuss this assumption later in the chapter.)

Figure 5.7 *Traditional and Contribution Margin Income Statements for Bikes Unlimited*

Traditional Income Statement
(external reporting format in accordance with GAAP)

Panel A

Sales	$600,000		
Cost of goods sold	363,796		[= $43,276* + ($53.42* x 6,000 units)]
Gross margin	$236,204		
Selling and administrative costs	164,000		[= $110,000* + ($9.00* x 6,000 units)]
Operating profit	$ 72,204		

Contribution Margin Income Statement
(internal reporting format for planning and decision making)

Panel B

Sales		$600,000	
Variable costs:			
Cost of goods sold	$320,520		(= $53.42* x 6,000 units)
Selling and administrative costs	54,000		(= $9.00* x 6,000 units)
Total variable costs		374,520	
Contribution margin		225,480	
Fixed costs:			
Cost of goods sold	$43,276*		
Selling and admin.	110,000*		
Total fixed costs		153,276	
Operating profit		$ 72,204	

*From Table 5.5 "Cost Equations for Bikes Unlimited".

The contribution margin income statement shown in panel B of Figure 5.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited"

clearly indicates which costs are variable and which are fixed. Recall that the variable cost *per unit* remains constant, and variable costs *in total* change in proportion to changes in activity. Because 6,000 units are expected to be sold in August, total variable costs are calculated by multiplying 6,000 units by the cost per unit ($53.42 per unit for cost of goods sold, and $9.00 per unit for selling and administrative costs). Thus total *variable* cost of goods sold is $320,520, and total *variable* selling and administrative costs are $54,000. These two amounts are combined to calculate total variable costs of $374,520, as shown in panel B of Figure 5.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited".

The contribution margin of $225,480 represents the sales revenue left over after deducting variable costs from sales ($225,480 = $600,000 – $374,520). It is the amount remaining that will *contribute* to covering fixed costs and to operating profit.

Recall that total fixed costs remain constant regardless of the level of activity. Thus *fixed* cost of goods sold remains at $43,276, and *fixed* selling and administrative costs stay at $110,000. This holds true at both the 5,000 unit level of activity for June, and the 6,000 unit level of activity projected for August. Total fixed costs of $153,276 (= $43,276 + $110,000) are deducted from the contribution margin to calculate operating profit of $72,204.

Armed with this information, Susan meets with Eric the next day. Refer to panel B of Figure 5.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited" as you read Susan's comments about the contribution margin income statement.

Susan:	*Eric, I have some numbers for you. My projection for August is complete, and I expect profit to be approximately $72,000 if sales volume increases 20 percent.*
Eric:	*Excellent! You were correct in figuring that profit would increase at a higher rate than sales because of our fixed costs.*
Susan:	*Here's a copy of our projected income for August. This income statement format provides the variable and fixed costs. As you can see, our monthly fixed costs total approximately $153,000. Now that we have this information, we can easily make projections for different scenarios.*
Eric:	*This will be very helpful in making projections for future months. I'll take your August projections to the management group this afternoon. Thanks for your help!*

Business in Action 5.3

Source: http://commons.wikimedia.org/wiki/File:LowesMeyerlandHoustonTX.jpg

Costs at **Lowe's Companies, Inc.**

Lowe's is the world's second largest home improvement retailer with more than 1,700 stores in the United States, Canada, and Mexico. The company has 234,000 employees. The following financial information is from **Lowe's** income statement for the year ended January 28, 2011 (amounts are in millions). Which of the company's costs are likely to be variable?

Net sales		$48,815
Cost of sales		31,663
Gross margin		17,152
Selling, general and administrative	$12,006	
Depreciation	1,586	
Other costs	332	
Total operating expenses		13,924
Pre-tax Operating income		$ 3,228

Variable costs probably include cost of sales (the cost of goods sold) and a portion of selling and general and administrative costs (e.g., the cost of hourly labor). Cost of sales alone represents 65 percent of net sales (rounded). Retail companies like **Lowe's** tend to have higher variable costs than manufacturing companies like **General Motors** and **Boeing**.

Source: **Lowe's** Web site (http://www.lowes.com).

KEY TAKEAWAY

- The contribution margin income statement shows fixed and variable components of cost information. Revenue minus variable costs equals the contribution margin. The contribution margin minus fixed costs equals operating profit. This statement provides a clearer picture of which costs change and which costs remain the same with changes in levels of activity.

REVIEW PROBLEM 5.7

Last month, Alta Production, Inc., sold its product for $2,500 per unit. Fixed production costs were $3,000, and variable production costs amounted to $1,400 per unit. Fixed selling and administrative costs totaled $50,000, and variable selling and administrative costs amounted to $200 per unit. Alta Production produced and sold 400 units last month.

Prepare a traditional income statement and a contribution margin income statement for Alta Production. Use Figure 5.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited" as a guide.

Solution to Review Problem 5.7

Traditional Income Statement

Sales	$1,000,000	(= $2,500 price per unit × 400 units)
Cost of goods sold	563,000	[= $3,000 + ($1,400 × 400 units)]
Gross margin	$ 437,000	
Selling and administrative costs	130,000	[= $50,000 + ($200 × 400 units)]
Operating profit	$ 307,000	

Contribution Margin Income Statement

Sales		$1,000,000	(= $2,500 price per unit* × 400 units*)
Variable costs:			
Cost of goods sold	$560,000		(= $1,400* × 400 units*)
Selling and administrative costs	80,000		(= $200* × 400 units*)
Total variable costs		640,000	
Contribution margin		360,000	
Fixed costs:			
Cost of goods sold	$ 3,000*		
Selling and administrative costs	50,000*		
Total fixed costs		53,000	
Operating profit		$ 307,000	

*Given.

5.4 The Relevant Range and Nonlinear Costs

LEARNING OBJECTIVE

1. Understand the assumptions used to estimate costs.

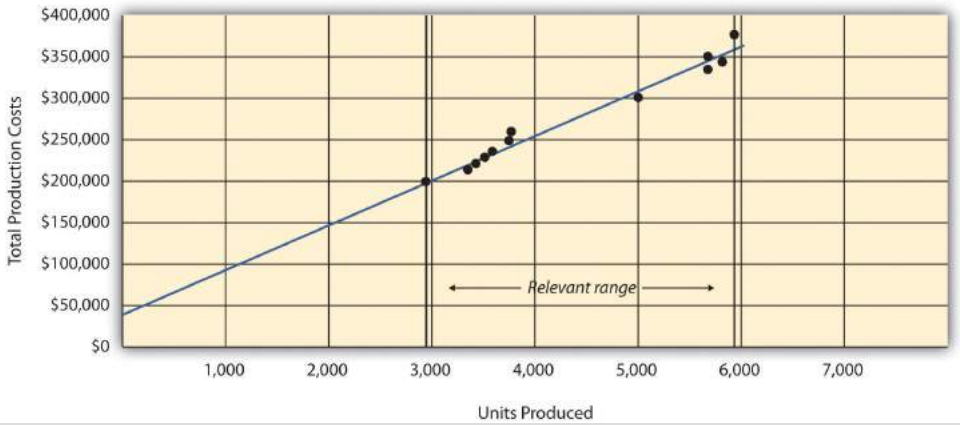
Question: Bikes Unlimited is making an important assumption in estimating fixed and variable costs. What is this important assumption and why might it be misleading?

Answer: The assumption is that total fixed costs and per unit variable costs will always be at the levels shown in Table 5.5 "Cost Equations for Bikes Unlimited" regardless of the level of production. This will not necessarily hold true under all circumstances.

For example, let's say Bikes Unlimited picks up a large contract with a customer that requires producing an additional 30,000 units per month. Do you think the cost equations in Table 5.5 "Cost Equations for Bikes Unlimited" would lead to accurate cost estimates? Probably not, because additional fixed costs would be incurred for facilities, salaried personnel, and other areas. Variable cost per unit would likely change also since additional direct labor would be required (either through overtime, which requires overtime pay, or by hiring more employees who are less efficient as they learn the process), and the volume of parts purchased from suppliers would increase, perhaps leading to reductions in per unit costs due to volume discounts for the parts.

As defined earlier, the relevant range is a term used to describe the range of activity (units of production in this example) for which cost behavior patterns are likely to be accurate. Because the historical data used to create these equations for Bikes Unlimited ranges from a low of 2,900 units in January to a high of 5,900 units in April (see Table 5.4 "Monthly Production Costs for Bikes Unlimited"), management would investigate costs further when production levels fall outside of this range. The relevant range for total production costs at Bikes Unlimited is shown in Figure 5.8 "Relevant Range for Total Production Costs at Bikes Unlimited". It is up to the cost accountant to determine the relevant range and make clear to management that estimates being made for activity outside of the relevant range must be analyzed carefully for accuracy.

Figure 5.8 *Relevant Range for Total Production Costs at Bikes Unlimited*



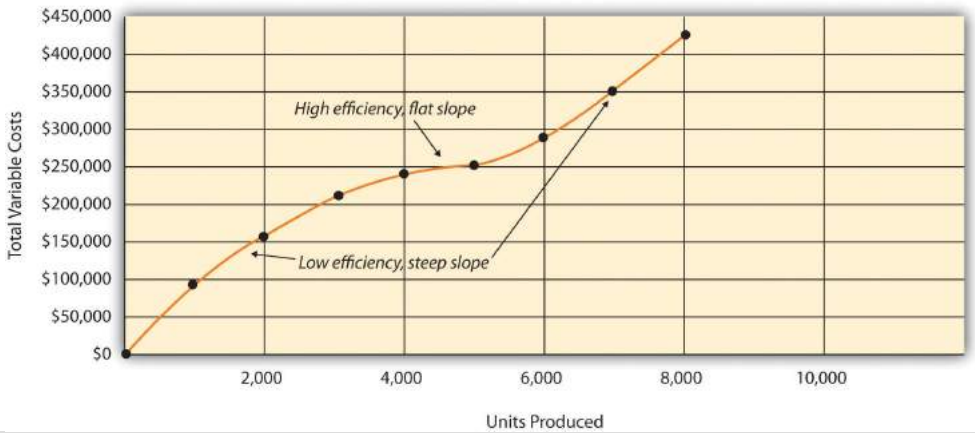
Recall that Bikes Unlimited estimated costs based on projected sales of 6,000 units for the month of August. Although this is slightly higher than the highest sales of 5,900 units in April, Susan (cost accountant) determined that Bikes Unlimited had the production capacity to produce 6,000 units without significantly affecting total fixed costs or per unit variable costs. Thus she determined that a sales level of 6,000 units was still within the relevant range. However, Susan also made Eric (CFO) aware that Bikes Unlimited was quickly approaching full capacity. If sales were expected to increase in the future, the company would have to increase capacity, and cost estimates would have to be revised.

Question: Another important assumption being made by Bikes Unlimited is that all costs behave in a linear manner. Variable, fixed, and mixed costs are all described and shown as a straight line. However, many costs are not linear and often take on a nonlinear pattern. Why do some costs behave in a nonlinear way?

Answer: Assume the pattern shown in Figure 5.9 "Nonlinear Variable Costs" is for total variable production costs. Consider this: Have you ever worked a job where you were very slow at first but improved rapidly with experience? If a company produces just a few units each month, workers (direct labor) do not gain the experience needed to work efficiently and may waste time and materials. This has the effect of driving up the per unit variable cost. Recall that the slope of the line represents the unit cost; thus, when the unit cost increases, so does the slope. If the company produces more units each month, workers gain experience resulting in

improved efficiency, and the per unit cost decreases (both in materials and labor). This causes the total cost line to flatten out a bit as the slope decreases. This is fine until the company starts to reach its limit in how much it can produce (called *capacity*). Now the company must hire additional inexperienced employees or pay its current employees overtime, which once again drives up the cost per unit. Thus the slope begins to increase.

Figure 5.9 Nonlinear Variable Costs



Although this is probably a more accurate description of how variable costs actually behave for most companies, it is much simpler to describe and estimate costs if you assume they are linear. As long as the relevant range is clearly identified, most companies can reasonably use the linearity assumption to estimate costs.

KEY TAKEAWAY

- Two important assumptions must be considered when estimating costs using the methods described in this chapter.

  1. When costs are estimated for a specific level of activity, the assumption is that the activity level is within the relevant range.
  2. Costs are estimated assuming that they are linear.

  Both assumptions are reasonable as long as the relevant range is clearly identified, and the linearity assumption does not significantly distort the resulting cost estimate.

REVIEW PROBLEM 5.8

1. Using the data in Note 5.21 "Review Problem 5.5", identify the relevant range.
2. Why is it important to determine the relevant range?

Solution to Review Problem 5.8

1. The relevant range, the range of activity for which cost estimates are more likely to be accurate, is from 150 units (lowest activity level) to 450 units of production (highest activity level).
2. Identifying the relevant range when estimating costs is important because if a cost estimate is being made for activity outside of the relevant range, total fixed costs and per unit variable costs may be different from those described in the cost equation. For example, if production is doubled, additional factory space may be needed, resulting in higher fixed costs.

5.5 Appendix: Performing Regression Analysis with Excel

LEARNING OBJECTIVE

1. Perform regression analysis using Excel.

Question: Regression analysis is often performed to estimate fixed and variable costs. Many different software packages have the capability of performing regression analysis, including Excel. This appendix provides a basic illustration of how to use Excel to perform regression analysis. Statistics courses cover this topic in more depth. How is regression analysis used to estimate fixed and variable costs?

Answer: As noted in the chapter, regression analysis uses a series of mathematical equations to find the best possible fit of the line to the data points. For the purposes of this chapter, the end goal of regression analysis is to estimate fixed and variable costs, which are described in the equation form of $Y = f + vX$. Recall that the following Excel output was provided earlier in the chapter based on the data presented in Table 5.4 "Monthly Production Costs for Bikes Unlimited" for Bikes Unlimited.

	Coefficients
y-intercept	43,276
x variable	53.42

The resulting equation to estimate production costs is Y = $43,276 + $53.42X. We now describe the steps to be performed in Excel to get this equation.

Step 1. Confirm that the Data Analysis package is installed.

Go to the *Data* tab on the top menu bar and look for *Data Analysis*. If *Data Analysis* appears, you are ready to perform regression analysis. If *Data Analysis* does not appear, go to the help button (denoted as a question mark in the upper right-hand

corner of the screen) and type *Analysis ToolPak*. Look for the *Load the Analysis ToolPak* option and follow the instructions given.

Step 2. Enter the data in the spreadsheet.

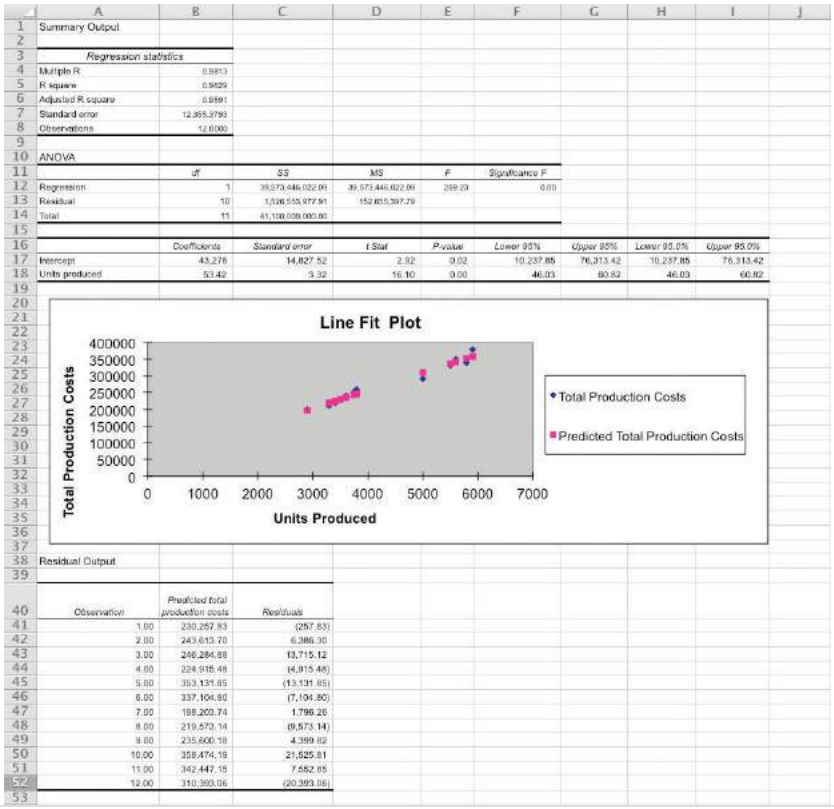
Using a new Excel spreadsheet, enter the data points in two columns. The monthly data in Table 5.4 "Monthly Production Costs for Bikes Unlimited" includes *Total Production Costs* and *Units Produced*. Thus use one column (column A) to enter Total Production Costs data and another column (column B) to enter Units Produced data.

	A	B	C	D
1		**Total Production Costs**	**Units Produced**	
2		$ 230,000	3,500	
3		$ 250,000	3,750	
4		$ 260,000	3,800	
5		$ 220,000	3,400	
6		$ 340,000	5,800	
7		$ 330,000	5,500	
8		$ 200,000	2,900	
9		$ 210,000	3,300	
10		$ 240,000	3,600	
11		$ 380,000	5,900	
12		$ 350,000	5,600	
13		$ 290,000	5,000	
14				

Step 3. Run the regression analysis.

Using the same spreadsheet set up in step 2, select *Data*, *Data Analysis*, and *Regression.* A box appears that requires the input of several items needed to perform regression. *Input Y Range* requires that you highlight the *y*-axis data, including the

heading (cells B1 through B13 in the example shown in step 2). *Input X Range* requires that you highlight the *x*-axis data, including the heading (cells C1 through C13 in the example shown in step 2). Check the *Labels* box; this indicates that the top of each column has a heading (B1 and C1). Select *New Workbook*; this will put the regression results in a new workbook. Lastly, check the *Line Fit Plots* box, then select *OK*. The result is as follows (note that we made a few minor format changes to allow for a better presentation of the data).



Step 4. Analyze the output.

Here, we discuss key items shown in the regression output provided in step 3.

- **Cost Equation:** The output shows that estimated fixed costs (shown as the *Intercept* coefficient in cell B17) total $43,276, and the estimated variable cost per unit (shown as the *Units Produced* coefficient in B18) is $53.42. Thus the cost equation is:

Y = $43,276 + $53.42X

or

Total Production Costs = $43,276 + ($53.42 × Units Produced)

- **Line Fit Plot and R-Squared:** The plot shows that actual *total production costs* are very close to *predicted total production costs* calculated using the cost equation. Thus the cost equation created from the regression analysis is likely to be useful in predicting total production costs. Another way to assess the accuracy of the regression output is to review the *R-squared* statistic shown in cell B5. **R-squared**[13] measures the percent of the variance in the dependent variable (*total production costs*, in this example) explained by the independent variable (*units produced*, in this example). According to the output, 96.29 percent of the variance in total production costs is explained by the level of units produced—further evidence that the regression results will be useful in predicting total production costs.

The discussion of regression analysis in this chapter is meant to serve as an introduction to the topic. To further enhance your knowledge of regression analysis and to provide for a more thorough analysis of the data, you should pursue the topic in an introductory statistics course.

KEY TAKEAWAY

- Software applications, such as Excel, can use regression analysis to estimate fixed and variable costs.
  - Once the data analysis package is installed, historical data are entered in the spreadsheet, and the regression analysis is run.
  - The resulting data are used to determine the cost equation, which includes estimated fixed and variable costs.

  The line fit plot and R-squared statistic are used to assess the usefulness of the cost equation in estimating costs.

13. Measures the percent of the variance in the dependent variable explained by the independent variable.

REVIEW PROBLEM 5.9

Refer to the monthly production cost data for Alta Production, Inc., in Note 5.21 "Review Problem 5.5". Use the four steps of regression analysis described in this appendix to estimate total fixed costs and variable cost per unit. State your results in the equation form $Y = f + vX$.

Solution to Review Problem 5.9

Regression analysis performed using Excel results in the following output:

	Coefficients
y-intercept	703
x variable	1,442.97

Thus the total cost equation is:

$Y = \$703 + \$1{,}442.97X$

END-OF-CHAPTER EXERCISES

Questions

1. What is a fixed cost? Provide two examples.
2. What is the difference between a committed fixed cost and a discretionary fixed cost? Provide examples of each.
3. What is a variable cost? Provide two examples.
4. What is a mixed cost? Provide two examples.
5. Describe the variables in the cost equation $Y = f + vX$.
6. How is the cost equation $Y = f + vX$ used to estimate future costs?
7. Why is it important to identify how costs behave with changes in activity?
8. Review Note 5.11 "Business in Action 5.2" Why was the school district's administration surprised to find out that cost savings from closing a school would be much lower than initially anticipated?
9. Explain how account analysis is used to estimate costs.
10. Describe the four steps of the high-low method and how these steps are used to estimate costs.
11. Why might the high-low method lead to inaccurate results?
12. Describe the five steps of the scattergraph method and how these steps are used to estimate costs.
13. How can the scattergraph method be used to identify unusual data points?
14. Describe how regression analysis is used to estimate costs.
15. How does the contribution margin income statement differ from the traditional income statement?
16. Review Note 5.27 "Business in Action 5.3" Which costs at **Lowe's** are likely to be variable costs?
17. Describe the term *relevant range*. Why is it important to stay within the relevant range when estimating costs?
18. Explain how some costs can behave in a nonlinear way.

Brief Exercises

19. **Planning at Bikes Unlimited.** Refer to the dialogue at Bikes Unlimited presented at the beginning of the chapter. What is the first step to be taken by Susan and her accounting staff to help in estimating profit for August?

20. **Identifying Cost Behavior.** Vasquez Incorporated is trying to identify the cost behavior of the three costs that follow. Cost information is provided for three months.

		Cost A		Cost B		Cost C	
Month	**Units Produced**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**
1	1,500	$1,500	_____	$4,500	_____	$3,000	_____
2	3,000	1,500	_____	5,250	_____	6,000	_____
3	750	1,500	_____	3,750	_____	1,500	_____

Required:

a. Calculate the cost per unit, and then identify how the cost behaves for each of the three costs (fixed, variable, or mixed). Explain the reasoning for your answers.
b. How does identifying cost behavior patterns help managers?

21. **Account Analysis.** Cordova Company would like to estimate production costs on an annual basis. Costs incurred for direct materials and direct labor are variable costs. The accounting records indicate that the following production costs were incurred last year for 50,000 units.

Direct materials	$100,000
Direct labor	$215,000
Manufacturing overhead	$300,000 (20 percent fixed; 80 percent variable)

Required:

Use account analysis to estimate the fixed costs per year, and the variable cost per unit.

22. **High-Low Method.** The city of Rockville reported the following annual cost data for maintenance work performed on its fleet of trucks.

Reporting Period (Year)	Total Costs	Level of Activity (Miles Driven)
Year 1	$ 750,000	225,000
Year 2	850,000	240,000
Year 3	1,100,000	430,000
Year 4	1,150,000	454,000
Year 5	1,250,000	560,000
Year 6	1,550,000	710,000

Required:

a. Use the four steps of the high-low method to estimate total fixed costs per year and the variable cost per mile. State your results in the cost equation form $Y = f + vX$.
b. What would the estimated costs be if the trucks drove 500,000 miles in year 7?

23. **Scattergraph Method.** Refer to the data in Brief Exercise 22 for the city of Rockville.

Required:

a. Use the five steps of the scattergraph method to estimate total fixed costs per year and the variable cost per mile. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. What would the estimated costs be if the trucks drove 500,000 miles in year 7?

24. **Regression Analysis.** Regression analysis was run using the data in Brief Exercise 22 for the city of Rockville. The output is shown here:

	Coefficients
y-intercept	441,013
x variable	1.53

Required:

a. Use the regression output to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
b. What would the city of Rockville's estimated costs be if its trucks drove 500,000 miles in year 7?

25. **Contribution Margin Income Statement.** Last year Pod Products, Inc., sold its product for $250 per unit. Production costs totaled $40,000 (25 percent fixed, 75 percent variable). Selling and administrative costs totaled $150,000 (10 percent fixed, 90 percent variable). Pod Products produced and sold 1,000 units last year.

    Required:

    Prepare a contribution margin income statement for Pod Products, Inc.

26. **Relevant Range.** Jersey Company produces jerseys for athletic teams, and typically produces between 1,000 and 5,000 jerseys annually. The accountant is asked to estimate production costs for this coming year assuming 9,000 jerseys will be produced.

    Required:

    What is meant by the term *relevant range*, and why is the relevant range important for estimating production costs for this coming year at Jersey Company?

Exercises: Set A

27. **Identifying Cost Behavior.** Zhang Corporation is trying to identify the cost behavior of the three costs shown. Cost information is provided for six months.

		Cost 1		Cost 2		Cost 3	
Month	Units Produced	Total Costs	Cost per Unit	Total Costs	Cost per Unit	Total Costs	Cost per Unit
1	18,000	$36,000	_____	$19,800	_____	$5,000	_____
2	16,000	32,000	_____	19,200	_____	5,000	_____
3	14,000	28,000	_____	18,200	_____	5,000	_____
4	12,000	24,000	_____	16,800	_____	5,000	_____
5	10,000	20,000	_____	14,500	_____	5,000	_____
6	8,000	16,000	_____	12,000	_____	5,000	_____

Required:

a. Calculate the cost per unit, and then identify how the cost behaves (fixed, variable, or mixed) for each of the three costs. Explain the reasoning behind your answers.
b. Why is it important to identify how costs behave with changes in activity?

28. **Account Analysis.** Baker Advertising Incorporated would like to estimate costs associated with its clients on an annual basis. Assume costs for supplies and advertising staff are variable costs. The accounting records indicate the following costs were incurred last year for 100 clients:

Supplies	$ 20,000
Advertising staff wages (hourly employees)	$170,000
Manager salary	$ 90,000
Building rent	$ 56,000

Required:

a. Use account analysis to estimate total fixed costs per year, and the variable cost per unit. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.

b. Estimate the total costs for this coming year assuming 120 clients will be served.

29. **High-Low Method.** Castanza Company produces computer printers. Management wants to estimate the cost of production equipment used to produce printers. The company reported the following monthly cost data related to production equipment:

Reporting Period (Month)	Total Costs	Machine Hours
January	$ 920,000	45,000
February	600,000	25,000
March	500,000	20,000
April	1,100,000	90,000
May	1,140,000	95,000
June	620,000	30,000
July	880,000	38,000
August	910,000	48,000
September	1,060,000	78,000
October	960,000	51,000
November	1,400,000	96,000
December	980,000	54,000

Required:

a. Use the four steps of the high-low method to estimate total fixed costs per month and the variable cost per machine hour. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. What would Castanza Company's estimated costs be if it used 50,000 machine hours next month?
c. What would Castanza Company's estimated costs be if it used 15,000 machine hours next month? Why should you feel uncomfortable estimating costs for 15,000 machine hours?

30. **Scattergraph Method.** Castanza Company produces computer printers. Management wants to estimate the cost of production equipment used to produce printers. The company reported the following monthly cost data related to production equipment (this is the same data as the previous exercise):

Reporting Period (Month)	Costs	Machine Hours
January	$ 920,000	45,000
February	600,000	25,000
March	500,000	20,000
April	1,100,000	90,000
May	1,140,000	95,000
June	620,000	30,000
July	880,000	38,000
August	910,000	48,000
September	1,060,000	78,000
October	960,000	51,000
November	1,400,000	96,000
December	980,000	54,000

Required:

a. Use the five steps of the scattergraph method to estimate total fixed costs per month and the variable cost per machine hour. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. What would Castanza Company's estimated costs be if it used 50,000 machine hours next month?
c. What would Castanza Company's estimated costs be if it used 15,000 machine hours next month?

31. **Regression Analysis.** Regression analysis was run for Castanza Company resulting in the following output (this is based on the same data as the previous two exercises):

	Coefficients
y-intercept	445,639
x variable	8.54

Required:

a. Use the regression output given to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
b. What would Castanza Company's estimated costs be if it used 50,000 machine hours next month?
c. What would Castanza Company's estimated costs be if it used 15,000 machine hours next month?

32. **Contribution Margin Income Statement.** Last month Kumar Production Company sold its product for $60 per unit. Fixed production costs were $40,000, and variable production costs amounted to $15 per unit. Fixed selling and administrative costs totaled $26,000, and variable selling and administrative costs amounted to $5 per unit. Kumar Production produced and sold 7,000 units last month.

Required:

a. Prepare a traditional income statement for Kumar Production Company.
b. Prepare a contribution margin income statement for Kumar Production Company.
c. Why do companies use the contribution margin income statement format?

33. **Regression Analysis Using Excel (Appendix).** Walleye Company produces fishing reels. Management wants to estimate the cost of production equipment used to produce the reels. The company reported the following monthly cost data related to production equipment:

Reporting Period (Month)	Total Costs	Machine Hours
January	$1,104,000	54,000

February	720,000	30,000
March	600,000	24,000
April	1,320,000	108,000
May	1,368,000	114,000
June	744,000	36,000
July	1,056,000	45,600
August	1,092,000	57,600
September	1,272,000	93,600
October	1,152,000	61,200
November	1,680,000	115,200
December	1,176,000	64,800

Required:

a. Use Excel to perform regression analysis. Provide a printout of the results.
b. Use the regression output to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
c. What would Walleye Company's estimated costs be if it used 90,000 machine hours this month?

Exercises: Set B

34. **Identifying Cost Behavior.** Ivanov, Inc., is trying to identify the cost behavior of the three costs shown. Cost information is provided for six months.

		Cost 1		Cost 2		Cost 3	
Month	**Units Produced**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**
1	8,000	$10,000	_____	$24,000	_____	$32,000	_____
2	10,000	10,000	_____	29,000	_____	40,000	_____

		Cost 1		Cost 2		Cost 3	
3	12,000	10,000	_____	33,600	_____	48,000	_____
4	14,000	10,000	_____	36,400	_____	56,000	_____
5	16,000	10,000	_____	38,400	_____	64,000	_____
6	18,000	10,000	_____	39,600	_____	72,000	_____

Required:

a. Calculate the cost per unit, and then identify how the cost behaves (fixed, variable, or mixed) for each of the three costs. Explain the reasoning behind your answers.
b. Why is it important to identify how costs behave with changes in activity?

35. **Account Analysis.** Swim-Safe Company hires several instructors who provide weekly one-hour private swim lessons to individuals. The company would like to estimate costs associated with its swim lessons on a weekly basis. Assume costs for towels, snacks, drinks, and instructor wages are variable costs. The accounting records indicate the following costs were incurred last week for 250 customer lessons:

Towels, snacks, drinks	$1,250
Instructor wages (hourly employees)	$3,000
Manager (owner) salary	$1,500
Pool rental	$2,000

Required:

a. Use account analysis to estimate total fixed costs per week, and the variable cost per lesson. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. Estimate the total costs for this coming week assuming 220 lessons will be provided.

36. **High-Low Method Quality Tools.** Quality Tools Incorporated would like to estimate costs associated with its sales personnel. Salespeople are paid a salary plus commission. Commission rates vary among products and are based on sales dollars. The company reported the following monthly cost data related to sales personnel:

Reporting Period (Month)	Total Costs	Sales Amount
January	$710,000	$13,800,000
February	695,000	13,600,000
March	765,000	15,100,000
April	650,000	12,000,000
May	775,000	15,500,000
June	750,000	14,700,000
July	715,000	14,500,000
August	680,000	13,100,000
September	830,000	16,500,000
October	815,000	16,000,000
November	800,000	15,600,000
December	690,000	13,200,000

Required:

a. Use the four steps of the high-low method to estimate total fixed costs per month and the variable cost per sales dollar. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. What would Quality Tools' estimated costs be if it had sales of $12,500,000 next month?
c. What would Quality Tools' estimated costs be if it had sales of $20,000,000 next month? Why should you feel uncomfortable estimating costs for $20,000,000 in sales?

37. **Scattergraph Method.** Quality Tools Incorporated would like to estimate costs associated with its sales personnel. Salespeople

are paid a salary plus commission. Commission rates vary among products and are based on sales dollars. The company reported the following monthly cost data related to sales personnel (this is the same data as the previous exercise):

Reporting Period (Month)	Total Costs	Sales Amount
January	$710,000	$13,800,000
February	695,000	13,600,000
March	765,000	15,100,000
April	650,000	12,000,000
May	775,000	15,500,000
June	750,000	14,700,000
July	715,000	14,500,000
August	680,000	13,100,000
September	830,000	16,500,000
October	815,000	16,000,000
November	800,000	15,600,000
December	690,000	13,200,000

Required:

a. Use the five steps of the scattergraph method to estimate total fixed costs per month and the variable cost per sales dollar. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. What would Quality Tools' estimated costs be if it had sales of $12,500,000 next month?
c. What would Quality Tools' estimated costs be if it had sales of $20,000,000 next month?

38. **Regression Analysis.** Regression analysis was run for Quality Tools Incorporated resulting in the following output (this is based on the same data as the previous two exercises):

	Coefficients

y-intercept	129,188
x variable	0.04

Required:

a. Use the regression output given to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
b. What would Quality Tools' estimated costs be if it had sales of $12,500,000 next month?
c. What would Quality Tools' estimated costs be if it had sales of $20,000,000 next month?

39. **Contribution Margin Income Statement, Service Company.** Last month Seafood Grill had total sales of $200,000. Food preparation and service costs totaled $90,000 (20 percent fixed, 80 percent variable). Selling and administrative costs totaled $30,000 (70 percent fixed, 30 percent variable).

Required:

a. Prepare a traditional income statement for Seafood Grill.
b. Prepare a contribution margin income statement for Seafood Grill.
c. Why do companies use the contribution margin income statement format?

40. **Regression Analysis Using Excel (Appendix).** Cain Company produces calculators. Management wants to estimate the cost of production equipment used to produce the calculators. The company reported the following monthly cost data related to production equipment:

Reporting Period (Month)	Total Costs	Machine Hours
January	$1,250,000	59,000
February	990,000	33,000
March	850,000	28,000
April	1,580,000	120,000

May	1,670,000	126,000
June	1,050,000	40,000
July	1,360,000	51,000
August	1,400,000	70,000
September	1,550,000	105,000
October	1,500,000	67,000
November	1,860,000	128,000
December	1,480,000	71,000

Required:

a. Use Excel to perform regression analysis. Provide a printout of the results.
b. Use the regression output to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
c. What would Cain Company's estimated costs be if it used 110,000 machine hours this month?

Problems

41. **Cost Behavior.** Assume you are a consultant performing work for two different companies. Each company has asked you to help them identify the behavior of certain costs.

Required:

a. Identify each of the following costs for Hwang Company, a producer of ski boats, as variable (V), fixed (F), or mixed (M):

1. _____Salary of production manager
2. _____Materials required for production
3. _____Monthly rent on factory building
4. _____Hourly wages for assembly workers

5. _____Straight-line depreciation for factory equipment
6. _____Annual insurance on factory building
7. _____Invoices sent to customers
8. _____Salaries and commissions of salespeople
9. _____Salary of chief executive officer
10. _____Company cell phones with first 50 hours free, then 10 cents per minute

b. Identify each of the following costs for Rainier Camping Products, a maker of backpacks, as variable (V), fixed (F), or mixed (M):

1. _____Hourly wages for assembly workers
2. _____Fabric required for production
3. _____Straight-line depreciation on factory building
4. _____Salaries and commissions of salespeople
5. _____Lease payments for factory equipment
6. _____Company cell phones with first 80 hours free, then 8 cents per minute
7. _____Invoices sent to customers
8. _____Salary of production manager
9. _____Salary of controller (accounting)
10. _____Electricity for factory building

c. How might the managers of these companies use the cost behavior information requested?

42. **Account Analysis and Contribution Margin Income Statement.** Madden Company would like to estimate costs associated with its production of football helmets on a monthly basis. The accounting records indicate the following production costs were incurred last month for 4,000 helmets.

Assembly workers' labor (hourly)	$70,000
Factory rent	3,000
Plant manager's salary	5,000
Supplies	20,000

Factory insurance	12,000
Materials required for production	20,000
Maintenance of production equipment (based on usage)	18,000

Required:

a. Use account analysis to estimate total fixed costs per month and the variable cost per unit. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. Estimate total production costs assuming 5,000 helmets will be produced and sold.
c. Prepare a contribution margin income statement assuming 5,000 helmets will be produced, and each helmet will be sold for $70. Fixed selling and administrative costs total $10,000. Variable selling and administrative costs are $8 per unit.

43. **High-Low, Scattergraph, and Regression Analysis; Manufacturing Company.** Woodworks, Inc., produces cabinet doors. Manufacturing overhead costs tend to fluctuate from one month to the next, and management would like to accurately estimate these costs for planning and decision-making purposes.

The accounting staff at Woodworks recommends that costs be broken down into fixed and variable components. Because the production process is highly automated, most of the manufacturing overhead costs are related to machinery and equipment. The accounting staff believes the best starting point is to review historical data for costs and machine hours:

Reporting Period (Month)	Total Costs	Machine Hours
January	$278,000	1,550
February	280,000	1,570
March	266,000	1,115
April	290,000	1,700
May	262,000	1,110

June	269,000	1,225
July	275,000	1,335
August	286,000	1,660
September	250,000	1,000
October	253,000	1,020
November	260,000	1,025
December	281,000	1,600

These data were entered into a computer regression program, which produced the following output:

	Coefficients
y-intercept	210,766
x variable	45.31

Required:

a. Use the four steps of the high-low method to estimate total fixed costs per month and the variable cost per machine hour. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. Use the five steps of the scattergraph method to estimate total fixed costs per month, and the variable cost per machine hour. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
c. Use the regression output given to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
d. Use the results of the high-low method (a), scattergraph method (b), and regression analysis (c), to estimate costs for 1,500 machine hours. (You will have three different answers—one for each method.) Which approach do you think is most accurate and why?
e. Management likes the regression analysis approach and asks you to estimate costs for 5,000 machine hours using this approach (the company plans to expand by opening another facility and hiring additional employees). Calculate your

estimate, and explain why your estimate might be misleading.

44. **High-Low, Scattergraph, and Regression Analysis; Service Company.** Sanchez Accounting Company prepares tax returns for individuals. Marie Sanchez, the owner, would like an accurate estimate of the company's costs for planning and decision-making purposes. When Marie asks you to devise a way to estimate costs on a monthly basis, you recall the importance of breaking costs into fixed and variable components. Because the company's costs are driven primarily by the number of tax returns prepared, you decide to use historical data for costs and tax returns prepared:

Reporting Period (Month)	Total Costs	Returns Prepared
January	$157,000	315
February	145,000	300
March	167,500	375
April	163,000	325
May	120,000	250
June	112,000	210
July	138,000	280
August	100,000	190
September	108,000	205
October	115,000	245
November	136,000	265
December	126,000	255

You enter these data into a computer regression program and get the following results:

	Coefficients
y-intercept	24,626
x variable	401.86

Required:

a. Use the four steps of the high-low method to estimate total fixed costs per month and the variable cost per tax return prepared. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
b. Use the five steps of the scattergraph method to estimate total fixed costs per month and the variable cost per tax return prepared. State your results in the cost equation form $Y = f + vX$ by filling in the dollar amounts for f and v.
c. Use the regression output given to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
d. Use the results of the high-low method (a), scattergraph method (b), and regression analysis (c) to estimate costs for 290 tax returns. (You will have three different answers—one for each method.) Which approach do you think is most accurate, and why?
e. Marie likes the regression analysis approach and asks you to estimate costs for 800 tax returns using this approach (she plans to expand by opening another office and hiring additional employees). Calculate your estimate, and explain why your estimate might be misleading.

45. **High-Low, Scattergraph, Regression Analysis, and Contribution Margin Income Statement.** Eye Care, Inc., provides vision correction surgery for its patients. You are the accountant for Eye Care, and management has asked you to devise a way of accurately estimating company costs for planning and decision-making purposes. You believe that reviewing historical data for costs and number of surgeries is the best starting point. These data are as follows:

Reporting Period (Month)	Total Costs	Number of Surgeries
January	$208,000	54
February	205,000	52
March	217,000	55
April	200,000	50

May	232,000	62
June	230,000	60
July	226,000	57
August	235,000	63
September	252,000	71
October	250,000	70
November	245,000	66
December	244,000	65

You enter these data into a computer regression program and get the following results:

	Coefficients
y-intercept	75,403
x variable	2,536.77

Required:

a. Use the four steps of the high-low method to estimate total fixed costs per month, and the variable cost per surgery. State your results in the cost equation form Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
b. Use the five steps of the scattergraph method to estimate total fixed costs per month, and the variable cost per surgery. State your results in the cost equation form Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
c. Use the regression output given to develop the cost equation Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
d. Use the results of the high-low method (a), scattergraph method (b), and regression analysis (c), to estimate costs for 70 surgeries. (You will have three different answers—one for each method.) Which approach do you think is most accurate and why?
e. Assume Eye Care charges $4,000 for each surgery performed. Use the regression analysis cost information (for 70 surgeries) to prepare a contribution margin income

statement. (Hint: You will only have one line item for variable costs and one line item for fixed costs.)

46. **Regression Analysis Using Excel (Appendix).** Metal Products, Inc., produces metal storage sheds. The company's manufacturing overhead costs tend to fluctuate from one month to the next, and management would like an accurate estimate of these costs for planning and decision-making purposes.

    The company's accounting staff recommends that costs be broken down into fixed and variable components. Because the production process is highly automated, most of the manufacturing overhead costs are related to machinery and equipment. The accounting staff agrees that reviewing historical data for costs and machine hours is the best starting point. Data for the past 18 months follow.

Reporting Period (Month)	Total Overhead Costs	Total Machine Hours
January	$695,000	3,875
February	700,000	3,925
March	665,000	2,788
April	725,000	4,250
May	655,000	2,775
June	672,500	3,063
July	687,500	3,338
August	715,000	4,150
September	625,000	2,500
October	632,500	2,550
November	650,000	2,563
December	702,500	4,000
January	730,000	4,025
February	735,000	4,088
March	697,500	2,900

April	762,500	4,425
May	687,500	2,888
June	705,000	3,188

Required:

a. Use Excel to perform regression analysis. Provide a printout of the results.
b. Use the regression output given to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
c. Use the results of the regression analysis to estimate costs for 3,750 machine hours.
d. Management is considering plans to expand by opening several new facilities and asks you to estimate costs for 22,000 machine hours. Calculate your estimate, and explain why this estimate may be misleading.
e. What can be done to improve the estimate made in part d?

One Step Further: Skill-Building Cases

47. **Internet Project: Variable and Fixed Costs.** Using the Internet, find the annual report of one retail company and one manufacturing company. Print out each company's income statement. (Hint: The income statement is often called the *statement of operations* or *statement of earnings*.)

Required:

a. Review each income statement, and provide an analysis of which operating costs are likely to be variable and which are likely to be fixed. Include copies of both income statements when submitting your answer.
b. How would you expect a retail company's mix of variable and fixed operating costs to differ from that of a manufacturing company?
c. How might the managers of these companies use cost behavior information?

48. **Group Activity: Identifying Variable and Fixed Costs.** To complete the following requirements, form groups of two to four students.

Required:

a. Each group should select a product that is easy to manufacture.
b. Prepare a list of materials, labor, and other resources needed to make the product.
c. Using the list prepared in requirement b, identify whether the costs associated with each item are variable, fixed, or mixed.
d. As a manager for this company, why would you want to know whether costs are variable, fixed, or mixed?

49. **Cost Behavior at** Best Buy**.** The following condensed income statement is for **Best Buy Co., Inc.**, a large retailer of consumer electronics.

Best Buy
Income Statement
for the Year Ended February 26, 2011
(in millions)

Net sales	$50,272
Cost of goods sold	37,653
Gross margin	$12,637
Selling and administrative expenses	10,523
Operating income	$ 2,114

Required:

Assume that cost of goods sold comprises only variable costs, and selling and administrative expenses are all fixed costs. Also assume that **Best Buy** expects sales to grow by 10 percent for the year ended March 3, 2012.

a. Calculate expected operating income for the year ended March 3, 2012 assuming the company is still within the relevant range of activity.
b. Calculate the expected percent increase in operating income from the year ended February 26, 2011, to the year ended March 3, 2012.
c. Why is the percent increase in operating income higher than the percent increase in sales?
d. Is the assumption that all selling and administrative expenses are fixed a reasonable assumption? Explain.

50. **Fixed Costs at** United Airlines**.** Review Note 5.4 "Business in Action 5.1".

Required:

a. What is meant by the term *fixed cost*?
b. Which costs at **United Airlines** were identified as fixed costs?
c. How might **United Airlines** reduce its fixed costs? Be specific.

Comprehensive Case

51. **Ethics: Manipulating Data to Establish a Budget (Appendix).** Healthy Bar, Inc., produces energy bars for sports enthusiasts. The company's fiscal year ends on December 31. The production manager, Jim Wallace, is establishing a cost budget for the production department for each month of this coming quarter (January through March). At the end of March, Jim will be evaluated based on his ability to meet the budget for the three months ending March 31. In fact, Jim will receive a significant bonus if actual costs are below budgeted costs for the quarter.

The production budget is typically established based on data from the last 18 months. These data are as follows:

Reporting Period (Month)	Total Overhead Costs	Total Machine Hours

July	$695,000	3,410
August	700,000	3,454
September	665,000	2,453
October	725,000	3,740
November	655,000	2,442
December	672,500	2,695
January	687,500	2,937
February	715,000	3,652
March	625,000	2,200
April	632,500	2,244
May	650,000	2,255
June	702,500	3,520
July	730,000	3,542
August	735,000	3,597
September	697,500	2,552
October	762,500	3,894
November	687,500	2,541
December	705,000	2,805

You are the accountant who assists Jim in preparing an estimate of production costs for the next three months. You intend to use regression analysis to estimate costs, as was done in the past. Jim expects that 3,100 machine hours will be used in January, 3,650 machine hours in February, and 2,850 machine hours in March.

Jim approaches you and asks that you add $100,000 to production costs for each of the past 18 months before running the regression analysis. As he puts it, “After all, management always takes my proposed budgets and reduces them by about 10 percent. This is my way of leveling the playing field!”

Required:

a. Use Excel to perform regression analysis using the historical data provided.

    1. Submit a printout of the results.
    2. Use the regression output to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
    3. Calculate estimated production costs for January, February, and March. Also provide a total for the three months.

b. Use Excel to perform regression analysis after adding $100,000 to production costs for each of the past 18 months, as Jim requested.

    1. Submit a printout of the results.
    2. Use the regression output to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
    3. Calculate estimated production costs for January, February, and March. Also provide a total for the three months.

c. Why did Jim ask you to add $100,000 to production costs for each of the past 18 months?
d. How should you handle Jim's request? (If necessary, review the presentation of ethics in Chapter 1 "What Is Managerial Accounting?" for additional information.)

Chapter 6

How Is Cost-Volume-Profit Analysis Used for Decision Making?

Recilia Vera is vice president of sales at Snowboard Company, a manufacturer of one model of snowboard. Lisa Donley is the company accountant. Recilia and Lisa are in their weekly meeting.

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Recilia:	*Lisa, I'm in the process of setting up an incentive system for my sales staff, and I'd like to get a better handle on our financial information.*
Lisa:	*No problem. How can I help?*
Recilia:	*I've reviewed our financial results for the past 12 months. It looks like we made a profit in some months, and had losses in other months. From what I can tell, we sell each snowboard for $250, our variable cost is $150 per unit, and our fixed cost is $75 per unit. It seems to me that if we sell just one snowboard each month, we should still show a profit of $25, and any additional units sold should increase total profit.*
Lisa:	*Your unit sales price of $250 and unit variable cost of $150 look accurate to me, but I'm not sure about your unit fixed cost of $75. Fixed costs total $50,000 a month regardless of the number of units we produce. Trying to express fixed costs on a per unit basis can be misleading because it depends on the number of units being produced and sold, which changes each month. I can tell you that each snowboard produced and sold provides $100 toward covering fixed costs—that is, $250, the sales price of one snowboard, minus $150 in variable cost.*
Recilia:	*The $75 per unit for fixed costs was my estimate based on last year's sales, but I get your point. As you know, I'd like to avoid having losses. Is it*

	possible to determine how many units we have to sell each month to at least cover our expenses? I'd also like to discuss what it will take to make a decent profit.
Lisa:	*We can certainly calculate how many units have to be sold to cover expenses, and I'd be glad to discuss how many units must be sold to make a decent profit.*
Recilia:	*Excellent! Let's meet again next week to go through this in detail.*

Answering questions regarding break-even and target profit points requires an understanding of the relationship among costs, volume, and profit (often called *CVP*). This chapter discusses **cost-volume-profit analysis**[1], which identifies how changes in key assumptions (for example, assumptions related to cost, volume, or profit) may impact financial projections. We address Recilia's questions in the next section.

1. The process of analyzing how changes in key assumptions (e.g., assumptions related to cost, volume, or profit) may impact financial projections.

6.1 Cost-Volume-Profit Analysis for Single-Product Companies

LEARNING OBJECTIVE

1. Perform cost-volume-profit analysis for single-product companies.

Question: The **profit equation**[2] *shows that profit equals total revenues minus total variable costs and total fixed costs. This profit equation is used extensively in cost-volume-profit (CVP) analysis, and the information in the profit equation is typically presented in the form of a contribution margin income statement (first introduced in Chapter 5 "How Do Organizations Identify Cost Behavior Patterns?"). What is the relationship between the profit equation and the contribution margin income statement?*

Answer: Recall that the contribution margin income statement starts with sales, deducts variable costs to determine the contribution margin, and deducts fixed costs to arrive at profit. We use the term "variable cost" because it describes a cost that *varies in total* with changes in volume of activity. We use the term "fixed cost" because it describes a cost that is *fixed (does not change) in total* with changes in volume of activity.

To allow for a mathematical approach to performing CVP analysis, the contribution margin income statement is converted to an equation using the following variables:

2. Profit equals total revenues minus total variable costs minus total fixed costs.

Key Equation

S = Selling price *per unit*

V = Variable cost *per unit*

F = *Total* fixed costs

Q = Quantity of units produced and sold

Thus

$$\text{Profit} = \text{Total sales} - \text{Total variable costs} - \text{Total fixed costs}$$

$$\text{Profit} = (S \times Q) - (V \times Q) - F$$

Figure 6.1 "Comparison of Contribution Margin Income Statement with Profit Equation" clarifies the link between the contribution margin income statement presented in Chapter 5 "How Do Organizations Identify Cost Behavior Patterns?" and the profit equation stated previously. Study this figure carefully because you will encounter these concepts throughout the chapter.

Figure 6.1 *Comparison of Contribution Margin Income Statement with Profit Equation*

Contribution Margin Income Statement		Profit Equation
Sales	$xxx,xxx	→ S × Q
Less total variable costs	xxx,xxx	→ V × Q
Contribution margin	$xxx,xxx	
Less total fixed costs	xxx,xxx	→ F
Operating profit	$xxx,xxx	

Recall that when identifying cost behavior patterns, we assume that management is using the cost information to make short-term decisions. Variable and fixed cost concepts are useful for short-term decision making. The short-term period varies, depending on a company's current production capacity and the time required to change capacity. In the long term, all cost behavior patterns are likely to change.

Break-Even and Target Profit

Question: Companies such as Snowboard Company often want to know the sales required to break even, which is called the break-even point. What is meant by the term break-even point?

Answer: The *break-even point* can be described either in units or in sales dollars. The **break-even point in units**[3] is the number of units that must be sold to achieve zero profit. The **break-even point in sales dollars**[4] is the total sales measured in dollars required to achieve zero profit. If a company sells products or services easily measured in units (e.g., cars, computers, or mountain bikes), then the formula for break-even point in *units* is used. If a company sells products or services not easily measured in units (e.g., restaurants, law firms, or electricians), then the formula for break-even point in *sales dollars* is used.

Break-Even Point in Units

Question: How is the break-even point in units calculated, and what is the break-even point for Snowboard Company?

Answer: The break-even point in units is found by setting profit to zero using the profit equation. Once profit is set to zero, fill in the appropriate information for selling price per unit (S), variable cost per unit (V), and total fixed costs (F), and solve for the quantity of units produced and sold (Q).

Let's calculate the break-even point in units for Snowboard Company. Recall that each snowboard sells for $250. Unit variable costs total $150, and total monthly fixed costs are $50,000. To find the break-even point in units for Snowboard Company, set the profit to zero, insert the unit sales price (S), insert the unit variable cost (V), insert the total fixed costs (F), and solve for the quantity of units produced and sold (Q):

3. The number of units that must be sold to achieve zero profit.
4. The total sales measured in dollars required to achieve zero profit.

$$\begin{aligned} \text{Profit} &= (S \times Q) - (V \times Q) - F \\ \$0 &= \$250Q - \$150Q - \$50{,}000 \\ \$0 &= \$100Q - \$50{,}000 \\ \$50{,}000 &= \$100Q \\ Q &= 500 \text{ units} \end{aligned}$$

Thus Snowboard Company must produce and sell 500 snowboards to break even. This answer is confirmed in the following contribution margin income statement.

	Amount	Calculation
Sales	$125,000	(500 units × $250)
Variable costs	75,000	(500 units × $150)
Contribution margin	$ 50,000	(500 units × $100)
Fixed costs	50,000	(given)
Operating profit	$ 0	

Target Profit in Units

Question: Although it is helpful for companies to know the break-even point, most organizations are more interested in determining the sales required to make a targeted amount of profit. How does finding the target profit in units help companies like Snowboard Company?

Answer: Finding a **target profit in units**[5] simply means that a company would like to know how many units of product must be sold to achieve a certain profit. At Snowboard Company, Recilia (the vice president of sales) and Lisa (the accountant) are in their next weekly meeting.

Lisa:	*Recilia, last week you asked how many units we have to sell to cover our expenses. This is called the break-even point. If each unit produced and sold provides $100 toward covering fixed costs, and if total monthly fixed costs are $50,000, we would have to sell 500 units to break even—that is, $50,000 divided by $100.*
Recilia:	*What happens once we sell enough units to cover all of our fixed costs for the month?*
Lisa:	*Good question! Once all fixed costs are covered for the month, each unit sold contributes $100 toward profit.*

5. The number of units that must be sold to achieve a certain profit.

Recilia:	*I think I'm getting the hang of this. It will take 500 units in sales to break even, and each unit sold above 500 results in a $100 increase in profit. So if we sell 503 units for a month, profit will total $300?*
Lisa:	*You've got it!*
Recilia:	*So if our goal is to make a profit of $30,000 per month (target profit), how many units must be sold?*
Lisa:	*It takes 500 units to break even. We also know each unit sold above and beyond 500 units contributes $100 toward profit. Thus we would have to sell an additional 300 units above the break-even point to earn a profit of $30,000. This means we would have to sell 800 units in total to make $30,000 in profit.*
Recilia:	*Wow, I'm not sure selling 800 units is realistic, but at least we have a better sense of what needs to be done to make a decent profit. Thanks for your help!*

Profit Equation

Question: Let's formalize this discussion by using the profit equation. How is the profit equation used to find a target profit amount in units?

Answer: Finding the target profit in units is similar to finding the break-even point in units except that profit is no longer set to zero. Instead, set the profit to the target profit the company would like to achieve. Then fill in the information for selling price per unit (S), variable cost per unit (V), and total fixed costs (F), and solve for the quantity of units produced and sold (Q):

$$\begin{aligned} \text{Profit} &= (\text{S} \times \text{Q}) - (\text{V} \times \text{Q}) - \text{F} \\ \$30{,}000 &= \$250\text{Q} - \$150\text{Q} - \$50{,}000 \\ \$30{,}000 &= \$100\text{Q} - \$50{,}000 \\ \$80{,}000 &= \$100\text{Q} \\ \text{Q} &= 800 \text{ units} \end{aligned}$$

Thus Snowboard Company must produce and sell 800 snowboards to achieve $30,000 in profit. This answer is confirmed in the following contribution margin income statement:

	Amount	Calculation
Sales	$200,000	(800 units × $250)
Variable costs	120,000	(800 units x $150)
Contribution margin	$ 80,000	(800 units x $100)
Fixed costs	50,000	(given)
Operating profit	$ 30,000	

Shortcut Formula

Question: Although using the profit equation to solve for the break-even point or target profit in units tends to be the easiest approach, we can also use a shortcut formula derived from this equation. What is the shortcut formula, and how is it used to find the target profit in units for Snowboard Company?

Answer: The shortcut formula is as follows:

Key Equation

Q = (F + Target Profit) ÷ (S − V)

If you want to find the *break-even point in units*, set "Target Profit" in the equation to zero. If you want to find a *target profit in units*, set "Target Profit" in the equation to the appropriate amount. To confirm that this works, use the formula for Snowboard Company by finding the number of units produced and sold to achieve a target profit of $30,000:

$$\begin{aligned} Q &= (F + \text{Target Profit}) \div (S - V) \\ Q &= (\$50{,}000 + \$30{,}000) \div (\$250 - \$150) \\ Q &= \$80{,}000 \div \$100 \\ Q &= 800 \text{ units} \end{aligned}$$

The result is the same as when we used the profit equation.

Break-Even Point in Sales Dollars

Question: Finding the break-even point in units works well for companies that have products easily measured in units, such as snowboard or bike manufacturers, but not so well for companies that have a variety of products not easily measured in units, such as law firms and restaurants. How do companies find the break-even point if they cannot easily measure sales in units?

Answer: For these types of companies, the break-even point is measured in sales dollars. That is, we determine the total revenue (total sales dollars) required to achieve zero profit for companies that cannot easily measure sales in units.

Finding the break-even point in sales dollars requires the introduction of two new terms: *contribution margin per unit* and *contribution margin ratio*.

Contribution Margin per Unit

The **contribution margin per unit**[6] is the amount *each unit sold* contributes to (1) covering fixed costs and (2) increasing profit. We calculate it by subtracting variable costs per unit (V) from the selling price per unit (S).

Key Equation

Contribution margin per unit = S − V

For Snowboard Company the contribution margin is $100:

$$\begin{aligned} \text{Contribution margin per unit} &= \text{S} - \text{V} \\ \$100 &= \$250 - \$150 \end{aligned}$$

Thus *each unit sold* contributes $100 to covering fixed costs and increasing profit.

6. The amount *each unit sold* contributes to (1) covering fixed costs and (2) increasing profit.

Contribution Margin Ratio

The **contribution margin ratio**[7] (often called *contribution margin percent*) is the contribution margin as a percentage of sales. It measures the amount *each sales dollar* contributes to (1) covering fixed costs and (2) increasing profit. The contribution margin ratio is the contribution margin per unit divided by the selling price per unit. (Note that the contribution margin ratio can also be calculated using the *total* contribution margin and *total* sales; the result is the same.)

Key Equation

Contribution margin ratio = (S − V) ÷ S

For Snowboard Company the contribution margin ratio is 40 percent:

$$\begin{aligned} \text{Contribution margin ratio} &= (S - V) \div S \\ 40\% &= (\$250 - \$150) \div \$250 \end{aligned}$$

Thus *each dollar in sales* contributes 40 cents ($0.40) to covering fixed costs and increasing profit.

Question: With an understanding of the contribution margin and contribution margin ratio, we can now calculate the break-even point in sales dollars. How do we calculate the break-even point in sales dollars for Snowboard Company?

Answer: The formula to find the break-even point in sales dollars is as follows.

7. The contribution margin as a percentage of sales; it measures the amount *each sales dollar* contributes to (1) covering fixed costs and (2) increasing profit; also called *contribution margin percent*.

Key Equation

$$\text{Break-even point in sales dollars} = \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}}$$

For Snowboard Company the break-even point in sales dollars is $125,000 per month:

$$\text{Break-even point in sales dollars} = \frac{\$50{,}000 + \$0}{0.40}$$

$$\$125{,}000 \text{ in sales} = \frac{\$50{,}000 + \$0}{0.40}$$

Thus Snowboard Company must achieve $125,000 in total sales to break even. The following contribution margin income statement confirms this answer:

	Amount	Calculation
Sales	*$125,000*	(500 units x $250)
Variable costs	75,000	(500 units x $150)
Contribution margin	$ 50,000	(500 units x $100)
Fixed costs	50,000	(given)
Operating profit	$ 0	

Target Profit in Sales Dollars

Key Equation

$$\text{Target profit in sales dollars} = \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}}$$

8. The total sales measured in dollars required to achieve a certain profit.

Question: Finding a **target profit in sales dollars**[8] *simply means that a company would like to know total sales measured in dollars required to achieve a certain profit. Finding the*

target profit in sales dollars is similar to finding the break-even point in sales dollars except that "target profit" is no longer set to zero. Instead, target profit is set to the profit the company would like to achieve. Recall that management of Snowboard Company asked the following question: What is the amount of total sales dollars required to earn a target profit of $30,000?

Answer: Use the break-even formula described in the previous section. Instead of setting the target profit to $0, set it to $30,000. This results in an answer of $200,000 in monthly sales:

$$\text{Target profit in sales dollars} = \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}}$$

$$\$200{,}000 \text{ in sales} = \frac{\$50{,}000 + \$30{,}000}{0.40}$$

Thus Snowboard Company must achieve $200,000 in sales to make $30,000 in monthly profit. The following contribution margin income statement confirms this answer:

	Amount	Calculation
Sales	*$200,000*	(800 units x $250)
Variable costs	120,000	(800 units x $150)
Contribution margin	$ 80,000	(800 units x $100)
Fixed costs	50,000	(given)
Operating profit	$ 30,000	

Business in Action 6.1

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Measuring the Break-Even Point for Airlines

During the month of September 2001, **United Airlines** was losing $15 million per day. With $2.7 billion in cash, **United** had six months to return to profitability before facing a significant cash shortage. Many analysts believed **United's** troubles resulted in part from a relatively high break-even point.

Airlines measure break-even points, also called *load factors*, in terms of the percentage of seats filled. At the end of 2001, one firm estimated that **United** had to fill 96 percent of its seats just to break even. This is well above the figure for other major airlines, as you can see in the list that follows:

- **American Airlines:** 85 percent
- **Delta Airlines:** 85 percent
- **Southwest Airlines:** 65 percent
- **Alaska Airlines:**75 percent

United Airlines filed for bankruptcy at the end of 2002 and emerged from bankruptcy in 2006 after reducing costs by $7 billion a year. Other airlines

continue to work on reducing their break-even points and maximizing the percentage of seats filled.

Source: Lisa DiCarlo, "Can This Airline Be Saved?" *Forbes* magazine's Web site (http://www.forbes.com), November 2001; "United Airlines Emerges from Bankruptcy," Reuters (http://www.foxnews.com), February 1, 2005.

CVP Graph

Question: The relationship of costs, volume, and profit can be displayed in the form of a graph. What does this graph look like for Snowboard Company, and how does it help management evaluate financial information related to the production of snowboards?

Answer: Figure 6.2 "CVP Graph for Snowboard Company" shows in graph form the relationship between cost, volume, and profit for Snowboard Company. The vertical axis represents dollar amounts for revenues, costs, and profits. The horizontal axis represents the volume of activity for a period, measured as units produced and sold for Snowboard.

There are three lines in the graph:

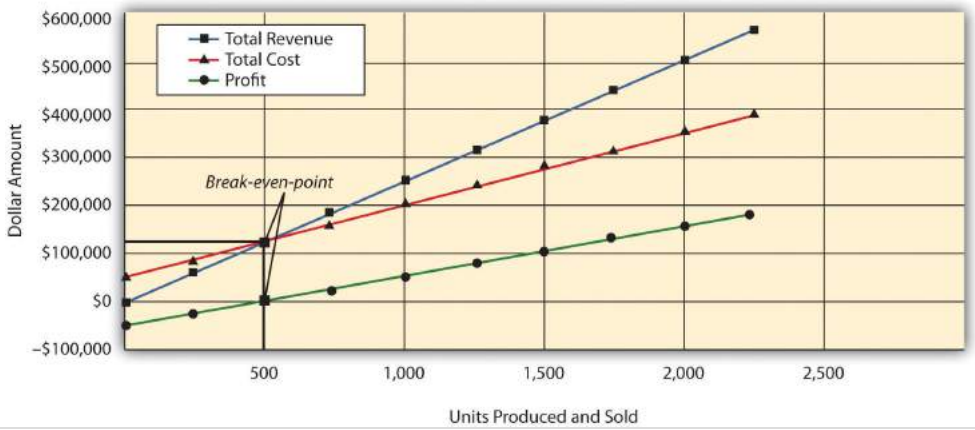
- Total revenue
- Total cost
- Profit

The total revenue line shows total revenue based on the number of units produced and sold. For example, if Snowboard produces and sells one unit, total revenue is $250 (= 1 × $250). If it produces and sells 2,000 units, total revenue is $500,000 (= 2,000 × $250).

The total cost line shows total cost based on the number of units produced and sold. For example, if Snowboard produces and sells one unit, total cost is $50,150 [= $50,000 + (1 × $150)]. If it produces and sells 2,000 units, total cost is $350,000 [= $50,000 + (2,000 × $150)].

The profit line shows profit or loss based on the number of units produced and sold. It is simply the difference between the total revenue and total cost lines. For example, if Snowboard produces and sells 2,000 units, the profit is $150,000 (= $500,000 – $350,000). If no units are sold, a loss is incurred equal to total fixed costs of $50,000.

Figure 6.2 *CVP Graph for Snowboard Company*



Margin of Safety

Question: Managers often like to know how close projected sales are to the break-even point. How is this information calculated and used by management?

Answer: The excess of projected sales over the break-even point is called the **margin of safety**[9]. The margin of safety represents the amount by which sales can fall before the company incurs a loss.

Key Equation

Margin of safety (in units) = Projected sales (in units) – Break-even sales (in units)

9. The excess of expected sales over the break-even point, measured in units and in sales dollars.

Assume Snowboard Company expects to sell 700 snowboards and that its break-even point is 500 units; the margin of safety is 200 units. The calculation is

$$\begin{aligned}\text{Margin of safety } (\text{in units}) &= \text{Projected sales } (\text{in units}) - \text{Break-even s}\\ 200 &= 700 - 500\end{aligned}$$

Thus sales can drop by 200 units per month before the company begins to incur a loss.

The margin of safety can also be stated in sales dollars.

Key Equation

Margin of safety (in sales $) = Projected sales (in sales $) - Break-even sales (in sales $)

For Snowboard the margin of safety in sales dollars is $50,000:

$$\begin{aligned}\text{Margin of safety } (\text{in sales \$}) &= \text{Projected sales } (\text{in sales \$}) - \text{Break-ev}\\ \$50{,}000 &= (700 \text{ units} \times \$250) - (500 \text{ units} \times \$2\end{aligned}$$

Thus sales revenue can drop by $50,000 per month before the company begins to incur a loss.

KEY TAKEAWAY

- Cost-volume-profit analysis involves finding the break-even and target profit point in units and in sales dollars. The key formulas for an organization with a single product are summarized in the following list. Set the target profit to $0 for break-even calculations, or to the appropriate profit dollar amount for target profit calculations. The margin of safety formula is also shown:
    - Break-even or target profit point measured in *units*:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Selling price per unit} - \text{Variable cost per unit}}$$

(The denominator is also called "contribution margin per unit.")

    - Break-even or target profit point measured in *sales dollars*:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}}$$

    - Margin of safety in units or sales dollars:

Projected sales – Break-even sales

REVIEW PROBLEM 6.1

Star Symphony would like to perform for a neighboring city. Fixed costs for the performance total $5,000. Tickets will sell for $15 per person, and an outside organization responsible for processing ticket orders charges the symphony a fee of $2 per ticket. Star Symphony expects to sell 500 tickets.

1. How many tickets must Star Symphony sell to break even?
2. How many tickets must the symphony sell to earn a profit of $7,000?
3. How much must Star Symphony have in sales dollars to break even?
4. How much must Star Symphony have in sales dollars to earn a profit of $7,000?
5. What is the symphony's margin of safety in units and in sales dollars?

Solution to Review Problem 6.1

Note: All solutions are rounded.

1. The symphony must sell 385 tickets to break even:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Selling price per unit} - \text{Variable cost per unit}} = \frac{\$5{,}000 + \$0}{\$15 - \$2} =$$

2. The symphony must sell 923 tickets to make a profit of $7,000:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Selling price per unit} - \text{Variable cost per unit}} = \frac{\$5{,}000 + \$7{,}000}{\$15 - \$2}$$

3. The symphony must make $5,769 in sales to break even:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}} = \frac{\$5{,}000 + \$0}{\$(15 - \$2) \div \$15} = \$5{,}769$$

4. The symphony must make $13,846 in sales to earn a profit of $7,000:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}} = \frac{\$5{,}000 + \$7{,}000}{\$(15 - \$2) \div \$15} = \$13{,}846$$

5. The symphony's margin of safety is 115 units or $1,725 in sales:

$$\begin{aligned}\text{Margin of safety} &= \text{Projected sales} - \text{Break-even sales}\\ 115 \text{ tickets} &= 500 \text{ tickets} - 385 \text{ tickets}\\ \$1{,}725 \text{ in sales} &= (500 \times \$15) - (385 \times \$15)\end{aligned}$$

6.2 Cost-Volume-Profit Analysis for Multiple-Product and Service Companies

LEARNING OBJECTIVE

1. Perform cost-volume-profit analysis for multiple-product and service companies.

Question: Although the previous section illustrated cost-volume-profit (CVP) analysis for companies with a single product easily measured in units, most companies have more than one product or perhaps offer services not easily measured in units. Suppose you are the manager of a company called Kayaks-For-Fun that produces two kayak models, River and Sea. What information is needed to calculate the break-even point for this company?

Answer: The following information is required to find the break-even point:

- Monthly fixed costs total $24,000.
- The River model represents 60 percent of total sales volume and the Sea model accounts for 40 percent of total sales volume.
- The unit selling price and variable cost information for the two products follow:

	River	Sea
Selling price	$500	$600
Variable cost	100	450
Contribution margin	$400	$150

Finding the Break-Even Point and Target Profit in Units for Multiple-Product Companies

Question: Given the information provided for Kayaks-For-Fun, how will the company calculate the break-even point?

Answer: First, we must expand the profit equation presented earlier to include multiple products. The following terms are used once again. However, subscript *r* identifies the River model, and subscript *s* identifies the Sea model (e.g., S_r stands for the River model's selling price per unit). CM is new to this section and represents the contribution margin.

Key Equation

S = Selling price *per unit*

V = Variable cost *per unit*

F = *Total* fixed costs

Q = Quantity of units produced and sold

CM = Contribution margin

Thus

$$\begin{aligned} \text{Profit} &= \text{Total sales} - \text{Total variable costs} - \text{Total fixed costs} \\ \text{Profit} &= \left[\left(S_r \times Q_r\right) + \left(S_s \times Q_s\right)\right] - \left[\left(V_r \times Q_r\right) + \left(V_s \times Q_s\right)\right] - F \end{aligned}$$

Without going through a detailed derivation, this equation can be restated in a simplified manner for Kayaks-For-Fun, as follows:

$$\begin{aligned} \text{Profit} &= \left(\text{Unit CM for River} \times \text{Quantity of River}\right) + \left(\text{Unit CM for Sea}\right. \\ \text{Profit} &= \$400Q_r + \$150Q_s - \$24{,}000 \end{aligned}$$

One manager at Kayaks-For-Fun believes the break-even point should be 60 units in total, and another manager believes the break-even point should be 160 units in total. Which manager is correct? The answer is both might be correct. If only the River kayak is produced and sold, 60 units is the break-even point. If only the Sea kayak is produced and sold, 160 units is the break-even point. There actually are many different break-even points, because the profit equation has two unknown variables, Q_r and Q_s.

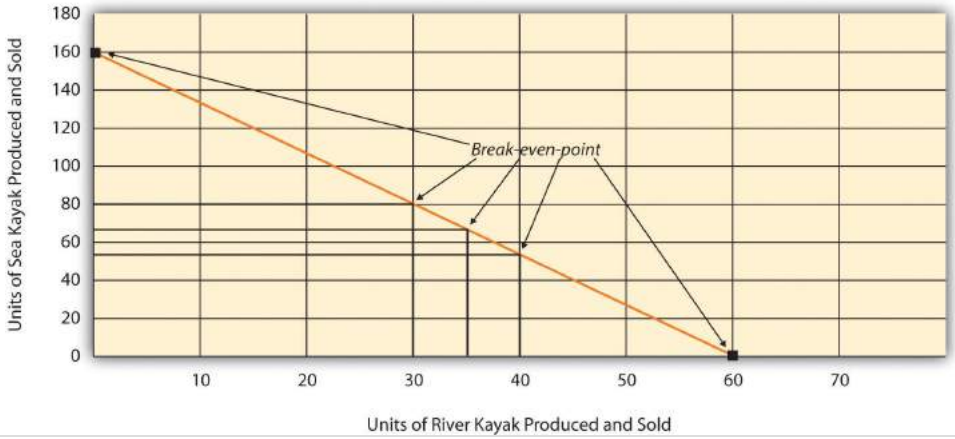
Further evidence of multiple break-even points is provided as follows (allow for rounding to the nearest unit), and shown graphically in Figure 6.3 "Multiple Break-Even Points for Kayaks-For-Fun":

Profit ($0) = ($400 × **30** units of River) + ($150 × **80** units of Sea) − $24,000

Profit ($0) = ($400 × **35** units of River) + ($150 × **67** units of Sea) − $24,000

Profit ($0) = ($400 × **40** units of River) + ($150 × **53** units of Sea) − $24,000

Figure 6.3 *Multiple Break-Even Points for Kayaks-For-Fun*



Break-Even Point in Units and the Weighted Average Contribution Margin per Unit

Question: Because most companies sell multiple products that have different selling prices and different variable costs, the break-even or target profit point depends on the sales mix. What is the sales mix, and how is it used to calculate the break-even point?

Answer: The **sales mix**[10] is the proportion of one product's sales to total sales. In the case of Kayaks-For-Fun, the River model accounts for 60 percent of total unit sales and the Sea model accounts for 40 percent of total unit sales.

In calculating the break-even point for Kayaks-For-Fun, we must assume the sales mix for the River and Sea models will remain at 60 percent and 40 percent, respectively, at all different sales levels. The formula used to solve for the break-even point in units for multiple-product companies is similar to the one used for a single-product company, with one change. Instead of using the contribution margin

10. The proportion of one product's sales to total sales.

per unit in the denominator, multiple-product companies use a *weighted average contribution margin per unit*. The formula to find the break-even point in units is as follows.

Key Equation

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin per unit}}$$

When a company assumes a constant sales mix, a **weighted average contribution margin per unit**[11] can be calculated by multiplying each product's unit contribution margin by its proportion of total sales. The resulting weighted unit contribution margins for all products are then added together.

At Kayaks-For-Fun, the weighted average contribution margin per unit of $300 is

$300 = ($400 × 60 percent) + ($150 × 40 percent)

We can now determine the break-even point in units by using the following formula:

$$\text{Break-even point in units} = \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin per u}}$$

$$\text{Break-even point in units} = \frac{\$24{,}000 + \$0}{\$300}$$

$$= 80 \text{ total kayaks}$$

Kayaks-For-Fun must sell 48 River models (= 60 percent × 80 units) and 32 Sea models (= 40 percent × 80 units) to break even. Again, this assumes the sales mix remains the same at different levels of sales volume.

Target Profit in Units

Question: We now know how to calculate the break-even point in units for a company with multiple products. How do we extend this process to find the target profit in units for a company with multiple products?

11. Calculated by multiplying each product's unit contribution margin by the product's proportion of total sales.

Answer: Finding the target profit in units for a company with multiple products is similar to finding the break-even point in units except that profit is no longer set to zero. Instead, profit is set to the target profit the company would like to achieve.

Key Equation

$$\text{Target profit in units} = \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin per unit}}$$

For example, assume Kayaks-For-Fun would like to know how many units it must sell to make a monthly profit of $96,000. Simply set the target profit to $96,000 and run the calculation:

$$\begin{aligned}\text{Target profit in units} &= \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin per unit}} \\ \text{Target profit in units} &= \frac{\$24{,}000 + \$96{,}000}{\$300} \\ &= 400 \text{ total kayaks}\end{aligned}$$

Kayaks-For-Fun must sell 240 River models (= 60 percent × 400) and 160 Sea models (= 40 percent × 400) to make a profit of $96,000.

REVIEW PROBLEM 6.2

International Printer Machines (IPM) builds three computer printer models: Inkjet, Laser, and Color Laser. Information for these three products is as follows:

	Inkjet	**Laser**	**Color Laser**	**Total**
Selling price per unit	$250	$400	$1,600	
Variable cost per unit	$100	$150	$ 800	
Expected unit sales (annual)	12,000	6,000	2,000	20,000
Sales mix	60 percent	30 percent	10 percent	100 percent

Total annual fixed costs are $5,000,000. Assume the sales mix remains the same at all levels of sales.

1.

    1. How many printers in total must be sold to break even?
    2. How many units of each printer must be sold to break even?

2.

    1. How many printers in total must be sold to earn an annual profit of $1,000,000?
    2. How many units of each printer must be sold to earn an annual profit of $1,000,000?

Solution to Review Problem 6.2

Note: All solutions are rounded.

1.

1. IPM must sell 20,408 printers to break even:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin per unit}}$$

$$\frac{\$5{,}000{,}000 + \$0}{(\$150 \times 0.60) + (\$250 \times 0.30) + (\$800 \times 0.10)} = \frac{\$5{,}00}{\$2}$$

2. As calculated previously, 20,408 printers must be sold to break even. Using the sales mix provided, the following number of units of each printer must be sold to break even:

   1. Inkjet: $12{,}245 \text{ units} = 20{,}408 \times 0.60$
   2. Laser: $6{,}122 \text{ units} = 20{,}408 \times 0.30$
   3. Color laser: $2{,}041 \text{ units} = 20{,}408 \times 0.10$

2.

1. IPM must sell 24,490 printers to earn $1,000,000 in profit:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin per unit}}$$

$$\frac{\$5{,}000{,}000 + \$1{,}000{,}000}{(\$150 \times 0.60) + (\$250 \times 0.30) + (\$800 \times 0.10)} = \frac{\$6{,}00}{\$2}$$

2. As calculated previously, 24,490 printers must be sold to earn $1,000,000 in profit. Using the sales mix provided, the following number of units for each printer must be sold to earn $1,000,000 in profit:

   1. Inkjet:$14{,}694 \text{ units} = 24{,}490 \times 0.60$
   2. Laser:$7{,}347 \text{ units} = 24{,}490 \times 0.30$
   3. Color laser:$2{,}449 \text{ units} = 24{,}490 \times 0.10$

Finding the Break-Even Point and Target Profit in Sales Dollars for Multiple-Product and Service Companies

A restaurant like **Applebee's**, which serves chicken, steak, seafood, appetizers, and beverages, would find it difficult to measure a "unit" of product. Such companies need a different approach to finding the break-even point. Figure 6.4 "Type of Good or Service Determines Whether to Calculate Break-Even Point and Target Profit Points in Units or Sales Dollars" illustrates this point by contrasting a company that has similar products easily measured in units (kayaks) with a company that has unique products (meals at a restaurant) not easily measured in units.

Figure 6.4 *Type of Good or Service Determines Whether to Calculate Break-Even Point and Target Profit Points in Units or Sales Dollars*

The break-even and target profit points for kayaks are easily measured in units.

The break-even and target profit points for meals at a restaurant are more easily measured in sales dollars.

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Break-Even Point in Sales Dollars and the Weighted Average Contribution Margin Ratio

Question: For companies that have unique products not easily measured in units, how do we find the break-even point?

Answer: Rather than measuring the break-even point in units, a more practical approach for these types of companies is to find the break-even point in sales dollars. We can use the formula that follows to find the break-even point in sales dollars for organizations with multiple products or services. Note that this formula is similar to the one used to find the break-even point in sales dollars for an

organization with one product, except that the contribution margin ratio now becomes the *weighted average* contribution margin ratio.

Key Equation

$$\text{Break-even point in sales dollars} = \frac{\text{Total fixed costs} + \text{Target prof}}{\text{Weighted average contribution margi}}$$

For example, suppose Amy's Accounting Service has three departments—tax, audit, and consulting—that provide services to the company's clients. Figure 6.5 "Income Statement for Amy's Accounting Service" shows the company's income statement for the year. Amy, the owner, would like to know what sales are required to break even. Note that fixed costs are known in total, but Amy does not allocate fixed costs to each department.

Figure 6.5 *Income Statement for Amy's Accounting Service*

	Tax	Audit	Consulting	Total
Sales	$100,000	$150,000	$250,000	$500,000
Variable costs	30,000	120,000	125,000	275,000
Contribution margin	$ 70,000	$ 30,000	$125,000	$225,000
Fixed costs				120,000
Operating profit				$105,000

The *contribution margin ratio* differs for each department:

Tax	70 percent (= $70,000 ÷ $100,000)
Audit	20 percent (= $30,000 ÷ $150,000)
Consulting	50 percent (= $125,000 ÷ $250,000)

Question: We have the contribution margin ratio for each department, but we need it for the company as a whole. How do we find the contribution margin ratio for all of the departments in the company combined?

Answer: The contribution margin ratio for the company as a whole is the **weighted average contribution margin ratio**[12]. We calculate it by dividing the *total* contribution margin by *total* sales. For Amy's Accounting Service, the weighted average contribution margin ratio is 45 percent (= $225,000 ÷ $500,000). For every dollar increase in sales, the company will generate an additional 45 cents ($0.45) in profit. This assumes that the sales mix remains the same at all levels of sales. (The sales mix here is measured in sales dollars for each department as a proportion of total sales dollars.)

Now that you know the weighted average contribution margin ratio for Amy's Accounting Service, it is possible to calculate the break-even point in sales dollars:

$$\text{Break-even point in sales dollars} = \frac{\text{Total fixed costs} + \text{Target pro}}{\text{Weighted average contribution marg}}$$

$$\text{Break-even point in sales dollars} = \frac{\$120{,}000 + \$0}{0.45}$$

$$= \$266{,}667 \ (\text{rounded})$$

Amy's Accounting Service must achieve $266,667 in sales to break even.The weighted average contribution margin ratio can also be found by multiplying each department's contribution margin ratio by its proportion of total sales. The resulting weighted average contribution margin ratios for all departments are then added. The calculation for Amy's Accounting Service is as follows:45 percent weighted average contribution margin ratio = (tax has 20 percent of total sales × 70 percent contribution margin ratio) + (audit has 30 percent of total sales × 20 percent contribution margin ratio) + (consulting has 50 percent of total sales × 50 percent contribution margin ratio)Thus 45 percent = 14 percent + 6 percent + 25 percent.

Target Profit in Sales Dollars

Question: How do we find the target profit in sales dollars for companies with products not easily measured in units?

Answer: Finding the target profit in sales dollars for a company with multiple products or services is similar to finding the break-even point in sales dollars

12. The total contribution margin divided by total sales.

except that profit is no longer set to zero. Instead, profit is set to the target profit the company would like to achieve.

Key Equation

$$\text{Target profit in sales dollars} = \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin rat}}$$

For example, assume Amy's Accounting Service would like to know sales dollars required to make $250,000 in annual profit. Simply set the target profit to $250,000 and run the calculation:

$$\begin{aligned}\text{Target profit in sales dollars} &= \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin ra}} \\ \text{Target profit in sales dollars} &= \frac{\$120{,}000 + \$250{,}000}{0.45} \\ &= \$822{,}222 \ (\text{rounded})\end{aligned}$$

Amy's Accounting Service must achieve $822,222 in sales to earn $250,000 in profit.

Important Assumptions

Question: Several assumptions are required to perform break-even and target profit calculations for companies with multiple products or services. What are these important assumptions?

Answer: These assumptions are as follows:

- Costs can be separated into fixed and variable components.
- Contribution margin ratio remains constant for each product, segment, or department.
- Sales mix remains constant with changes in total sales.

These assumptions simplify the CVP model and enable accountants to perform CVP analysis quickly and easily. However, these assumptions may not be realistic, particularly if significant changes are made to the organization's operations. When performing CVP analysis, it is important to consider the accuracy of these simplifying assumptions. It is always possible to design a more accurate and complex CVP model. But the benefits of obtaining more accurate data from a complex CVP model must outweigh the costs of developing such a model.

Margin of Safety

Question: Managers often like to know how close expected sales are to the break-even point. As defined earlier, the excess of projected sales over the break-even point is called the margin of safety. How is the margin of safety calculated for multiple-product and service organizations?

Answer: Let's return to Amy's Accounting Service and assume that Amy expects annual sales of $822,222, which results in expected profit of $250,000. Given a break-even point of $266,667, the margin of safety in sales dollars is calculated as follows:

$$\begin{aligned} \text{Margin of safety} &= \text{Projected sales} - \text{Break-even sales} \\ \$555{,}555 &= \$822{,}222 - \$266{,}667 \end{aligned}$$

Thus sales revenue can drop by $555,555 per year before the company begins to incur a loss.

KEY TAKEAWAYS

- The key formula used to calculate the break-even or target profit point **in units** for a company with multiple products is as follows. Simply set the target profit to $0 for break-even calculations, or to the appropriate profit dollar amount for target profit calculations.

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin per unit}}$$

- The formula used to find the break-even point or target profit in **sales dollars** for companies with multiple products or service is as follows. Simply set the "Target Profit" to $0 for break-even calculations, or to the appropriate profit dollar amount for target profit calculations:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted Average contribution margin ratio}}$$

REVIEW PROBLEM 6.3

Ott Landscape Incorporated provides landscape maintenance services for three types of clients: commercial, residential, and sports fields. Financial projections for this coming year for the three segments are as follows:

	Commercial	Residential	Sports Fields	Total
Sales	$2,100,000	$1,000,000	$1,900,000	$5,000,000
Variable costs	1,800,000	800,000	1,400,000	4,000,000
Contribution margin	$ 300,000	$ 200,000	$ 500,000	$1,000,000
Fixed costs				200,000
Operating profit				$ 800,000

Assume the sales mix remains the same at all levels of sales.

1. How much must Ott Landscape have in total sales dollars to break even?
2. How much must Ott Landscape have in total sales dollars to earn an annual profit of $1,500,000?
3. What is the margin of safety, assuming projected sales are $5,000,000 as shown previously?

Solution to Review Problem 6.3

1. Sales of $1,000,000 are required to break even:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin ratio *}} = \frac{\$200{,}000 + \$0}{0.20}$$

*Weighted average contribution margin ratio = $1,000,000 ÷ $5,000,000 = 20 percent or 0.20.

2. Sales of $8,500,000 are required to make a profit of $1,500,000:

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Weighted average contribution margin ratio}} = \frac{\$200{,}000 + \$1{,}500}{0.20}$$

3. The margin of safety is $4,000,000 in sales:

$$\text{Margin of safety} = \text{Projected sales} - \text{Break-even sales}$$
$$\$4{,}000{,}000 \text{ in sales} = \$5{,}000{,}000 - \$1{,}000{,}000$$

6.3 Using Cost-Volume-Profit Models for Sensitivity Analysis

LEARNING OBJECTIVE

1. Use sensitivity analysis to determine how changes in the cost-volume-profit equation affect profit.

Question: We can use the cost-volume-profit (CVP) financial model described in this chapter for single-product, multiple-product, and service organizations to perform sensitivity analysis, also called what-if analysis. How is sensitivity analysis used to help managers make decisions?

Answer: **Sensitivity analysis**[13] shows how the CVP model will change with changes in any of its variables (e.g., changes in fixed costs, variable costs, sales price, or sales mix). The focus is typically on how changes in variables will alter profit.

Sensitivity Analysis: An Example

To illustrate sensitivity analysis, let's go back to Snowboard Company, a company that produces one snowboard model. The assumptions for Snowboard were as follows:

Sales price per unit	$ 250
Variable cost per unit	150
Fixed costs per month	50,000
Target profit	30,000

Recall from earlier calculations that the break-even point is 500 units, and Snowboard must sell 800 units to achieve a target profit of $30,000. Management believes a goal of 800 units is overly optimistic and settles on a best guess of 700 units in monthly sales. This is called the "base case." The base case is summarized as follows in contribution margin income statement format:

13. An analysis that shows how the CVP model will change with changes in any of its variables.

Sales	$175,000	(700 units x $250)
Variable costs	105,000	(700 units x $150)
Contribution margin	$ 70,000	
Fixed costs	50,000	(Given)
Operating profit	$ 20,000	

Question: Although management believes the base case is reasonably accurate, it is concerned about what will happen if certain variables change. As a result, you are asked to address the following questions from management (you are now performing sensitivity analysis!). Each scenario is independent of the others. Unless told otherwise, assume that the variables used in the base case remain the same. How do you answer the following questions for management?

1. How will profit change if the sales price increases by $25 per unit (10 percent)?
2. How will profit change if sales volume decreases by 70 units (10 percent)?
3. How will profit change if fixed costs decrease by $15,000 (30 percent) and variable cost increases $15 per unit (10 percent)?

Answer: The CVP model shown in Figure 6.6 "Sensitivity Analysis for Snowboard Company" answers these questions. Each column represents a different scenario, with the first column showing the base case and the remaining columns providing answers to the three questions posed by management. The top part of Figure 6.6 "Sensitivity Analysis for Snowboard Company" shows the value of each variable based on the scenarios presented previously, and the bottom part presents the results in contribution margin income statement format.

Figure 6.6 *Sensitivity Analysis for Snowboard Company*

		Scenario 1	Scenario 2	Scenario 3
	Base Case	Price Increase 10%	Sales Volume Decrease 10%	Fixed Costs Decrease 30%; Variable Cost Increase 10%
Variable values				
Sales price per unit	$ 250	$ 275	$ 250	$ 250
Variable cost per unit	$ 150	$ 150	$ 150	$ 165
Monthly fixed costs	$ 50,000	$ 50,000	$ 50,000	$ 35,000
Volume of sales	700 units	700 units	630 units	700 units
CVP model results				
Sales	$175,000	$ 192,500	$157,500	$175,000
Variable costs	105,000	105,000	94,500	115,500
Contribution margin	$ 70,000	$ 87,500	$ 63,000	$ 59,500
Fixed costs	50,000	50,000	50,000	35,000
Operating profit	$ 20,000	$ 37,500	$ 13,000	$ 24,500
Dollar change in profit from base case		$ 17,500*	($ 7,000)	$ 4,500
Percent change in profit from base case		87.5%**	(35.0%)	22.5%

[a] *$17,500 = $37,500 − $20,000.*

[b] *87.5 percent = $17,500 ÷ $20,000.*

Carefully review Figure 6.6 "Sensitivity Analysis for Snowboard Company". The column labeled *Scenario 1* shows that increasing the price by 10 percent will increase profit 87.5 percent ($17,500). Thus profit is highly sensitive to changes in sales price. Another way to look at this is that for every one percent *increase* in sales price, profit will *increase* by 8.75 percent, or for every one percent *decrease* in sales price, profit will *decrease* by 8.75 percent.

The column labeled *Scenario 2* shows that decreasing sales volume 10 percent will decrease profit 35 percent ($7,000). Thus profit is also highly sensitive to changes in sales volume. Stated another way, every one percent *decrease* in sales volume will *decrease* profit by 3.5 percent; or every one percent *increase* in sales volume will *increase* profit by 3.5 percent.

When comparing Scenario 1 with Scenario 2, we see that Snowboard Company's profit is more sensitive to changes in sales price than to changes in sales volume, although changes in either will significantly affect profit.

The column labeled *Scenario 3* shows that decreasing fixed costs by 30 percent and increasing variable cost by 10 percent will increase profit 22.5 percent ($4,500). (Perhaps Snowboard Company is considering moving toward less automation and more direct labor!)

Computer Application

Using Excel to Perform Sensitivity Analysis

The accountants at Snowboard Company would likely use a spreadsheet program, such as Excel, to develop a CVP model for the sensitivity analysis shown in Figure 6.6 "Sensitivity Analysis for Snowboard Company". An example of how to use Excel to prepare the CVP model shown in Figure 6.6 "Sensitivity Analysis for Snowboard Company" is presented as follows. Notice that the basic data are entered at the top of the spreadsheet (*data entry section*), and the rest of the information is driven by formulas. This allows for quick sensitivity analysis of different scenarios.

Using the base case as an example, sales of $175,000 (cell D14) are calculated by multiplying the $250 sales price per unit (cell D5) by 700 units (cell D8). Variable costs of $105,000 (cell D15) are calculated by multiplying the $150 variable cost per unit (cell D6) by 700 units (cell D8). Fixed costs of $50,000 come from the top section (cell D7). The contribution margin of $70,000 is calculated by subtracting variable costs from sales, and profit of $20,000 is calculated by subtracting fixed costs from the contribution margin.

	C	D	E	F	G
1	**Data Entry Section**				
2		**Base Case**	**Scenario (1)**	**Scenario (2)**	**Scenario (3)**
3	**Variable**		**Price Increase 10%**	**Sales volume decrease 10%**	**Fixed costs decrease 30%; variable cost increase 10%**
5	Sales price per unit	$250	$275	$250	$250
6	Variable cost per unit	$150	$150	$150	$165
7	Monthly fixed cost	$50,000	$50,000	$50,000	$35,000
8	Volume of sales (units)	700	700	630	700
11	**Snowboard Company**				
12	**Sensitivity Analysis Result**				
14	Sales	$175,000	$192,500	$157,500	$175,000
15	Variable costs	105,000	105,000	94,500	115,500
16	Contribution margin	$70,000	$87,500	$63,000	$59,500
17	Fixed costs	50,000	50,000	50,000	35,000
18	Operating profit	$20,000	$37,500	$13,000	$24,500
20	Dollar change in profit from base case		$17,500	($7,000)	$4,500
22	Percent change in profit from base case		87.50%	(35%)	22.50%

Expanding the Use of Sensitivity Analysis

Question: Although the focus of sensitivity analysis is typically on how changes in variables will affect profit (as shown in Figure 6.6 "Sensitivity Analysis for Snowboard Company"), accountants also use sensitivity analysis to determine the impact of changes in variables on the break-even point and target profit. How is sensitivity analysis used to evaluate the impact changes in variables will have on break-even and target profit points?

Answer: Let's look at an example for Snowboard Company. Assume the company is able to charge $275 per unit, instead of $250 per unit. How many units must Snowboard Company sell to break even? The following calculation is based on the shortcut formula presented earlier in the chapter:

$$\begin{aligned} Q &= (F + \text{Target Profit}) \div (S - V) \\ Q &= (\$50{,}000 + \$0) \div (\$275 - \$150) \\ Q &= \$50{,}000 \div \$125 \\ Q &= 400 \text{ units} \end{aligned}$$

Thus if the sales price per unit increases from $250 to $275, the break-even point decreases from 500 units (calculated earlier) to 400 units, which is a decrease of 100 units.

How would this same increase in sales price change the required number of units sold to achieve a profit of $30,000? We apply the same shortcut formula:

$$\begin{aligned} Q &= (F + \text{Target Profit}) \div (S - V) \\ Q &= (\$50{,}000 + \$30{,}000) \div (\$275 - \$150) \\ Q &= \$80{,}000 \div \$125 \\ Q &= 640 \text{ units} \end{aligned}$$

Thus if the sales price per unit increases from $250 to $275, the number of units sold to achieve a profit of $30,000 decreases from 800 units (calculated earlier) to 640 units, which is a decrease of 160 units.

Business in Action 6.2

Performing Sensitivity Analysis for a Brewpub

Three entrepreneurs in California were looking for investors and banks to finance a new brewpub. Brewpubs focus on two segments: food from the restaurant segment, and freshly brewed beer from the beer production segment. All parties involved in the process of raising money—potential investors and banks, as well as the three entrepreneurs (i.e., the owners)—wanted to know what the new business's projected profits would be. After months of research, the owners created a financial model that provided this information. Projected profits were slightly more than $300,000 for the first year (from sales of $1.95 million) and were expected to increase in each of the next four years.

One of the owners asked, "What if our projected revenues are too high? What will happen to profits if sales are lower than we expect? After all, we will have debt of well over $1 million, and I don't want anyone coming after my personal assets if the business doesn't have the money to pay!" Although all three owners felt the financial model was reasonably accurate, they decided to find the break-even point and the resulting margin of safety.

Because a brewpub does not sell "units" of a specific product, the owners found the break-even point in sales dollars. The owners knew the contribution margin ratio and all fixed costs from the financial model. With this information, they were able to calculate the break-even point and margin of safety. The worried owner was relieved to discover that sales could drop over 35 percent from initial projections before the brewpub incurred an operating loss.

KEY TAKEAWAY

- Sensitivity analysis shows how the cost-volume-profit model will change with changes in any of its variables. Although the focus is typically on how changes in variables affect profit, accountants often analyze the impact on the break-even point and target profit as well.

REVIEW PROBLEM 6.4

This problem is an extension of Note 6.28 "Review Problem 6.2". Recall that International Printer Machines (IPM) builds three computer printer models: Inkjet, Laser, and Color Laser. Base case information for these three products is as follows:

	Inkjet	Laser	Color Laser	Total
Selling price per unit	$250	$400	$1,600	
Variable cost per unit	$100	$150	$ 800	
Expected unit sales (annual)	12,000	6,000	2,000	20,000
Sales mix	60 percent	30 percent	10 percent	100 percent

Total annual fixed costs are $5,000,000. Assume that each scenario that follows is independent of the others. Unless stated otherwise, the variables are the same as in the base case.

1. Prepare a contribution margin income statement for the base case. Use the format shown in Figure 6.5 "Income Statement for Amy's Accounting Service".
2. How will total profit change if the Laser sales price increases by 10 percent? (Hint: Use the format shown in Figure 6.5 "Income Statement for Amy's Accounting Service", and compare your result with requirement 1.)
3. How will total profit change if the Inkjet sales volume decreases by 4,000 units and the sales volume of other products remains the same?
4. How will total profit change if fixed costs decrease by 20 percent?

Solution to Review Problem 6.4

1. Base Case:

	Inkjet	Laser	Color Laser	Total
Sales	$3,000,000	$2,400,000	$3,200,000	$8,600,000
Variable costs	1,200,000	900,000	1,600,000	3,700,000
Contribution margin	$1,800,000	$1,500,000	$1,600,000	$4,900,000
Fixed costs				5,000,000
Operating loss				($ 100,000)

2. Laser sales price increases 10 percent:

	Inkjet	Laser	Color Laser	Total
Sales	$3,000,000	$2,640,000	$3,200,000	$8,840,000
Variable costs	1,200,000	900,000	1,600,000	3,700,000
Contribution margin	$1,800,000	$1,740,000	$1,600,000	$5,140,000
Fixed costs				5,000,000
Operating profit				$ 140,000

Total profit would increase $240,000 (from *loss* of $100,000 in base case to *profit* of $140,000 in this scenario).

3. Inkjet sales volume decreases 4,000 units:

	Inkjet	Laser	Color Laser	Total
Sales	$2,000,000	$2,400,000	$3,200,000	$7,600,000
Variable costs	800,000	900,000	1,600,000	3,300,000
Contribution margin	$1,200,000	$1,500,000	$1,600,000	$4,300,000
Fixed costs				5,000,000
Operating loss				($ 700,000)

Total profit would decrease $600,000 (from *loss* of $100,000 in base case to *loss* of $700,000 in this scenario).

4. Fixed costs decrease 20 percent:

	Inkjet	Laser	Color Laser	Total
Sales	$3,000,000	$2,400,000	$3,200,000	$8,600,000
Variable costs	1,200,000	900,000	1,600,000	3,700,000
Contribution margin	$1,800,000	$1,500,000	$1,600,000	$4,900,000
Fixed costs				4,000,000
Operating profit				$ 900,000

Total profit would increase $1,000,000 (from *loss* of $100,000 in base case to profit of $900,000 in this scenario).

6.4 Impact of Cost Structure on Cost-Volume-Profit Analysis

LEARNING OBJECTIVE

1. Understand how cost structure affects cost-volume-profit sensitivity analysis.

Question: Describing an organization's cost structure helps us to understand the amount of fixed and variable costs within the organization. What is meant by the term cost structure?

Answer: **Cost structure**[14] is the term used to describe the proportion of fixed and variable costs to total costs. For example, if a company has $80,000 in fixed costs and $20,000 in variable costs, the cost structure is described as 80 percent fixed costs and 20 percent variable costs.

Question: **Operating leverage**[15] *refers to the level of fixed costs within an organization. How do we determine if a company has high operating leverage?*

Answer: Companies with a relatively high proportion of fixed costs have high operating leverage. For example, companies that produce computer processors, such as **NEC** and **Intel**, tend to make large investments in production facilities and equipment and therefore have a cost structure with high fixed costs. Businesses that rely on direct labor and direct materials, such as auto repair shops, tend to have higher variable costs than fixed costs.

Operating leverage is an important concept because it affects how sensitive profits are to changes in sales volume. This is best illustrated by comparing two companies with identical sales and profits but with different cost structures, as we do in Figure 6.7 "Operating Leverage Example". High Operating Leverage Company (HOLC) has relatively high fixed costs, and Low Operating Leverage Company (LOLC) has relatively low fixed costs.

14. The proportion of fixed and variable costs to total costs.

15. The level of fixed costs within an organization.

Figure 6.7 *Operating Leverage Example*

	High Operating Leverage Company (HOLC)		Low Operating Leverage Company (LOLC)	
Sales	$500,000	100%	$500,000	100%
Variable costs	100,000	20	350,000	70
Contribution margin	$400,000	80	$150,000	30
Fixed costs	300,000	60	50,000	10
Operating profit	$100,000	20	$100,000	20

One way to observe the importance of operating leverage is to compare the break-even point in sales dollars for each company. HOLC needs sales of $375,000 to break even (= $300,000 ÷ 0.80), whereas LOLC needs sales of $166,667 to break even (= $50,000 ÷ 0.30).

Question: Why don't all companies strive for low operating leverage to lower the break-even point?

Answer: In Figure 6.7 "Operating Leverage Example", LOLC looks better up to the sales point of $500,000 and profit of $100,000. However, once sales exceed $500,000, HOLC will have higher profit than LOLC. This is because every additional dollar in sales will provide $0.80 in profit for HOLC (80 percent contribution margin ratio), and only $0.30 in profit for LOLC (30 percent contribution margin ratio). If a company is relatively certain of increasing sales, then it makes sense to have higher operating leverage.

Financial advisers often say, "the higher the risk, the higher the potential profit," which can also be stated as "the higher the risk, the higher the potential *loss*." The same applies to operating leverage. Higher operating leverage can lead to higher profit. However, high operating leverage companies that encounter declining sales tend to feel the negative impact more than companies with low operating leverage.

To prove this point, let's assume both companies in Figure 6.7 "Operating Leverage Example" experience a 30 percent *decrease* in sales. HOLC's profit would decrease by

$120,000 (= 30 percent × $400,000 contribution margin) and LOLC's profit would decrease by $45,000 (= 30 percent × $150,000 contribution margin). HOLC would certainly feel the pain more than LOLC.

Now assume both companies in Figure 6.7 "Operating Leverage Example" experience a 30 percent *increase* in sales. HOLC's profit would increase by $120,000 (= 30 percent × $400,000 contribution margin) and LOLC's profit would increase by $45,000 (= 30 percent × $150,000 contribution margin). HOLC benefits more from increased sales than LOLC.

KEY TAKEAWAY

- The cost structure of a firm describes the proportion of fixed and variable costs to total costs. Operating leverage refers to the level of fixed costs within an organization. The term "high operating leverage" is used to describe companies with relatively high fixed costs. Firms with high operating leverage tend to profit more from increasing sales, and lose more from decreasing sales than a similar firm with low operating leverage.

REVIEW PROBLEM 6.5

What are the characteristics of a company with high operating leverage, and how do these characteristics differ from those of a company with low operating leverage?

Solution to Review Problem 6.5

Companies with high operating leverage have a relatively high proportion of fixed costs to total costs, and their profits tend to be much more sensitive to changes in sales than their low operating leverage counterparts. Companies with low operating leverage have a relatively low proportion of fixed costs to total costs, and their profits tend to be much less sensitive to changes in sales than their high operating leverage counterparts.

6.5 Using a Contribution Margin When Faced with Resource Constraints

LEARNING OBJECTIVE

1. Use an alternative form of contribution margin when faced with a resource constraint.

Question: Many companies have limited resources in such areas as labor hours, machine hours, facilities, and materials. These constraints will likely affect a company's ability to produce goods or provide services. When a company that produces multiple products faces a constraint, managers often calculate the contribution margin per unit of constraint in addition to the contribution margin per unit. The **contribution margin per unit of constraint**[16] *is the contribution margin per unit divided by the units of constrained resource required to produce one unit of product. How is this measure used by managers to make decisions when faced with resource constraints?*

Answer: Let's examine the Kayaks-For-Fun example introduced earlier in the chapter. The company produces two kayak models, River and Sea. Based on the information shown, Kayaks-For-Fun would prefer to sell more of the River model because it has the highest contribution margin per unit.

	River	Sea
Selling price	$500	$600
Variable cost	100	450
Contribution margin	$400	$150

Kayaks-For-Fun has a total of 320 labor hours available each month. The specialized skills required to build the kayaks makes it difficult for management to find additional workers. Assume the River model requires 4 labor hours per unit and the Sea model requires 1 labor hour per unit (most of the variable cost for the Sea model is related to expensive materials required for production). Kayaks-For-Fun sells everything it produces. Given its labor hours constraint, the company would prefer to maximize the contribution margin per labor hour.

16. The contribution margin per unit divided by the units of constrained resource required to produce one unit of product.

	River	Sea
Contribution margin per unit	$400	$150
Divided by labor hours per unit	÷ 4	÷1
Contribution margin per labor hour	$100	$150

Based on this information, Kayaks-For-Fun would prefer to sell the Sea model because it provides a contribution margin per labor hour of $150 versus $100 for the River model. The company would prefer only to make the Sea model, which would yield a total contribution margin of $48,000 (= $150 × 320 hours). If the River model were the only model produced, the total contribution margin to the company would be $32,000 (= $100 × 320 hours).

Analysis such as this often leads to further investigation. It may be that Kayaks-For-Fun can find additional labor to alleviate this resource constraint. Or perhaps the production process can be modified in a way that reduces the labor required to build the River model (e.g., through increased automation). Whatever the outcome, companies with limited resources are wise to calculate the contribution margin per unit of constrained resource.

KEY TAKEAWAY

- Many organizations operate with limited resources in areas such as labor hours, machine hours, facilities, or materials. The contribution margin per unit of constraint is a helpful measure in determining how constrained resources should be utilized.

REVIEW PROBLEM 6.6

This review problem is based on the information for Kayaks-For-Fun presented previously. Assume Kayaks-For-Fun found additional labor, thereby eliminating this resource constraint. However, the company now faces limited available machine hours. It has a total of 3,000 machine hours available each month. The River model requires 16 machine hours per unit, and the Sea model requires 10 machine hours per unit.

1. Calculate the contribution margin per unit of constrained resource for each model.
2. Which model would Kayaks-For-Fun prefer to sell to maximize overall company profit?

Solution to Review Problem 6.6

1.

	River	Sea
Contribution margin per unit	$400	$150
Divided by machine hours per unit	÷16	÷10
Contribution margin per machine hour	$ 25	$ 15

2. Kayaks-For-Fun would prefer to sell the River model because it provides a contribution margin per machine hour of $25 compared to $15 for the Sea model. If only the River model were sold, the total contribution margin would be $75,000 (= $25 × 3,000 machine hours). If only the Sea model were sold, the total contribution margin would be $45,000 (= $15 × 3,000 machine hours).

6.6 Income Taxes and Cost-Volume-Profit Analysis

LEARNING OBJECTIVE

1. Understand the effect of income taxes on cost-volume-profit analysis.

Question: Some organizations, such as not-for-profit entities and governmental agencies, are not required to pay income taxes. However, most for-profit organizations must pay income taxes on their profits. How do we find the target profit in units or sales dollars for organizations that pay income taxes?

Answer: Three steps are required:

Step 1. Determine the desired target profit *after taxes* **(i.e., after accounting for income taxes).**

Step 2. Convert the desired target profit after taxes to the target profit *before taxes***.**

Step 3. Use the target profit *before taxes* **in the appropriate formula to calculate the target profit in units or sales dollars.**

Using Snowboard Company as an example, the assumptions are as follows:

Sales price per unit	$ 250
Variable cost per unit	150
Fixed costs per month	50,000
Target profit	30,000

Assume also that the $30,000 target profit is the monthly profit desired *after taxes* and that Snowboard has a tax rate of 20 percent.

Step 1. Determine the desired target profit ***after taxes*****.**

Snowboard's management wants to know how many units must be sold to earn a profit of $30,000 after taxes. Target profit *before taxes* will be higher than $30,000, and we calculate it in the next step.

Step 2. Convert the desired target profit after taxes to the target profit ***before taxes*****.**

The formula used to solve for target profit *before taxes* is as follows.

Key Equation

Target profit *before taxes* = Target profit *after taxes* ÷ (1 – tax rate)

Using Snowboard Company's data, the formula would read as follows:

$$\begin{aligned}\text{Target profit before taxes} &= \$30{,}000 \div (1 - 0.20)\\ \text{Target profit before taxes} &= \$37{,}500\end{aligned}$$

Step 3. Use the target profit ***before taxes*** **in the appropriate formula to calculate the target profit in units or sales dollars.**

The formula used to solve for target profit in units is

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Selling price per unit} - \text{Variable cost per unit}}$$

For Snowboard Company, it would read as follows:

$$\begin{aligned}\text{Target profit in units} &= (\$50{,}000 + \$37{,}500) \div (\$250 - \$150)\\ &= \$87{,}500 \div \$100\\ &= 875 \text{ units}\end{aligned}$$

This answer is confirmed in the following contribution margin income statement.

	Amount	Calculation
Sales	$218,750	(875 units × $250)
Variable costs	131,250	(875 units × $150)
Contribution margin	$ 87,500	(875 units × $100)
Fixed costs	50,000	(given)
Profit before taxes	$ 37,500	
Income taxes	7,500	($37,500 profit before taxes x 20%)
Profit after taxes	$ 30,000	

KEY TAKEAWAY

- Companies that incur income taxes must follow three steps to find the break-even point or target profit.

Step 1. Determine the desired target profit after taxes.

Step 2. Convert the desired target profit after taxes to target profit before taxes using the following formula:

Target profit *before taxes* = Target profit *after taxes* ÷ (1 – tax rate)

Step 3. Use the target profit before taxes from step 2 in the appropriate target profit formula to calculate the target profit in units or in sales dollars.

REVIEW PROBLEM 6.7

This review problem is based on the information for Snowboard Company. Assume Snowboard's tax rate remains at 20 percent.

1. Use the three steps described in this section to determine how many *units* Snowboard Company must sell to earn a monthly profit of $50,000 after taxes.
2. Use the three steps to determine the *sales dollars* Snowboard needs to earn a monthly profit of $60,000 after taxes.

Solution to Review Problem 6.7

1. The three steps to determine how many units must be sold to earn a target profit after taxes are as follows:

Step 1. Determine the desired target profit *after taxes*.

Management wants a profit of $50,000 after taxes and needs to know how many units must be sold to earn this profit.

Step 2. Convert the desired target profit after taxes to the target profit *before taxes*.

The formula used to solve for target profit *before taxes* is

$$\begin{aligned}\text{Target profit } \textit{before} \text{ taxes} &= \text{Target profit } \textit{after} \text{ taxes} \div (1 - \text{tax ra}\\ \text{Target profit before taxes} &= \$50{,}000 \div (1 - 0.20)\\ \text{Target profit before taxes} &= \$62{,}500\end{aligned}$$

Step 3. Use the target profit *before taxes* **in the appropriate formula to calculate the target profit in units.**

The formula to solve for target profit in units is

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Selling price per unit} - \text{Variable cost per unit}}$$

For Snowboard Company, it would read as follows:

$$\begin{aligned}\text{Target profit in units} &= (\$50{,}000 + \$62{,}500) \div (\$250 - \$150) \\ &= \$112{,}500 \div \$100 \\ &= 1{,}125 \text{ units}\end{aligned}$$

2. The three steps to determine how many sales dollars are required to achieve a target profit after taxes are as follows:

Step 1. Determine the desired target profit *after taxes*.

Management wants a profit of $60,000 after taxes and needs to know the sales dollars required to earn this profit.

Step 2. Convert the desired target profit after taxes to target profit *before taxes*.

The formula used to solve for target profit *before taxes* is

$$\begin{aligned}\text{Target profit } \textit{before} \text{ taxes} &= \text{Target profit } \textit{after} \text{ taxes} \div (1 - \text{tax ra} \\ \text{Target profit before taxes} &= \$60{,}000 \div (1 - 0.20) \\ \text{Target profit before taxes} &= \$75{,}000\end{aligned}$$

Step 3. Use the target profit *before taxes* **in the appropriate formula to calculate the target profit in sales dollars.**

The formula used to solve for target profit in sales dollars is

$$\frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}}$$

$$\begin{aligned}\text{Target profit in sales dollars} &= (\$50{,}000 + \$75{,}000) \div (\$100 \div \\ &= \$125{,}000 \div 0.40 \\ &= \$312{,}500 \text{ in sales}\end{aligned}$$

6.7 Using Variable Costing to Make Decisions

LEARNING OBJECTIVE

1. Understand how managers use variable costing to make decisions.

In Chapter 2 "How Is Job Costing Used to Track Production Costs?", we discussed how to report manufacturing costs and nonmanufacturing costs following U.S. Generally Accepted Accounting Principles (U.S. GAAP). Under U.S. GAAP, all nonmanufacturing costs (selling and administrative costs) are treated as period costs because they are expensed on the income statement in the period in which they are incurred. All costs associated with production are treated as product costs, including direct materials, direct labor, and fixed and variable manufacturing overhead. These costs are attached to inventory as an asset on the balance sheet until the goods are sold, at which point the costs are transferred to cost of goods sold on the income statement as an expense. This method of accounting is called **absorption costing**[17] because *all* manufacturing overhead costs (fixed and variable) are *absorbed* into inventory until the goods are sold. (The term *full costing* is also used to describe absorption costing.)

Question: Although absorption costing is used for external reporting, managers often prefer to use an alternative costing approach for internal reporting purposes called variable costing. What is variable costing, and how does it compare to absorption costing?

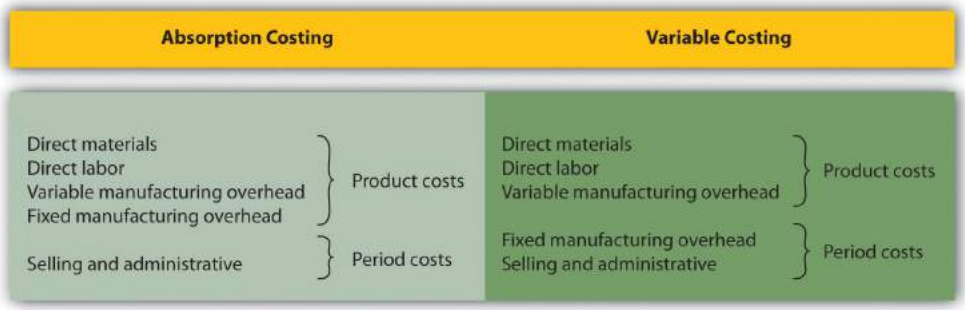
Answer: **Variable costing**[18] requires that all *variable* production costs be included in inventory, and all *fixed* production costs (fixed manufacturing overhead) be reported as period costs. Thus all fixed production costs are expensed as incurred.

The only difference between absorption costing and variable costing is in the treatment of fixed manufacturing overhead. Using absorption costing, fixed manufacturing overhead is reported as a *product cost*. Using variable costing, fixed manufacturing overhead is reported as a *period cost*. Figure 6.8 "Absorption Costing Versus Variable Costing" summarizes the similarities and differences between absorption costing and variable costing.

17. A costing method that includes all manufacturing costs (fixed and variable) in inventory until the goods are sold.

18. A costing method that includes all variable manufacturing costs in inventory until the goods are sold (just like absorption costing) but reports all fixed manufacturing costs as an expense on the income statement when incurred.

Figure 6.8 Absorption Costing Versus Variable Costing



Impact of Absorption Costing and Variable Costing on Profit

Question: If a company uses just-in-time inventory, and therefore has no beginning or ending inventory, profit will be exactly the same regardless of the costing approach used. However, most companies have units of product in inventory at the end of the reporting period. How does the use of absorption costing affect the value of ending inventory?

Answer: Since absorption costing includes fixed manufacturing overhead as a product cost, all products that remain in ending inventory (i.e., are unsold at the end of the period) include a portion of fixed manufacturing overhead costs as an asset on the balance sheet. Since variable costing treats fixed manufacturing overhead costs as period costs, all fixed manufacturing overhead costs are expensed on the income statement when incurred. Thus if the quantity of units produced exceeds the quantity of units sold, absorption costing will result in higher profit.

We illustrate this concept with an example. The following information is for Bullard Company, a producer of clock radios:

Monthly production	10,000 units
Sales price	$25 per unit
Variable production cost per unit	
Direct materials	$4
Direct labor	1 } $7 per unit
Manufacturing overhead	2
Fixed production costs	$40,000 each month; $4 per unit at 10,000 units of production
Variable selling and administrative cost	$3 per unit
Fixed selling and administrative cost	$20,000 each month

Assume Bullard has no finished goods inventory at the beginning of month 1. We will look at absorption costing versus variable costing for three different scenarios:

- Month 1 scenario: 10,000 units produced *equals* 10,000 units sold
- Month 2 scenario: 10,000 units produced is *greater than* 9,000 units sold
- Month 3 scenario: 10,000 units produced is *less than* 11,000 units sold

Month 1: Number of Units Produced Equals Number of Units Sold

Question: During month 1, Bullard Company sells all 10,000 units produced during the month. How does operating profit compare using absorption costing and variable costing when the number of units produced equals the number of units sold?

Answer: Figure 6.9 "Number of Units Produced Equals Number of Units Sold" presents the results for each costing method. Notice that the absorption costing income statement is called a traditional income statement, and the variable costing income statement is called a contribution margin income statement.

As you review Figure 6.9 "Number of Units Produced Equals Number of Units Sold", notice that when the number of units produced equals the number sold, profit totaling $90,000 is identical for both costing methods. With absorption costing, fixed manufacturing overhead costs are fully expensed because all units produced are sold (there is no ending inventory). With variable costing, fixed manufacturing overhead costs are treated as period costs and therefore are always expensed in the

period incurred. Because all other costs are treated the same regardless of the costing method used, profit is identical when the number of units produced and sold is the same.

Figure 6.9 Number of Units Produced Equals Number of Units Sold

Month 1

Absorption Costing (Traditional Income Statement)		Variable Costing (Contribution Margin Income Statement)		
Sales	$250,000[a]	Sales		$250,000[a]
Cost of goods sold	110,000[b]	Variable costs		
Gross margin	$140,000	Cost of goods sold	$70,000[c]	
Selling and administrative costs	50,000[d]	Selling and administrative costs	30,000[e]	
Operating profit	$ 90,000	Total variable costs		100,000
		Contribution margin		$150,000
		Fixed costs		
		Cost of goods sold	$40,000[f]	
		Selling and administrative costs	20,000[g]	
		Total fixed costs		60,000
		Operating profit		$ 90,000

[a] *$250,000 = $25 × 10,000 units sold.*

[b] *$110,000 = ($4 per unit fixed production cost × 10,000 units sold) + ($7 per unit variable production cost × 10,000 units sold).*

[c] *$70,000 = $7 per unit variable production cost × 10,000 units sold.*

[d] *$50,000 = $20,000 fixed selling and admin. cost + ($3 per unit variable selling and admin. cost × 10,000 units sold).*

[e] *$30,000 = $3 per unit variable selling and admin. cost × 10,000 units sold.*

[f] *Variable costing treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.*

[g] *Given.*

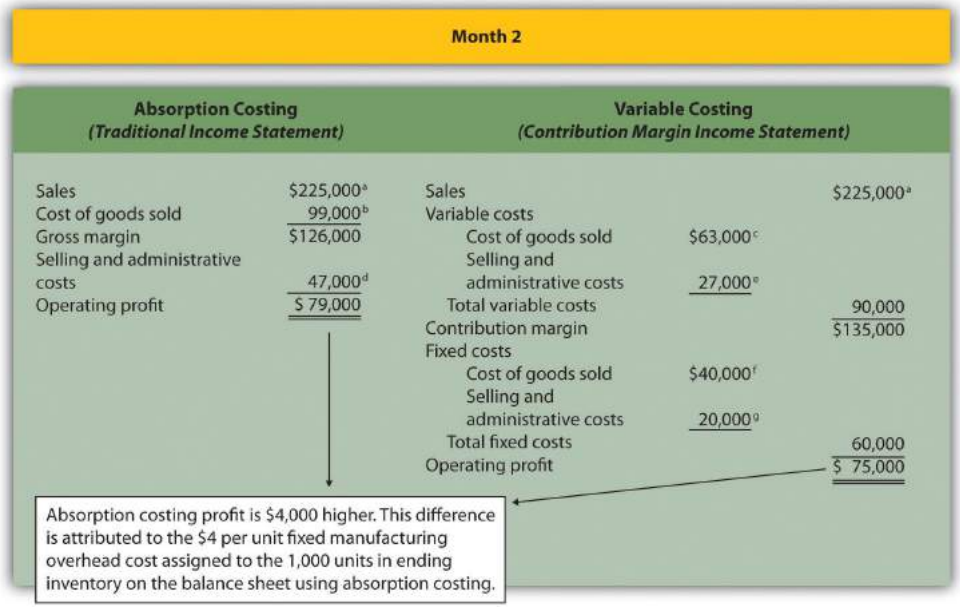
Month 2: Number of Units Produced Is Greater Than Number of Units Sold

Question: During month 2, Bullard Company produces 10,000 units but sells only 9,000 units. How does operating profit compare using absorption costing and variable costing when the number of units produced is greater than the number of units sold?

Answer: Figure 6.10 "Number of Units Produced Is Greater Than Number of Units Sold" presents the results for each costing method. Notice that absorption costing results in higher profit. When absorption costing is used, a portion of fixed manufacturing overhead costs remains in ending inventory as an asset on the balance sheet until the goods are sold. However, variable costing requires that all fixed manufacturing overhead costs be expensed as incurred regardless of the level of sales. Thus when more units are produced than are sold, variable costing results in higher costs and lower profit.

The difference in profit between the two methods of $4,000 (= $79,000 – $75,000) is attributed to the $4 per unit fixed manufacturing overhead cost assigned to the 1,000 units in ending inventory using absorption costing ($4,000 = $4 × 1,000 units).

Figure 6.10 *Number of Units Produced Is Greater Than Number of Units Sold*



[a] *$225,000 = $25 × 9,000 units sold.*

[b] *$99,000 = ($4 per unit fixed production cost × 9,000 units sold) + ($7 per unit variable production cost × 9,000 units sold).*

[c] *$63,000 = $7 per unit variable production cost × 9,000 units sold.*

[d] *$47,000 = $20,000 fixed selling and admin. cost + ($3 per unit variable selling and admin. cost × 9,000 units sold).*

[e] *$27,000 = $3 per unit variable selling and admin. cost × 9,000 units sold.*

[f] *Variable costing always treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.*

[g] *Given.*

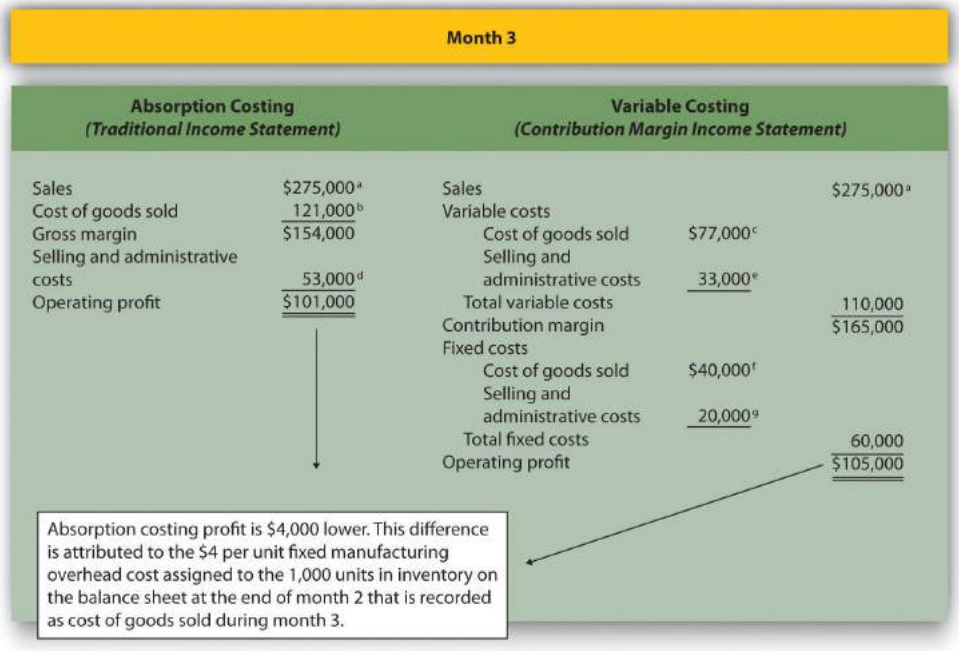
Month 3: Number of Units Produced Is Less Than Number of Units Sold

Question: During month 3, Bullard Company produces 10,000 units but sells 11,000 units (1,000 units were left over from month 2 and therefore were in inventory at the beginning of month 3). How does operating profit compare using absorption costing and variable costing when the number of units produced is less than the number of units sold?

Answer: Figure 6.11 "Number of Units Produced Is Less Than Number of Units Sold" presents the results for each costing method. Using variable costing, the $40,000 in fixed manufacturing overhead costs continues to be expensed when incurred. However, using absorption costing, the entire $40,000 is expensed because all 10,000 units produced were sold; an additional $4,000 related to the 1,000 units produced last month and pulled from inventory this month is also expensed. Thus when fewer units are produced than are sold, absorption costing results in higher costs and lower profit.

The difference in profit between the two methods of $4,000 (= $105,000 – $101,000) is attributed to the $4 per unit fixed manufacturing overhead cost assigned to the 1,000 units in inventory on the balance sheet at the end of month 2 and recorded as cost of goods sold during month 3 using absorption costing ($4,000 = $4 × 1,000 units).

Figure 6.11 Number of Units Produced Is Less Than Number of Units Sold



[a] *$275,000 = $25 × 11,000 units sold.*

[b] *$121,000 = ($4 per unit fixed production cost × 11,000 units sold) + ($7 per unit variable production cost × 11,000 units sold).*

[c] *$77,000 = $7 per unit variable production cost × 11,000 units sold.*

[d] *$53,000 = $20,000 fixed selling and admin. cost + ($3 per unit variable selling and admin. cost × 11,000 units sold).*

[e] *$33,000 = $3 per unit variable selling and admin. cost × 11,000 units sold.*

[f] *Variable costing always treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.*

[g] *Given.*

Advantages of Using Variable Costing

Question: Why do organizations use variable costing?

Answer: Variable costing provides managers with the information necessary to prepare a contribution margin income statement, which leads to more effective cost-volume-profit (CVP) analysis. By separating variable and fixed costs, managers are able to determine contribution margin ratios, break-even points, and target profit points, and to perform sensitivity analysis. Conversely, absorption costing meets the requirements of U.S. GAAP, but is not as useful for internal decision-making purposes.

Another advantage of using variable costing internally is that it prevents managers from increasing production solely for the purpose of inflating profit. For example, assume the manager at Bullard Company will receive a bonus for reaching a certain profit target but expects to be $15,000 short of the target. The company uses absorption costing, and the manager realizes increasing production (and therefore increasing inventory levels) will increase profit. The manager decides to produce 20,000 units in month 4, even though only 10,000 units will be sold. Half of the $40,000 in fixed production cost ($20,000) will be included in inventory at the end of the period, thereby lowering expenses on the income statement and increasing profit by $20,000. At some point, this will catch up to the manager because the company will have excess or obsolete inventory in future months. However, in the short run, the manager will increase profit by increasing production. This strategy does not work with variable costing because all fixed manufacturing overhead costs are expensed as incurred, regardless of the level of sales.

KEY TAKEAWAY

- As shown in Figure 6.8 "Absorption Costing Versus Variable Costing", the only difference between absorption costing and variable costing is in the treatment of fixed manufacturing overhead costs. Absorption costing treats fixed manufacturing overhead as a product cost (included in inventory on the balance sheet until sold), while variable costing treats fixed manufacturing overhead as a period cost (expensed on the income statement as incurred).

  When comparing absorption costing with variable costing, the following three rules apply: (1) When units produced equals units sold, profit is the same for both costing approaches. (2) When units produced is greater than units sold, absorption costing yields the highest profit. (3) When units produced is less than units sold, variable costing yields the highest profit.

REVIEW PROBLEM 6.8

Winter Sports, Inc., produces snowboards. The company has no finished goods inventory at the beginning of year 1. The following information pertains to Winter Sports, Inc.,:

Annual production		100,000 units
Sales price		$200 per unit
Variable production cost per unit		
Direct materials	$60	
Direct labor	30	$130 per unit
Manufacturing overhead	40	
Fixed production costs		$500,000 each year; $5 per unit at 100,000 units of production
Variable selling and administrative cost		$10 per unit
Fixed selling and administrative cost		$800,000 each year

1. All 100,000 units produced during year 1 are sold during year 1.

    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.

2. Although 100,000 units are produced during year 2, only 80,000 are sold during the year. The remaining 20,000 units are in finished goods inventory at the end of year 2.

    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.

Solution to Review Problem 6.8

1.

1. Traditional income statement (absorption costing), year 1:

Sales	$20,000,000[a]
Cost of goods sold	13,500,000[b]
Gross margin	$ 6,500,000
Selling and administrative costs	1,800,000[c]
Operating profit	$ 4,700,000

[a] *$20,000,000 = $200 × 100,000 units sold.*

[b] *$13,500,000 = ($5 per unit fixed production cost × 100,000 units sold) + ($130 per unit variable production cost × 100,000 units sold).*

[c] *$1,800,000 = $800,000 fixed selling and admin. cost + ($10 per unit variable selling and admin. cost × 100,000 units sold).*

2. Contribution margin income statement (variable costing), year 1:

Sales		$20,000,000[a]
Variable costs		
Cost of goods sold	$13,000,000[b]	
Selling and administrative costs	1,000,000[c]	
Total variable costs		14,000,000
Contribution margin		6,000,000
Fixed costs		
Cost of goods sold	$ 500,000[d]	
Selling and administrative costs	800,000[e]	
Total fixed costs		1,300,000
Operating profit		$ 4,700,000

[a] *$20,000,000 = $200 × 100,000 units sold.*

[b] *$13,000,000 = $130 per unit variable production cost × 100,000 units sold.*

[c] *$1,000,000 = $10 per unit variable selling and admin. cost × 100,000 units sold.*

[d] *Variable costing treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.*

[e] *Given.*

2.

1. Traditional income statement (absorption costing), year 2:

Sales	$16,000,000[a]
Cost of goods sold	10,800,000[b]
Gross margin	$ 5,200,000
Selling and administrative costs	1,600,000[c]
Operating profit	$ 3,600,000

[a] *$16,000,000 = $200 × 80,000 units sold.*

[b] *$10,800,000 = ($5 per unit fixed production cost × 80,000 units sold) + ($130 per unit variable production cost × 80,000 units sold).*

2. Contribution margin income statement (variable costing), year 2:

Sales		$16,000,000[a]
Variable costs		
Cost of goods sold	$10,400,000[b]	
Selling and administrative costs	800,000[c]	
Total variable costs		11,200,000
Contribution margin		$ 4,800,000
Fixed costs		
Cost of goods sold	$ 500,000[d]	
Selling and administrative costs	800,000[e]	
Total fixed costs		1,300,000
Operating profit		$ 3,500,000

[a] *$16,000,000 = $200 × 80,000 units sold.*

[b] *$10,400,000 = $130 per unit variable production cost × 80,000 units sold.*

[c] *$800,000 = $10 per unit variable selling and admin. cost × 80,000 units sold.*

[d] *Variable costing treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.*

[e] *Given.*

END-OF-CHAPTER EXERCISES

Questions

1. Describe the components of the profit equation.
2. What is the difference between a variable cost and a fixed cost? Provide examples of each.
3. You are asked to find the break-even point in units and in sales dollars. What does this mean?
4. You are asked to find the target profit in units and in sales dollars. What does this mean?
5. For a company with one product, describe the equation used to calculate the break-even point or target profit in (a) units, and (b) sales dollars.
6. Distinguish between contribution margin per unit and contribution margin ratio.
7. What does the term *margin of safety* mean? How might management use this information?
8. Review Note 6.16 "Business in Action 6.1" How do airlines measure break-even points? In 2001, which airline had the lowest break-even point?
9. How does the break-even point equation change for a company with multiple products or services compared to a single-product company?
10. Describe the assumptions made to simplify the cost-volume-profit analysis described in the chapter.
11. What is sensitivity analysis and how might it help those performing cost-volume-profit analysis?
12. Review Note 6.37 "Business in Action 6.2" What were the owners concerned about with regards to projected profits? What were the results of the calculations made to address the owners' concerns?
13. If you are asked to review the cost structure of an organization, what are you being asked to do?
14. When might the contribution margin per unit of constraint be more effective than the contribution margin per unit for making decisions?
15. Describe the three steps used to calculate the target profit for companies that incur income tax costs.
16. Describe the difference between absorption costing and variable costing.
17. Why do some organizations use variable costing?

Brief Exercises

18. **Planning at Snowboard Company.** Refer to the dialogue at Snowboard Company presented at the beginning of the chapter. What information

is Recilia, vice president of sales, requesting from Lisa, the company accountant? How does Recilia plan on using this information?

19. **Contribution Margin Calculations.** Ace Company sells lawn mowers for $200 per unit. Variable cost per unit is $40, and fixed costs total $4,000. Find (a) the contribution margin per unit, and (b) the contribution margin ratio.
20. **Weighted Average Contribution Margin Calculation.** Radio Control, Inc., sells radio controlled cars for $300 per unit representing 80 percent of total sales, and radio controlled boats for $400 per unit representing 20 percent of total sales. Variable cost per unit is $150 for cars and $300 for boats. Find (a) the contribution margin per unit for each product, and (b) the weighted average contribution margin per unit.
21. **Sensitivity Analysis, Sales Price.** Refer to the base case for Snowboard Company presented in the first column of Figure 6.6 "Sensitivity Analysis for Snowboard Company". Assume the unit sales price decreases by 10 percent. Calculate (a) the new projected profit, (b) the dollar change in profit from the base case, and (c) the percent change in profit from the base case.
22. **Sensitivity Analysis, Unit Sales.** Refer to the base case for Snowboard Company presented in the first column of Figure 6.6 "Sensitivity Analysis for Snowboard Company". Assume the number of units sold increases by 10 percent. Calculate (a) the new projected profit, (b) the dollar change in profit from the base case, and (c) the percent change in profit from the base case.
23. **Operating Leverage.** High operating leverage means:

    1. The company has relatively low fixed costs.
    2. The company has relatively high fixed costs.
    3. The company will have to sell *more* units than a comparable company with low operating leverage to break even.
    4. The company will have to sell *fewer* units than a comparable company with low operating leverage to break even.
    5. Both (2) and (3) are correct.
    6. Both (1) and (4) are correct.

24. **Contribution Margin per Unit of Constraint.** Paint Toys Company sells paint ball guns for $100 per unit. Variable cost is $60 per unit. Each paint ball gun requires 1.25 machine hours and 2.00 direct labor hours to produce. Calculate the contribution margin (a) per unit, (b) per machine hour, and (c) per direct labor hour.
25. **Target Profit with Taxes.** Management of Lakewood Company would like to achieve a target profit after taxes of $300,000. The company's

income tax rate is 40 percent. What target profit before taxes is required to achieve the $300,000 after-tax profit desired by management?

26. **Absorption Costing Versus Variable Costing.** Describe the difference between absorption costing and variable costing. Which approach yields the highest profit when the units produced are greater than the units sold? Explain.

Exercises: Set A

27. **Break-Even Point and Target Profit Measured in Units (Single Product).** Nellie Company has monthly fixed costs totaling $100,000 and variable costs of $20 per unit. Each unit of product is sold for $25.

    Required:

    a. Calculate the contribution margin per unit.
    b. Find the break-even point in units.
    c. How many units must be sold to earn a monthly profit of $40,000?

28. **Break-Even Point and Target Profit Measured in Sales Dollars (Single Product).** Nellie Company has monthly fixed costs totaling $100,000 and variable costs of $20 per unit. Each unit of product is sold for $25 (these data are the same as the previous exercise):

    Required:

    a. Calculate the contribution margin ratio.
    b. Find the break-even point in sales dollars.
    c. What amount of sales dollars is required to earn a monthly profit of $60,000?

29. **Margin of Safety (Single Product).** Nellie Company has monthly fixed costs totaling $100,000 and variable costs of $20 per unit. Each unit of product is sold for $25 (these data are the same as the previous exercise). Assume Nellie Company expects to sell 24,000 units of product this coming month.

    Required:

a. Find the margin of safety in units.
b. Find the margin of safety in sales dollars.

30. **Break-Even Point and Target Profit Measured in Units (Multiple Products).** Hi-Tech Incorporated produces two different products with the following monthly data.

	Cell	GPS	Total
Selling price per unit	$100	$400	
Variable cost per unit	$ 40	$240	
Expected unit sales	21,000	9,000	30,000
Sales mix	70 percent	30 percent	100 percent
Fixed costs			$1,800,000

Assume the sales mix remains the same at all levels of sales.

Required:

a. Calculate the weighted average contribution margin per unit.
b. How many units in total must be sold to break even?
c. How many units of each product must be sold to break even?
d. How many units in total must be sold to earn a monthly profit of $180,000?
e. How many units of each product must be sold to earn a monthly profit of $180,000?

31. **Break-Even Point and Target Profit Measured in Sales Dollars (Multiple Products).** Hi-Tech Incorporated produces two different products with the following monthly data (these data are the same as the previous exercise).

	Cell	GPS	Total
Selling price per unit	$100	$400	
Variable cost per unit	$ 40	$240	
Expected unit sales	21,000	9,000	30,000
Sales mix	70 percent	30 percent	100 percent

Fixed costs			$1,800,000

Assume the sales mix remains the same at all levels of sales.

Required:

Round your answers to the nearest hundredth of a percent and nearest dollar where appropriate. (An example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $379.)

a. Using the information provided, prepare a contribution margin income statement for the month similar to the one in Figure 6.5 "Income Statement for Amy's Accounting Service".
b. Calculate the weighted average contribution margin ratio.
c. Find the break-even point in sales dollars.
d. What amount of sales dollars is required to earn a monthly profit of $540,000?
e. Assume the contribution margin income statement prepared in requirement **a** is the company's base case. What is the margin of safety in sales dollars?

32. **Changes in Sales Mix.** Hi-Tech Incorporated produces two different products with the following monthly data (these data are the same as the previous exercise).

	Cell	**GPS**	**Total**
Selling price per unit	$100	$400	
Variable cost per unit	$ 40	$240	
Expected unit sales	21,000	9,000	30,000
Sales mix	70 percent	30 percent	100 percent
Fixed costs			$1,800,000

Required:

a. If the sales mix shifts to 50 percent Cell and 50 percent GPS, would the break-even point in units increase or decrease?

Explain. (Detailed calculations are not necessary but may be helpful in confirming your answer.)

b. Go back to the original projected sales mix. If the sales mix shifts to 80 percent Cell and 20 percent GPS, would the break-even point in units increase or decrease? Explain. (Detailed calculations are not necessary but may be helpful in confirming your answer.)

33. **CVP Sensitivity Analysis (Single Product).** Bridgeport Company has monthly fixed costs totaling $200,000 and variable costs of $40 per unit. Each unit of product is sold for $50. Bridgeport expects to sell 30,000 units each month (this is the base case).

Required:

For each of the independent situations in requirements **b** through **d**, assume that the number of units sold remains at 30,000.

a. Prepare a contribution margin income statement for the base case.
b. Refer to the base case. What would the operating profit be if the unit sales price increases 10 percent?
c. Refer to the base case. What would the operating profit be if the unit variable cost decreases 20 percent?
d. Refer to the base case. What would the operating profit be if total fixed costs decrease 20 percent?

34. **CVP Sensitivity Analysis (Multiple Products).** Gonzalez Company produces two different products that have the following monthly data (this is the base case).

	Cruiser	**Racer**	**Total**
Selling price per unit	$300	$1,200	
Variable cost per unit	$120	$ 720	
Expected unit sales	1,400	600	2,000
Sales mix	70 percent	30 percent	100 percent

Fixed costs			$180,000

Required:

For each of the independent situations in requirements **b** through **d**, assume that total sales remains at 2,000 units.

a. Prepare a contribution margin income statement.
b. Refer to the base case. What would the operating profit be if the Cruiser sales price (1) increases 20 percent, or (2) decreases 20 percent?
c. Refer to the base case. What would the operating profit be if the Cruiser sales volume increases 400 units with a corresponding decrease of 400 units in Racer sales?
d. Refer to the base case. What would the operating profit be if total fixed costs increase five percent? Does this increase in fixed costs result in higher operating leverage or lower operating leverage? Explain.

35. **Contribution Margin with Resource Constraints.** CyclePath Company produces two different products that have the following price and cost characteristics.

	Bicycle	**Tricycle**
Selling price per unit	$200	$100
Variable cost per unit	$120	$ 50

Management believes that pushing sales of the Bicycle product would maximize company profits because of the high contribution margin per unit for this product. However, only 50,000 labor hours are available each year, and the Bicycle product requires 4 labor hours per unit while the Tricycle model requires 2 labor hours per unit. The company sells everything it produces.

Required:

a. Calculate the contribution margin per unit of constrained resource for each model.

b. Which model would CyclePath prefer to sell to maximize overall company profit? Explain.

36. **Target Profit Measured in Units (with Taxes).** Optical Incorporated has annual fixed costs totaling $6,000,000 and variable costs of $350 per unit. Each unit of product is sold for $500. Assume a tax rate of 20 percent.

Required:

Use the three steps described in the chapter to determine how many units must be sold to earn an annual profit of $100,000 after taxes. (Round to the nearest unit.)

37. **Target Profit Measured in Sales Dollars (with Taxes).** Optical Incorporated has annual fixed costs totaling $6,000,000 and variable costs of $350 per unit. Each unit of product is sold for $500. Assume a tax rate of 20 percent (these data are the same as the previous exercise).

Required:

Use the three steps described in the chapter to determine the sales dollars required to earn an annual profit of $150,000 after taxes.

38. **Absorption Costing Versus Variable Costing.** Technic Company produces portable CD players. The company has no finished goods inventory at the beginning of year 1. The following information pertains to Technic Company.

Annual production		50,000 units
Sales price		$40 per unit
Variable production cost per unit		
Direct materials	$10	
Direct labor	3	$25 per unit
Manufacturing overhead	12	
Fixed production costs		$150,000 each year; $3 per unit at 50,000 units of production
Variable selling and administrative cost		$1 per unit
Fixed selling and administrative cost		$100,000 each year

Required:

a. All 50,000 units produced during year 1 are sold during year 1.

   1. Prepare a traditional income statement assuming the company uses absorption costing.
   2. Prepare a contribution margin income statement assuming the company uses variable costing.

b. Although 50,000 units are produced during year 2, only 40,000 are sold during the year. The remaining 10,000 units are in finished goods inventory at the end of year 2.

   1. Prepare a traditional income statement assuming the company uses absorption costing.
   2. Prepare a contribution margin income statement assuming the company uses variable costing.

Exercises: Set B

39. **Break-Even Point and Target Profit Measured in Units (Single Product).** Phan Incorporated has annual fixed costs

totaling $6,000,000 and variable costs of $350 per unit. Each unit of product is sold for $500.

Required:

a. Calculate the contribution margin per unit.
b. Find the break-even point in units.
c. How many units must be sold to earn an annual profit of $750,000?

40. **Break-Even Point and Target Profit Measured in Sales Dollars (Single Product).** Phan Incorporated has annual fixed costs totaling $6,000,000 and variable costs of $350 per unit. Each unit of product is sold for $500 (these data are the same as the previous exercise).

Required:

a. Calculate the contribution margin ratio.
b. Find the break-even point in sales dollars.
c. What amount of sales dollars is required to earn an annual profit of $300,000?

41. **Margin of Safety (Single Product).** Phan Incorporated has annual fixed costs totaling $6,000,000 and variable costs of $350 per unit. Each unit of product is sold for $500 (these data are the same as the previous exercise). Assume Phan Incorporated expects to sell 51,000 units of product this coming year.

Required:

a. Find the margin of safety in units.
b. Find the margin of safety in sales dollars.

42. **Break-Even Point and Target Profit Measured in Units (Multiple Products).** Advanced Products Company produces three different CDs with the following annual data.

	Music	Data	DVD	Total

Selling price per unit	$10	$4	$12	
Variable cost per unit	$ 3	$1	$ 3	
Expected unit sales	8,000	10,000	22,000	40,000
Sales mix	20 percent	25 percent	55 percent	100 percent
Fixed costs				$205,900

Assume the sales mix remains the same at all levels of sales.

Required:

(Round all answers to the nearest cent and nearest unit where appropriate.)

a. Calculate the weighted average contribution margin per unit.
b. How many units in total must be sold to break even?
c. How many units of each product must be sold to break even?
d. How many units in total must be sold to earn an annual profit of $200,000?
e. How many units of each product must be sold to earn an annual profit of $200,000?

43. **Break-Even Point and Target Profit Measured in Sales Dollars (Multiple Products).** Advanced Products Company produces three different CDs with the following annual data (these data are the same as the previous exercise).

	Music	**Data**	**DVD**	**Total**
Selling price per unit	$10	$4	$12	
Variable cost per unit	$ 3	$1	$ 3	
Expected unit sales	8,000	10,000	22,000	40,000

Sales mix	20 percent	25 percent	55 percent	100 percent
Fixed costs				$205,900

Assume the sales mix remains the same at all levels of sales.

Required:

Round your answers to the nearest hundredth of a percent and nearest dollar where appropriate. (An example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $379.)

a. Using the information provided, prepare a contribution margin income statement similar to the one in Figure 6.5 "Income Statement for Amy's Accounting Service".
b. Calculate the weighted average contribution margin ratio.
c. Find the break-even point in sales dollars.
d. What amount of sales dollars is required to earn an annual profit of $200,000?
e. Assume the contribution margin income statement prepared in requirement **a** is the company's base case. What is the margin of safety in sales dollars?

44. **Changes in Sales Mix.** Advanced Products Company produces three different CDs with the following annual data (these data are the same as the previous exercise).

	Music	**Data**	**DVD**	**Total**
Selling price per unit	$10	$4	$12	
Variable cost per unit	$ 3	$1	$ 3	
Expected unit sales	8,000	10,000	22,000	40,000
Sales mix	20 percent	25 percent	55 percent	100 percent
Fixed costs				$205,900

Required:

If the sales mix shifts more toward the Data product than the other two products, would the break-even point in units increase or decrease? Explain. (Detail calculations are not necessary, but may be helpful in confirming your answer.)

45. **CVP Sensitivity Analysis (Single Product).** Skyler Incorporated has monthly fixed costs of $1,000,000 and variable costs of $24 per unit. Each unit of product is sold for $120. Skyler expects to sell 15,000 units each month (this is the base case).

Required:

For each of the independent situations in requirements **b** through **d**, assume that the number of units sold remains at 15,000. (Round to the nearest cent where appropriate.)

a. Prepare a contribution margin income statement for the base case.
b. Refer to the base case. What would the operating profit be if the unit sales price decreases 10 percent?
c. Refer to the base case. What would the operating profit be if the unit variable cost increases 10 percent?
d. Refer to the base case. What would the operating profit be if total fixed costs decrease 20 percent?

46. **CVP Sensitivity Analysis (Multiple Products).** CyclePath Company produces two different products that have the following annual data (this is the base case).

	Bicycle	**Tricycle**	**Total**
Selling price per unit	$200	$100	
Variable cost per unit	$120	$ 50	
Expected unit sales	5,000	20,000	25,000
Sales mix	20 percent	80 percent	100 percent
Fixed costs			$1,000,000

Required:

For each of the independent situations in requirements **b** through **d**, assume that total sales remains at 25,000 units.

a. Prepare a contribution margin income statement for the base case.
b. Refer to the base case. What would the operating profit be if the Tricycle sales price (1) increases 10 percent, or (2) decreases 10 percent?
c. Refer to the base case. What would the operating profit be if Bicycle sales volume decreases 500 units and there is a corresponding increase of 500 units in Tricycle sales?
d. Refer to the base case. What would the operating profit be if total fixed costs decrease 10 percent? Does this decrease in fixed costs result in higher operating leverage or lower operating leverage? Explain.

47. **Contribution Margin with Resource Constraints.** CyclePath Company produces two different products that have the following price and cost characteristics.

	Bicycle	**Tricycle**
Selling price per unit	$200	$100
Variable cost per unit	$120	$ 50

Management believes that pushing sales of the Bicycle product would maximize company profits because of the high contribution margin per unit for this product. However, only 23,000 machine hours are available each year, and the Bicycle product requires 2 machine hours per unit while the Tricycle model requires 1 machine hour per unit. The company sells everything it produces.

Required:

a. Calculate the contribution margin per unit of constrained resource for each model.
b. Which model would CyclePath prefer to sell to maximize overall company profit? Explain.

48. **Target Profit Measured in Units (with Taxes).** Martis Company has annual fixed costs totaling $4,000,000 and variable costs of $300 per unit. Each unit of product is sold for $400. Assume a tax rate of 20 percent.

    Required:

    Use the three steps described in the chapter to determine how many units must be sold to earn an annual profit of $500,000 after taxes. (Round to the nearest unit.)

49. **Target Profit Measured in Sales Dollars (with Taxes).** Martis Company has annual fixed costs totaling $4,000,000 and variable costs of $300 per unit. Each unit of product is sold for $400. Assume a tax rate of 20 percent (these data are the same as the previous exercise).

    Required:

    Use the three steps described in the chapter to determine the sales dollars required to earn an annual profit of $1,000,000 after taxes.

50. **Absorption Costing Versus Variable Costing.** Photo Company produces digital cameras. The company has no finished goods inventory at the beginning of year 1. The following information pertains to Photo Company.

Annual production		60,000 units
Sales price		$80 per unit
Variable production cost per unit		
Direct materials	$12	$30 per unit
Direct labor	8	
Manufacturing overhead	10	
Fixed production costs		$240,000 each year; $4 per unit at 60,000 units of production
Variable selling and administrative cost		$2 per unit
Fixed selling and administrative cost		$80,000 each year

Required:

a. All 60,000 units produced during year 1 are sold during year 1.

   1. Prepare a traditional income statement assuming the company uses absorption costing.
   2. Prepare a contribution margin income statement assuming the company uses variable costing.

b. Although 60,000 units are produced during year 2, only 40,000 are sold during the year. The remaining 20,000 units are in finished goods inventory at the end of year 2.

   1. Prepare a traditional income statement assuming the company uses absorption costing.
   2. Prepare a contribution margin income statement assuming the company uses variable costing.

Problems

51. **CVP and Sensitivity Analysis (Single Product).** Madera Company has annual fixed costs totaling $120,000 and variable costs of $3 per unit. Each unit of product is sold for $15. Madera expects to sell 12,000 units this year (this is the base case).

    Required:

    a. Find the break-even point in units.
    b. How many units must be sold to earn an annual profit of $50,000? (Round to the nearest unit.)
    c. Find the break-even point in sales dollars.
    d. What amount of sales dollars is required to earn an annual profit of $70,000?
    e. Find the margin of safety in units and in sales dollars.
    f. Prepare a contribution margin income statement for the base case.

g. What will the operating profit (loss) be if the sales price decreases 30 percent? (Assume total sales remains at 12,000 units, and round to the nearest cent where appropriate.)
h. Go back to the base case. What will the operating profit (loss) be if the variable cost per unit increases 10 percent? (Assume total sales remains at 12,000 units, and round to the nearest cent where appropriate.)

52. **CVP Analysis and Cost Structure (Single Product).** Riviera Incorporated produces flat panel televisions. The company has annual fixed costs totaling $10,000,000 and variable costs of $600 per unit. Each unit of product is sold for $1,000. Riviera expects to sell 70,000 units this year.

Required:

a. Find the break-even point in units.
b. How many units must be sold to earn an annual profit of $2,000,000?
c. Find the break-even point in sales dollars.
d. What amount of sales dollars is required to earn an annual profit of $500,000?
e. Find the margin of safety in units.
f. Find the margin of safety in sales dollars.
g. How much will operating profit change if fixed costs are 15 percent higher than anticipated? Would this increase in fixed costs result in higher or lower operating leverage? Explain.

53. **CVP Analysis with Taxes (Single Product).** Riviera Incorporated produces flat panel televisions. The company has annual fixed costs totaling $10,000,000 and variable costs of $600 per unit. Each unit of product is sold for $1,000. Riviera expects to sell 70,000 units this year (this is the same data as the previous problem). Assume a tax rate of 30 percent.

Required:

Round all calculations to the nearest dollar and nearest unit where appropriate.

a. How many units must be sold to earn an annual profit of $2,000,000 after taxes?
b. What amount of sales dollars is required to earn an annual profit of $500,000 after taxes?
c. Refer to requirement **a**. What would happen to the number of units required to earn $2,000,000 in operating profit if the company were a non-profit organization that did not incur income taxes? Explain. (Detailed calculations are not necessary but may be helpful in confirming your answer.)

54. **CVP Analysis and Sales Mix (Multiple Products).** Sierra Books Incorporated produces two different products with the following monthly data (this is the base case).

	Text	**Lecture Notes**	**Total**
Selling price per unit	$100	$12	
Variable cost per unit	$ 60	$ 3	
Expected unit sales	21,000	14,000	35,000
Sales mix	60 percent	40 percent	100 percent
Fixed costs			$750,000

Assume the sales mix remains the same at all levels of sales except for requirement **i.**

Required:

Round to the nearest unit of product, hundredth of a percent, and nearest cent where appropriate. (An example for unit calculations is 3,231.15 = 3,231; an example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $378.98.)

a. Calculate the weighted average contribution margin per unit.

b.

1. How many units in total must be sold to break even?
2. How many units of each product must be sold to break even?

c.

1. How many units in total must be sold to earn a monthly profit of $100,000?
2. How many units of each product must be sold to earn a monthly profit of $100,000?

d. Using the base case information, prepare a contribution margin income statement for the month similar to the one in Figure 6.5 "Income Statement for Amy's Accounting Service".
e. Calculate the weighted average contribution margin ratio.
f. Find the break-even point in sales dollars.
g. What amount of sales dollars is required to earn a monthly profit of $80,000?
h. Assume the contribution margin income statement prepared in requirement **d** is the company's base case. What is the margin of safety in sales dollars?
i. If the sales mix shifts more toward the Text product than the Lecture Notes product, would the break-even point in units increase or decrease? Explain. (Detail calculations are not necessary, but may be helpful in confirming your answer.)

55. **CVP Analysis and Cost Structure (Service Company).** Conway Electrical Services provides services to two types of clients: residential and commercial. The company's contribution margin income statement for the year is shown (this is the base case). Fixed costs are known in total, but Conway does not allocate fixed costs to each department.

	Residential	Commercial	Total
Sales	$600,000	$900,000	$1,500,000
Variable costs	100,000	275,000	375,000
Contribution margin	$500,000	$625,000	$1,125,000
Fixed costs			600,000
Operating profit			$ 525,000

Required:

a. Find the break-even point in sales dollars.
b. What is the margin of safety in sales dollars?
c. What amount of sales dollars is required to earn an annual profit of $750,000?
d. Refer to the base case shown previously. What would the operating profit be if the Commercial variable costs are 20 percent higher than originally anticipated? How does this increase in Commercial variable costs impact the operating leverage of the company?

56. **CVP and Sensitivity Analysis, Resource Constraint (Multiple Products).** Hobby Shop Incorporated produces three different models with the following annual data (this is the base case).

	Plane	**Car**	**Boat**	**Total**
Selling price per unit	$20	$14	$24	
Variable cost per unit	$ 5	$ 7	$ 8	
Expected unit sales	30,000	50,000	20,000	100,000
Sales mix	30 percent	50 percent	20 percent	100 percent
Fixed costs				$650,000

Assume the sales mix remains the same at all levels of sales except for requirements **i** and **j**.

Required:

Round to the nearest unit of product, hundredth of a percent, and nearest cent where appropriate. (An example for unit calculations is 3,231.151 = 3,231; an example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $378.98.)

a. Calculate the weighted average contribution margin per unit.

b.

1. How many units in total must be sold to break even?
2. How many units of each product must be sold to break even?

c.

1. How many units in total must be sold to earn an annual profit of $500,000?
2. How many units of each product must be sold to earn an annual profit of $500,000?

d. Using the base case information, prepare a contribution margin income statement for the year similar to the one in Figure 6.5 "Income Statement for Amy's Accounting Service".
e. Calculate the weighted average contribution margin ratio.
f. Find the break-even point in sales dollars.
g. What amount of sales dollars is required to earn an annual profit of $400,000?
h. Go back to the base case contribution margin income statement prepared in requirement **d**. What would the operating profit be if the Plane sales price (1) increases 10 percent, or (2) decreases 10 percent? (Assume total sales remains at 100,000 units.)
i. Go back to the base case contribution margin income statement prepared in requirement **d**. If the sales mix shifts more toward the Car product than to the other two products, would the break-even point in units increase or decrease? (Detailed calculations are not necessary.) Explain.
j. Assume the company has a limited number of labor hours available in production, and management would like to make efficient use of these labor hours. The Plane product requires 4 labor hours per unit, the Car product requires 3 labor hours per unit, and the Boat product requires 5 hours per unit. The company sells everything it produces. Based on this information, calculate the contribution margin per labor hour for each model (round to the nearest cent), and determine the top two models the company would prefer to sell to maximize overall company profit.

57. **Absorption Costing Versus Variable Costing.** Wall Tech Company produces wood siding. The company has no finished goods inventory at the beginning of year 1. The following information pertains to Wall Tech Company.

Annual production	200,000 units
Sales price	$30 per unit
Variable production cost per unit	
Direct materials	$8
Direct labor	3 } $15 per unit
Manufacturing overhead	4
Fixed production costs	$1,000,000 each year; $5 per unit at 200,000 units of production
Variable selling and administrative cost	$2 per unit
Fixed selling and administrative cost	$800,000 each year

Required:

a. All 200,000 units produced during year 1 are sold during year 1.

   1. Prepare a traditional income statement assuming the company uses absorption costing.
   2. Prepare a contribution margin income statement assuming the company uses variable costing.

b. Although 200,000 units are produced during year 2, only 170,000 units are sold during the year. The remaining 30,000 units are in finished goods inventory at the end of year 2.

   1. Prepare a traditional income statement assuming the company uses absorption costing.
   2. Prepare a contribution margin income statement assuming the company uses variable costing.

c. Although 200,000 units are produced during year 3, a total of 230,000 units are sold during the year. The

30,000 units remaining in inventory at the end of year 2 are sold during year 3.

1. Prepare a traditional income statement assuming the company uses absorption costing.
2. Prepare a contribution margin income statement assuming the company uses variable costing.

d. Analyze the results in years 1 through 3 (requirements **a** through **c**).

One Step Further: Skill-Building Cases

58. **Internet Project: CVP Analysis.** Using the Internet, go to the Web site for **Nordstrom, Inc.** (http://www.nordstrom.com), and select *investor relations*. Find the most recent annual report and print the income statement (called the *consolidated statements of earnings*).

Required:

a. Calculate the gross profit percentage (also called the *gross margin percentage*) by dividing the gross profit by net sales.
b. Explain how the gross profit percentage is different than the contribution margin ratio (no calculations are necessary)?

59. **Decision Making: Automated Versus Labor Intensive Production.** Wood Furniture, Inc., builds high-quality wood desks. Management of the company is considering going from a labor-intensive process of building desks to an automated process that requires expensive machinery and equipment. If the company moves to an automated process, variable production costs will decrease (direct materials, direct labor, and variable manufacturing overhead) due to improved efficiency, and fixed production costs will increase as a result of additional depreciation costs. The costs predicted for the coming year are shown. The selling price is expected to be $900 per unit for both processes.

	Labor-Intensive Process	Automated Process
Variable cost of goods sold	$490 per unit	$290 per unit
Fixed cost of goods sold (annual)	$1,000,000	$2,600,000
Variable selling and administrative	$10 per unit	$10 per unit
Fixed selling and admin. (annual)	$400,000	$400,000

Required:

a. Calculate the break-even point in units assuming that (1) the labor-intensive process is used, and (2) the automated process is used.
b. Explain why there is such a significant difference in break-even points between the labor-intensive process and the automated process.
c. Assume Wood Furniture, Inc., expects to produce and sell 8,000 units this coming year and is certain sales will grow by at least 10 percent per year in future years. Calculate the expected operating profit assuming that (1) the labor intensive process is used, and (2) the automated process is used.
d. Using requirement **c** as a guide, explain whether management should stay with the labor-intensive process or switch to an automated process.

60. **Group Activity: Sensitivity Analysis and Decision Making.** Performance Sports produces inflatable rafts used for river rafting. Sales have grown slowly over the years, and cost increases are causing Performance Sports to incur losses. Financial data for the most recent year are shown.

Sales		$2,600,000	(= $2,000 x 1,300 units)
Variable costs			
Cost of goods sold	$1,040,000		(= $800 x 1,300 units)
Selling and administrative costs	390,000		(= $300 x 1,300 units)
Total variable costs		1,430,000	
Contribution margin		$1,170,000	
Fixed costs			
Cost of goods sold	$800,000		
Selling and administrative costs	400,000		
Total fixed costs		1,200,000	
Operating loss		($ 30,000)	

Members of the management group at Performance Sports arrived at these three possible courses of action to return the company to profitability (each scenario is independent of the others):

1. Increase the sales price for each raft by 10 percent, which will cause a 5 percent drop in sales volume. Although sales volume will drop 5 percent, the group believes the increased sales price will more than offset the drop in rafts sold.
2. Decrease the sales price for each raft by 10 percent, which will cause an 8 percent increase in sales volume. Although the sales price will drop by 10 percent, the group believes an increase in rafts sold will more than offset the sales price reduction.
3. Increase advertising costs by $200,000, which will increase sales volume by 15 percent. Although fixed selling and administrative costs will increase by $200,000, the group believes the increase in rafts sold will more than offset the increase in advertising costs.

Required:

Form groups of two to four students and assign one of the three options listed previously to each group. Each group must perform the following requirements:

a. Calculate the projected operating profit (loss) for the option assigned, and determine whether the option is acceptable.
b. Discuss and document the advantages and disadvantages of the option assigned.

c. As a class, discuss each option based on the findings of your group.

61. **Sensitivity Analysis Using Excel.** Refer to the information for Performance Sports in Skill-Building Case 60. Prepare an Excel spreadsheet to calculate the operating profit (loss) for the base case and for each of the three scenarios presented in the case. Using the spreadsheet in the *Computer Application* box in this chapter as a guide, include "data entry" and "sensitivity analysis results" sections, and combine variable cost of goods sold and selling and administrative costs on one line and fixed cost of goods sold and selling and administrative costs on another line.

62. **Ethics: Increasing Production to Boost Profit.** Hauser Company produces heavy machinery used for snow removal. Over half of the production costs incurred by Hauser are related to fixed manufacturing overhead. Although the company has maximum production capacity of 20,000 units per year, only 2,000 units were produced and sold during year 1, yielding $25 million in operating losses. As required by U.S. GAAP, the company uses absorption costing.

    At the beginning of year 2, the board of directors fired the president of the company and began searching for a new president who was willing to make substantial changes to get the company turned around. One candidate, Paul Glezner, indicated he could turn the company around within a year. He felt the company was producing too few products, and could benefit from increased production. The members of the board of directors were impressed and considered Paul's contract demands: $10,000 in base annual salary, plus 30 percent of operating profit. Paul made it clear he would help the company for year 2, but intended to move on after the year ended.

    Management of Hauser Company approached you with Paul's offer and asked you to determine whether the offer is reasonable.

    Required:

a. Assume the company's sales will remain close to 2,000 units in year 2. How does Paul intend to "turn the company around" during year 2?
b. Why do you think Paul insists on leaving the company after year 2?
c. What type of costing system would you recommend Hauser Company use during year 2? Explain.

Comprehensive Case

63. **CVP and Sensitivity Analysis for a Brewpub.** As described in Note 6.37 "Business in Action 6.2", three entrepreneurs were looking for private investors and financial institutions to fund a new brewpub near Sacramento, California. This brewpub was to be called Roseville Brewing Company (RBC).

Brewpubs provide two products to customers: food from the restaurant segment, and freshly brewed beer from the beer production segment. Both segments are typically in the same building, which allows customers to see the beer brewing process.

After months of research, the three entrepreneurs created a financial model that showed the following projections for the first year of operations:

Sales		
Beer sales	$ 781,200	
Food sales	1,074,150	
Other sales	97,650	
Total sales		$1,953,000
Cost of sales		525,358
Gross margin		$1,427,642
Marketing and administrative expenses		1,125,430
Operating profit		$ 302,212

In the process of pursuing capital (cash) through private investors and financial institutions, they were asked several questions. The following is a sample of the questions most commonly asked:

- What is the break-even point?
- What sales dollars will be required to make $200,000? To make $500,000?
- Is the product mix reasonable? (Beer tends to have a higher contribution margin ratio than food, and therefore product mix assumptions are critical to profit projections.)
- What happens to operating profit if the product mix shifts?
- How will changes in price affect operating profit?
- How much does a pint of beer cost to produce?

It became clear that the initial financial model was not adequate for answering these questions. After further research, the entrepreneurs created another financial model that provided the following information for the first year of operations. (Notice that operating profit of $302,212 is the same as in the first model.)

Sales		
Beer sales (40% of total sales)	$ 781,200	
Food sales (55% of total sales)	1,074,150	
Other sales (5% of total sales)	97,650	
Total sales		$1,953,000
Variable costs		
Cost of sales		
Beer (15% of beer sales)	$117,180	
Food (35% of food sales)	375,953	
Other (33% of other sales)	32,225	
Wages of employees (25% of sales)	488,250	
Supplies (1% of sales)	19,530	
Utilities (3% of sales)	58,590	
Other: credit card and miscellaneous (2% of sales)	39,060	
Total variable costs		1,130,788
Contribution margin		$ 822,212
Fixed costs		
Salaries: manager, chef, brewer, and so on	$140,000	
Equipment and building maintenance	30,000	
Advertising	20,000	
Other: cleaning, menus, and miscellaneous	40,000	
Insurance and accounting	40,000	
Property taxes	24,000	
Depreciation	94,000	
Debt service (interest on debt)	132,000	
Total fixed costs		520,000
Operating profit		$ 302,212

Required:

Round your answers to the nearest hundredth of a percent and nearest dollar where appropriate. (An example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $379.)

a. What were potential investors and financial institutions concerned about when asking the questions listed previously?
b. Why was the first financial model inappropriate for answering most of the questions asked by investors and bankers? Be specific.
c. Suppose you are deciding whether to invest in RBC. Which financial ratio would you use to check the reasonableness of RBC's projected operating profit as compared with that of similar businesses?
d. Why is it difficult to answer the question "How much does a pint of beer cost to produce?" Which costs would you include in answering this question?

e. Perform CVP analysis by answering the following questions:

    1. What is the break-even point in sales dollars for RBC?
    2. What is the margin of safety in sales dollars for RBC?
    3. Why is it not possible for RBC to find the break-even point in units?
    4. What sales dollars would be required to achieve an operating profit of $200,000 and of $500,000? What assumptions are made in these calculations?

f. Assume total revenue remains the same, but the product mix changes so that each of the three revenue categories is weighted as follows: food 70 percent, beer 25 percent, other 5 percent. Prepare a contribution margin income statement to reflect these changes. How will this shift in product mix affect operating profit?
g. Although the financial model is important, what other strategic factors should RBC and its investors consider?

Chapter 7

How Are Relevant Revenues and Costs Used to Make Decisions?

Bob Lee is president of Best Boards, Inc., a manufacturer of wakeboards. In the face of stiff competition, Best Boards' profits have declined steadily over the past few years. Bob is concerned about the decline in profits and has instructed Jim Muller, the vice president of operations, to do whatever it takes to reduce costs. In fact, Bob offered to pay Jim a bonus equal to 25 percent of any production cost savings the company achieves during the coming year.

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Jim Muller thinks he has a way to cut costs and earn his bonus, and he approaches Bob Lee and Amy Eckstrom, the company's accountant, to discuss his plan:

Jim:	*Bob and Amy, I hope you've had a chance to review my proposal to outsource production. I think it could save the company thousands of dollars this coming year.*
Bob:	*I did review your proposal. Give me a quick summary of what you have in mind.*
Jim:	*Our staff accountants tell me that the average unit product cost for our wakeboards is about $110, and we make 10,000 wakeboards each year.*
Amy:	*Sounds about right.*
Jim:	*My thought is that we could save substantial amounts of money by having an outside supplier make our wakeboards rather than doing it ourselves. I contacted one reputable wakeboard manufacturer interested in producing the boards for us.*
Bob:	*What did you find?*
Jim:	*They told me the wakeboards could be purchased from them for $70 a board. This amounts to $40 in savings per unit, and $400,000 in total savings! Even after my 25 percent bonus of $100,000, Best Boards would save $300,000.*

Amy:	*Jim has an interesting idea, but there are some issues that should be considered. Jim, you are correct in stating the average unit product cost for our wakeboards is $110 given production of 10,000 units per year. However, it is not accurate to assume we will eliminate $1,100,000, which is $110 per unit cost times 10,000 units, in total production costs by outsourcing production. The average unit cost includes factory equipment lease payments, along with supervisors' salaries, and factory rent. These costs don't go away quickly if we stop production. The equipment lease is for several years, we are locked into a long-term lease for the factory building, and we would have to look at our supervisors' contracts before letting them go.*
Bob:	*Can we get a better idea of which costs would be eliminated by outsourcing production, and which costs would remain?*
Amy:	*Sure. I'll get a team working on this right away.*

Best Boards is facing a decision common to many organizations: whether to build its own product or to have another company build the product. We will come back to this scenario after describing how companies facing such decisions can use *differential analysis* to make wise business decisions.

7.1 Using Differential Analysis to Make Decisions

LEARNING OBJECTIVE

1. Describe the format used for differential analysis.

Differential revenues and costs[1] (also called *relevant revenues and costs* or *incremental revenues and costs*) represent the difference in revenues and costs among alternative courses of action. Analyzing this difference is called **differential analysis**[2] (or *incremental analysis*). We begin with a relatively simple example to establish the format used to perform differential analysis and present more complicated examples later in the chapter. As you work through this example, notice that we also use the contribution margin income statement format presented in Chapter 5 "How Do Organizations Identify Cost Behavior Patterns?" and Chapter 6 "How Is Cost-Volume-Profit Analysis Used for Decision Making?".

Question: Assume Phillips Accountancy provides bookkeeping, tax, and audit services to its clients. Management believes Phillips Accountancy has several unprofitable customers and would like to perform differential analysis to find out how profits would change if Phillips dropped these customers. Alternative 1 includes the annual revenues, costs, and resulting profit if the company keeps all existing customers. Alternative 2 includes the annual revenues, costs, and resulting profit if the company drops what it believes are unprofitable customers. How should management decide whether to keep all existing customers or drop certain customers?

Answer: Figure 7.1 "Differential Analysis for Phillips Accountancy" presents the format used by management to perform differential analysis. In this case, differential analysis is used to evaluate whether Phillips Accounting should keep all customers or drop unprofitable customers. The information in Figure 7.1 "Differential Analysis for Phillips Accountancy" confirms that Phillips Accountancy would be better off dropping the unprofitable customers (Alternative 2), because company profits would increase by $20,000. The general rule is to select the alternative with the highest differential profit. Take a close look at Figure 7.1 "Differential Analysis for Phillips Accountancy" before reading the description of this information that follows.

1. The difference in revenues and costs from one alternative to another (also called *relevant revenues and costs* or *incremental revenues and costs*).
2. The process of analyzing differential revenues and costs from one alternative to another (also called *incremental analysis*).

Figure 7.1 *Differential Analysis for Phillips Accountancy*

	Alternative 1 (Keep All Customers)		Alternative 2 (Drop Unprofitable Customers)		Differential Amount	*Alternative 1 Is*
Sales revenue	$7,000,000	–	$6,000,000	=	$1,000,000	Higher
Variable costs	5,250,000	–	4,500,000	=	750,000	Higher
Contribution margin	$1,750,000	–	$1,500,000	=	$ 250,000	Higher
Fixed costs	450,000	–	180,000	=	270,000	Higher
Profit	$1,300,000	–	$1,320,000	=	$ (20,000)	Lower

Notice that in Figure 7.1 "Differential Analysis for Phillips Accountancy" the columns labeled *Alternative 1* and *Alternative 2* show revenues, costs, and profit for each alternative. The third column, labeled *Differential Amount*, presents the differential revenues and costs and resulting differential profit. Positive amounts appearing in this column indicate Alternative 1 is higher than Alternative 2. Negative amounts appearing in the *Differential Amount* column indicate Alternative 1 is lower than Alternative 2. The fourth column shows whether Alternative 1 is higher or lower than Alternative 2 for each line item.

For example, the differential amount of $1,000,000 for revenue indicates Alternative 1 produces $1,000,000 more in revenue than Alternative 2. The differential amount of $750,000 for variable costs indicates variable costs are $750,000 higher for Alternative 1 than for Alternative 2. Move to the bottom of Figure 7.1 "Differential Analysis for Phillips Accountancy". Notice that the differential amount for profit is negative ($20,000). This indicates that Alternative 1 results in profits that are $20,000 lower than Alternative 2. Thus Alternative 2 (dropping unprofitable customers) is the desirable course of action.

Notice that the columns labeled *Alternative 1* and *Alternative 2* show information in summary form (i.e., no detail is provided for revenues, variable costs, or fixed costs). Some managers may want only this type of summary information, whereas others may prefer more detailed information. It is important to be flexible with the format, to best meet the needs of managers. We will build upon the differential analysis format shown in Figure 7.1 "Differential Analysis for Phillips Accountancy" throughout this chapter, and show how more detail can easily be provided using the same format.

Next, this chapter focuses on how we use differential analysis to assist in making the following types of decisions:

- Make or buy products

- Keep or drop product lines
- Keep or drop customers
- Accept or reject special customer orders

KEY TAKEAWAY

- Differential revenues and costs represent the difference in revenues and costs among alternative courses of action. Analyzing this difference is called differential analysis. Differential analysis is useful in making managerial decisions related to making or buying products, keeping or dropping product lines, keeping or dropping customers, and accepting or rejecting special customer orders.

REVIEW PROBLEM 7.1

Coffee Express is a small coffee shop looking to expand its product offerings beyond coffee. The company is evaluating two alternatives—sandwiches and cookies. Annual projections for sales of sandwiches are as follows: sales, $18,000; variable costs, $13,000; and fixed costs, $500. Annual projections for sales of cookies are as follows: sales, $10,000; variable costs, $3,000; and no additional fixed costs.

Using the format in Figure 7.1 "Differential Analysis for Phillips Accountancy", perform differential analysis to determine which alternative is more profitable, and by how much. Assume adding sandwiches is Alternative 1 and adding cookies is Alternative 2.

Solution to Review Problem 7.1

As shown in the differential analysis given, selling cookies is the most profitable alternative. Selling cookies results in profits of $7,000 for the year, which is $2,500 higher than the sandwich alternative.

	Alternative 1 (add sandwiches)		Alternative 2 (add cookies)		Differential Amount	*Alternative 1 Is*
Sales revenue	$18,000	–	$10,000	=	$ 8,000	Higher
Variable costs	13,000	–	3,000	=	10,000	Higher
Contribution margin	$ 5,000	–	$ 7,000	=	$(2,000)	Lower
Fixed costs	500	–	0	=	500	Higher
Profit	$ 4,500	–	$ 7,000	=	$(2,500)	Lower

7.2 Make-or-Buy Decisions

LEARNING OBJECTIVE

1. Use differential analysis for make-or-buy decisions.

Question: With the differential analysis format in hand, we can now go back to Best Boards, Inc., introduced at the beginning of the chapter. Recall that Best Boards produces each wakeboard for $110, and Jim Muller, vice president of operations, received a bid for $70 per board from an outside manufacturer. Best Boards' president asked the company's accountant, Amy Eckstrom, to investigate whether it makes sense for Best Boards to hire an outside company to produce the wakeboards. What information should Amy provide that will help management make this decision?

Answer: Table 7.1 "Make-or-Buy Decision" presents the costs that the vice president of operations at Best Boards must evaluate in deciding whether to make the wakeboards or buy them from an outside company. This is called a *make-or-buy* decision because the company must decide whether to *make* the product internally or *buy* the product from an outside firm (often called *outsourcing*).

Table 7.1 Make-or-Buy Decision

	Costs to Make Wakeboard	Costs to Buy Wakeboard
Variable production costs	Direct materials	Wakeboards from supplier
	Direct labor	
	Manufacturing overhead	
Fixed production costs	Factory equipment lease	Factory equipment lease
	Factory building rent	Factory building rent
	Supervisor salaries	Supervisor salaries

Determining Differential Product Costs

Question: What information did Amy find to help Best Boards with the decision whether to make their own wakeboards or buy them from an outside supplier?

Answer: After further research, Amy identified the following product costs associated with wakeboard production at Best Boards:

	Per Unit	Total Annual Cost at 2,000 Units
Variable production costs		
Direct materials	$30	$ 300,000
Direct labor	16	160,000
Manufacturing overhead	10	100,000
Fixed production costs		
Factory equipment lease		110,000
Factory building rent		290,000
Production supervisors' salaries		140,000
Total production costs		$1,100,000

Since Best Boards produces 10,000 wakeboards each year, the product cost per unit is $110 (= $1,100,000 ÷ 10,000 units). However, Amy must identify which of the costs listed previously are *differential* costs if the company acquires the wakeboards from an outside producer. That is, Amy must determine which costs will change and which will remain the same. Here's what she found:

- All variable production costs will be eliminated if Best Boards buys the wakeboards rather than making them. These are differential costs.
- The factory equipment lease will continue for several years whether Best Boards makes or buys the wakeboards. This is *not* a differential cost.
- The factory building lease covers several years, so this cost will continue whether Best Boards makes or buys the wakeboards. This is *not* a differential cost.
- One of Best Boards' two production supervisors was hired recently, is paid $50,000 per year, and can be let go if needed. This is a differential cost.
- The other of Best Boards' two production supervisors has been with the company for several years, is paid $90,000 per year, and has five years remaining on her contract. This is *not* a differential cost.

Question: Amy must now prepare a differential analysis to determine which alternative is best for the company. Her analysis appears in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Because the focus of make-or-buy decisions is on product costs, and because sales revenue is not differential to this decision, it is not necessary to include sales revenue in the analysis. This in turn eliminates the need to show the contribution margin or net income. (Even if sales revenue were included, the outcome would remain the same.) What does Amy's analysis tell us?

Figure 7.2 Make-or-Buy Differential Analysis for Best Boards, Inc.

	Alternative 1 (Make Internally)		Alternative 2 (Buy from Outside)		Differential Amount	Alternative 1 Is
Variable costs						
Cost to buy from outside	$ 00		$ 700,000[a]	=	$(700,000)	Lower
Direct materials	300,000	–	0	=	300,000	Higher
Direct labor	160,000	–	0	=	160,000	Higher
Manufacturing overhead	100,000	–	0	=	100,000	Higher
Fixed costs						
Factory equipment lease	110,000	–	110,000	=	0	
Factory building rent	290,000	–	290,000	=	0	
Production supervisors' salaries	140,000	–	90,000[b]	=	50,000	Higher
Total production costs	$1,100,000	–	$1,190,000	=	$ (90,000)	Lower

[a] *$700,000 = $70 per unit × 10,000 units.*

[b] *One supervisor must be paid $90,000 per year even if the company buys the product. The other supervisor, who is paid $50,000 per year, can be let go if the company buys the product.*

Answer: Realizing that the information shown in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." does not provide the savings initially hoped for, Amy presents the unfavorable analysis to Jim Muller and the company's president, Bob Lee. Refer to Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." as you follow Amy's comments to Bob and Jim about her analysis.

Bob:	*Hi, Amy, what have you got for us?*
Amy:	*As you can see from my analysis, outsourcing the production of our wakeboards does not reduce overall production costs.*

Jim:	*How can that be? I got a bid from an outside supplier for $70 per board, and our cost to produce the very same board is $110.*
Amy:	*As I mentioned before, the $110 includes costs that do not go away if we outsource production. Let's look at my analysis. Alternative 1 represents the production costs we incur to make the board ourselves, and Alternative 2 represents the costs we incur if we buy the board from an outside supplier using Jim's quote of $70 each.*
Jim:	*Well, this certainly explains where the $110 product cost per board comes from if we produce the boards ourselves. I see the total cost of $1,100,000. Divide this by 10,000 units produced annually, and the resulting cost per unit is $110.*
Amy:	*Exactly! Now let's look at Alternative 2 more carefully. Although we eliminate all variable product costs such as direct materials and direct labor by outsourcing production, several fixed product costs remain. We still must lease the factory equipment at a rate of $110,000 per year, and the factory building lease of $290,000 per year is in effect for several more years. Also, one of our factory supervisors has a long-term contract for $90,000 per year and cannot be let go any time soon. None of these costs can be eliminated if we outsource production. Add these costs to the $700,000 cost incurred to purchase the boards from a supplier, and the total cost of $1,190,000 is $90,000 higher than if we produce the boards ourselves.*
Bob:	*Perhaps we should consider outsourcing in a few years as these long-term commitments expire. Jim, I commend you for your creative approach to reducing costs, but the numbers don't make it feasible for us to discontinue production and buy the products elsewhere.*

Using a Summary Format for Differential Analysis

Question: The Differential Amount column presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." indicates Best Boards would be better off producing wakeboards internally. However, management may want a more concise explanation of why production costs are $90,000 higher when outsourcing production. How can we present this information in a more concise format?

Answer: We show a more concise presentation in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.", which includes the *Differential Amount* column shown in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." along with a brief description for each item. Look closely at Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." to confirm that the *Differential Amount* column matches Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.", and review the explanation of the difference for each line item. As

you compare these two figures, notice that only differential costs are presented in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.", and therefore costs for the factory equipment lease, factory building rent, and a portion of supervisor salaries are excluded from Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.". That is, costs that do *not* differ from one alternative to another are excluded from the summary differential analysis since this information is irrelevant to the decision. The amounts in parentheses in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc." indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Figure 7.3 *Summary of Differential Analysis for Best Boards, Inc.*

Result of Outsourcing Production of Wakeboards	
Cost increase to buy from outside	$(700,000)
Direct materials cost savings	300,000
Direct labor cost savings	160,000
Manufacturing overhead cost savings	100,000
Supervisor salaries cost savings	50,000
Cost increase from outsourcing	$ (90,000)

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

The analysis shown in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc." is particularly useful if *all* costs are not easily identified, and differential costs can be determined. After all, the goal of differential analysis is to analyze the costs that differ from one alternative to the next.

We often use the term **avoidable cost**[3] to describe a cost that can be avoided, or eliminated, if one alternative is chosen over another. If Best Boards chooses to buy the product from an outside producer, the company avoids such costs as direct materials, direct labor, manufacturing overhead, and the salary of one supervisor. In this context, *avoidable cost* is the same as *differential cost*.

3. A cost that can be avoided, or eliminated, if one alternative is chosen over another.

Business in Action 7.1

Source: Photo courtesy of C.G.P. Grey, http://www.cgpgrey.com/.

Outsourcing Construction

Salt Lake City, Utah, recently built a $65 million library. The library's façade was assembled from precast concrete panels that a company called **Pretecsa** produced in a plant near Mexico City. Trucks hauled 140 truckloads of these panels—each truckload averaging 10 tons—2,350 miles from Mexico City to Salt Lake City. In all, four million pounds of concrete were shipped. As the director of **Pretecsa** noted, "The idea of manufacturing a building a couple of thousand miles away and then exporting it, well it was considered crazy."

The manager in charge of the library construction had tried to obtain the concrete panels from sources in the United States. He stated, "We contacted precast contractors in Phoenix, Denver, and Las Vegas, but they didn't feel they could do it cheaply enough, once you factored in their shipping costs. **Pretecsa's** low-cost labor made up for the higher shipping costs, and they came in the cheapest."

Pretecsa disclosed that it took 163,000 labor hours to produce the concrete panels and charged $2.5 million for all its services, including materials. Labor costs alone in the United States would have been $3 million.

Source: Joel Millman, "Blueprint for Outsourcing," *The Wall Street Journal,* March 3, 2004.

KEY TAKEAWAY

- Differential analysis requires the identification of all revenues and costs that differ from one alternative to another. In general, managers select the alternative with the highest profit. If the only differences between the alternatives are with costs (as in the make-or-buy decision for Best Boards), decision makers would select the alternative with the lowest cost.

REVIEW PROBLEM 7.2

Quality Bikes, Inc., currently produces racing bikes. Management is interested in outsourcing production of these bikes to a reputable manufacturing company that can supply the bikes for $600 per unit. Quality Bikes incurs the following annual production costs to produce 2,000 racing bikes internally:

	Per Unit	Total Annual Cost at 2,000 Units
Variable production costs		
Direct materials	$400	$ 800,000
Direct labor	100	200,000
Manufacturing overhead	50	100,000
Fixed production costs		
Factory building and equipment lease		180,000
Factory insurance		60,000
Production supervisors' salary		70,000
Total production costs		$1,410,000

Outsourcing production eliminates all variable production costs, the production supervisor's salary, and factory insurance costs. Factory building and equipment lease costs will remain the same regardless of the decision to outsource or to produce internally.

1. Perform differential analysis using the format presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Assume making the bike internally is Alternative 1, and buying the bike from an outside manufacturer is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of outsourcing production using the format presented in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.".

Solution to Review Problem 7.2

1.

	Alternative 1 (make internally)		Alternative 2 (buy from outside)		Differential Amount	Alternative 1 Is
Variable costs						
Cost to buy from outside	$ 0	–	$1,200,000[a]	–	$(1,200,000)	Lower
Direct materials	800,000	–	0	–	800,000	Higher
Direct labor	200,000	–	0	–	200,000	Higher
Manufacturing overhead	100,000	–	0	–	100,000	Higher
Fixed costs						
Factory and equipment lease	180,000	–	180,000	–	0	
Factory insurance	60,000	–	0	–	60,000	Higher
Supervisors' salary	70,000	–	0	–	70,000	Higher
Total production costs	$1,410,000	–	$ 1,380,000	–	$ 30,000	Higher

**$1,200,000 = $600 per unit × 2,000 units.*

2. Buying the bikes from an outside supplier is the best alternative. This alternative results in total costs of $1,380,000, providing $30,000 in savings compared to the $1,410,000 cost of producing bikes internally.

3.

Result of Outsourcing Production of Racing Bikes	
Cost increase to buy from outside	$(1,200,000)
Direct materials cost savings	800,000
Direct labor cost savings	200,000
Manufacturing overhead cost savings	100,000
Factory insurance cost savings	60,000
Supervisor's salary cost savings	70,000
Cost savings from outsourcing	$ 30,000

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

7.3 Product Line Decisions

LEARNING OBJECTIVE

1. Use differential analysis for product line decisions.

Question: As competitors enter the market and as products go through life cycles, managers often must decide whether to keep or drop product lines. A **product line**[4] *is a group of related products. The Home Depot, Inc., has many different product lines such as appliances, flooring, and paint products. Ford Motor Co. produces a variety of products such as compact cars, trucks, and tractors. Companies must continually assess whether they should add new product lines, and whether they should discontinue current product lines. Differential analysis provides a format for these types of decisions. How would differential analysis be used to make a product line decision?*

Answer: Let's look at an example of a product line decision. Assume Barbeque Company has three product lines: gas barbecues, charcoal barbecues, and barbecue accessories. Charcoal barbecue sales have declined in recent years, leading management to question whether this product line is worth keeping. Barbeque Company would like to consider two alternatives. Alternative 1 is to retain all three product lines, and Alternative 2 is to eliminate the charcoal barbecues product line. Figure 7.4 "Product Line Decision" shows the decision facing the manager at Barbeque Company: whether to eliminate or keep the charcoal barbecue product line.

4. A group of related products.

Figure 7.4 *Product Line Decision*

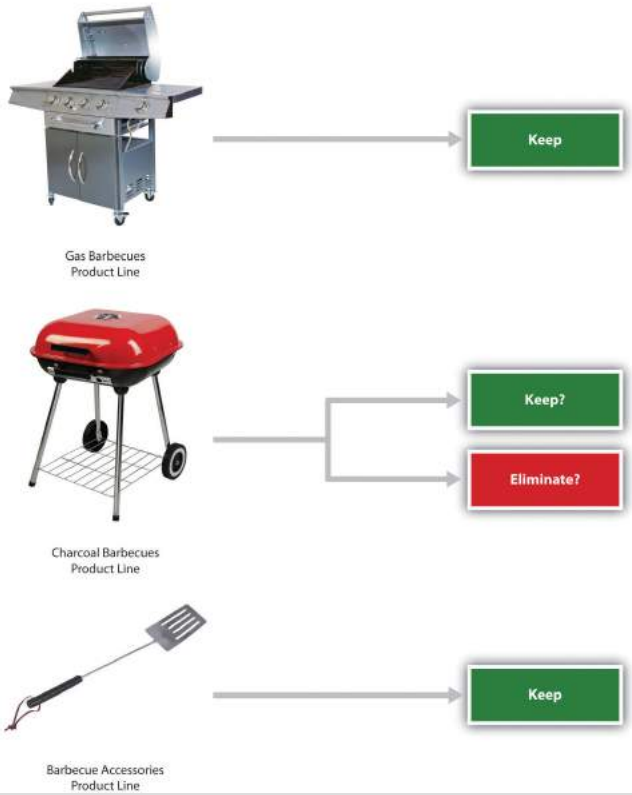


Figure 7.5 "Income Statement for Barbeque Company" presents the income statement for the past year, separated by product line (this is often referred to as a *segmented income statement*). Carefully examine Figure 7.5 "Income Statement for Barbeque Company". Notice that the charcoal barbecues product line shows a loss of $8,000 for the year. This is the reason management would like to consider dropping this product line.

Figure 7.5 *Income Statement for Barbeque Company*

	Product Lines			
	Gas Barbecues	Charcoal Barbecues	Barbecue Accessories	Total
Sales revenue	$450,000	$ 90,000	$60,000	$600,000
Variable costs[a]	110,000	40,000	15,000	165,000
Contribution margin	$340,000	$ 50,000	$45,000	$435,000
Direct fixed costs	60,000	40,000	16,000	116,000
Allocated fixed costs	90,000	18,000	12,000	120,000
Profit (loss)	$190,000	$ (8,000)	$17,000	$199,000

*Includes cost of goods sold and other variable costs.

The variable costs in Figure 7.5 "Income Statement for Barbeque Company" are related directly to each product line, and thus are eliminated if the product line is eliminated. That is, all variable costs are differential costs for the two alternatives facing Barbeque Company.

Question: Notice that two lines appear for fixed costs: direct fixed costs and allocated fixed costs. What is the difference between direct fixed costs and allocated fixed costs?

Answer: **Direct fixed costs**[5] are fixed costs that can be traced directly to a product line. Direct fixed costs are often differential costs. For example, the salary of the manager responsible for charcoal barbecues is easily traced to the charcoal barbecues product line. If this product line is eliminated, the product line manager's salary is also eliminated (unless the product line manager has a long-term employment contract).

Allocated fixed costs[6] (also called *common fixed costs*) are fixed costs that *cannot* be traced directly to a product line, and therefore are assigned to product lines using an allocation process. Allocated fixed costs are typically *not* differential costs. For example, rent paid for Barbeque Company's retail store is allocated to all three product lines because it is not easily traced to each product line. However, the retail store rent likely will not decrease if the charcoal barbecues product line is eliminated (unless the company chooses to move to a smaller, less costly store). The charcoal barbecues' allocation for rent would simply be reallocated to the other two products. Thus rent for the retail store is an example of an allocated fixed cost that is *not* a differential cost for the two alternatives facing Barbeque Company.

5. Fixed costs that can be traced directly to a product line or customer.

6. Fixed costs that cannot be traced directly to a product line or customer, and therefore are assigned to product lines or customers using an allocation process (also called *common fixed costs*).

Question: How are Barbeque Company's allocated fixed costs assigned to individual product lines?

Answer: Barbeque Company's total allocated fixed costs of $120,000 are allocated based on sales. Sales revenue for gas barbecues totals $450,000, which is 75 percent of total company sales (= $450,000 ÷ $600,000). Thus 75 percent of all allocated fixed costs are assigned to the gas barbecues product line. This amounts to $90,000 (= $120,000 × 0.75).

Question: Will dropping the charcoal barbecues product line result in higher company profit?

Answer: The differential analysis presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company" provides the answer. Panel A shows the income statement for Alternative 1: keeping all three product lines. Panel B shows the income statement for Alternative 2: dropping the charcoal barbecues product line. And panel C presents the differential analysis for the two alternatives. The differential analysis in panel C shows that overall profit will *decrease* by $10,000 if the charcoal barbecue product line is dropped.

Figure 7.6 Product Line Differential Analysis for Barbeque Company

Panel A: Alternative 1 (keep all product lines)

	Gas Barbecues	Charcoal Barbecues	Barbecue Accessories	Total
Sales revenue	$450,000	$90,000	$60,000	$600,000
Variable costs	110,000	40,000	15,000	165,000
Contribution margin	$340,000	$50,000	$45,000	$435,000
Direct fixed costs	60,000	40,000	16,000	116,000
Allocated fixed costs	90,000	18,000	12,000	120,000
Profit (loss)	$190,000	$(8,000)	$17,000	$199,000

Panel B: Alternative 2 (drop the charcoal barbecues line)

	Gas Barbecues	Barbecue Accessories		Total
Sales revenue	$450,000	$60,000		$510,000
Variable costs	110,000	15,000		125,000
Contribution margin	$340,000	$45,000		$385,000
Direct fixed costs	60,000	16,000		76,000
Allocated fixed costs	105,882[a]	14,118[b]		120,000
Profit	$174,118	$14,882		$189,000

Panel C: Differential Analysis

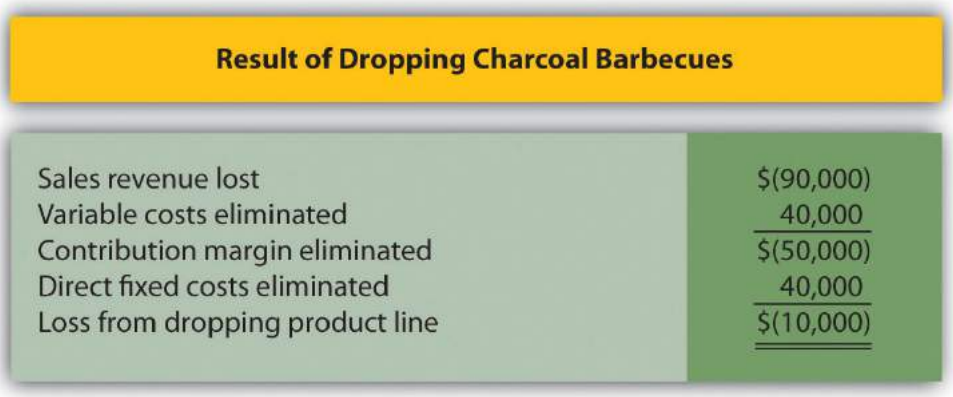
	Alternative 1 Total (keep all product lines; panel A)	Alternative 2 Total (drop charcoal barbecues; panel B)	Differential Amount	*Alternative 1 Is*
Sales revenue	$600,000	$510,000	$90,000	Higher
Variable costs	165,000	125,000	40,000	Higher
Contribution margin	$435,000	$385,000	$50,000	Higher
Direct fixed costs	116,000	76,000	40,000	Higher
Allocated fixed costs	120,000	120,000	0	
Profit	$199,000	$189,000	$10,000	Higher

[a] *$105,882 = ($450,000 ÷ $510,000) × $120,000.*

[b] *$14,118 = ($60,000 ÷ $510,000) × $120,000.*

The *Differential Amount* column in panel C of Figure 7.6 "Product Line Differential Analysis for Barbeque Company" indicates the company would be better off continuing with all three product lines. However, management may want a more concise explanation of why profit is $10,000 higher when all three product lines are maintained. We provide such an explanation in Figure 7.7 "Summary of Differential Analysis for Barbeque Company", which presents the *Differential Amount* column shown in panel C of Figure 7.6 "Product Line Differential Analysis for Barbeque Company" along with a brief description for each item. Take a close look at panel C of Figure 7.6 "Product Line Differential Analysis for Barbeque Company", confirm that the *Differential Amount* column matches Figure 7.7 "Summary of Differential Analysis for Barbeque Company", and review the explanation of the difference.

Figure 7.7 *Summary of Differential Analysis for Barbeque Company*



Result of Dropping Charcoal Barbecues	
Sales revenue lost	$(90,000)
Variable costs eliminated	40,000
Contribution margin eliminated	$(50,000)
Direct fixed costs eliminated	40,000
Loss from dropping product line	$(10,000)

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Figure 7.7 "Summary of Differential Analysis for Barbeque Company" shows that Barbeque Company will lose sales revenue of $90,000 if it drops the charcoal barbecues product line. However, it saves variable costs of $40,000 and direct fixed costs of $40,000 if it drops the charcoal barbecues product line. Because the $80,000 in cost savings is not enough to make up for the $90,000 loss in sales revenue, profit will decline by $10,000 (= $80,000 – $90,000).

Misleading Allocation of Fixed Costs

Question: How can the charcoal barbecues product line show a loss of $8,000 in Figure 7.6 "Product Line Differential Analysis for Barbeque Company", while the company as a whole is better off keeping this product line?

Answer: The answer lies within allocated fixed costs. Even though total allocated fixed costs of $120,000 cannot easily be traced to each product line, company management wants each product line manager to be aware of these costs. As a result, it uses an allocation process to assign the costs to product lines. Thus the charcoal barbecues product line is assigned $18,000 in allocated fixed costs even though these costs cannot be controlled by the product line. If the charcoal barbecues product line is eliminated, $18,000 in allocated fixed costs is not eliminated. Instead, $18,000 in costs is assigned to the other two product lines.

In many situations, this increased allocation to other product lines may cause other product lines to appear unprofitable. The message here is to be careful when analyzing segmented information containing cost allocations. Allocated costs are typically not differential costs, and therefore are typically not relevant to the decision.

An alternative view of the decision facing Barbeque Company—whether to keep or drop the charcoal barbecues product line—is simply to calculate profitability of this product line *before* deducting allocated fixed costs. Figure 7.6 "Product Line Differential Analysis for Barbeque Company" shows a contribution margin of $50,000 for charcoal barbecues. Deduct direct fixed costs of $40,000 and this product line has a remaining profit of $10,000. This explains why Barbeque Company's overall profit would be $10,000 lower if the charcoal barbecues product line were eliminated. (As discussed previously, the allocated fixed costs are irrelevant to this decision.)

Including Opportunity Costs in Differential Analysis

Managers must often consider the impact of opportunity costs when making decisions. An **opportunity cost**[7] is the benefit foregone when one alternative is selected over another. For example, assume you have the choice between going to school and working. The opportunity cost of attending school is the lost wages from working.

Question: In the case of Barbeque Company, assume the company can lease the space currently being used by the charcoal barbecues product line for $25,000 per year. Thus the opportunity cost (benefit foregone) of keeping the charcoal barbecues is $25,000. How does this affect Barbeque Company's decision to keep or drop charcoal barbecues?

Answer: Figure 7.8 "Differential Analysis with Opportunity Cost for Barbeque Company" provides the answer by simply adding one item to Figure 7.7 "Summary of Differential Analysis for Barbeque Company". Barbeque Company would increase profits $15,000 by dropping the charcoal barbecues.

7. The benefit forgone when one alternative is selected over another.

Figure 7.8 *Differential Analysis with Opportunity Cost for Barbeque Company*

Result of Dropping Charcoal Barbecues (with Opportunity Cost)	
Sales revenue lost	$(90,000)
Variable costs eliminated	40,000
Contribution margin eliminated	$(50,000)
Direct fixed costs eliminated	40,000
Loss from dropping product line	$(10,000)
Lease of space formerly used by charcoal barbecues product line	25,000
Profit from dropping product line	$ 15,000

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Opportunity costs can also be included in the differential analysis format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company". Panel C of Figure 7.6 "Product Line Differential Analysis for Barbeque Company" is simply modified to reflect the opportunity cost, as shown.

Panel C: Differential Analysis				
	Alternative 1 Total (keep all product lines; panel A)	Alternative 2 Total (drop charcoal barbecues; panel B)	Differential Amount	*Alternative 1 Is*
Sales revenue	$600,000	$510,000	$90,000	Higher
Variable costs	165,000	125,000	40,000	Higher
Contribution margin	$435,000	$385,000	$50,000	Higher
Direct fixed costs	116,000	76,000	40,000	Higher
Allocated fixed costs	120,000	120,000	0	
Opportunity cost	**25,000**	**0**	**25,000**	**Higher**
Profit	$174,000	$189,000	($15,000)	Lower

Sunk Costs and Differential Analysis

Question: What is a sunk cost, and how do sunk costs affect differential analysis?

Answer: A **sunk cost**[8] is a cost incurred in the past that cannot be changed by future decisions. For example, suppose Barbeque Company must dispose of store equipment related to the charcoal barbecues product line if charcoal barbecues are eliminated. The original cost of this store equipment is a sunk cost and should have no bearing on the decision whether to eliminate charcoal barbecues. As a general rule, sunk costs are not differential costs.

8. A cost incurred in the past that cannot be changed by future decisions.

Business in Action 7.2

Source: Photo courtesy of Paul Sableman, http://www.flickr.com/photos/pasa/5583935536/.

Kmart Sells Stores

The management of **Kmart Corp.**, a mass merchandising company with more than 1,500 stores throughout the United States, agreed to sell 24 stores to **Home Depot** for $365 million in cash. Julian Day, **Kmart's** president and chief executive officer, stated, "We will take advantage of opportunities to create value that include the sale of existing stores."

In deciding whether to sell the stores, management likely considered the differential revenues and costs associated with keeping the stores versus selling them. Perhaps the stores were not profitable enough to exceed the $365 million in cash that **Kmart** received from the sale. Large retail companies with many widely dispersed stores commonly review their unprofitable stores on a regular basis and consider closing or selling stores that cannot turn a profit in the near future.

Source: **Kmart Corp.** press release, June 4, 2004 (http://www.kmartcorp.com).

KEY TAKEAWAY

- Managers often use differential analysis to determine whether to keep or drop a product line. Direct fixed costs are typically eliminated if a product line is eliminated, and are considered differential costs. Allocated fixed costs are typically not eliminated if a product line is eliminated, and are not differential costs. Managers compare sales revenue and costs for each alternative (keep or drop), and select the alternative with the highest profit.

REVIEW PROBLEM 7.3

The following annual income statement is for Austin Appliances, Inc., a maker of electrical appliances:

	Product Lines			
	Blenders	Coffee Makers	Toasters	Total
Sales revenue	$750,000	$1,000,000	$250,000	$2,000,000
Variable costs	320,000	550,000	100,000	970,000
Contribution margin	$430,000	$ 450,000	$150,000	$1,030,000
Direct fixed costs	390,000	320,000	70,000	780,000
Allocated fixed costs	56,250	75,000	18,750	150,000
Profit (loss)	$(16,250)	$ 55,000	$ 61,250	$ 100,000

Austin Appliances is concerned about the losses associated with the blenders product line and is considering dropping this product line. Allocated fixed costs are assigned to product lines based on sales. For example, $56,250 in allocated fixed costs is allocated to the blenders product line based on the blenders product line sales as a percent of total sales [$56,250 = $150,000 × ($750,000 ÷ $2,000,000)]. If Austin Appliances eliminates a product line, total allocated fixed costs are assigned to the remaining product lines. All variable costs and direct fixed costs are differential costs.

1. Using the differential analysis format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company", determine whether Austin Appliances would be better off dropping the blenders product line or keeping the product line. Support your conclusion.
2. Assume Austin Appliances can lease the warehouse space currently being used by the blenders product line for $15,000 per year. How does this affect the company's decision to keep or drop the blenders product line?
3. Summarize the result of dropping the blenders product line and leasing the warehouse space using the format presented in Figure 7.8 "Differential Analysis with Opportunity Cost for Barbeque Company".

Solution to Review Problem 7.3

1. As shown in the differential analysis given here, Austin Appliances would be better off keeping the blenders product line. Dropping this product line would result in a drop in total profit of $40,000.

Alternative 1 (keep all product lines)

	Blenders	Coffee Makers	Toasters	Total
Sales revenue	$750,000	$1,000,000	$250,000	$2,000,000
Variable costs	320,000	550,000	100,000	970,000
Contribution margin	$430,000	$ 450,000	$150,000	$1,030,000
Direct fixed costs	390,000	320,000	70,000	780,000
Allocated fixed costs	56,250	75,000	18,750	150,000
Profit (loss)	$ (16,250)	$ 55,000	$ 61,250	$ 100,000

Alternative 2 (drop the blenders line)

		Coffee Makers	Toasters	Total
Sales revenue		$1,000,000	$250,000	$1,250,000
Variable costs		550,000	100,000	650,000
Contribution margin		$ 450,000	$150,000	$ 600,000
Direct fixed costs		320,000	70,000	390,000
Allocated fixed costs		120,000[a]	30,000[b]	150,000
Profit		$ 10,000	$ 50,000	$ 60,000

Differential Analysis

	Alternative 1 Total (keep all product lines)	Alternative 2 Total (drop blenders)	Differential Amount	*Alternative 1 is:*
Sales revenue	$2,000,000	$1,250,000	$750,000	Higher
Variable costs	970,000	650,000	320,000	Higher
Contribution margin	$1,030,000	$ 600,000	$430,000	Higher
Direct fixed costs	780,000	390,000	390,000	Higher
Allocated fixed costs	150,000	150,000	0	
Profit	$ 100,000	$ 60,000	$ 40,000	Higher

[a] *$120,000 = ($1,000,000 ÷ $1,250,000) × $150,000.*

[b] *$30,000 = ($250,000 ÷ $1,250,000) × $150,000.*

2. The $15,000 opportunity cost of keeping all three product lines would not affect the company's decision to keep the blenders product line. If the blenders are dropped, total profit will decrease by $40,000. Lease revenue of $15,000 is not enough to offset the $40,000 decrease in profit. In this scenario, total profit would decrease by $25,000 (= $40,000 – $15,000). This result is presented formally, as follows:

	Alternative 1 Total (keep all product lines)	Alternative 2 Total (drop blenders)	Differential Amount	*Alternative 1 Is*
Sales revenue	$2,000,000	$1,250,000	$750,000	Higher
Variable costs	970,000	650,000	320,000	Higher
Contribution margin	$1,030,000	$ 600,000	$430,000	Higher
Direct fixed costs	780,000	390,000	390,000	Higher
Allocated fixed costs	150,000	150,000	0	
Opportunity cost	15,000	0	15,000	Higher
Profit	$ 85,000	$ 60,000	$ 25,000	Higher

3.

Result of Dropping Blenders and Leasing Warehouse

Sales revenue lost	$(750,000)
Variable costs eliminated	320,000
Contribution margin eliminated	$(430,000)
Direct fixed costs eliminated	390,000
Lease of space formerly used by blender product line	15,000
Loss from dropping product line	$ (25,000)

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

7.4 Customer Decisions

LEARNING OBJECTIVE

1. Use differential analysis to decide whether to keep or drop customers.

Question: Much like product line decisions, managers often use profitability as a determining factor to decide whether to keep or drop customers. This is an issue for all types of organizations, including manufacturers, retailers, and service companies. How does the differential analysis format differ for customer decisions compared to product line decisions?

Answer: Instead of tracing revenues, variable costs, and fixed costs directly to *product lines*, we track this information by *customer*. Fixed costs that cannot be traced directly to customers are allocated to customers. Let's look at an example for a company called Colony Landscape Maintenance to identify the similarities and differences between the two formats.

Evaluating Customer Information

Question: Colony Landscape Maintenance provides services to three large customers: Brumfield, Hodges, and Orth. The segmented income statement in Figure 7.9 "Income Statement for Colony Landscape Maintenance" provides annual revenue and cost information by customer. Notice that this information is formatted similarly to the product line information in Figure 7.8 "Differential Analysis with Opportunity Cost for Barbeque Company". However, instead of tracking information by product line, here we track information by customer. Examine Figure 7.9 "Income Statement for Colony Landscape Maintenance" carefully and notice that the Brumfield account shows a loss for the year of $15,000. Should Colony Landscape Maintenance drop the Brumfield account?

Answer: To answer this question we must take a closer look at the information in Figure 7.9 "Income Statement for Colony Landscape Maintenance". The variable costs and direct fixed costs are related directly to each customer, and thus are eliminated if Colony eliminates the Brumfield account. That is, all variable costs and direct fixed costs are differential costs for the two alternatives facing Colony.

Colony assigns the allocated fixed costs of $20,000 to Brumfield based on sales revenue, and those costs will continue regardless of Colony's decision. Thus allocated fixed costs are *not* differential costs.

Figure 7.9 *Income Statement for Colony Landscape Maintenance*

	Customers			
	Brumfield	**Hodges**	**Orth**	**Total**
Sales revenue	$200,000	$500,000	$300,000	$1,000,000
Variable costs	170,000	380,000	200,000	750,000
Contribution margin	$ 30,000	$120,000	$100,000	$ 250,000
Direct fixed costs	25,000	40,000	30,000	95,000
Allocated fixed costs	20,000	50,000	30,000	100,000
Profit (loss)	$ (15,000)	$ 30,000	$ 40,000	$ 55,000

Management of Colony Landscape Maintenance would like to know if dropping the Brumfield account would increase overall company profit. The differential analysis presented in Figure 7.10 "Customer Differential Analysis for Colony Landscape Maintenance" provides the answer. Panel A shows the income statement for Alternative 1: keeping all three customers. Panel B shows the income statement for Alternative 2: dropping the Brumfield account. And panel C presents the differential analysis for both alternatives. The differential analysis presented in panel C shows that overall profit will decrease by $5,000 if Colony drops the Brumfield account.

Figure 7.10 Customer Differential Analysis for Colony Landscape Maintenance

Panel A: Alternative 1 (keep all customers)

	Brumfield	Hodges	Orth	Total
Sales revenue	$200,000	$500,000	$300,000	$1,000,000
Variable costs	170,000	380,000	200,000	750,000
Contribution margin	$ 30,000	$120,000	$100,000	$ 250,000
Direct fixed costs	25,000	40,000	30,000	95,000
Allocated fixed costs	20,000	50,000	30,000	100,000
Profit (loss)	$ (15,000)	$ 30,000	$ 40,000	$ 55,000

Panel B: Alternative 2 (drop Brumfield account)

		Hodges	Orth	Total
Sales revenue		$500,000	$300,000	$800,000
Variable costs		380,000	200,000	580,000
Contribution margin		$120,000	$100,000	$220,000
Direct fixed costs		40,000	30,000	70,000
Allocated fixed costs		62,500[a]	37,500[b]	100,000
Profit		$ 17,500	$ 32,500	$ 50,000

Panel C: Differential Analysis

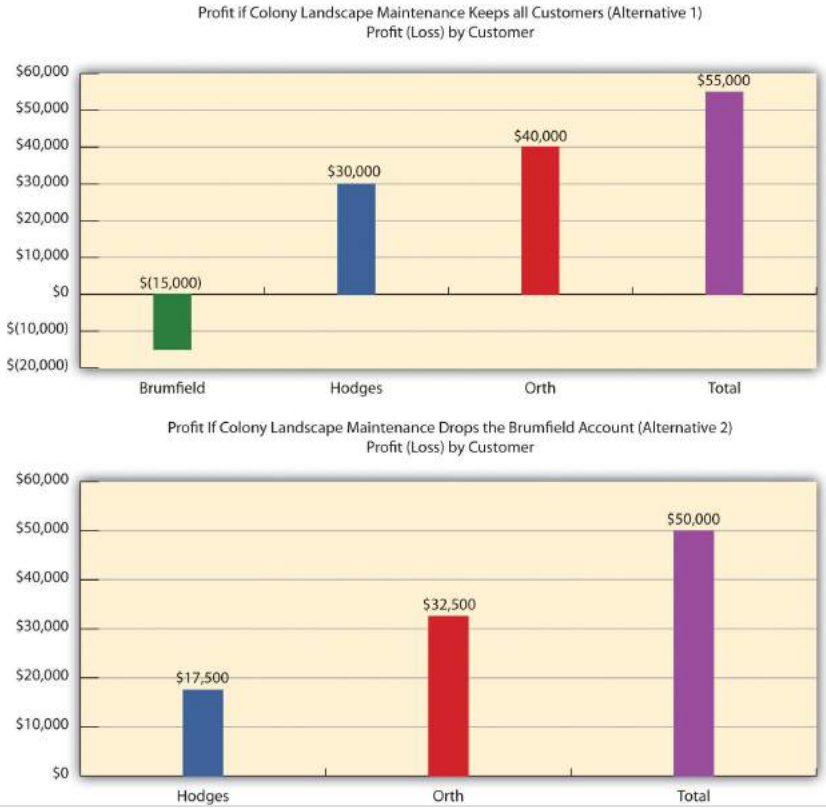
	Alternative 1 Total (keep all customers; panel A)	Alternative 2 Total (drop Brumfield account; panel B)	Differential Amount	*Alternative 1 Is*
Sales revenue	$1,000,000	$800,000	$200,000	Higher
Variable costs	750,000	580,000	170,000	Higher
Contribution margin	$ 250,000	$220,000	$ 30,000	Higher
Direct fixed costs	95,000	70,000	25,000	Higher
Allocated fixed costs	100,000	100,000	0	
Profit	$ 55,000	$ 50,000	$ 5,000	Higher

[a] *$62,500 = ($500,000 ÷ $800,000) × $100,000.*

[b] *$37,500 = ($300,000 ÷ $800,000) × $100,000.*

Figure 7.11 "Keep or Drop Customer" provides a bar chart summarizing how total profit will decrease if the Brumfield account is dropped. This information comes from the bottom of panels A and B in Figure 7.10 "Customer Differential Analysis for Colony Landscape Maintenance".

Figure 7.11 *Keep or Drop Customer*



We show a more concise explanation in Figure 7.12 "Summary of Differential Analysis for Colony Landscape Maintenance", which presents the *Differential Amount* column shown in panel C of Figure 7.10 "Customer Differential Analysis for Colony Landscape Maintenance" along with a brief description of each item.

Figure 7.12 *Summary of Differential Analysis for Colony Landscape Maintenance*

Result of Dropping Brumfield Account	
Sales revenue lost	$(200,000)
Variable costs eliminated	170,000
Contribution margin eliminated	$ (30,000)
Direct fixed costs eliminated	25,000
Loss from dropping customer	$ (5,000)

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

An alternative way of handling the decision facing Colony Landscape Maintenance is simply to calculate profitability of the Brumfield account *before* deducting allocated fixed costs. Figure 7.12 "Summary of Differential Analysis for Colony Landscape Maintenance" shows a contribution margin of $30,000 for the Brumfield account. Deduct direct fixed costs of $25,000 and the customer has a remaining profit of $5,000. This explains why Colony's overall profit would be $5,000 lower if it eliminated the Brumfield account.

Business in Action 7.3

Engineering Firm Fires Its Biggest Customer

The president of **ABCO Automation, Inc.**, a 120-person engineering firm in North Carolina, decided it was time to fire the firm's biggest client. Although the client provided close to 60 percent of the firm's annual revenue, **ABCO** decided that firing this client was necessary. The president of **ABCO** stated, "We cannot be a great place to work without employees, and this client was bullying my employees. Its demands for turnaround were impossible to meet even with people working seven days a week. No client is worth losing my valued employees."

The initial impact on revenues was significant. However, **ABCO** was able to cut costs and obtain new customers to fill the void. In addition, the fired client later gave **ABCO** two new projects on more equitable terms.

The lesson from this is that dropping customers is not always a financial decision. **ABCO's** client was profitable, but in the long run, the firm was at risk of losing valuable employees. This was a risk **ABCO** was not willing to take.

Source: Roger Herman and Joyce Gioia, "Herman Trend Alert," Strategic Business Futurists 2004 (http://www.hermangroup.com).

Using Activity-Based Costing to Assess Customer Profitability

Question: Activity-based costing, which we discussed in Chapter 3 "How Does an Organization Use Activity-Based Costing to Allocate Overhead Costs?", is a refined approach to allocating costs to products or customers. Activity-based costing first assigns costs to activities and then to products or customers based on their use of the activities. The cost information provided by activity-based costing is generally regarded as more accurate than most traditional costing methods. How can using activity-based costing information with differential analysis lead to better decisions in areas such as product lines and customer profitability?

Answer: Let's look at a brief example of how activity-based costing can help with customer profitability. When assessing customer profitability, costs can be assigned to customers based on each customer's use of activities. Consultants from **PricewaterhouseCoopers** suggest that customer costs are measurable across four categories of activities:Joseph A. Ness, Michael J. Schroeck, Rick A. Letendre, and Willmar J. Douglas, "The Role of ABM in Measuring Customer Value—Part 2," *Strategic Finance* (April 2001): 44–49.

- *Cost to acquire customers:* Consists of activities such as advertising and promotional materials.
- *Cost to provide goods and services:* Consists of activities such as processing customer orders and delivering goods.
- *Cost to serve customers:* Consists of activities such as technical support and processing customer payments.
- *Cost to retain customers:* Consists of activities such as offering discounts and building relationships.

With the help of activity-based costing, costs can be assigned to activities within each category. These costs are then allocated to customers based on each customer's use of activities. A significant advantage of using activity-based costing is having accurate data for decision-making purposes, particularly in the area of differential analysis.

KEY TAKEAWAY

- Managers use differential analysis to determine whether to keep or drop a customer. The format is similar to the differential analysis format used for making product line decisions. However, sales revenue, variable costs, and fixed costs are traced directly to customers rather than to product lines.

REVIEW PROBLEM 7.4

The following annual income statement is for Tatum & Associates, a firm that provides legal services to its customers.

	Customers			
	New Haven Company	Penryn, Inc.	Elko Corporation	Total
Sales revenue	$1,200,000	$750,000	$1,050,000	$3,000,000
Variable costs	700,000	300,000	800,000	1,800,000
Contribution margin	$ 500,000	$450,000	$ 250,000	$1,200,000
Direct fixed costs	200,000	180,000	255,000	635,000
Allocated fixed costs	120,000	75,000	105,000	300,000
Profit (loss)	$ 180,000	$195,000	$ (110,000)	$ 265,000

Tatum & Associates is concerned about the losses associated with the Elko Corporation account and is considering dropping this customer. Allocated fixed costs are assigned to customers based on sales. For example, $105,000 in allocated fixed costs is assigned to Elko based on this customer's sales as a percent of total sales [$105,000 = $300,000 × ($1,050,000 ÷ $3,000,000)]. If a customer is dropped, total allocated fixed costs are assigned to the remaining customers. All variable costs and direct fixed costs are differential costs.

1. Using the differential analysis format presented in Figure 7.10 "Customer Differential Analysis for Colony Landscape Maintenance", determine whether Tatum & Associates would be better off dropping the Elko Corporation account or keeping the account. Explain your conclusion.
2. Summarize the result of dropping the Elko Corporation account using the differential analysis format presented in Figure 7.12 "Summary of Differential Analysis for Colony Landscape Maintenance".

Solution to Review Problem 7.4

1. As shown in the differential analysis provided, Tatum & Associates would be better off dropping the Elko Corporation account. Profit is $5,000 lower if the Elko account is retained.

Alternative 1 (keep all customers)

	New Haven Company	Penryn, Inc.	Elko Corporation	Total
Sales revenue	$1,200,000	$750,000	$1,050,000	$3,000,000
Variable costs	700,000	300,000	800,000	1,800,000
Contribution margin	$ 500,000	$450,000	$ 250,000	$1,200,000
Direct fixed costs	200,000	180,000	255,000	635,000
Allocated fixed costs	120,000	75,000	105,000	300,000
Profit (loss)	$ 180,000	$195,000	$ (110,000)	$ 265,000

Alternative 2 (drop Elko Corporation customer)

	New Haven Company	Penryn, Inc.		Total
Sales revenue	$1,200,000	$750,000		$1,950,000
Variable costs	700,000	300,000		1,000,000
Contribution margin	$ 500,000	$450,000		$ 950,000
Direct fixed costs	200,000	180,000		380,000
Allocated fixed costs	184,615[a]	115,385[b]		300,000
Profit	$ 115,385	$154,615		$ 270,000

Differential Analysis

	Alternative 1 Total (keep all customers)	Alternative 2 Total (drop Elko Corp.)	Differential Amount	*Alternative 1 Is*
Sales revenue	$3,000,000	$1,950,000	$1,050,000	Higher
Variable costs	1,800,000	1,000,000	800,000	Higher
Contribution margin	$1,200,000	$ 950,000	$ 250,000	Higher
Direct fixed costs	635,000	380,000	255,000	Higher
Allocated fixed costs	300,000	300,000	0	
Profit (loss)	$ 265,000	$ 270,000	$ (5,000)	Lower

[a] *$184,615 rounded = ($1,200,000 ÷ $1,950,000) × $300,000.*

[b] *$115,385 rounded = ($750,000 ÷ $1,950,000) × $300,000.*

2.

Result of Dropping Elko Account

Sales revenue decrease	$(1,050,000)
Variable costs decrease	800,000
Contribution margin decrease	$ (250,000)
Direct fixed costs decrease	255,000
Profit increase from dropping Elko account	$ 5,000

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

7.5 Review of Cost Terms Used in Differential Analysis

LEARNING OBJECTIVE

1. Understand cost terms used in differential analysis.

Question: We've introduced many new terms in this chapter. What are these important terms, and how do they relate to differential analysis?

Answer: The important terms introduced in this chapter are outlined here:

Differential analysis requires that we consider all *differential revenues and costs*—costs that differ from one alternative to another—when deciding between alternative courses of action. *Avoidable costs*—costs that can be avoided by selecting a particular course of action—are always differential costs and must be considered when deciding between alternative courses of action.

Opportunity costs—the benefits foregone when one alternative is selected over another—are differential costs, and must be included when performing differential analysis. *Sunk costs*—costs incurred in the past that cannot be changed by future decisions—are *not* differential costs because they cannot be changed by future decisions.

Direct fixed costs—fixed costs that can be traced directly to a product line or customer—are differential costs and therefore pertinent to making decisions. However, we must review these costs on a case-by-case basis because some direct fixed costs may not be considered differential in spite of being traced directly to a product line. For example, a five-year lease on a warehouse used solely for one product line is a direct fixed cost but not a differential cost because the costs will continue even if the product line is eliminated.

Allocated fixed costs—fixed costs that cannot be traced directly to a product—are typically *not* differential costs. For example, if a product line is eliminated, these costs are simply allocated to the remaining product lines.

KEY TAKEAWAY

- When deciding between alternatives, only those revenues and costs that differ from one alternative course of action to another are relevant. Avoidable costs, opportunity costs, and direct fixed costs typically fall into this category. Revenues and costs that do **not** differ from one alternative course of action to another are irrelevant to the decision.

REVIEW PROBLEM 7.5

Match each of the following terms with the appropriate definition in the list given.

1. Differential analysis
2. Differential revenues and costs
3. Avoidable costs
4. Sunk costs
5. Direct fixed costs
6. Allocated fixed costs
7. Opportunity costs

a. The benefits forgone when one alternative is selected over another.
b. Fixed costs that can be traced directly to a product line.
c. Revenues and costs that differ from one alternative to another.
d. Costs incurred in the past that cannot be changed by future decisions.
e. Costs that can be avoided by selecting a particular course of action.
f. Fixed costs that cannot be traced directly to a product line.
g. Analyzing the difference in revenues and costs from one alternative course of action to another.

Solution to Review Problem 7.5

1. g
2. c
3. e
4. d
5. b
6. f
7. a

7.6 Special Order Decisions

LEARNING OBJECTIVE

1. Use differential analysis for special order decisions.

Question: We have already learned that managers use differential analysis for make-or-buy decisions, product line decisions, and customer decisions. Differential analysis also provides a format that helps managers decide whether to accept special orders made by customers. What is a special order, and how can differential analysis be used to make a special order decision?

Answer: A **special order**[9] is a unique one-time order made by a customer. Differential analysis provides a format that helps managers decide whether to accept or reject special orders, as shown in the example that follows.

Special Order Considerations

Assume Tony's T-shirts makes shirts for local soccer, baseball, basketball, and other sports teams. The owner, Tony, purchases the shirts and prints graphics on the shirts for each team. The graphics were designed several years ago, so design costs are no longer incurred. On average, Tony sells 1,000 shirts each month. Typical monthly financial data follow:

	Per Unit		Total Monthly Data at 1,000 Shirts	
Sales revenue		$20		$20,000
Variable costs				
Direct materials	$8		$8,000	
Direct labor	2		2,000	
Manufacturing overhead	3		3,000	
Total variable costs		13		13,000
Contribution margin		$ 7		$ 7,000
Fixed costs (rent, salaries, etc.)				4,000
Profit				$ 3,000

9. A unique one-time order made by a customer.

The monthly information provided relates to the company's routine monthly operations. A representative of the local high school recently approached Tony to ask about a one-time special order. The high school will be hosting a statewide track and field event and is willing to pay Tony's T-shirts $17 per shirt to make 200 custom T-shirts for the event. Because enough idle capacity exists to handle this order, it will not affect other sales. That is, Tony has the factory space and machinery available to produce more T-shirts.

Tony incurs the same variable costs of $13 per unit to produce the special order, and he will pay a firm $600 to design the graphics that will be printed on the shirts. This special order will have no other effect on Tony's monthly fixed costs.

Question: Should Tony accept the special order?

Answer: Let's use differential analysis to answer this question. As shown in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", Alternative 1 assumes Tony rejects the special order, and Alternative 2 assumes he accepts the special order. The differential analysis in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts" shows that Tony's would be better off accepting the special order, as profit increases $200.

Figure 7.13 *Special Order Differential Analysis for Tony's T-Shirts*

	Alternative 1 (reject special order)		Alternative 2 (accept special order)		Differential Amount	*Alternative 1 Is*
Sales revenue	$20,000	–	$23,400[a]	=	$(3,400)	Lower
Variable costs	13,000	–	15,600[b]	=	(2,600)	Lower
Contribution margin	$ 7,000	–	$ 7,800	=	$ (800)	Lower
Fixed costs	4,000	–	4,600[c]	=	(600)	Lower
Profit	$ 3,000	–	$ 3,200	=	$ (200)	Lower

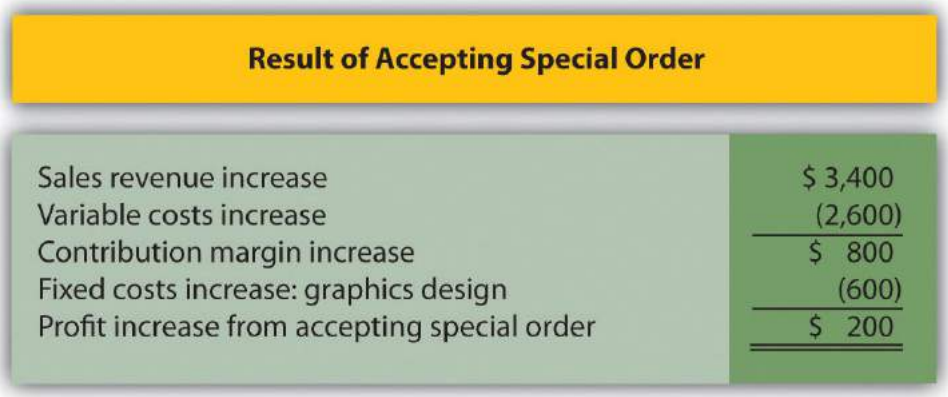
[a] *$23,400 = $20,000 + ($17 per shirt × 200 shirts).*

[b] *$15,600 = $13,000 + ($13 × 200 shirts).*

[c] *$4,600 = $4,000 + $600 cost for special order design.*

Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts" provides an alternative presentation of differential analysis for Tony's T-shirts. As discussed earlier in the chapter, this presentation summarizes the differential revenues and costs.

Figure 7.14 *Summary of Differential Analysis for Tony's T-Shirts*



Result of Accepting Special Order	
Sales revenue increase	$ 3,400
Variable costs increase	(2,600)
Contribution margin increase	$ 800
Fixed costs increase: graphics design	(600)
Profit increase from accepting special order	$ 200

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts" shows the differential revenues and costs for the special order being considered. If Tony's T-shirts accepts the special order, sales revenue will increase $3,400 with a corresponding increase in variable costs of $2,600. Fixed costs will increase by $600 because design work is required for the special order. Thus profit will increase by $200 (= $3,400 – $2,600 – $600).

Special Order Assumptions

Question: What assumptions were made with the differential analysis performed for Tony's T-shirts?

Answer: We made two important assumptions in the Tony's T-shirts special order example. The first assumption is that Tony's has enough idle capacity to handle the order without disrupting regular customer orders. Suppose Tony's T-shirts is operating at capacity and cannot produce any more T-shirts. Tony must turn away

regular customers to make room for the special order. In this scenario, the opportunity cost of turning away existing customers must be considered in the differential analysis.

The second assumption is that this is a one-time order, and therefore represents a short-run pricing decision. If Tony's T-shirts expects future orders from the high school at the $17 per shirt price, the company must consider the impact this might have on long-run pricing with other customers. That is, regular customers may hear of this special price and demand the same price, particularly those customers who have been loyal to Tony's T-shirts for many years. Tony's might be forced to lower prices for regular customers, thereby eroding the company's profits over time. The key point is that companies evaluating special orders can drop prices in the short run to cover differential variable and fixed costs. But in the long run, prices must cover all variable and fixed costs.

Computer Application

Using Excel to Perform Differential Analysis

Managers often perform differential analysis with the help of computer software for several reasons:

- Once the format is established, the template can be used repeatedly for different scenarios.
- Formulas underlie all calculations, thereby minimizing the potential for math errors and speeding up the process.
- Changes can be made easily without having to redo the entire analysis.

An example of how to use Excel to perform differential analysis for the special order scenario presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts" is shown here. Although many accounting courses do not require the use of computer spreadsheets, you are encouraged to use spreadsheet software like Excel when preparing homework or working review problems.

	A	B	C	D	E	F	G	H	I	J
1			Alternative 1		Alternative 2					
2			(Reject Special Order)		(Accept Special Order)		Differential Amount		*Alternative 1 Is*	
3		Sales revenue	$ 20,000	–	$ 23,400	=	$ (3,400)		Lower	
4		Variable costs	13,000	–	15,600	=	$ (2,600)		Lower	
5		Contribution margin	7,000	–	7,800	=	$ (800)		Lower	
6		Fixed costs	4,000	–	4,600	=	$ (600)		Lower	
7		Profit	$ 3,000	–	$ 3,200	=	$ (200)		Lower	
8										

KEY TAKEAWAY

- Managers often use differential analysis to decide whether to accept a special one-time order made by a customer. Managers compare sales revenue and costs for each alternative (accept or reject the special order), and select the alternative with the highest profit. Organizations must be careful to consider the long-run implications of reducing prices for special orders.

REVIEW PROBLEM 7.6

The following monthly financial data are for Quicko's, a company that makes photocopies for its customers. On average, Quicko's makes 100,000 copies each month.

	Per Unit	Total Monthly Data at 100,000 Copies
Sales revenue	$0.08	$8,000
Variable costs	0.05	5,000
Contribution margin	$0.03	$3,000
Fixed costs		2,000
Profit		$1,000

Quicko's is approached by a local restaurant that would like to have 20,000 flyers copied. The restaurant asks Quicko's to produce the flyers for 7 cents a copy rather than the standard price of 8 cents. Quicko's can produce up to 130,000 copies a month, so the special order will not affect regular customer sales. Variable costs per copy will remain at 5 cents, but production of the restaurant flyers will require a special copy machine part that costs $250. This special order will have no other effect on monthly fixed costs.

1. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Quicko's would be better off accepting or rejecting the special order.
2. Summarize the result of accepting the special order using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".
3. Assume Quicko's can only produce 100,000 copies per month, and that regular customer sales would decrease as a result of the special order. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Quicko's would be better off accepting or rejecting the special order.

Solution to Review Problem 7.6

1.

	Alternative 1 (reject special order)		Alternative 2 (accept special order)		Differential Amount	Alternative 1 Is
Sales revenue	$8,000	–	$9400[a]	=	$(1,400)	Lower
Variable costs	5,000	–	6,000[b]	=	(1,000)	Lower
Contribution margin	$3,000	–	$ 3,400	=	$ (400)	Lower
Fixed costs	2,000	–	2,250[c]	=	(250)	Lower
Profit	$1,000	–	$ 1,150	=	$ (150)	Lower

[a] *$9,400 = $8,000 + ($0.07 per copy × 20,000 copies);or alternative approach: ($0.08 per copy × 100,000 copies) + ($0.07 per copy × 20,000 copies).*

[b] *$6,000 = $5,000 + ($0.05 per copy × 20,000 copies); or alternative approach: $0.05 × 120,000 copies.*

[c] *$2,250 = $2,000 + $250 cost for copy machine part.*

This analysis shows that Quicko's would be better off accepting the special order because profit is $150 higher for Alternative 2.

2.

Result of Accepting Special Order	
Sales revenue increase	$1,400
Variable costs increase	(1,000)
Contribution margin increase	$ 400
Fixed costs increase: copy machine part	(250)
Profit increase from accepting special order	$ 150

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

3. Assuming Quicko's has a capacity of 100,000 copies per month, the analysis shows the company would be better off rejecting the special order because profit is $450 higher for this alternative.

	Alternative 1 (reject special order)		Alternative 2 (accept special order)		Differential Amount	*Alternative 1 Is*
Sales revenue	$8,000	−	$7,800[a]	=	$200	Higher
Variable costs	5,000	−	5,000[b]	=	0	
Contribution margin	$3,000	−	$ 2,800	=	$200	Higher
Fixed costs	2,000	−	2,250[c]	=	(250)	Lower
Profit	$1,000	−	$ 550	=	$450	Higher

[a] *$7,800 = ($0.08 × 80,000 regular customer copies) + ($0.07 × 20,000 special order copies).*

[b] *$2,250 = $2,000 + $250 cost for copy machine part.*

7.7 Cost-Plus Pricing and Target Costing

LEARNING OBJECTIVE

1. Understand how to use cost-plus pricing and target costing to establish prices.

The previous section focuses on using differential analysis to assess pricing for special orders. Organizations also use other approaches to establish prices, such as *cost-plus pricing* and *target costing*. We cover these two approaches next.

Cost-Plus Pricing

Questions: Companies that produce custom products, such as homes or landscaping for commercial buildings, often have a difficult time determining a reasonable market price. Prices for these products can be determined using cost-plus pricing. How is cost-plus pricing used to arrive at a reasonable price?

Answer: **Cost-plus pricing**[10] starts with an estimate of the costs incurred to build a product or provide a service, and a certain profit percentage is added to establish the price. For example, a defense contractor working with the government assumes the cost to build a new fighter jet is $60 million. As there is no open market price for this product, the contractor must come up with an approach to establishing the price that does not rely on market pricing. Based on industry-wide standards and negotiations with the government, the contractor requests a 10 percent markup on cost. If the government accepts this proposal, the contractor will receive $66 million for each plane delivered [$66 million = $60 million + ($60 million × 10 percent)].

The concept of cost-plus pricing sounds simple. However, the difficulty is in determining which costs should be included. Are only variable product costs included? Should fixed manufacturing overhead be included? What about selling costs? The answers to these questions depend on the negotiations between buyer and seller, and should be clearly defined in the agreement. When using cost-plus pricing, it is important to establish in advance which costs are to be included for pricing purposes.

10. An approach to establishing prices that starts with an estimate of the costs incurred to build a product, and a certain profit percentage is added to establish the price.

Target Costing

Question: Organizations are constantly trying to find ways to become more efficient and reduce costs. However, once manufacturing firms design a product and begin production, it is difficult to make significant changes that will reduce costs. How can target costing help with this issue?

Answer: **Target costing**[11] is an approach that mitigates cost efficiency problems associated with introducing new products by integrating the product design, desired price, desired profit, and desired cost into one process beginning at the product development stage. Target costing has four steps:

Step 1. Design a product that provides the features and price demanded by customers.

Step 2. Determine the company's desired profit.

Step 3. Derive the target cost by subtracting the desired profit (from step 2) from the desired price (from step 1).

Step 4. Engineer the product to achieve the target cost (from step 3). If the desired target cost cannot be achieved, the company must go back to step 1 and reevaluate the features and price.

For example, suppose **Hewlett-Packard** designs a laser printer with features that customers have requested and wants to sell it for $240; this is Step 1. Management requires a profit equal to 40 percent of the selling price, or $96 (= $240 × 40 percent); this is Step 2. The target cost is $144 (= $240 – $96); this is Step 3. The product engineers must now design this product in detail to achieve or beat the target cost of $144; this is Step 4.

11. An approach to pricing that integrates the product design, desired price, desired profit, and desired cost into one process beginning at the product development stage.

KEY TAKEAWAY

- Cost-plus pricing starts with an estimate of the costs incurred to build a product, and a certain profit percentage is added to establish the price. Companies often use this method when it is difficult to determine a reasonable market price. Target costing integrates the product design, desired price, desired profit, and desired cost into one process beginning at the product development stage.

REVIEW PROBLEM 7.7

Suppose **Nike, Inc.**, has developed a new shoe that can be sold for $140 a pair. Management requires a profit equal to 60 percent of the selling price. Determine the target cost of this product.

Solution to Review Problem 7.7

The target cost of $56 is found by subtracting the target profit from the target selling price. This calculation is as follows.

Target selling price	$140	
Target profit	84	($140 × 60%)
Target cost	$ 56	

7.8 Identifying and Managing Bottlenecks

LEARNING OBJECTIVE

1. Understand the theory of constraints.

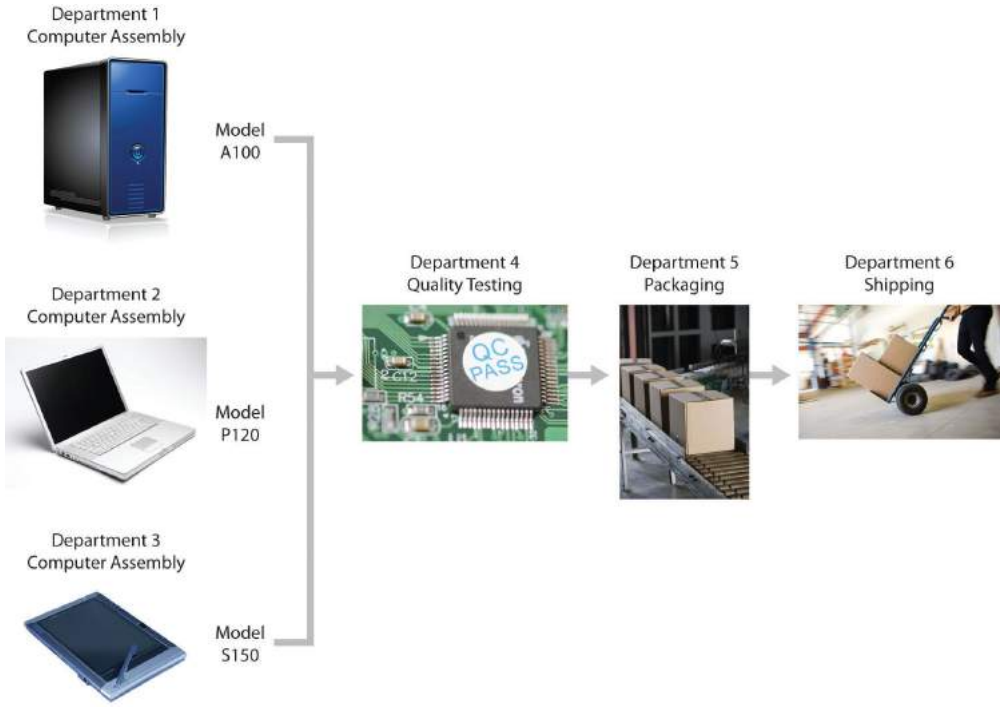
Question: As we noted in Chapter 6 "How Is Cost-Volume-Profit Analysis Used for Decision Making?", many companies have limited resources in such areas as labor hours, machine hours, facilities, and materials. These constraints will likely affect a company's ability to produce goods or provide services. Companies facing constraints often use a variation of differential analysis to optimize the use of constrained resources called the theory of constraints. What are constrained resources, and how does the theory of constraints help managers make better use of these resources?

Answer: Constrained resources are often referred to as *bottlenecks*. A **bottleneck**[12] is a process in which the work to be performed exceeds available capacity. The **theory of constraints**[13] is a recently developed approach to managing bottlenecks.

We will look at an example to help explain how the theory of constraints works. Assume Computers, Inc., produces desktop computers using six departments as shown in Figure 7.15 "Production Process at Computers, Inc.". Computers are assembled in departments 1, 2, and 3 and are then sent to department 4 for quality testing. Once testing is complete, products are packaged in department 5. Department 6 is responsible for shipping the products.

12. A process in which the work to be performed exceeds available capacity.
13. A five-step approach to managing bottlenecks.

Figure 7.15 Production Process at Computers, Inc.



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Question: The theory of constraints provides five steps to help managers make efficient use of constrained resources. What are these five steps, and how will they help Computers, Inc.?

Answer: The five steps are described here, with a narrative indicating how Computers, Inc., would utilize each step.

Step 1. Find the constrained resource (bottleneck).

In this step, the process that limits production is identified. The management at Computers, Inc., has identified department 4, quality testing, as the bottleneck

because assembled computers are backing up at department 4. Quality testing cannot be performed fast enough to keep up with the inflow of computers coming from departments 1, 2, and 3. A limitation of labor hours available to perform testing is causing this backlog.

Step 2. Optimize the use of the constrained resource.

The constrained resource has been identified as the number of labor hours available to perform testing. At this point, Computers, Inc., would like to optimize the labor hours used for quality testing. To assist in this goal, we will calculate the contribution margin per unit of constraint (the unit of constraint is *labor hour* in this example). Production will then focus on products with the highest contribution margin per labor hour. Figure 7.16 "Contribution Margin per Unit of Constrained Resource for Computers, Inc." provides this information for each product. (We first introduced the concept of calculating a contribution margin per unit of constraint in Chapter 6 "How Is Cost-Volume-Profit Analysis Used for Decision Making?".)

Figure 7.16 *Contribution Margin per Unit of Constrained Resource for Computers, Inc.*

	A100 Model	P120 Model	S150 Model
Price per unit	$500	$600	$750
Variable cost per unit	400	350	510
Contribution margin per unit	$100	$250	$240
Labor hours to perform quality test per unit	÷0.2	÷0.4	÷0.3
Contribution margin per labor hour	$500	$625	$800

Based on the information presented in Figure 7.16 "Contribution Margin per Unit of Constrained Resource for Computers, Inc.", and given that labor hours in department 4 is the constraint, Computers, Inc., would optimize the use of labor hours by producing the S150 model because it provides a contribution margin of $800 per labor hour versus $500 for the A100 model, and $625 for the P120 model.

Step 3. Subordinate all nonbottleneck resources to the bottleneck.

The goal in this step is to shift nonbottleneck resources to the bottleneck in department 4. At this point, improving efficiencies in other departments does little to alleviate the bottleneck in department 4. Thus Computers, Inc., must try to move resources from other areas to department 4 to reduce the backlog of computers to be tested.

Step 4. Increase bottleneck efficiency and capacity.

Management's goal is to loosen the constraint by providing more labor hours to department 4. For example, management may decide to move employees from departments 1, 2, and 3 to the quality testing department. Another option is to authorize overtime for the workers in department 4. Perhaps management will consider hiring additional workers for department 4.

Step 5. Repeat steps 1 through 4 for the new bottleneck.

Once the bottleneck in department 4 is relieved, a new bottleneck will likely arise elsewhere. Going back to step 1 requires management to identify the new bottleneck and follow steps 2 through 4 to alleviate the bottleneck.

KEY TAKEAWAY

- Most companies have limited resources in areas such as labor hours, machine hours, facilities, and materials. The theory of constraints is an approach that enables companies to optimize the use of limited resources. Five steps are involved. First, find the constrained resource (or bottleneck). Second, optimize the use of the constrained resource. Third, subordinate all nonbottleneck resources to the bottleneck. Fourth, increase bottleneck efficiency and capacity. Fifth, repeat the first four steps for the new bottleneck.

REVIEW PROBLEM 7.8

Southside Company produces three types of baseball gloves: child, teen, and adult. The gloves are produced in separate departments and sent to the quality testing department before being packaged and shipped. A machine-hour bottleneck has been identified in the quality testing department. Southside would like to optimize its use of machine hours (step 2) by producing the two most profitable gloves. The machine hours required for each glove follow:

Child glove	0.25 machine hours
Teen glove	0.40 machine hours
Adult glove	0.50 machine hours

Price and variable cost information is as follows:

	Price	Variable Cost
Child glove	$15	$ 5
Teen glove	20	8
Adult glove	35	22

1. Calculate the contribution margin per unit of constrained resource for each glove.
2. Which two gloves would Southside prefer to produce and sell to optimize the use of machine hours in the quality testing department?

Solution to Review Problem 7.8

1.

	Child Glove	Teen Glove	Adult Glove
Price per unit	$15	$20	$35
Variable cost per unit	5	8	22
Contribution margin per unit	$10	$12	$13
Machine hours to perform quality test per unit	÷0.25	÷0.4	÷0.5
Contribution margin per machine hour	$40	$30	$26

2. The company would prefer to produce and sell the child and teen gloves, since these products have the highest contribution margin per machine hour.

7.9 Be Aware of Qualitative Factors

LEARNING OBJECTIVE

1. Evaluate qualitative factors when using differential analysis.

Question: This chapter has focused on using relevant revenue and cost information to perform differential analysis. Using these quantitative factors to make decisions allows managers to support decisions with measurable data. For example, the idea of outsourcing production of wakeboards at Best Boards, Inc., presented at the beginning of the chapter, was rejected because it was more costly to outsource production of the boards than to produce them internally. Although using quantitative factors for decision making is important, management must also consider qualitative factors. How might the consideration of qualitative factors improve decisions made by managers?

Answer: Qualitative factors may outweigh the quantitative factors in making a decision. For example, assume management at Best Boards, Inc., believes there will be a decline in the market for wakeboards after next year. Outsourcing production makes it easier to quickly reduce costs in the face of a downturn by simply ordering fewer wakeboards from the supplier. Continuing to build the boards internally takes away this flexibility. The significant fixed costs often associated with manufacturing firms are difficult to reduce in the short run if production declines. Thus the qualitative factor of being able to reduce manufacturing costs quickly by outsourcing production may outweigh the quantitative factors shown in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc." and Figure 7.4 "Product Line Decision".

Question: What if the quantitative differential analysis for Best Boards had a different result, in that it showed the company should outsource? What qualitative factors should management consider before implementing this decision?

Answer: Management must consider whether product quality would remain the same. Financial stability of the producer must be considered as well. It does no good to outsource production and eliminate production facilities and employees if the producer being used suddenly shuts down. Also, employee morale tends to slide if employees in one segment of a company are fired. This can lead to an unhappy and inefficient workforce in other areas of the company, causing costs to rise. These are just a few of the qualitative factors that must be weighed against quantitative factors when performing differential analysis.

KEY TAKEAWAY

- Although accountants are responsible for providing relevant and objective financial information to help managers make decisions, qualitative factors also play a significant role in the decision-making process.

REVIEW PROBLEM 7.9

What qualitative factors should management consider when deciding whether to outsource production or keep production within the company?

Solution to Review Problem 7.9

The qualitative factors that management should consider when deciding whether to outsource production include the following:

- Will the quality of the products remain the same?
- Will shutting down the manufacturing facility have a negative impact on the morale of remaining employees?
- Is the producer that will be making the product financially stable and reliable?

7.10 Appendix: Making Decisions Involving Joint Costs

LEARNING OBJECTIVE

1. Analyze the impact that joint costs have on decision making.

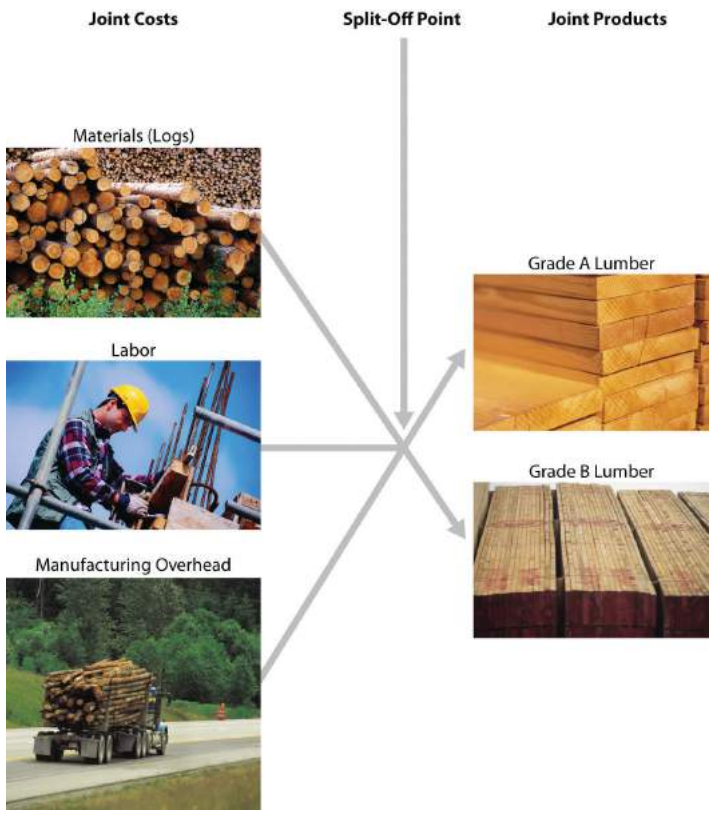
Question: When two or more products are produced from a single input, these products are called **joint products**[14]*. The cost of this single input and the related manufacturing process costs are called* **joint costs**[15]*. For example, lumber companies often must deal with joint products (different types of lumber) resulting from one input (a log). How do the concepts of joint products and joint costs help a lumber company establish a cost for each of its products?*

Answer: Suppose Oregon Lumber Company takes a log (the single input) and mills it into two types of products: high quality Grade A lumber, and lower quality Grade B lumber. Grade A lumber and Grade B lumber are examples of joint products, and the cost of the logs and related manufacturing process costs are examples of joint costs.

Figure 7.17 "Joint Costs and Joint Product Flows at Oregon Lumber Company" presents the information for Oregon Lumber for the month of June. Joint costs for the month total $250,000. Notice that the **split-off point**[16] is the point at which identifiable products emerge from the production process. The issue is how to allocate joint costs—the $250,000 in production costs incurred prior to the split-off point—to the resulting joint products.

14. Two or more products produced from a single input.
15. The cost of inputs required to produce joint products.
16. The point at which identifiable joint products emerge from the production process.

Figure 7.17 *Joint Costs and Joint Product Flows at Oregon Lumber Company*



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Two methods are commonly used to allocate these joint costs to the joint products: the *physical quantities method* and the *sales value method*. We discuss each of these methods next.

The Physical Quantities Method

Question: The **physical quantities method**[17] *allocates joint costs based on a physical measure of output. Assume Oregon Lumber produces 600,000 board feet of Grade A lumber and 200,000 board feet of Grade B lumber during June. How would Oregon Lumber use this information to allocate $250,000 in joint production costs to each grade of lumber?*

17. A method that allocates joint costs based on a physical measure of output.

Answer: Oregon Lumber would allocate 75 percent of the joint costs to Grade A lumber (75 percent = 600,000 Grade A board feet ÷ 800,000 total board feet), and 25 percent of the joint costs to Grade B lumber.

Grade A allocation:

$187,500 allocation = $250,000 joint costs × (600,000 Grade A board feet ÷ 800,000 total board feet)

Grade B allocation:

$62,500 allocation = $250,000 joint costs × (200,000 Grade B board feet ÷ 800,000 total board feet)

Figure 7.18 "Joint Product Profitability for Oregon Lumber Company: Physical Quantities Method" presents the profitability of each joint product for the month using the physical quantities method assuming Grade A lumber sells for $0.40 per board foot and Grade B lumber sells for $0.30 per board foot.

Figure 7.18 *Joint Product Profitability for Oregon Lumber Company: Physical Quantities Method*

	Grade A	Grade B	Total
Sales revenue	$240,000[a]	$60,000[b]	$300,000
Joint costs allocated	187,500[c]	62,500[d]	250,000
Profit (loss)	$ 52,500	$ (2,500)	$ 50,000

[a] *$240,000 = $0.40 per board foot × 600,000 Grade A board feet.*

[b] *$60,000 = $0.30 per board foot × 200,000 Grade B board feet.*

[c] *$187,500 = $250,000 joint costs × (600,000 Grade A board feet ÷ 800,000 total board feet).*

[d] *$62,500 = $250,000 joint costs × (200,000 Grade B board feet ÷ 800,000 total board feet).*

Although Grade B lumber appears to be unprofitable, elimination of Grade B lumber sales would *not* increase overall profit for Oregon Lumber. Grade B lumber contributes $60,000 to covering joint costs. Thus elimination of Grade B lumber sales would result in a decrease in overall profit of $60,000. The $62,500 in joint cost allocated to Grade B lumber would simply be reallocated to Grade A lumber.

The Sales Value Method

Question: A different approach to allocating joint costs to joint products is the **sales value method**[18]*, which allocates joint costs based on the relative sales value of each product at the split-off point. How would Oregon Lumber allocate joint production costs using this method?*

Answer: Because sales revenue totals $240,000 for Grade A lumber and $60,000 for Grade B lumber, 80 percent of the joint costs are allocated to Grade A lumber (80 percent = $240,000 Grade A revenue ÷ $300,000 total revenue), and 20 percent of the joint costs are allocated to Grade B lumber:

Grade A allocation:

$200,000 allocation = $250,000 joint costs × ($240,000 Grade A sales value ÷ $300,000 total sales value)

Grade B allocation:

$50,000 allocation = $250,000 joint costs × ($60,000 Grade B sales value ÷ $300,000 total sales value)

Figure 7.19 "Joint Product Profitability for Oregon Lumber Company: Sales" presents the profitability of each joint product for the month using the sales value method, again assuming Grade A lumber sells for $0.40 per board foot, and Grade B lumber sells for $0.30 per board foot.

Figure 7.19 *Joint Product Profitability for Oregon Lumber Company: Sales*

	Grade A	Grade B	Total
Sales revenue	$240,000[a]	$60,000[b]	$300,000
Joint costs allocated	200,000[c]	50,000[d]	250,000
Profit	$ 40,000	$ 10,000	$ 50,000

[a] *$240,000 = $0.40 per board foot × 600,000 Grade A board feet.*

[b] *$60,000 = $0.30 per board foot × 200,000 Grade B board feet.*

[c] *$200,000 = $250,000 joint costs × ($240,000 Grade A sales value ÷ $300,000 total sales value).*

18. A method that allocates joint costs based on the relative sales value of each product at the split-off point.

[d] *$50,000 = $250,000 joint costs × ($60,000 Grade B sales value ÷ $300,000 total sales value).*

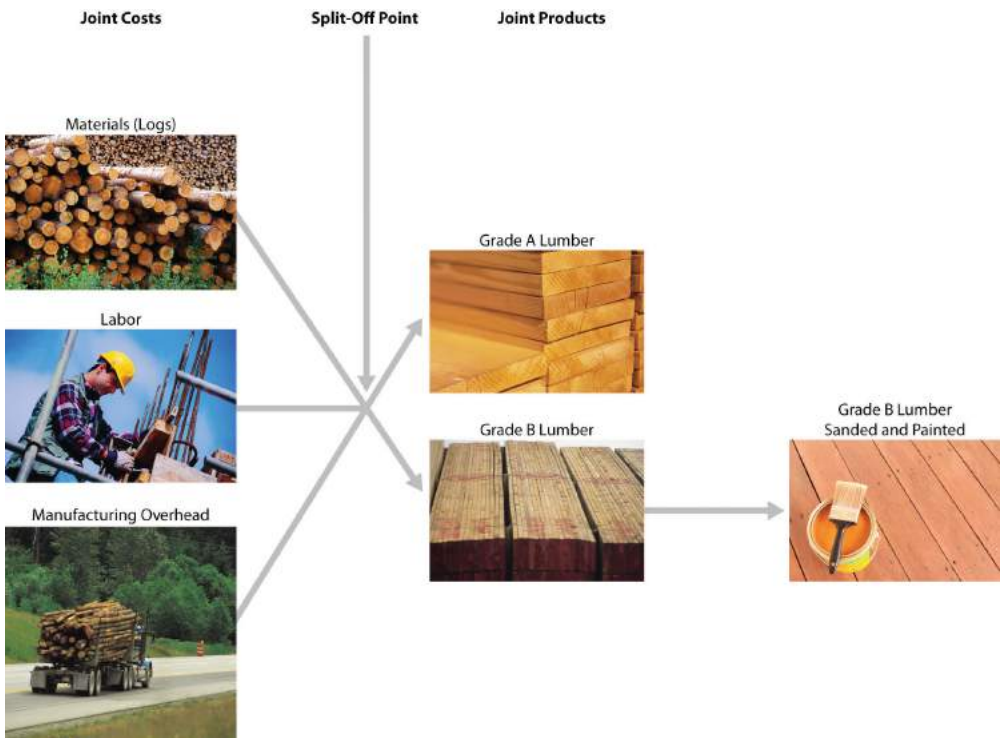
The sales value method assumes that profit as a percent of sales will remain the same across all products. For example, Figure 7.19 "Joint Product Profitability for Oregon Lumber Company: Sales" shows that Grade A lumber has a profit margin ratio of 16.67 percent (= $40,000 profit ÷ $240,000 sales), as does Grade B lumber (= $10,000 profit ÷ $60,000 sales). This method also ensures that joint costs allocated to each product will not exceed sales revenue for each product (unless total joint costs are higher than total revenue).

As you review Figure 7.18 "Joint Product Profitability for Oregon Lumber Company: Physical Quantities Method" and Figure 7.19 "Joint Product Profitability for Oregon Lumber Company: Sales", notice that the total column for both methods of joint cost allocation is the same. The issue is *not* with the overall results. The issue is how to allocate joint costs to each joint product.

Deciding Whether to Process Further

Question: Assume Oregon Lumber Company has the option of processing Grade B lumber further into a finished product by sanding the lumber and painting it with primer. This option is presented in Figure 7.20 "Further Processing of Oregon Lumber Company's Grade B Lumber". The sanded and painted Grade B lumber sells for $0.45 per board foot rather than $0.30 for the unfinished Grade B lumber. The additional cost to sand and paint the Grade B lumber is $0.05 per board foot. Should Oregon Lumber process Grade B lumber further into finished lumber?

Figure 7.20 *Further Processing of Oregon Lumber Company's Grade B Lumber*



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Answer: The answer depends on whether the additional revenue exceeds the additional cost of processing Grade B lumber further. Since the additional revenue of $0.15 per board foot (= $0.45 finished price – $0.30 unfinished price) is greater than the additional $0.05 per board foot processing cost, Oregon Lumber should process the Grade B lumber further into finished lumber. Profit increases $0.10 per board foot as a result of processing further (= $0.15 additional revenue – $0.05 additional cost).

Oregon Lumber will decide whether or not to process Grade B lumber further regardless of how joint costs are allocated to Grade A and Grade B lumber. In a sense, joint costs are sunk costs with respect to this decision, and will not influence future processing decisions. Thus joint costs incurred *prior* to the split-off point are irrelevant to the decision whether to process further *after* the split-off point.

KEY TAKEAWAY

- Two or more products made from a single input are called joint products. The costs of the single input and related manufacturing process costs must be allocated to each of the joint products. The physical quantities method allocates joint costs based on a physical measure of output (e.g., pounds or yards of material). The sales value method allocates joint costs based on the relative sales value for each of the joint products. Regardless of the allocation method used, total joint costs and total profit remain the same. Companies must often decide whether to process a joint product further. If as a result of processing the product further, additional sales revenue exceeds additional costs, the wise decision is to process further.

REVIEW PROBLEM 7.10.

Fresh Veggies, Inc., purchased 10,000 pounds of fresh apples from a local grower for $4,000. The apples were separated into high-quality Grade A apples (3,000 pounds) and lower-quality Grade B apples (7,000 pounds). Fresh Veggies sells Grade A apples for $0.80 per pound and Grade B apples for $0.50 per pound.

1. Allocate joint costs to each product using the physical quantities method (pounds), and calculate the profit or loss for each product.
2. Allocate joint costs to each product using the relative sales value method, and calculate the profit or loss for each product.
3. Assume Grade B apples can be processed further into dried apple slices for an additional $0.20 per pound. Customers are willing to pay $0.65 per pound for dried apple slices. Should Fresh Veggies, Inc., process the Grade B apples further?

Solution to Review Problem 7.10.

1.

	Grade A Apples	Grade B Apples	Total
Sales revenue	$2,400[a]	$3,500[b]	$5,900
Joint costs allocated	1,200[c]	2,800[d]	4,000
Profit	$1,200	$ 700	$1,900

[a] *$2,400 = $0.80 per pound × 3,000 pounds of Grade A apples.*

[b] *$3,500 = $0.50 per pound × 7,000 pounds of Grade B apples.*

[c] *$1,200 = $4,000 joint costs × (3,000 pounds of Grade A apples ÷ 10,000 total pounds).*

[d] *$2,800 = $4,000 joint costs × (7,000 pounds of Grade B apples ÷ 10,000 total pounds).*

2.

	Grade A Apples	Grade B Apples	Total
Sales revenue	$2,400[a]	$3,500[b]	$5,900
Joint costs allocated	1,627[c]	2,373[d]	4,000
Profit	$ 773	$ 1,127	$1,900

[a] *$2,400 = $0.80 per pound × 3,000 pounds of Grade A apples.*

[b] *$3,500 = $0.50 per pound × 7,000 pounds of Grade B apples.*

[c] *$1,627 (rounded) = $4,000 joint costs × ($2,400 Grade A sales value ÷ $5,900 total sales value).*

[d] *$2,373 (rounded) = $4,000 joint costs × ($3,500 Grade B sales value ÷ $5,900 total sales value).*

3. Because the additional revenue of $0.15 per pound (= $0.65 price with further processing – $0.50 without further processing) is less than the additional $0.20 per pound processing cost, Fresh Veggies should *not* process the Grade B apples further into dried apples. Profit decreases $0.05 per pound (= $0.20 additional cost – $0.15 additional revenue) as a result of processing further.

END-OF-CHAPTER EXERCISES

Questions

1. What are differential revenues and costs?
2. What is differential analysis?
3. Define what is meant by a “make-or-buy” decision. Describe how differential analysis can be used to assist in making this type of decision.
4. Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." and Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc." provide two different formats for presenting the same analysis. Describe the similarities and differences in these two formats.
5. What is an avoidable cost?
6. Review Note 7.8 "Business in Action 7.1" Why did Salt Lake City choose to outsource the concrete panels to a company in Mexico City even though the library was being constructed in Salt Lake City?
7. How is differential analysis used in deciding whether to keep or drop product lines?
8. Why are direct fixed costs typically differential costs?
9. Why are allocated fixed costs typically not differential costs?
10. What is an opportunity cost? Why is an opportunity cost a differential cost?
11. Review Note 7.17 "Business in Action 7.2" What did **Kmart** do with 24 of its stores? Why might **Kmart** have taken this action?
12. How is differential analysis similar for customer decisions and product line decisions?
13. Review Note 7.21 "Business in Action 7.3" Why did **ABCO Automation, Inc.**, fire its biggest client even though the client provided close to 60 percent of **ABCO’s** annual revenue?
14. What two important assumptions must be considered when evaluating special order scenarios?
15. What is cost-plus pricing?
16. Describe the four steps of target costing.
17. Describe the five steps used to manage constraints according to the theory of constraints.
18. What is a qualitative advantage of keeping unprofitable customers?
19. What are joint products and joint costs?
20. Describe the two methods of allocating joint costs.

Brief Exercises

21. **Cutting Costs at Best Boards, Inc.** Refer to the dialogue at Best Boards, Inc., presented at the beginning of the chapter. How does the vice president of operations, Jim Muller, expect to reduce costs and earn his bonus? What was the flaw in his plan?

22. **Make-or-Buy Decision.** Coffee Mugs, Inc., currently manufactures ceramic coffee mugs. Management is interested in outsourcing production to a reputable manufacturing company that can supply the cups for $2 per unit. Coffee Mugs produces 100,000 mugs each year. Variable production costs are $0.80 and annual fixed costs are $150,000. If production is outsourced, all variable costs and 40 percent of annual fixed costs will be eliminated.

    Perform differential analysis using the format presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." and explain which alternative is best, Alternative 1 (producing internally) or Alternative 2 (outsourcing).

23. **Product Line Decision.** The following segmented annual income statement is for Flash Drive, Inc.:

	Product Lines			
	1 Gig	2 Gig	4 Gig	Total
Sales revenue	$1,000,000	$4,000,000	$5,000,000	$10,000,000
Variable costs	600,000	2,500,000	3,500,000	6,600,000
Contribution margin	$ 400,000	$1,500,000	$1,500,000	$ 3,400,000
Direct fixed costs	300,000	800,000	1,000,000	2,100,000
Allocated fixed costs	(A)	(B)	(C)	1,100,000
Profit (loss)	$ (D)	$ (E)	$ (F)	$ 200,000

    For items **A**, **B**, and **C**, assign allocated fixed costs to each product line based on sales revenue for each product line as a proportion of total sales revenue. For example, the 1 Gig product will be assigned 10 percent of allocated fixed costs (= $1,000,000 in 1 Gig sales revenue ÷ $10,000,000 total sales revenue), or $110,000 (=$1,100,000 total allocated fixed costs × 10 percent). For items **D**, **E**, and **F**, calculate the profit or loss for each product line.

24. **Customer Decision.** Consulting Group LLC has two customers. Customer One generates $150,000 in income after *direct* fixed costs are deducted, and Customer Two generates $200,000 in

income after *direct* fixed costs are deducted. *Allocated* fixed costs total $300,000 and are assigned 30 percent to Customer One and 70 percent to Customer Two based on several different cost drivers. Total allocated fixed costs remain the same regardless of how these costs are assigned to customers.

Calculate the amount of allocated fixed costs to be assigned to each customer, and determine the profit or loss for each customer. Should Consulting Group drop Customer Two? Explain.

25. **Special Order Decision: Operating with Idle Capacity.** Jerseys, Inc., currently produces 10,000 jerseys a year for its regular customers and charges $10 per jersey. Jerseys, Inc., has capacity to produce an additional 5,000 jerseys if sales grow in the future. Variable costs total $6 per jersey and annual fixed costs total $15,000. The city of Rockville recently approached the company and proposed a one-time purchase of 3,000 jerseys for $8 each. Should Jerseys, Inc., accept the proposal? Explain.
26. **Cost-Plus Pricing.** KJ Home Builders is bidding on a custom home for a potential customer. The company typically charges 15 percent above cost and estimates the home will cost $500,000 to build. Calculate the price bid by KJ Home Builders.
27. **Constrained Resources.** Deal, Inc., produces two types of computers: Vortex and Zoom. The computers are produced in separate departments and sent to the quality testing department before being packaged and shipped. A labor-hour bottleneck has been identified in the quality testing department due to the high skill requirements of the job. Deal, Inc., would like to optimize its use of labor hours by producing the most profitable computer. Based on the information shown, calculate the contribution margin per quality testing labor hour for each product:

	Quality Testing Labor Hours	Contribution Margin
Vortex	0.50	$600
Zoom	0.40	500

28. **Evaluating Qualitative Factors.** Assume your company is considering whether to outsource production. What qualitative factors should be considered before making this decision?
29. **Allocating Joint Costs (Appendix).** Charlotte Company produces two joint chemical products, product A and B. Prior to the split-off point, the

company incurred $100,000 in joint costs. Production totaled 12,000 gallons for product A and 8,000 gallons for product B. Allocate joint costs to each product using the physical quantities method (gallons).

Exercises: Set A

30. **Make-or-Buy Decision.** Wheels, Inc., currently manufactures its own custom rims for automobiles. Management is interested in outsourcing production of these rims to a reputable manufacturing company that can supply the rims for $80 per unit. Wheels, Inc., incurs the following annual production costs to produce 10,000 rims internally.

	Per Unit	Total Annual Cost at 10,000 Units
Variable production costs		
Direct materials	$20	$200,000
Direct labor	10	100,000
Manufacturing overhead	30	300,000
Fixed production costs		
Factory building and equipment lease		70,000
Factory insurance		50,000
Production supervisor's salary		100,000
Total production costs		$820,000

If production is outsourced, all variable production costs, factory building and equipment lease costs, and factory insurance costs will be eliminated. The production supervisor's salary cost will remain regardless of the decision to outsource or to produce internally because the supervisor recently signed a long-term contract with Wheels, Inc.

Required:

a. Perform differential analysis using the format presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Assume making the rims internally is Alternative 1, and buying the rims from an outside manufacturer is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of outsourcing production using the format presented in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.".

d. Compare the format used in requirement **a** with that of requirement **c**.

31. **Product Line Decision.** The following monthly segmented income statement is for Durango Company.

	Product Lines			
	A	B	C	Total
Sales revenue	$37,500	$50,000	$12,500	$100,000
Variable costs	16,000	27,500	5,000	48,500
Contribution margin	$21,500	$ 22,500	$ 7,500	$ 51,500
Direct fixed costs	19,500	16,000	3,500	39,000
Allocated fixed costs	3,750	5,000	1,250	10,000
Profit (loss)	$(1,750)	$ 1,500	$ 2,750	$ 2,500

Management is concerned about the losses associated with product line A and is considering dropping this product line. Allocated fixed costs are assigned to product lines based on sales. If product line A is eliminated, total allocated fixed costs are assigned to the remaining product lines, and all variable and direct fixed costs for product line A will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company". Assume keeping all product lines is Alternative 1, and dropping product line A is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of dropping product line A using the format presented in Figure 7.7 "Summary of Differential Analysis for Barbeque Company".
d. Explain why the loss shown for product line A in the segmented income statement might be misleading to management.

32. **Customer Decision.** The following customer segmented quarterly income statement is for Accounting Associates.

	Customers			
	Sanchez	Nguyen	Decker	Total
Sales revenue	$300,000	$1,500,000	$200,000	$2,000,000
Variable costs	250,000	1,200,000	160,000	1,610,000
Contribution margin	$ 50,000	$ 300,000	$ 40,000	$ 390,000
Direct fixed costs	15,000	315,000	10,000	340,000
Allocated fixed costs	6,000	30,000	4,000	40,000
Profit (loss)	$ 29,000	$ (45,000)	$ 26,000	$ 10,000

Management is concerned about the significant losses associated with the Nguyen account and would like to drop this customer. Allocated fixed costs are assigned to customers based on sales revenue. If Nguyen is dropped, total allocated fixed costs are assigned to the remaining customers, and all variable and direct fixed costs for the Nguyen account will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.10 "Customer Differential Analysis for Colony Landscape Maintenance". Assume keeping all customers is Alternative 1, and dropping the Nguyen account is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of dropping the Nguyen account using the format presented in Figure 7.12 "Summary of Differential Analysis for Colony Landscape Maintenance".
d. Explain what happened to the profitability of the other two customers as a result of dropping the Nguyen account.

33. **Special Order Decision: Operating with Idle Capacity.** The following monthly financial data are for RadioCom, Inc., a maker of handheld VHF radios. RadioCom produces and sells 5,000 radios each month to regular customers.

	Per Unit	Total Monthly Data at 5,000 Radios
Sales revenue	$100	$500,000
Variable costs	60	300,000
Contribution margin	$ 40	$200,000
Fixed costs		135,000
Profit		$ 65,000

RadioCom received an offer from the Coast Guard Auxiliary to purchase 1,000 radios next month for $75 per unit. RadioCom can produce up to 7,000 radios a month, so the special order would not affect regular customer sales. Variable costs per radio will remain at $60. This special order will have no effect on monthly fixed costs.

Required:

a. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether RadioCom would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2).
b. Summarize the result of accepting the special order using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".

34. **Special Order Decision: Operating at Full Capacity.** The following monthly financial data are for RadioCom, Inc., a maker of handheld VHF radios. RadioCom produces and sells 5,000 radios each month to regular customers.

	Per Unit	Total Monthly Data at 5,000 Radios
Sales revenue	$100	$500,000
Variable costs	60	300,000
Contribution margin	$ 40	$200,000
Fixed costs		135,000
Profit		$ 65,000

RadioCom received an offer from the Coast Guard Auxiliary to purchase 1,000 radios next month for $75 per unit. RadioCom can only produce up to 5,000 radios a month, so the special order would result in reduced sales to regular customers. Variable costs per radio will remain at $60. This special order will have no effect on monthly fixed costs.

Required:

a. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts",

determine whether RadioCom would be better off rejecting (Alternative 1) or accepting (Alternative 2) the offer received from the Coast Guard Auxiliary.

b. Summarize the result of accepting the special order using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".

35. **Target Costing.** Quality Sounds, Inc., makes speakers and headphones for high-end sound systems. The marketing department has identified a market for a specific type of headphones that Quality Sounds does not currently produce, and expects to be able to sell each pair for $150. Management requires a profit of 45 percent of the selling price.

Required:

Determine the highest cost (target cost) management would be willing to accept to produce this product.

36. **Constrained Resources.** Cycle, Inc., produces three types of bicycles: racer, cruiser, and climber. The bikes are produced in separate departments and sent to the quality testing department before being packaged and shipped. A labor-hour bottleneck has been identified in the quality testing department due to the high skill requirements of the job. Cycle, Inc., would like to optimize its use of labor hours by producing the two most profitable bikes. Information for each bike follows.

	Quality Testing Labor Hours	Price	Variable Cost
Racer	1.25	$1,000	$400
Cruiser	1.00	500	300
Climber	1.00	800	450

Required:

a. Calculate the contribution margin per unit of constrained resource for each product.

b. Which two products would Cycle, Inc., prefer to produce and sell to optimize the use of labor hours in the quality testing department?

37. **Qualitative Factors.** For each of the following independent scenarios, identify at least one *qualitative* factor that should be considered before making the decision.

    a. A company sells three types of computers (laptops, desktops, and palmtops), all of which are profitable. The company faces a machine-hour bottleneck and plans to eliminate the palmtop product because it has the lowest contribution margin per machine hour.
    b. A company plans to drop an unprofitable customer.
    c. A maker of high-end stereo equipment would like to shut down its manufacturing facility and outsource production.

38. **Allocating Joint Costs (Appendix).** Clemson Products produces two joint products, product Y and Z. Prior to the split-off point, the company incurred $60,000 in joint costs. Clemson Products produced 10,000 yards of product Y and 30,000 yards of product Z produced. Product Y sells for $4 per yard and product Z sells for $2 per yard.

    Required:

    a. Allocate joint costs to each product using the physical quantities method (yards), and calculate the profit or loss for each product.
    b. Allocate joint costs to each product using the relative sales value method, and calculate the profit or loss for each product.

Exercises: Set B

39. **Make-or-Buy Decision.** Quality Glass currently manufactures windshields for automobiles. Management is interested in outsourcing production of these windshields to a reputable manufacturing company that can supply the windshields for $45

per unit. Quality Glass incurs the following annual production costs to produce 15,000 windshields internally.

	Per Unit	Total Annual Cost at 15,000 Units
Variable production costs		
Direct materials	$ 8	$120,000
Direct labor	10	150,000
Manufacturing overhead	11	165,000
Fixed production costs		390,000
Total production costs		$825,000

If production is outsourced, all variable production costs will be eliminated, and 80 percent of fixed production costs will be eliminated. Regardless of the decision to outsource or to produce internally, 20 percent of fixed production costs will remain .

Required:

a. Perform differential analysis using the format presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Assume making windshields internally is Alternative 1, and buying windshields from an outside manufacturer is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of outsourcing production using the format presented in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.".
d. Why might some managers prefer the format presented in requirement **c**?

40. **Product Line Decision.** The following segmented annual income statement is for Office Express.

	Product Lines			
	Computers	Furniture	Supplies	Total
Sales revenue	$1,125,000	$1,500,000	$375,000	$3,000,000
Variable costs	480,000	825,000	150,000	1,455,000
Contribution margin	$ 645,000	$ 675,000	$225,000	$1,545,000
Direct fixed costs	650,000	480,000	105,000	1,235,000
Allocated fixed costs	112,500	150,000	37,500	300,000
Profit (loss)	$ (117,500)	$ 45,000	$ 82,500	$ 10,000

Management is concerned about the significant losses associated with the computers product line and would like to drop this product line. Allocated fixed costs are assigned to product lines based on sales. If the computers product line is eliminated, total allocated fixed costs are assigned to the remaining product lines, and all variable and direct fixed costs for the computers product line will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company". Assume keeping all product lines is Alternative 1, and dropping the computers product line is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of dropping the computer product line using the format presented in Figure 7.7 "Summary of Differential Analysis for Barbeque Company".
d. Explain what happened to the profitability of the furniture product line as a result of dropping the computers product line.

41. **Customer Decision.** The following customer segmented annual income statement is for Management Consulting, Inc.

	Customers			
	Cherry Corp	Orange, Inc.	Apple, LLP	Total
Sales revenue	$500,000	$500,000	$250,000	$1,250,000
Variable costs	400,000	370,000	180,000	950,000
Contribution margin	$100,000	$130,000	$ 70,000	$ 300,000
Direct fixed costs	30,000	40,000	65,000	135,000
Allocated fixed costs	40,000	40,000	20,000	100,000
Profit (loss)	$ 30,000	$ 50,000	$(15,000)	$ 65,000

Management is concerned about the losses associated with the Apple LLP account and would like to drop this customer. Allocated fixed costs are assigned to customers based on sales revenue. If Apple LLP is dropped, total allocated fixed costs are assigned to the remaining customers, and all variable and direct fixed costs for the Apple LLP account will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.10 "Customer Differential Analysis for Colony Landscape Maintenance". Assume keeping all customers is Alternative 1, and dropping the Apple LLP account is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of dropping the Apple LLP account using the format presented in Figure 7.12 "Summary of Differential Analysis for Colony Landscape Maintenance".
d. Explain why the loss shown for the Apple LLP account in the segmented income statement might be misleading to management.

42. **Special Order Decision: Operating with Idle Capacity.** The following monthly financial data are for Sport Socks, Inc., a maker of socks for runners. Sport Socks makes and sells 40,000 pairs each month to regular customers.

	Per Unit	Total Monthly Data at 40,000 Pairs
Sales revenue	$1.00	$40,000
Variable costs	0.70	28,000
Contribution margin	$0.30	$12,000
Fixed costs		7,000
Profit		$ 5,000

Sport Socks received an offer from a large sporting goods store to purchase 15,000 socks next month for $0.90 per pair. Sport Socks can produce up to 60,000 pairs of socks a month, so the special order would not affect regular customer sales. Variable costs per pair will remain at $0.70. This special order will cause fixed costs to increase by $6,000 for next month.

Required:

a. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Sport Socks would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2).

b. Summarize the result of accepting the special order using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".

43. **Special Order Decision: Operating at Full Capacity.** The following monthly financial data are for Sport Socks, Inc., a maker of socks for runners. Sport Socks makes and sells 40,000 pairs each month to regular customers.

	Per Unit	Total Monthly Data at 40,000 Pairs
Sales revenue	$1.00	$40,000
Variable costs	0.70	28,000
Contribution margin	$0.30	$12,000
Fixed costs		7,000
Profit		$ 5,000

Sport Socks received an offer from a large sporting goods store to purchase 15,000 socks next month for $0.90 per pair. Assume Sport Socks can only produce up to 40,000 pairs of socks each month. Thus any special orders would result in reduced sales to regular customers. However, fixed costs will *not* change as a result of the special order.

Required:

a. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Sport Socks would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2).
b. Summarize the result of accepting the special order using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".

44. **Target Costing.** Nature Wood, Inc., makes wood tables for commercial use. The marketing department has identified a market for a specific table that the company does not currently produce, and it expects that each table could be sold for $1,000. Management requires a profit of 30 percent of the selling price.

Required:

Determine the highest cost (target cost) management would be willing to accept to produce this product.

45. **Constrained Resources.** Ratcliff Enterprises produces three types of computers; laptop, desktop, and palmtop. A machine-hour bottleneck has been identified in the production department. Ratcliff would like to optimize its use of machine hours by producing the two most profitable computers. Information for each computer follows.

	Production Machine Hours	Price	Variable Cost
Laptop	2.00	$1,200	$900
Desktop	1.00	800	700
Palmtop	1.25	300	180

Required:

a. Calculate the contribution margin per unit of constrained resource for each product.
b. Which two products would Ratcliff Enterprises prefer to produce and sell to optimize the use of machine hours in the production department?

46. **Qualitative Factors.** For each of the following independent scenarios, identify at least one *qualitative* factor that should be considered before making the decision.

a. A company sells three types of chainsaws (light duty, medium duty, and heavy duty), all of which are profitable. The company faces a labor-hour bottleneck and plans to eliminate the light duty product because it has the lowest contribution margin per labor hour.
b. A company plans to drop an unprofitable customer.
c. A maker of farm equipment would like to shut down its manufacturing facility and outsource production.

47. **Allocating Joint Costs and Evaluating Overall Company Profit (Appendix).** Elexor, Inc., produces two joint products, product A and product B. Prior to the split-off point, the company incurred

$10,000 in joint costs. Production of product A totaled 400 pounds, and product B totaled 600 pounds. Product A sells for $60 per pound and product B sells for $10 per pound.

Required:

a. Allocate joint costs to each product using the physical quantities method (pounds), and calculate the profit or loss for each product.
b. Allocate joint costs to each product using the relative sales value method, and calculate the profit or loss for each product.
c. Using your answer to requirement **a**, describe what will happen to overall company profit if the least profitable product is eliminated.

Problems

48. **Make-or-Buy Decision.** Vail Door Company currently manufactures doors used in the production of custom homes. Management is interested in outsourcing production of the doors to a reputable manufacturing company that can supply the doors for $90 per unit. Vail incurs the following annual production costs to produce 3,000 doors internally.

	Per Unit	Total Annual Cost at 3,000 Units
Variable production costs		
Direct materials	$30	$ 90,000
Direct labor	15	45,000
Manufacturing overhead	20	60,000
Fixed production costs		
Factory lease		80,000
Equipment lease		40,000
Factory insurance		25,000
Production supervisor's salary		90,000
Total production costs		$430,000

If production is outsourced, all variable production costs, equipment lease costs, and factory insurance costs will be eliminated. The production supervisor's salary cost will remain regardless of the decision to outsource or to produce internally because the supervisor recently signed a long-term contract with

the company. The factory lease has five years remaining and cannot be terminated before then.

Required:

a. Perform differential analysis using the format presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Assume making the product internally is Alternative 1, and buying the product from an outside manufacturer is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of outsourcing production using the format presented in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.".
d. Assume Vail Door Company can lease the space it currently uses to produce doors for $30,000 per year if production of doors is outsourced. Because the company subleasing this space would also pay for insurance, Vail would not be required to pay for factory insurance. Use the format presented in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc." to determine if Vail would be better off outsourcing production. (Hint: $30,000 will appear in the analysis as an opportunity cost similar to Figure 7.8 "Differential Analysis with Opportunity Cost for Barbeque Company".)

49. **Make-or-Buy Decision and Qualitative Factors.** Soda Bottling, Inc., currently bottles its own soda drinks. Management is interested in outsourcing the production of bottles to a reputable manufacturing company that can supply the bottles for $0.04 each. Soda Bottling incurs the following monthly production costs to produce 1,000,000 bottles internally.

	Per Unit	Total Monthly Cost at 1,000,000 Units
Variable production cost	$0.02	$20,000
Fixed production cost		25,000
Total production cost		$45,000

If production is outsourced, all variable production costs and 70 percent of fixed production costs will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Assume making the product internally is Alternative 1, and buying the product from an outside manufacturer is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of outsourcing production using the format presented in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc.".
d. Assume all the facts of this problem remain the same. However, management of Soda Bottling has an opportunity to lease the space it currently uses to produce bottles for $6,000 per month if production of bottles is outsourced. Use the format presented in Figure 7.3 "Summary of Differential Analysis for Best Boards, Inc." to determine if Soda Bottling would be better off outsourcing production. (Hint: $6,000 will appear in the analysis as an opportunity cost similar to Figure 7.8 "Differential Analysis with Opportunity Cost for Barbeque Company".)
e. Identify at least one *qualitative* factor that should be considered before management decides to outsource production.

50. **Product Line Decision.** The following monthly segmented income statement is for Hal's Hardware.

	Product Lines			
	Garden Supplies	Tools	Paint	Total
Sales revenue	$20,000	$15,000	$23,000	$58,000
Variable costs	11,000	8,000	9,000	28,000
Contribution margin	$ 9,000	$ 7,000	$14,000	$30,000
Direct fixed costs	3,000	1,500	8,500	13,000
Allocated fixed costs	2,000	5,000	3,000	10,000
Profit	$ 4,000	$ 500	$ 2,500	$ 7,000

Management is concerned about the low profit associated with the tools product line and is considering dropping this product line. Allocated fixed costs are assigned to product lines based on floor space used by each product line (measured in square feet),

resulting in the following percentages for garden supplies, tools, and paint, respectively: 20 percent, 50 percent, and 30 percent. If the tools product line is eliminated, total allocated fixed costs will be assigned as follows: 62.5 percent to garden supplies, and 37.5 percent to paint. All variable and direct fixed costs for the tools product line will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company". Assume keeping all product lines is Alternative 1, and dropping the tools product line is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of dropping the tools product line using the format presented in Figure 7.7 "Summary of Differential Analysis for Barbeque Company".
d. Assume the space available from dropping the tools product line can be used by the paint product line, resulting in increased revenues for paint of $12,000 and increased variable costs for paint of $4,000. No additional direct fixed costs would be incurred, and 80 percent of allocated fixed costs would be assigned to paint and 20 percent assigned to garden supplies. Should Hal's Hardware drop the tools product line and use the freed-up space to expand the paint product line? (Hint: Prepare a differential analysis using the format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company" to find the answer. Alternative 1 assumes all product lines are kept, and Alternative 2 assumes the tools product line is dropped with a corresponding expansion of the paint product line.)

51. **Product Line Decision and Qualitative Factors.** The following annual segmented income statement is for Wax, Inc., a maker of wax for cars, boats, and floors.

	Product Lines			
	Cars	Boats	Floors	Total
Sales revenue	$400,000	$300,000	$460,000	$1,160,000
Variable costs	220,000	160,000	280,000	660,000
Contribution margin	$180,000	$140,000	$180,000	$ 500,000
Direct fixed costs	85,000	70,000	115,000	270,000
Allocated fixed costs	60,000	50,000	90,000	200,000
Profit	$ 35,000	$ 20,000	$(25,000)	$ 30,000

Management is concerned about the loss associated with the floors product line and is considering dropping this product line. Allocated fixed costs are assigned to product lines based on direct labor hours associated with each product line, resulting in the following percentages for cars, boats, and floors, respectively: 30 percent, 25 percent, and 45 percent. If the floors product line is eliminated, total allocated fixed costs will be assigned to the remaining products as follows: 55 percent to cars, and 45 percent to boats. All variable and direct fixed costs for the floors product line will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company". Assume keeping all product lines is Alternative 1, and dropping the floors product line is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of dropping the floors product line using the format presented in Figure 7.7 "Summary of Differential Analysis for Barbeque Company".
d. Assume the space available from dropping the floors product line can be used by the boats product line, resulting in increased revenues for boats of $200,000 and increased variable costs for boats of $110,000. An additional $10,000 in direct fixed costs would be incurred for the boats product line. Allocated fixed costs would be assigned as follows: 40 percent to cars, and 60 percent to boats. Should Wax, Inc., drop the floors product line and use the freed-up space to expand the boats product line? (Hint: Prepare a differential analysis using the format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company" to find the answer. Alternative 1 assumes all product lines are kept, and

Alternative 2 assumes the floors product line is dropped with a corresponding expansion of the boats product line.)

e. Identify at least one *qualitative* factor that should be considered before management decides to drop a product line.

52. **Customer Decision.** The following customer segmented quarterly income statement is for Ciena and Associates, a firm that performs legal services.

	Customers			
	Koontz	Davis	Nello	Total
Sales revenue	$150,000	$750,000	$100,000	$1,000,000
Variable costs	125,000	600,000	80,000	805,000
Contribution margin	$ 25,000	$150,000	$ 20,000	$ 195,000
Direct fixed costs	7,500	157,500	5,000	170,000
Allocated fixed costs	3,000	15,000	2,000	20,000
Profit (loss)	$ 14,500	$(22,500)	$ 13,000	$ 5,000

Management is concerned about the significant losses associated with the Davis account and would like to drop this customer. Allocated fixed costs are assigned to customers based on sales revenue. If Davis is dropped, total allocated fixed costs are assigned to the remaining customers, and all variable and direct fixed costs for the Davis account will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.10 "Customer Differential Analysis for Colony Landscape Maintenance". Assume keeping all customers is Alternative 1, and dropping the Davis account is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of dropping the Davis account using the format presented in Figure 7.12 "Summary of Differential Analysis for Colony Landscape Maintenance".
d. Explain what happened to the profitability of the other two customers as a result of dropping the Davis account.
e. Assume all the facts of this problem remain the same with one exception. As a result of dropping the Davis account, Ciena and Associates is only able to reduce the *direct* fixed

costs associated with the Davis account by 90 percent. The remaining 10 percent will not be eliminated for several more years. Does this change Ciena's decision as to whether to drop the Davis customer? Explain. (Hint: Modify one line item in your answer to requirement **c.**)

53. **Customer Decision and Qualitative Factors.** The following customer segmented monthly income statement is for Quality Web, Inc., a firm that provides Web site maintenance services.

	Customers			
	Anderson	**Houston**	**Murray**	**Total**
Sales revenue	$50,000	$50,000	$25,000	$125,000
Variable costs	40,000	37,000	18,000	95,000
Contribution margin	$10,000	$13,000	$ 7,000	$ 30,000
Direct fixed costs	3,000	4,000	6,500	13,500
Allocated fixed costs	4,000	4,000	2,000	10,000
Profit (loss)	$ 3,000	$ 5,000	$(1,500)	$ 6,500

Management is concerned about the losses associated with the Murray account and would like to drop this customer. Allocated fixed costs are assigned to customers based on sales revenue. If Murray is dropped, total allocated fixed costs are assigned to the remaining customers, and all variable and direct fixed costs for the Murray account will be eliminated.

Required:

a. Perform differential analysis using the format presented in Figure 7.10 "Customer Differential Analysis for Colony Landscape Maintenance". Assume keeping all customers is Alternative 1, and dropping the Murray account is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of dropping the Murray account using the format presented in Figure 7.12 "Summary of Differential Analysis for Colony Landscape Maintenance".
d. Explain what happened to the profitability of the other two customers as a result of dropping the Murray account.
e. Assume all the facts of this problem remain the same with one exception. As a result of dropping the Murray account, Quality Web, Inc., is able to reduce total *allocated* fixed costs

by 20 percent. The remaining 80 percent will be allocated to the other two products based on sales revenue. Does this change Quality Web's decision as to whether to drop the Murray customer? Explain. (Hint: Add one line item in the requirement **c** analysis to reflect allocated fixed cost savings.)

f. Identify at least one *qualitative* factor that should be considered before deciding whether to drop the Murray account.

54. **Special Order Decision with Idle Capacity and at Full Capacity.** The following quarterly financial data are for Pneumatic, Inc., a maker of compressors. On average, Pneumatic makes 20,000 compressors each quarter.

	Per Unit	Total Quarterly Data at 20,000 Compressors
Sales revenue	$300	$6,000,000
Variable costs	100	2,000,000
Contribution margin	$200	$4,000,000
Fixed costs		3,500,000
Profit		$ 500,000

Pneumatic received an offer from a one-time customer to purchase 5,000 compressors this coming quarter for $275 per unit. Pneumatic can produce up to 30,000 units a quarter, so the special order would not affect regular customer sales. Variable costs per unit will remain at $100. This special order will have no effect on fixed costs.

Required:

a. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Pneumatic would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2).
b. Summarize the result of accepting the special order using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".
c. Assume Pneumatic is approached with the same special offer, but has limited capacity, and can only produce up to 20,000

units per quarter. Thus any special orders will result in reduced sales to regular customers. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Pneumatic would be better off rejecting (Alternative 1) or accepting (Alternative 2) the special order.

d. Summarize the result of accepting the special order in requirement **c** using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".

55. **Special Order Decision at Full Capacity.** The following monthly financial data are for Green Mowers, Inc., a maker of electric lawn mowers. On average, Green Mowers makes 5,000 mowers each month.

	Per Unit	Total Monthly Data at 5,000 Mowers
Sales revenue	$200	$1,000,000
Variable costs	150	750,000
Contribution margin	$ 50	$ 250,000
Fixed costs		160,000
Profit		$ 90,000

Green Mowers received an offer from a one-time customer to purchase 1,000 mowers this coming month for $180 per unit. Green Mowers can produce up to 5,000 units a month, so the special order would reduce regular customer sales. Variable costs per unit will remain at $150. This special order will have no effect on fixed costs.

Required:

a. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Green Mowers would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2).
b. Summarize the result of accepting the special order using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".
c. Assume Green Mowers can increase capacity to accommodate the special order by paying an additional $20

in variable costs per unit (for overtime pay) for the additional 1,000 units. With this increased capacity, the special order would not affect regular customer sales. Using the differential analysis format presented in Figure 7.13 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Green Mowers would be better off rejecting (Alternative 1) or accepting (Alternative 2) the special order.

d. Summarize the result of accepting the special order in requirement **c** using the format presented in Figure 7.14 "Summary of Differential Analysis for Tony's T-Shirts".

56. **Target Costing.** Toolmakers, Inc., produces table saws. The marketing department has identified a market for a specific type of table saw that Toolmakers does not currently produce, and expects to be able to sell each saw for $800. Management requires a profit of 60 percent of the selling price.

Required:

a. Determine the highest cost (target cost) management would be willing to accept to produce this product.
b. Describe the four steps of target costing, and identify what Toolmakers would do next if it cannot make the product at or below the target cost.

57. **Constrained Resources.** Instrumental Strings, Inc., produces three types of string instruments: violin, cello, and bass. The instruments are produced in separate departments and sent to the quality testing department before being packaged and shipped. A labor-hour bottleneck has been identified in the quality testing department due to the high skill requirements of the job. Instrumental Strings would like to optimize its use of labor hours by producing the two most profitable instruments. Information for each product follows.

	Quality Testing Labor Hours	Price	Variable Cost
Violin	5.00	$4,000	$ 700
Cello	8.00	4,800	900
Bass	6.25	6,000	1,800

Required:

a. Calculate the contribution margin per unit of constrained resource for each product.
b. Which two products would Instrumental Strings prefer to produce and sell to optimize the use of labor hours in the quality testing department?

c. Assume additional employees are hired and trained for the quality testing department thereby alleviating this constraint. A labor-hour bottleneck has now been identified in the packaging department, which is recognized by management as a crucial department given the fine craftsmanship of each instrument. Of the three instruments produced by the company, identify which two products Instrumental Strings would prefer to produce and sell to optimize the use of labor hours in the packaging department. Assume the following labor hours are required to package each instrument:

Violin:	4.00 hours
Cello:	4.00 hours
Bass:	6.00 hours

58. **Allocating Joint Costs and Product Profitability (Appendix).** Fresh Catch, Inc., has a fleet of fishing boats. The most recent outing cost $90,000 and yielded 24,000 pounds of salmon and 8,000 pounds of halibut. Fresh Catch can sell salmon for $3 per pound and halibut for $6 per pound.

Required:

a. Allocate joint costs to each product using the physical quantities method, and calculate the profit or loss for each product.
b. Allocate joint costs to each product using the relative sales value method, and calculate the profit or loss for each product.

c. Explain what happened to the profitability of each product as the allocation method was changed from requirement **a** to requirement **b**. Why might management make bad decisions using the information from requirement **a**?
d. Assume salmon can be processed further into smoked salmon for an additional $2.50 per pound. Customers are willing to pay $7 per pound for smoked salmon. Should Fresh Catch process the salmon further? Explain.

59. **Allocating Joint Costs (Appendix).** Fruit Tree Nursery (FTN) grows peach and apple trees in containers for its customers. This past year, FTN grew 3,000 peach trees and 7,000 apple trees at a cost of $100,000. FTN can sell peach trees for $20 each and apple trees for $11 each.

Required:

a. Allocate joint costs to each product using the physical quantities method, and calculate the profit or loss for each product.
b. Allocate joint costs to each product using the relative sales value method, and calculate the profit or loss for each product.
c. Assume peach trees can be processed further by allowing them to grow for another few months. The additional processing cost is $4 per tree, and customers are willing to pay $23 for the larger trees. Should FTN process the peach trees further? Explain.

One Step Further: Skill-Building Cases

60. **Outsourcing Building Materials.** Review Note 7.8 "Business in Action 7.1" What qualitative factors did the manager of the library's construction likely consider in deciding to have **Pretecsa** produce the concrete panels?
61. **Internet Project: Outsourcing.** Accenture LLP is a global management consulting, technology services, and outsourcing company with more than $17 billion in annual revenues. Go to Accenture's Web site (http://www.accenture.com) and select *outsourcing*, or type *outsourcing* in Accenture's search feature. Review the information provided about

outsourcing, select a specific outsourcing topic, and write a one-page report summarizing your findings.

62. **Sale of Stores at** Kmart. Refer to Note 7.17 "Business in Action 7.2" What qualitative factors were likely considered by the company's management in considering whether to keep the stores?

63. **Group Activity: Qualitative Factors.** Each of the following scenarios is being considered at three separate companies.

    1. A company sells three types of bicycles (racers, cruisers, and climbers), all of which are profitable. The company faces a labor-hour bottleneck and plans to eliminate the cruiser product because it has the lowest contribution margin per labor hour.
    2. A company plans to accept a special order at a reduced price from a one-time customer.
    3. A maker of car batteries plans to eliminate one of its unprofitable product lines.

    Required:

    Form groups of two to four students and assign one of the three independent scenarios listed previously to each group. Each group must perform the following requirements:

    a. Identify at least two qualitative factors that should be considered before making the decision.
    b. Discuss each option, based on the findings of your group, with the class.

64. **Special Order Decision Using Excel.** The following monthly financial data are for Green Mowers, Inc., a maker of electric lawn mowers. Green Mowers makes and sells 5,000 mowers each month.

	Per Unit	Total Monthly Data at 5,000 Mowers
Sales revenue	$200	$1,000,000
Variable costs	150	750,000
Contribution margin	$ 50	$ 250,000
Fixed costs		160,000
Profit		$ 90,000

Green Mowers received an offer from a one-time customer to purchase 1,000 mowers this coming month for $180 per unit. Green Mowers can only produce up to 5,000 units a month, so the special order would reduce regular customer sales. Variable costs per unit will remain at $150. This special order will have no effect on fixed costs.

Required:

Prepare an Excel spreadsheet, similar to the one shown in the *Computer Application* box, to determine whether Green Mowers would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2). Make a recommendation as to which alternative should be accepted and explain the reasoning for your recommendation.

65. **Ethics: Cost-Plus Pricing.** JR Engineering recently negotiated a cost-plus contract with Pineville City to provide engineering services at a rate equal to direct labor costs plus 30 percent. On a separate note, the partners at JR Engineering discovered that one of its customers filed for bankruptcy last month and will not be able to pay the $200,000 owed to the firm.

    The two partners at JR Engineering, Julie and Ron, decided to include some of the direct labor costs incurred working on the bankrupt company with the direct labor costs associated with Pineville City. As Ron stated, "After all, customers fail from time to time, and it's only fair that our other customers shoulder some of the burden. This enables us to provide the high-quality service we know is so important to our customers."

    Are JR Engineering's actions ethical? What are the long-term implications of JR's actions? Explain.

Comprehensive Cases

66. **Make-or-Buy Decision.** Keyboard, Inc., a manufacturer of pianos, typically sells each of its pianos for $1,480. The cost of manufacturing and marketing one piano at the company's usual monthly volume of 6,000 units is shown.

	Per Unit		Total at 6,000 Units	
Manufacturing costs				
Variable	$600		$3,600,000	
Fixed	240		1,440,000	
Total manufacturing		$ 840		$5,040,000
Marketing and administrative costs				
Variable	$100		$ 600,000	
Fixed	280		1,680,000	
Total marketing and administrative costs		380		2,280,000
Total cost		$1,220		$7,320,000

Required:

a. Keyboard, Inc., received a proposal from an independent piano manufacturer that will produce and ship 2,000 pianos each month directly to Keyboard's customers as requested by Keyboard's salespeople, at a cost of $900 each. This will have the effect of reducing total fixed marketing and administrative costs by 5 percent. As a result of reducing production capacity, Keyboard's total fixed manufacturing costs will decrease 30 percent. Total variable manufacturing costs will decrease since only 4,000 pianos will be produced rather than 6,000. Total variable marketing and administrative costs will remain unchanged.

   Perform differential analysis using the format presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." to determine if Keyboard should accept the proposal from the outside supplier. Assume making all 6,000 pianos internally is Alternative 1, and outsourcing the production of 2,000 pianos and producing 4,000 pianos internally is Alternative 2. Explain which alternative is best.

b. Assume the same facts as in requirement **a**, with one additional point. If production of 2,000 pianos is outsourced and 4,000 pianos are produced internally, Keyboard can use the idle capacity to produce an additional 1,400 beginner pianos that can be sold for

$1,100 each. Fixed marketing and administrative costs would be unchanged (the 5 percent reduction described in requirement **a** no longer applies). Fixed manufacturing costs would decrease by 10 percent (rather than the 30 percent described in requirement **a**). Per unit variable cost information for the beginner pianos would be as follows:

Variable manufacturing costs	$400
Variable marketing and administrative costs	$ 80

Perform differential analysis using the format presented in Figure 7.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." to determine if Keyboard should accept the proposal from the independent supplier. Assume making all 6,000 pianos internally is Alternative 1. Alternative 2 consists of outsourcing the production of 2,000 pianos and producing 5,400 pianos internally (= 4,000 regular pianos + 1,400 beginner pianos). Explain which alternative is best. (Hint: Include a line item for *sales revenue* in your analysis to determine the best alternative.)

67. **Product Line Decision.** The following monthly segmented income statement is for Thirst Quench, a maker of soda, sports drink, and lemonade.

	Product Lines			
	Soda	Sports Drink	Lemonade	Total
Sales revenue	$800,000	$600,000	$920,000	$2,320,000
Variable costs	440,000	320,000	560,000	1,320,000
Contribution margin	$360,000	$280,000	$360,000	$1,000,000
Direct fixed costs	170,000	290,000	255,000	715,000
Allocated fixed costs	50,000	40,000	110,000	200,000
Profit	$140,000	$(50,000)	$ (5,000)	$ 85,000

Management is concerned about the losses associated with the sports drink and lemonade product lines and is considering dropping all product lines except soda. Allocated fixed costs are

assigned to product lines based on direct labor hours associated with each product line resulting in the following percentages for soda, sports drink, and lemonade, respectively: 25 percent, 20 percent, and 55 percent. If the sports drink and lemonade product lines are eliminated, total allocated fixed costs will decrease by $40,000, and variable costs and direct fixed costs for these two product lines will be eliminated. (No allocated fixed cost savings occur if only one product line is dropped.)

Required:

a. Perform differential analysis using the format presented in Figure 7.6 "Product Line Differential Analysis for Barbeque Company". Assume keeping all product lines is Alternative 1, and keeping only the soda product line is Alternative 2.
b. Which alternative is best? Explain.
c. Summarize the result of keeping only the soda product line using the format presented in Figure 7.7 "Summary of Differential Analysis for Barbeque Company".
d. Management has asked you to look at the numbers for each product line and make a recommendation on how to increase overall company profit. What course of action would you recommend? Based on your recommendation, describe the qualitative factors that should be considered.