



### A Look Back

Chapter 4 introduced the activity-based costing (ABC) system with the potential for greater accuracy of cost allocations, ABC provides managers with cost information for strategic decisions.



### A Look at This Chapter

This chapter shows how information on both costs and sales behavior is useful to managers in performing cost-volume-profit analysis. This analysis is an important part of successful management and sound business decisions.



### A Look Ahead

Chapter 6 compares reports prepared under variable costing with those under absorption costing, and it explains how variable costing can improve managerial decisions.

# 5

## Chapter

# Cost Behavior and Cost-Volume-Profit Analysis

### Learning Objectives

## CAP

#### Conceptual

- C1** Describe different types of cost behavior in relation to production and sales volume. (p. 168)
- C2** Identify assumptions in cost-volume-profit analysis and explain their impact. (p. 177)
- C3** Describe several applications of cost-volume-profit analysis. (p. 179)

#### Analytical

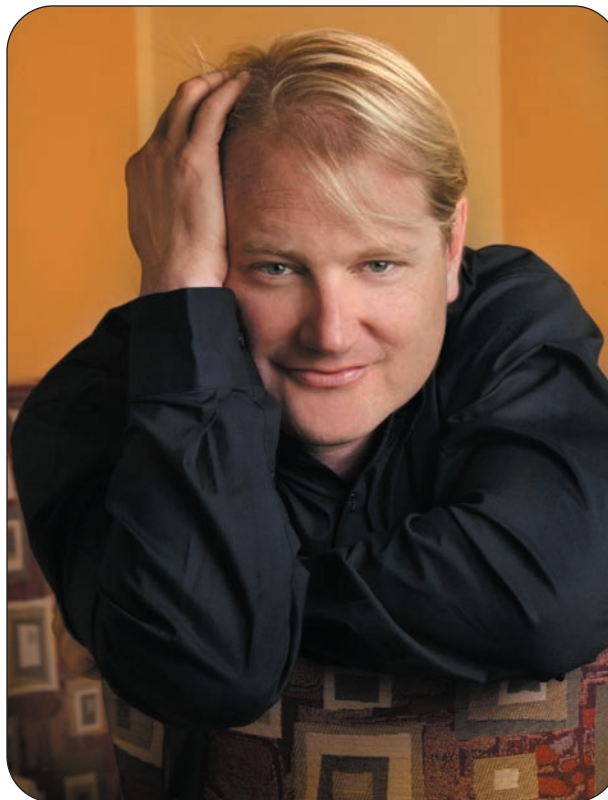
- A1** Compare the scatter diagram, high-low, and regression methods of estimating costs. (p. 173)
- A2** Compute the contribution margin and describe what it reveals about a company's cost structure. (p. 174)
- A3** Analyze changes in sales using the degree of operating leverage. (p. 184)

#### Procedural

- P1** Determine cost estimates using three different methods. (p. 171)
- P2** Compute the break-even point for a single product company. (p. 175)
- P3** Graph costs and sales for a single product company. (p. 176)
- P4** Compute the break-even point for a multiproduct company. (p. 181)



LPS



## Decision Feature

# Recipe for Growth



“Welcome to Moe’s”! A chorus of welcomes greets each customer at **Moe’s Southwest Grill (Moes.com)**, a chain of quirky Tex-Mex restaurants, which is part of Raving Brands. The zaniness continues with menu items such as Art Vandalay, Joey Bag of Donuts, the Close Talker, and the Billy Barou. They play music from “dead rock stars” like the Beatles, Elvis Presley, and Jimi Hendrix because “Moe wanted to pay tribute to his heroes who have passed on and would never have a chance to taste his food.”

Moe’s founder Martin Sprock explains, “We make a point of having the happiest associates. You feel good visiting our stores, and that means something to me. I’d go so far as to say I’d actually be willing to take a date to them.”

But there is more to Moe’s than fun. Moe’s features burritos, tacos, quesadillas, and salads. To appeal to health-conscious diners, Moe’s does not use frozen ingredients or microwaves or cook with fat. This recipe has resulted in Moe’s being one of the fastest-growing “fast casual” restaurants.

*“Don’t sit on the sidelines talking about your dream . . . get out and make it happen”*—Martin Sprock

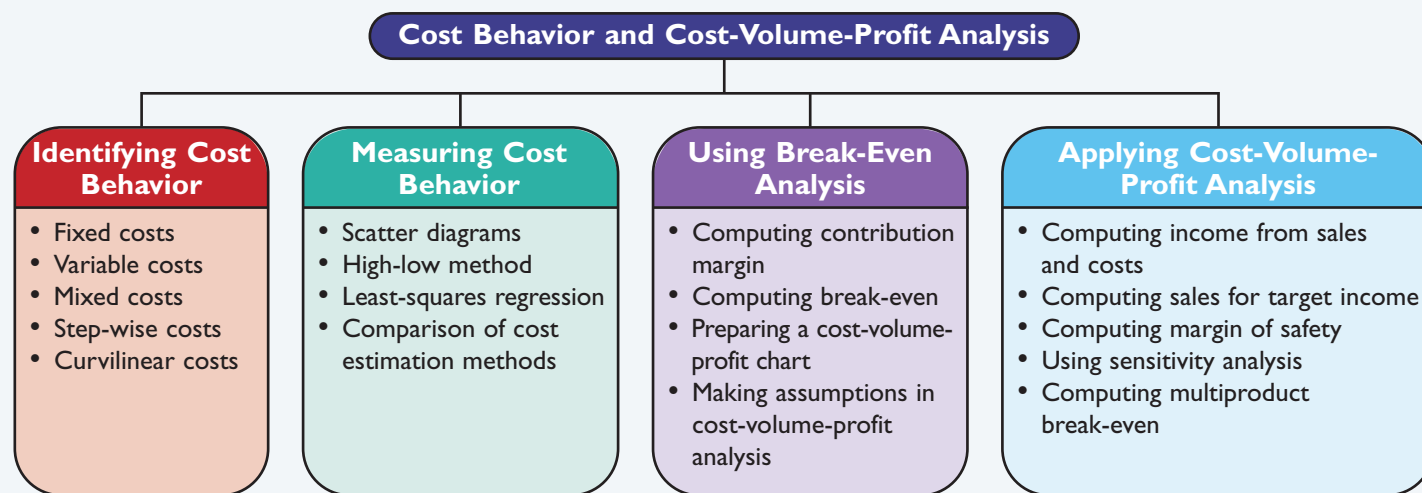
With such rapid growth, an understanding of cost behavior is critical. Identifying fixed and variable costs is key to understanding break-even points and maintaining the right mix of menu choices. Each Moe’s manager earns a degree from “Moe’s Training School,” where the finer points of cost management are taught. Moe’s online ordering and payment system is linked with its cash registers to enable managers to better determine which menu items are in demand. An understanding of how costs relate to sales volume and profits helps drive the menu options.

Martin Sprock’s vision is to run a chain of restaurants that treats employees as well as they treat owners. This family-first mentality and service-oriented approach have spurred Moe’s growth. Sprock, a former ski bum, encourages potential entrepreneurs to get out and make it happen. “I had no money when I started trying to fulfill my ambitions . . . I just did it.”

[Sources: *Moe’s Southwest Grill Website*, January 2009; *Go AirTran Airways Magazine*, 2005; *Atlanta Business Chronicle*, May 2008; *Pittsburgh Business Times*, March 2008.

This chapter describes different types of costs and shows how changes in a company's operating volume affect these costs. The chapter also analyzes a company's costs and sales to explain how different operating strategies affect profit or loss.

Managers use this type of analysis to forecast what will happen if changes are made to costs, sales volume, selling prices, or product mix. They then use these forecasts to select the best business strategy for the company.



## Identifying Cost Behavior



Video5.1

**Point:** Profit is another term for income.

Planning a company's future activities and events is a crucial phase in successful management. One of the first steps in planning is to predict the volume of activity, the costs to be incurred, sales to be made, and profit to be received. An important tool to help managers carry out this step is **cost-volume-profit (CVP) analysis**, which helps them predict how changes in costs and sales levels affect income. In its basic form, CVP analysis involves computing the sales level at which a company neither earns an income nor incurs a loss, called the *break-even point*. For this reason, this basic form of cost-volume-profit analysis is often called *break-even analysis*. Managers use variations of CVP analysis to answer questions such as these:

- What sales volume is needed to earn a target income?
- What is the change in income if selling prices decline and sales volume increases?
- How much does income increase if we install a new machine to reduce labor costs?
- What is the income effect if we change the sales mix of our products or services?

Consequently, cost-volume-profit analysis is useful in a wide range of business decisions.

Conventional cost-volume-profit analysis requires management to classify all costs as either *fixed* or *variable* with respect to production or sales volume. The remainder of this section discusses the concepts of fixed and variable cost behavior as they relate to CVP analysis.

### Decision Insight

**No Free Lunch** Hardly a week goes by without a company advertising a free product with the purchase of another. Examples are a free printer with a digital camera purchase or a free monitor with a computer purchase. Can these companies break even, let alone earn profits? We are reminded of the *no-free-lunch* adage, meaning that companies expect profits from the companion or add-on purchase to make up for the free product.

**C1** Describe different types of cost behavior in relation to production and sales volume.

### Fixed Costs

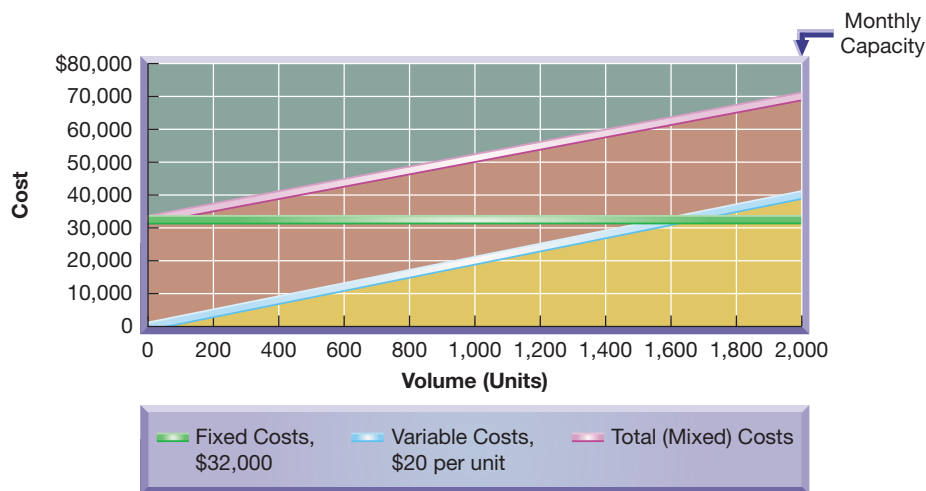
A *fixed cost* remains unchanged in amount when the volume of activity varies from period to period within a relevant range. For example, \$5,000 in monthly rent paid for a factory building remains the same whether the factory operates with a single eight-hour shift or around the clock.

with three shifts. This means that rent cost is the same each month at any level of output from zero to the plant's full productive capacity. Notice that while *total* fixed cost does not change as the level of production changes, the fixed cost *per unit* of output decreases as volume increases. For instance, if 20 units are produced when monthly rent is \$5,000, the average rent cost per unit is \$250 (computed as \$5,000/20 units). When production increases to 100 units per month, the average cost per unit decreases to \$50 (computed as \$5,000/100 units). The average cost decreases to \$10 per unit if production increases to 500 units per month. Common examples of fixed costs include depreciation, property taxes, office salaries, and many service department costs.



When production volume and costs are graphed, units of product are usually plotted on the *horizontal axis* and dollars of cost are plotted on the *vertical axis*.

Fixed costs then are represented as a horizontal line because they remain constant at all levels of production. To illustrate, the graph in Exhibit 5.1 shows that fixed costs remain at \$32,000 at all production levels up to the company's monthly capacity of 2,000 units of output. The *relevant range* for fixed costs in Exhibit 5.1 is 0 to 2,000 units. If the relevant range changes (that is, production capacity extends beyond this range), the amount of fixed costs will likely change.



**Point:** Fixed costs do not change when volume changes, but the per unit cost declines as volume increases.

**Example:** If the fixed cost line in Exhibit 5.1 is shifted upward, does the total cost line shift up, down, or remain in the same place? Answer: It shifts up by the same amount.

**EXHIBIT 5.1**  
Relations of Fixed and Variable Costs to Volume

**Example:** If the level of fixed costs in Exhibit 5.1 changes, does the slope of the total cost line change? Answer: No, the slope doesn't change. The total cost line is simply shifted upward or downward.

## Variable Costs

A *variable cost* changes in proportion to changes in volume of activity. The direct materials cost of a product is one example of a variable cost. If one unit of product requires materials costing \$20, total materials costs are \$200 when 10 units of product are manufactured, \$400 for 20 units, \$600 for 30 units, and so on. Notice that variable cost *per unit* remains constant but the *total* amount of variable cost changes with the level of production. In addition to direct materials, common variable costs include direct labor (if employees are paid per unit), sales commissions, shipping costs, and some overhead costs.

When variable costs are plotted on a graph of cost and volume, they appear as a straight line starting at the zero cost level. This straight line is upward (positive) sloping. The line rises as volume of activity increases. A variable cost line using a \$20 per unit cost is graphed in Exhibit 5.1.

## Mixed Costs

A **mixed cost** includes both fixed and variable cost components. For example, compensation for sales representatives often includes a fixed monthly salary and a variable commission based on sales. The total cost line in Exhibit 5.1 is a mixed cost. Like a fixed cost, it is greater than zero when volume is zero; but unlike a fixed cost, it increases steadily in proportion to increases in volume. The mixed cost line in Exhibit 5.1 starts on the vertical axis at the \$32,000

**Point:** Fixed costs are constant in total but vary (decline) per unit as more units are produced. Variable costs vary in total but are fixed per unit.



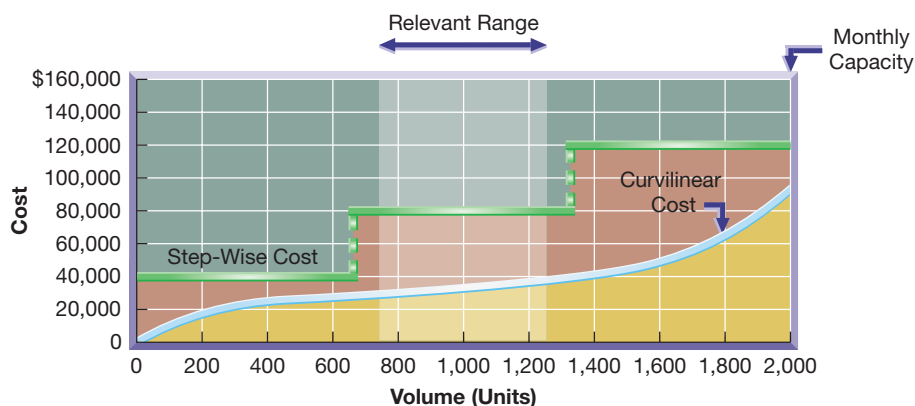
fixed cost point. Thus, at the zero volume level, total cost equals the fixed costs. As the activity level increases, the mixed cost line increases at an amount equal to the variable cost per unit. This line is highest when volume of activity is at 2,000 units (the end point of the relevant range). In CVP analysis, mixed costs are often separated into fixed and variable components. The fixed component is added to other fixed costs, and the variable component is added to other variable costs.

## Step-Wise Costs

A **step-wise cost** reflects a step pattern in costs. Salaries of production supervisors often behave in a step-wise manner in that their salaries are fixed within a *relevant range* of the current production volume. However, if production volume expands significantly (for example, with the addition of another shift), additional supervisors must be hired. This means that the total cost for supervisory salaries goes up by a lump-sum amount. Similarly, if volume takes another significant step up, supervisory salaries will increase by another lump sum. This behavior reflects a step-wise cost, also known as a *stair-step cost*, which is graphed in Exhibit 5.2. See how the step-wise cost line is flat within ranges (steps). Then, when volume significantly changes, it shifts to another level for that range (step).

### EXHIBIT 5.2

#### Step-Wise and Curvilinear Costs



In a conventional CVP analysis, a step-wise cost is usually treated as either a fixed cost or a variable cost. This treatment involves manager judgment and depends on the width of the range and the expected volume. To illustrate, suppose after the production of every 25 snowboards, an operator lubricates the finishing machine. The cost of this lubricant reflects a step-wise pattern. Also, suppose that after the production of every 1,000 units, the snowboard cutting tool is replaced. Again, this is a step-wise cost. Note that the range of 25 snowboards is much narrower than the range of 1,000 snowboards. Some managers might treat the lubricant cost as a variable cost and the cutting tool cost as a fixed cost.

## Curvilinear Costs

A variable cost, as explained, is a *linear* cost; that is, it increases at a constant rate as volume of activity increases. A **curvilinear cost**, also called a *nonlinear cost*, increases at a nonconstant rate as volume increases. When graphed, curvilinear costs appear as a curved line. Exhibit 5.2 shows a curvilinear cost beginning at zero when production is zero and then increasing at different rates.

An example of a curvilinear cost is total direct labor cost when workers are paid by the hour. At low to medium levels of production, adding more employees allows each of them to specialize by doing certain tasks repeatedly instead of doing several different tasks. This often yields additional units of output at lower costs. A point is eventually reached at which adding more employees creates inefficiencies. For instance, a large crew demands more time and effort in communicating and coordinating their efforts. While adding employees in this case increases output, the labor cost per unit increases, and the total labor cost goes up at a steeper slope. This pattern is seen in Exhibit 5.2 where the curvilinear cost curve starts at zero, rises, flattens out, and then increases at a faster rate as output nears the maximum.

**Point:** Computer spreadsheets are important and effective tools for CVP analysis and for analyzing alternative "what-if" strategies.

**Point:** Cost-volume-profit analysis helped Rod Canion, Jim Harris, and Bill Murto raise start-up capital of \$20 million to launch **Compaq Computer**. They showed that break-even volumes were attainable within the first year.

**Quick Check**

Answers—p. 188

1. Which of the following statements is typically true? (a) Variable cost per unit increases as volume increases, (b) fixed cost per unit decreases as volume increases, or (c) a curvilinear cost includes both fixed and variable elements.
2. Describe the behavior of a fixed cost.
3. If cost per unit of activity remains constant (fixed), why is it called a variable cost?

## Measuring Cost Behavior

Identifying and measuring cost behavior requires careful analysis and judgment. An important part of this process is to identify costs that can be classified as either fixed or variable, which often requires analysis of past cost behavior. Three methods are commonly used to analyze past costs: scatter diagrams, high-low method, and least-squares regression. Each method is discussed in this section using the unit and cost data shown in Exhibit 5.3, which are taken from a start-up company that uses units produced as the activity base in estimating cost behavior.

**P1** Determine cost estimates using three different methods.

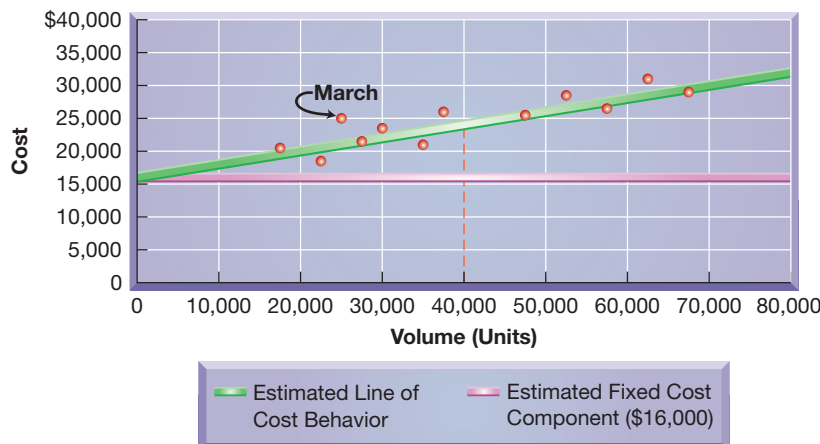
Month	Units Produced	Total Cost
January	17,500	\$20,500
February	27,500	21,500
March	25,000	25,000
April	35,000	21,500
May	47,500	25,500
June	22,500	18,500
July	30,000	23,500
August	52,500	28,500
September	37,500	26,000
October	57,500	26,000
November	62,500	31,000
December	67,500	29,000

**EXHIBIT 5.3**

Data for Estimating Cost Behavior

## Scatter Diagrams

**Scatter diagrams** display past cost and unit data in graphical form. In preparing a scatter diagram, units are plotted on the horizontal axis and cost is plotted on the vertical axis. Each individual point on a scatter diagram reflects the cost and number of units for a prior period. In Exhibit 5.4, the prior 12 months' costs and numbers of units are graphed. Each point reflects total costs incurred and units produced for one of those months. For instance, the point labeled March had units produced of 25,000 and costs of \$25,000.



**EXHIBIT 5.4**

Scatter Diagram

The **estimated line of cost behavior** is drawn on a scatter diagram to reflect the relation between cost and unit volume. This line best visually “fits” the points in a scatter diagram. Fitting this line demands judgment. The line drawn in Exhibit 5.4 intersects the vertical axis at approximately \$16,000, which reflects fixed cost. To compute variable cost per unit, or the slope, we perform three steps. First, we select any two points on the horizontal axis (units), say 0 and 40,000. Second, we draw a vertical line from each of these points to intersect the estimated line of cost behavior. The point on the vertical axis (cost) corresponding to the 40,000 units point that intersects the estimated line is roughly \$24,000. Similarly, the cost corresponding to zero units is \$16,000 (the fixed cost point). Third, we compute the slope of the line, or variable cost, as the change in cost divided by the change in units. Exhibit 5.5 shows this computation.

**EXHIBIT 5.5**

Variable Cost per Unit  
(Scatter Diagram)

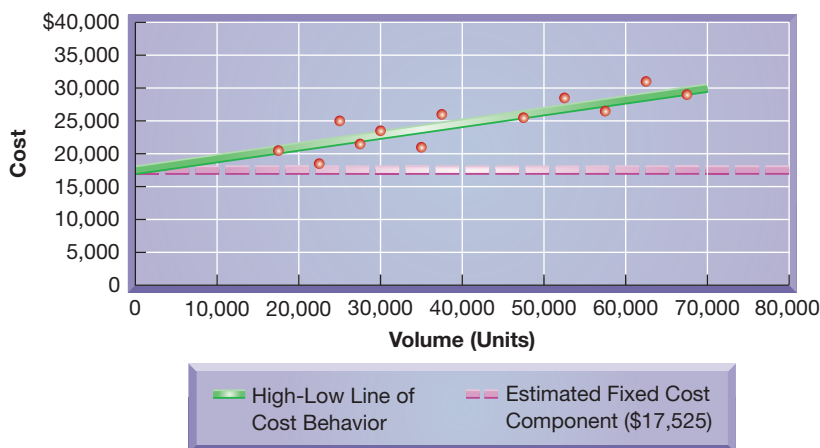
$$\frac{\text{Change in cost}}{\text{Change in units}} = \frac{\$24,000 - \$16,000}{40,000 - 0} = \frac{\$8,000}{40,000} = \$0.20 \text{ per unit}$$

**Example:** In Exhibits 5.4 and 5.5, if units are projected at 30,000, what is the predicted cost?  
Answer: Approximately \$22,000.

Variable cost is \$0.20 per unit. Thus, the cost equation that management will use to estimate costs for different unit levels is **\$16,000 plus \$0.20 per unit**.

**High-Low Method**

The **high-low method** is a way to estimate the cost equation by graphically connecting the two cost amounts at the highest and lowest unit volumes. In our case, the lowest number of units is 17,500, and the highest is 67,500. The costs corresponding to these unit volumes are \$20,500 and \$29,000, respectively (see the data in Exhibit 5.3). The estimated line of cost behavior for the high-low method is then drawn by connecting these two points on the scatter diagram corresponding to the lowest and highest unit volumes as follows.



**Point:** Note that the high-low method identifies the high and low points of the volume (activity) base, and the costs linked with those extremes—which may not be the highest and lowest costs.

The variable cost per unit is determined as the change in cost divided by the change in units and uses the data from the high and low unit volumes. This results in a slope, or variable cost per unit, of \$0.17 as computed in Exhibit 5.6.

**EXHIBIT 5.6**

Variable Cost per Unit  
(High-Low Method)

$$\frac{\text{Change in cost}}{\text{Change in units}} = \frac{\$29,000 - \$20,500}{67,500 - 17,500} = \frac{\$8,500}{50,000} = \$0.17 \text{ per unit}$$

To estimate the fixed cost for the high-low method, we use the knowledge that total cost equals fixed cost plus variable cost per unit times the number of units. Then we pick either the high or low point to determine the fixed cost. This computation is shown in Exhibit 5.7—where we use the high point (67,500 units) in determining the fixed cost of \$17,525. Use of the low point (17,500 units) yields the same fixed cost estimate: \$20,500 = Fixed cost + (\$0.17 per unit × 17,500), or Fixed cost = \$17,525.

$$\begin{aligned} \text{Total cost} &= \text{Fixed cost} + (\text{Variable cost} \times \text{Units}) \\ \$29,000 &= \text{Fixed cost} + (\$0.17 \text{ per unit} \times 67,500 \text{ units}) \\ \text{Then, Fixed cost} &= \$17,525 \end{aligned}$$

**EXHIBIT 5.7**

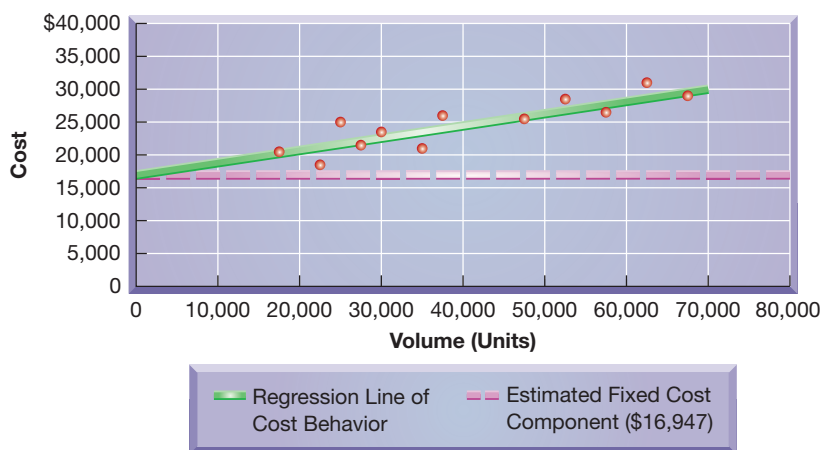
Fixed Cost (High-Low Method)

Thus, the cost equation used to estimate costs at different units is **\$17,525 plus \$0.17 per unit**. This cost equation differs slightly from that determined from the scatter diagram method. A deficiency of the high-low method is that it ignores all cost points except the highest and lowest. The result is less precision because the high-low method uses the most extreme points rather than the more usual conditions likely to recur.

**Least-Squares Regression**

**Least-squares regression** is a statistical method for identifying cost behavior. For our purposes, we use the cost equation estimated from this method but leave the computational details for more advanced courses. Such computations for least-squares regression are readily done using most spreadsheet programs or calculators. We illustrate this using Excel® in Appendix 5A.

The regression cost equation for the data presented in Exhibit 5.3 is **\$16,947 plus \$0.19 per unit**; that is, the fixed cost is estimated as \$16,947 and the variable cost at \$0.19 per unit. Both costs are reflected in the following graph.



**Comparison of Cost Estimation Methods**

The three cost estimation methods result in slightly different estimates of fixed and variable costs as summarized in Exhibit 5.8. Estimates from the scatter diagram are based on a visual fit of the cost line and are subject to interpretation. Estimates from the high-low method use only two sets of values corresponding to the lowest and highest unit volumes. Estimates from least-squares regression use a statistical technique and all available data points.

**A1** Compare the scatter diagram, high-low, and regression methods of estimating costs.

Estimation Method	Fixed Cost	Variable Cost
Scatter diagram . . . . .	\$16,000	\$0.20 per unit
High-low method . . . . .	17,525	0.17 per unit
Least-squares regression . . . . .	16,947	0.19 per unit

**EXHIBIT 5.8**

Comparison of Cost Estimation Methods

We must remember that all three methods use *past data*. Thus, cost estimates resulting from these methods are only as good as the data used for estimation. Managers must establish that the data are reliable in deriving cost estimates for the future.



**Quick Check**

Answers—p. 188

4. Which of the following methods is likely to yield the most precise estimated line of cost behavior? (a) High-low, (b) least-squares regression, or (c) scatter diagram.
5. What is the primary weakness of the high-low method?
6. Using conventional CVP analysis, a mixed cost should be (a) disregarded, (b) treated as a fixed cost, or (c) separated into fixed and variable components.

## Using Break-Even Analysis



Video5.2

Break-even analysis is a special case of cost-volume-profit analysis. This section describes break-even analysis by computing the break-even point and preparing a CVP (or break-even) chart.

### Contribution Margin and Its Measures

**A2** Compute the contribution margin and describe what it reveals about a company's cost structure.

We explained how managers classify costs by behavior. This often refers to classifying costs as being fixed or variable with respect to volume of activity. In manufacturing companies, volume of activity usually refers to the number of units produced. We then classify a cost as either fixed or variable, depending on whether total cost changes as the number of units produced changes. Once we separate costs by behavior, we can then compute a product's contribution margin. **Contribution margin per unit**, or *unit contribution margin*, is the amount by which a product's unit selling price exceeds its total unit variable cost. This excess amount contributes to covering fixed costs and generating profits on a per unit basis. Exhibit 5.9 shows the contribution margin per unit formula.

**EXHIBIT 5.9**

Contribution Margin per Unit

$$\text{Contribution margin per unit} = \text{Sales price per unit} - \text{Total variable cost per unit}$$

The **contribution margin ratio**, which is the percent of a unit's selling price that exceeds total unit variable cost, is also useful for business decisions. It can be interpreted as the percent of each sales dollar that remains after deducting the total unit variable cost. Exhibit 5.10 shows the formula for the contribution margin ratio.

**EXHIBIT 5.10**

Contribution Margin Ratio

$$\text{Contribution margin ratio} = \frac{\text{Contribution margin per unit}}{\text{Sales price per unit}}$$

To illustrate the use of contribution margin, let's consider **Rydell**, which sells footballs for \$100 per unit and incurs variable costs of \$70 per unit sold. Its fixed costs are \$24,000 per month with monthly capacity of 1,800 units (footballs). Rydell's contribution margin per unit is \$30, which is computed as follows.

Selling price per unit . . . . .	\$100
Variable cost per unit . . . . .	70
Contribution margin per unit . . . . .	<u>\$ 30</u>



Its contribution margin ratio is 30%, computed as \$30/\$100. This reveals that for each unit sold, Rydell has \$30 that contributes to covering fixed cost and profit. If we consider sales in dollars, a contribution margin of 30% implies that for each \$1 in sales, Rydell has \$0.30 that contributes to fixed cost and profit.

## Decision Maker



**Sales Manager** You are evaluating orders from two customers but can accept only one of the orders because of your company's limited capacity. The first order is for 100 units of a product with a contribution margin ratio of 60% and a selling price of \$1,000. The second order is for 500 units of a product with a contribution margin ratio of 20% and a selling price of \$800. The incremental fixed costs are the same for both orders. Which order do you accept? [Answer—p. 187]

## Computing the Break-Even Point

The **break-even point** is the sales level at which a company neither earns a profit nor incurs a loss. The concept of break-even is applicable to nearly all organizations, activities, and events. One of the most important items of information when launching a project is whether it will break even—that is, whether sales will at least cover total costs. The break-even point can be expressed in either units or dollars of sales.

To illustrate the computation of break-even analysis, let's again look at Rydell, which sells footballs for \$100 per unit and incurs \$70 of variable costs per unit sold. Its fixed costs are \$24,000 per month. Rydell breaks even for the month when it sells 800 footballs (sales volume of \$80,000). We compute this break-even point using the formula in Exhibit 5.11. This formula uses the contribution margin per unit, which for Rydell is \$30 (\$100 – \$70). From this we can compute the break-even sales volume as \$24,000/\$30, or 800 units per month.

**P2** Compute the break-even point for a single product company.

$$\text{Break-even point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

At a price of \$100 per unit, monthly sales of 800 units yield sales dollars of \$80,000 (called *break-even sales dollars*). This \$80,000 break-even sales can be computed directly using the formula in Exhibit 5.12.

$$\text{Break-even point in dollars} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

Rydell's break-even point in dollars is computed as \$24,000/0.30, or \$80,000 of monthly sales. To verify that Rydell's break-even point equals \$80,000 (or 800 units), we prepare a simplified income statement in Exhibit 5.13. It shows that the \$80,000 revenue from sales of 800 units exactly equals the sum of variable and fixed costs.

### EXHIBIT 5.11

Formula for Computing Break-Even Sales (in Units)

**Point:** The break-even point is where total expenses equal total sales and the profit is zero.

### EXHIBIT 5.12

Formula for Computing Break-Even Sales (in Dollars)

**Point:** Even if a company operates at a level in excess of its break-even point, management may decide to stop operating because it is not earning a reasonable return on investment.

RYDELL COMPANY	
Contribution Margin Income Statement (at Break-Even)	
For Month Ended January 31, 2009	
Sales (800 units at \$100 each) . . . . .	\$80,000
Variable costs (800 units at \$70 each) . . . . .	<u>56,000</u>
<b>Contribution margin</b> . . . . .	24,000
Fixed costs . . . . .	<u>24,000</u>
<b>Net income</b> . . . . .	<u>\$ 0</u>

### EXHIBIT 5.13

Contribution Margin Income Statement for Break-Even Sales

**Point:** A contribution margin income statement is also referred to as a **variable costing income statement**. This differs from the traditional **absorption costing** approach where all product costs are assigned to units sold and to units in ending inventory. Recall that variable costing expenses all fixed product costs. Thus, income for the two approaches differs depending on the level of finished goods inventory; the lower inventory is, the more similar the two approaches are.

The statement in Exhibit 5.13 is called a *contribution margin income statement*. It differs in format from a conventional income statement in two ways. First, it separately classifies costs and expenses as variable or fixed. Second, it reports contribution margin (Sales – Variable costs). The contribution margin income statement format is used in this chapter's assignment materials because of its usefulness in CVP analysis.

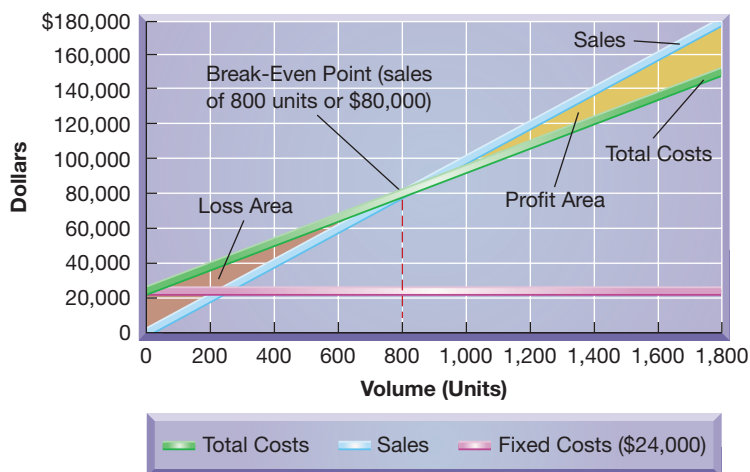
## Preparing a Cost-Volume-Profit Chart

**P3** Graph costs and sales for a single product company.

Exhibit 5.14 is a graph of Rydell's cost-volume-profit relations. This graph is called a **cost-volume-profit (CVP) chart**, or a *break-even chart* or *break-even graph*. The horizontal axis is the number of units produced and sold and the vertical axis is dollars of sales and costs. The lines in the chart depict both sales and costs at different output levels.

### EXHIBIT 5.14

Cost-Volume-Profit Chart



We follow three steps to prepare a CVP chart, which can also be drawn with computer programs that convert numeric data to graphs:

1. Plot fixed costs on the vertical axis (\$24,000 for Rydell). Draw a horizontal line at this level to show that fixed costs remain unchanged regardless of output volume (drawing this fixed cost line is not essential to the chart).
2. Draw the total (variable plus fixed) costs line for a relevant range of volume levels. This line starts at the fixed costs level on the vertical axis because total costs equal fixed costs at zero volume. The slope of the total cost line equals the variable cost per unit (\$70). To draw the line, compute the total costs for any volume level, and connect this point with the vertical axis intercept (\$24,000). Do not draw this line beyond the productive capacity for the planning period (1,800 units for Rydell).
3. Draw the sales line. Start at the origin (zero units and zero dollars of sales) and make the slope of this line equal to the selling price per unit (\$100). To sketch the line, compute dollar sales for any volume level and connect this point with the origin. Do not extend this line beyond the productive capacity. Total sales will be at the highest level at maximum capacity.

**Example:** In Exhibit 5.14, the sales line intersects the total cost line at 800 units. At what point would the two lines intersect if selling price is increased by 20% to \$120 per unit? Answer:  $\$24,000 / (\$120 - \$70) = 480$  units

The total costs line and the sales line intersect at 800 units in Exhibit 5.14, which is the break-even point—the point where total dollar sales of \$80,000 equals the sum of both fixed and variable costs (\$80,000).

On either side of the break-even point, the vertical distance between the sales line and the total costs line at any specific volume reflects the profit or loss expected at that point. At volume levels to the left of the break-even point, this vertical distance is the amount of the expected loss because the total costs line is above the total sales line. At volume levels to the right of the break-even point, the vertical distance represents the expected profit because the total sales line is above the total costs line.



### Decision Maker

**Operations Manager** As a start-up manufacturer, you wish to identify the behavior of manufacturing costs to develop a production cost budget. You know three methods can be used to identify cost behavior from past data, but past data are unavailable because this is a start-up. What do you do? [Answer—p. 187]

## Making Assumptions in Cost-Volume-Profit Analysis

Cost-volume-profit analysis assumes that relations can normally be expressed as simple lines similar to those in Exhibits 5.4 and 5.14. Such assumptions allow users to answer several important questions, but the usefulness of the answers depends on the validity of three assumptions: (1) constant selling price per unit, (2) constant variable costs per unit, and (3) constant total fixed costs. These assumptions are not always realistic, but they do not necessarily limit the usefulness of CVP analysis as a way to better understand costs and sales. This section discusses these assumptions and other issues for CVP analysis.

**Working with Assumptions** The behavior of individual costs and sales often is not perfectly consistent with CVP assumptions. If the expected costs and sales behavior differ from the assumptions, the results of CVP analysis can be limited. Still, we can perform useful analyses in spite of limitations with these assumptions for several reasons.

**Summing costs can offset individual deviations.** Deviations from assumptions with individual costs are often minor when these costs are summed. That is, individual variable cost items may not be perfectly variable, but when we sum these variable costs, their individual deviations can offset each other. This means the assumption of variable cost behavior can be proper for total variable costs. Similarly, an assumption that total fixed costs are constant can be proper even when individual fixed cost items are not exactly constant.

**CVP is applied to a relevant range of operations.** Sales, variable costs, and fixed costs often are reasonably reflected in straight lines on a graph when the assumptions are applied over a relevant range. The **relevant range of operations** is the normal operating range for a business. Except for unusually difficult or prosperous times, management typically plans for operations within a range of volume neither close to zero nor at maximum capacity. The relevant range excludes extremely high and low operating levels that are unlikely to occur. The validity of assuming that a specific cost is fixed or variable is more acceptable when operations are within the relevant range. As shown in Exhibit 5.2, a curvilinear cost can be treated as variable and linear if the relevant range covers volumes where it has a nearly constant slope. If the normal range of activity changes, some costs might need reclassification.

**CVP analysis yields estimates.** CVP analysis yields approximate answers to questions about costs, volumes, and profits. These answers do not have to be precise because the analysis makes rough estimates about the future. As long as managers understand that CVP analysis gives estimates, it can be a useful tool for starting the planning process. Other qualitative factors also must be considered.

**Working with Output Measures** CVP analysis usually describes the level of activity in terms of *sales volume*, which can be expressed in terms of either units sold or dollar sales. However, other measures of output exist. For instance, a manufacturer can use the number of units produced as a measure of output. Also, to simplify analysis, we sometimes assume that the production level is the same as the sales level. That is, inventory levels do not change. This often is justified by arguing that CVP analysis provides only approximations.

**C2** Identify assumptions in cost-volume-profit analysis and explain their impact.



**Point:** CVP analysis can be very useful for business decision making even when its assumptions are not strictly met.



Video5.2

**Example:** If the selling price declines, what happens to the break-even point?  
Answer: It increases.

### Quick Check

Answers—p. 188

7. Fixed cost divided by the contribution margin ratio yields the (a) break-even point in dollars, (b) contribution margin per unit, or (c) break-even point in units.
8. A company sells a product for \$90 per unit with variable costs of \$54 per unit. What is the contribution margin ratio?
9. Refer to Quick Check (8). If fixed costs for the period are \$90,000, what is the break-even point in dollars?
10. What three basic assumptions are used in CVP analysis?

**Working with Changes in Estimates** Because CVP analysis uses estimates, knowing how changes in those estimates impact break-even is useful. For example, a manager might form three estimates for each of the components of breakeven: optimistic, most likely, and pessimistic. Then ranges of break-even points in units can be computed using the formula in Exhibit 5.11.

To illustrate, assume Rydell’s managers provide the set of estimates in Exhibit 5.15.

**EXHIBIT 5.15**

Alternative Estimates for Break-Even Analysis

	Selling Price per Unit	Variable Cost per Unit	Total Fixed Costs
Optimistic . . . . .	\$105	\$68	\$21,000
Most likely . . . . .	100	70	24,000
Pessimistic . . . . .	95	72	27,000

If, for example, Rydell’s managers believe they can raise the selling price of a football to \$105, without any change in variable or fixed costs, then the revised contribution margin per football is \$35, and the revised break-even in units follows in Exhibit 5.16.

**EXHIBIT 5.16**

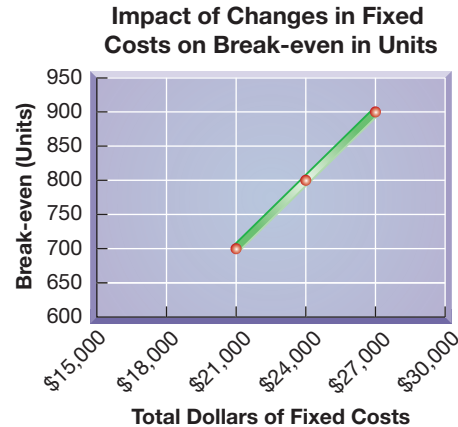
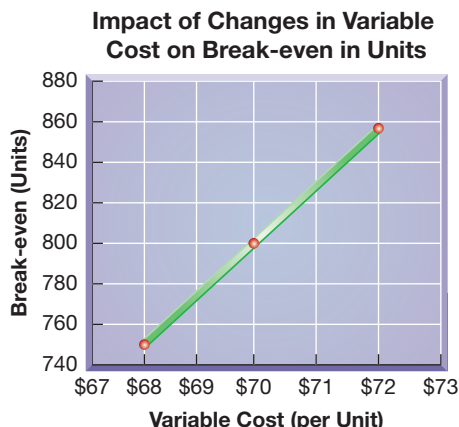
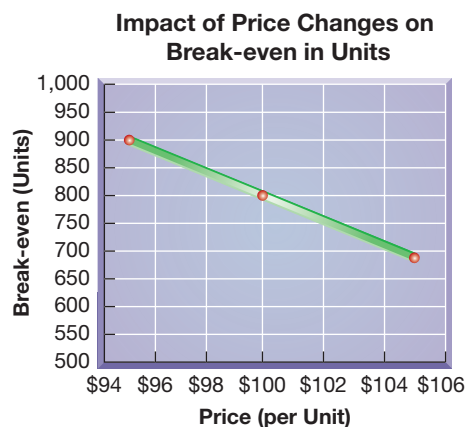
Revised Break-Even in Units

$$\text{Revised break-even point in units} = \frac{\$24,000}{\$35} = 686 \text{ units}$$

**EXHIBIT 5.17**

Scatter Diagrams—Break-Even Points for Alternative Estimates

Repeating this calculation using each of the other eight separate estimates above, and graphing the results, yields the three scatter diagrams in Exhibit 5.17.



These scatter diagrams show how changes in selling prices, variable costs, and fixed costs impact break-even. When selling prices can be increased without impacting costs, break-even decreases. When competition drives selling prices down, and the company cannot reduce costs, break-even increases. Increases in either variable or fixed costs, if they cannot be passed on to customers via higher selling prices, will increase break-even. If costs can be reduced and selling prices held constant, the break-even decreases.

**Point:** This analysis changed only one estimate at a time; managers can examine how combinations of changes in estimates will impact break-even.

## Applying Cost-Volume-Profit Analysis

Managers consider a variety of strategies in planning business operations. Cost-volume-profit analysis is useful in helping managers evaluate the likely effects of these strategies, which is the focus of this section.

## Computing Income from Sales and Costs

An important question managers often need an answer to is “What is the predicted income from a predicted level of sales?” To answer this, we look at four variables in CVP analysis. These variables and their relations to income (pretax) are shown in Exhibit 5.18. We use these relations to compute expected income from predicted sales and cost levels.

Sales
– Variable costs
— Contribution margin
– Fixed costs
— Income (pretax)

**C3** Describe several applications of cost-volume-profit analysis.

### EXHIBIT 5.18

Income Relations in CVP Analysis

To illustrate, let’s assume that Rydell’s management expects to sell 1,500 units in January 2009. What is the amount of income if this sales level is achieved? Following Exhibit 5.18, we compute Rydell’s expected income in Exhibit 5.19.

RYDELL COMPANY Contribution Margin Income Statement For Month Ended January 31, 2009	
Sales (1,500 units at \$100 each) . . . . .	\$150,000
Variable costs (1,500 units at \$70 each) . . . . .	105,000
Contribution margin . . . . .	45,000
Fixed costs . . . . .	24,000
Income (pretax) . . . . .	<u>\$ 21,000</u>

### EXHIBIT 5.19

Computing Expected Pretax Income from Expected Sales

The \$21,000 income is pretax. To find the amount of *after-tax* income from selling 1,500 units, management must apply the proper tax rate. Assume that the tax rate is 25%. Then we can prepare the after-tax income statement shown in Exhibit 5.20. We can also compute pretax income as after-tax income divided by (1 – tax rate); for Rydell, this is \$15,750/(1 – 0.25), or \$21,000.

RYDELL COMPANY Contribution Margin Income Statement For Month Ended January 31, 2009	
Sales (1,500 units at \$100 each) . . . . .	\$150,000
Variable costs (1,500 units at \$70 each) . . . . .	105,000
Contribution margin . . . . .	45,000
Fixed costs . . . . .	24,000
Pretax income . . . . .	21,000
Income taxes (25%) . . . . .	5,250
Net income (after tax) . . . . .	<u>\$ 15,750</u>

### EXHIBIT 5.20

Computing Expected After-Tax Income from Expected Sales

Management then assesses whether this income is an adequate return on assets invested. Management should also consider whether sales and income can be increased by raising or lowering prices. CVP analysis is a good tool for addressing these kinds of “what-if” questions.

## Computing Sales for a Target Income

Many companies’ annual plans are based on certain income targets (sometimes called *budgets*). Rydell’s income target for this year is to increase income by 10% over the prior year. When prior year income is known, Rydell easily computes its target income. CVP analysis helps to determine the sales level needed to achieve the target income. Computing this sales level is important because planning for the year is then based on this level. We use the formula shown in Exhibit 5.21 to compute sales for a target *after-tax* income.



**EXHIBIT 5.21**

Computing Sales (Dollars) for a Target After-Tax Income

$$\text{Dollar sales at target after-tax income} = \frac{\text{Fixed costs} + \text{Target pretax income}}{\text{Contribution margin ratio}}$$

To illustrate, Rydell has monthly fixed costs of \$24,000 and a 30% contribution margin ratio. Assume that it sets a target monthly after-tax income of \$9,000 when the tax rate is 25%. This means the pretax income is targeted at \$12,000 [ $\$9,000 / (1 - 0.25)$ ] with a tax expense of \$3,000. Using the formula in Exhibit 5.21, we find that \$120,000 of sales are needed to produce a \$9,000 after-tax income as shown in Exhibit 5.22.

**EXHIBIT 5.22**

Rydell's Dollar Sales for a Target Income

$$\text{Dollar sales at target after-tax income} = \frac{\$24,000 + \$12,000}{30\%} = \$120,000$$

**Point:** Break-even is a special case of the formulas in Exhibits 5.21 and 5.23; simply set target pretax income to \$0 and the formulas reduce to those in Exhibits 5.11 and 5.12.

We can alternatively compute *unit sales* instead of dollar sales. To do this, we substitute *contribution margin per unit* for the contribution margin ratio in the denominator. This gives the number of units to sell to reach the target after-tax income. Exhibit 5.23 illustrates this for Rydell. The two computations in Exhibits 5.22 and 5.23 are equivalent because sales of 1,200 units at \$100 per unit equal \$120,000 of sales.

**EXHIBIT 5.23**

Computing Sales (Units) for a Target After-Tax Income

$$\begin{aligned} \text{Unit sales at target after-tax income} &= \frac{\text{Fixed costs} + \text{Target pretax income}}{\text{Contribution margin per unit}} \\ &= \frac{\$24,000 + \$12,000}{\$30} = 1,200 \text{ units} \end{aligned}$$

**Computing the Margin of Safety**

All companies wish to sell more than the break-even number of units. The excess of expected sales over the break-even sales level is called a company's **margin of safety**, the amount that sales can drop before the company incurs a loss. It can be expressed in units, dollars, or even as a percent of the predicted level of sales. To illustrate, if Rydell's expected sales are \$100,000, the margin of safety is \$20,000 above break-even sales of \$80,000. As a percent, the margin of safety is 20% of expected sales as shown in Exhibit 5.24.

**EXHIBIT 5.24**

Computing Margin of Safety (in Percent)

$$\begin{aligned} \text{Margin of safety (in percent)} &= \frac{\text{Expected sales} - \text{Break-even sales}}{\text{Expected sales}} \\ &= \frac{\$100,000 - \$80,000}{\$100,000} = 20\% \end{aligned}$$

Management must assess whether the margin of safety is adequate in light of factors such as sales variability, competition, consumer tastes, and economic conditions.

**Decision Ethics**

**Supervisor** Your team is conducting a cost-volume-profit analysis for a new product. Different sales projections have different incomes. One member suggests picking numbers yielding favorable income because any estimate is "as good as any other." Another member points to a scatter diagram of 20 months' production on a comparable product and suggests dropping unfavorable data points for cost estimation. What do you do? [Answer—p. 187]

## Using Sensitivity Analysis

Earlier we showed how changing one of the estimates in a CVP analysis impacts breakeven. We can also examine strategies that impact several estimates in the CVP analysis. For instance, we might want to know what happens to income if we automate a currently manual process. We can use CVP analysis to predict income if we can describe how these changes affect a company's fixed costs, variable costs, selling price, and volume.

To illustrate, assume that Rydell Company is looking into buying a new machine that would increase monthly fixed costs from \$24,000 to \$30,000 but decrease variable costs from \$70 per unit to \$60 per unit. The machine is used to produce output whose selling price will remain unchanged at \$100. This results in increases in both the unit contribution margin and the contribution margin ratio. The revised contribution margin per unit is \$40 (\$100 – \$60), and the revised contribution margin ratio is 40% of selling price (\$40/\$100). Using CVP analysis, Rydell's revised break-even point in dollars would be \$75,000 as computed in Exhibit 5.25.

$$\text{Revised break-even point in dollars} = \frac{\text{Revised fixed costs}}{\text{Revised contribution margin ratio}} = \frac{\$30,000}{40\%} = \$75,000$$

The revised fixed costs and the revised contribution margin ratio can be used to address other issues including computation of (1) expected income for a given sales level and (2) the sales level needed to earn a target income. Once again, we can use sensitivity analysis to generate different sets of revenue and cost estimates that are *optimistic*, *pessimistic*, and *most likely*. Different CVP analyses based on these estimates provide different scenarios that management can analyze and use in planning business strategy.

### Decision Insight

**Eco-CVP** Ford Escape, Toyota Prius, and Honda Insight are hybrids. Many promise to save owners \$1,000 or more a year in fuel costs relative to comparables, and they generate fewer greenhouse gases. Are these models economically feasible? Analysts estimate that **Ford** can break even with its Escape when a \$3,000 premium is paid over comparable gas-based models.



### Quick Check

Answers—p. 188

11. A company has fixed costs of \$50,000 and a 25% contribution margin ratio. What dollar sales are necessary to achieve an after-tax net income of \$120,000 if the tax rate is 20%? (a) \$800,000, (b) \$680,000, or (c) \$600,000.
12. If a company's contribution margin ratio decreases from 50% to 25%, what can be said about the unit sales needed to achieve the same target income level?
13. What is a company's margin of safety?

## Computing a Multiproduct Break-Even Point

To this point, we have looked only at cases where the company sells a single product or service. This was to keep the basic CVP analysis simple. However, many companies sell multiple products or services, and we can modify the CVP analysis for use in these cases. An important assumption in a multiproduct setting is that the sales mix of different products is known and remains constant during the planning period. **Sales mix** is the ratio (proportion) of the sales volumes for the various products. For instance, if a company normally sells 10,000 footballs, 5,000 softballs, and 4,000 basketballs per month, its sales mix can be expressed as 10:5:4 for footballs, softballs, and basketballs.

**Example:** If fixed costs decline, what happens to the break-even point? *Answer:* It decreases.

### EXHIBIT 5.25

Revising Break-Even When Changes Occur

**Point:** Price competition led paging companies to give business to resellers—companies that lease services at a discount and then resell to subscribers. **Paging Network** charged some resellers under \$1 per month, less than a third of what was needed to break even. Its CEO now admits the low-price strategy was flawed.

**P4** Compute the break-even point for a multiproduct company.





To apply multiproduct CVP analysis, we can estimate the break-even point by using a **composite unit**, which consists of a specific number of units of each product in proportion to their expected sales mix. Multiproduct CVP analysis treats this composite unit as a single product. To illustrate, let's look at **Hair-Today**, a styling salon that offers three cuts: basic, ultra, and budget in the ratio of 4 basic units to 2 ultra units to 1 budget unit (expressed as 4:2:1). Management wants to estimate its break-even point for next year. Unit selling prices for these three cuts are basic, \$20; ultra, \$32; and budget, \$16. Using the 4:2:1 sales mix, the selling price of a composite unit of the three products is computed as follows.

4 units of basic @ \$20 per unit . . . . .	\$ 80
2 units of ultra @ \$32 per unit . . . . .	64
1 unit of budget @ \$16 per unit . . . . .	16
Selling price of a composite unit . . . . .	<u>\$160</u>

**Point:** Selling prices and variable costs are usually expressed in per unit amounts. Fixed costs are usually expressed in total amounts.

Hair-Today's fixed costs are \$192,000 per year, and its variable costs of the three products are basic, \$13; ultra, \$18.00; and budget, \$8.00. Variable costs for a composite unit of these products follow.

4 units of basic @ \$13 per unit . . . . .	\$52
2 units of ultra @ \$18 per unit . . . . .	36
1 unit of budget @ \$8 per unit . . . . .	8
Variable costs of a composite unit . . . . .	<u>\$96</u>

Hair-Today's \$64 contribution margin for a composite unit is computed by subtracting the variable costs of a composite unit (\$96) from its selling price (\$160). We then use the contribution margin to determine Hair-Today's break-even point in composite units in Exhibit 5.26.

**EXHIBIT 5.26**

Break-Even Point in Composite Units

$$\text{Break-even point in composite units} = \frac{\text{Fixed costs}}{\text{Contribution margin per composite unit}}$$

$$= \frac{\$192,000}{\$64} = 3,000 \text{ composite units}$$

**Point:** The break-even point in dollars for Exhibit 5.26 is  $\$192,000/(\$64/\$160) = \$480,000$ .

This computation implies that Hair-Today breaks even when it sells 3,000 composite units. To determine how many units of each product it must sell to break even, we multiply the number of units of each product in the composite by 3,000 as follows.

Basic: 4 × 3,000 . . . . .	12,000 units
Ultra: 2 × 3,000 . . . . .	6,000 units
Budget: 1 × 3,000 . . . . .	3,000 units

Instead of computing contribution margin per composite unit, a company can compute a **weighted-average contribution margin**. Given the 4:2:1 product mix, basic cuts comprise 57.14% (computed as 4/7) of the company's haircuts, ultra makes up 14.29% of its business, and budget cuts comprise 28.57%. The weighted-average contribution margin follows in Exhibit 5.27.

**EXHIBIT 5.27**

Weighted-Average Contribution Margin

	Unit contribution margin	×	Percentage of sales mix	=	Weighted unit contribution margin
Basic . . . . .	\$ 7		57.14%		\$4.000
Ultra . . . . .	14		28.57		4.000
Budget . . . . .	8		14.29		1.143
<b>Weighted-average contribution margin . . . . .</b>					<u><b>\$9.143</b></u>

The company's break-even point in units is computed as follows:

$$\begin{aligned} \text{Break-even point in units} &= \frac{\text{Fixed costs}}{\text{Weighted-average contribution margin}} \\ &= \frac{\$192,000}{\$9.143} = 21,000 \text{ units} \end{aligned}$$

**EXHIBIT 5.28**

Break-Even in Units Using Weighted-Average Contribution Margin

We see that the weighted-average contribution margin method yields 21,000 whole units as the break-even amount, the same total as the composite unit approach.

Exhibit 5.29 verifies the results for composite units by showing Hair-Today's sales and costs at this break-even point using a contribution margin income statement.

HAIR-TODAY				
Forecasted Contribution Margin Income Statement (at Breakeven)				
	Basic	Ultra	Budget	Totals
Sales				
Basic (12,000 @ \$20) . . . . .	\$240,000			
Ultra (6,000 @ \$32) . . . . .		\$192,000		
Budget (3,000 @ \$16) . . . . .			\$48,000	
Total sales . . . . .				\$480,000
Variable costs				
Basic (12,000 @ \$13) . . . . .	156,000			
Ultra (6,000 @ \$18) . . . . .		108,000		
Budget (3,000 @ \$8) . . . . .			24,000	
Total variable costs . . . . .				288,000
Contribution margin . . . . .	<u>\$ 84,000</u>	<u>\$ 84,000</u>	<u>\$24,000</u>	192,000
Fixed costs . . . . .				192,000
Net income . . . . .				<u>\$ 0</u>

**EXHIBIT 5.29**

Multiproduct Break-Even Income Statement

A CVP analysis using composite units can be used to answer a variety of planning questions. Once a product mix is set, all answers are based on the assumption that the mix remains constant at all relevant sales levels as other factors in the analysis do. We also can vary the sales mix to see what happens under alternative strategies.

**Decision Maker**



**Entrepreneur** A CVP analysis indicates that your start-up, which markets electronic products, will break even with the current sales mix and price levels. You have a target income in mind. What analysis might you perform to assess the likelihood of achieving this income? [Answer—p. 187]

**Quick Check**

Answers—p. 188

- The sales mix of a company's two products, X and Y, is 2:1. Unit variable costs for both products are \$2, and unit sales prices are \$5 for X and \$4 for Y. What is the contribution margin per composite unit? (a) \$5, (b) \$10, or (c) \$8.
- What additional assumption about sales mix must be made in doing a conventional CVP analysis for a company that produces and sells more than one product?

## Decision Analysis

## Degree of Operating Leverage

**A3** Analyze changes in sales using the degree of operating leverage.

CVP analysis is especially useful when management begins the planning process and wishes to predict outcomes of alternative strategies. These strategies can involve changes in selling prices, fixed costs, variable costs, sales volume, and product mix. Managers are interested in seeing the effects of changes in some or all of these factors.

One goal of all managers is to get maximum benefits from their fixed costs. Managers would like to use 100% of their output capacity so that fixed costs are spread over the largest number of units. This would decrease fixed cost per unit and increase income. The extent, or relative size, of fixed costs in the total cost structure is known as **operating leverage**. Companies having a higher proportion of fixed costs in their total cost structure are said to have higher operating leverage. An example of this is a company that chooses to automate its processes instead of using direct labor, increasing its fixed costs and lowering its variable costs. A useful managerial measure to help assess the effect of changes in the level of sales on income is the **degree of operating leverage (DOL)** defined in Exhibit 5.30.

**EXHIBIT 5.30**

Degree of Operating Leverage

$$\text{DOL} = \text{Total contribution margin (in dollars)} / \text{Pretax income}$$

To illustrate, let's return to Rydell Company. At a sales level of 1,200 units, Rydell's total contribution margin is \$36,000 (1,200 units  $\times$  \$30 contribution margin per unit). Its pretax income, after subtracting fixed costs of \$24,000, is \$12,000 (\$36,000  $-$  \$24,000). Rydell's degree of operating leverage at this sales level is 3.0, computed as contribution margin divided by pretax income (\$36,000/\$12,000). We then use DOL to measure the effect of changes in the level of sales on pretax income. For instance, suppose Rydell expects sales to increase by 10%. If this increase is within the relevant range of operations, we can expect this 10% increase in sales to result in a 30% increase in pretax income computed as DOL multiplied by the increase in sales (3.0  $\times$  10%). Similar analyses can be done for expected decreases in sales.

## Demonstration Problem

Sport Caps Co. manufactures and sells caps for different sporting events. The fixed costs of operating the company are \$150,000 per month, and the variable costs for caps are \$5 per unit. The caps are sold for \$8 per unit. The fixed costs provide a production capacity of up to 100,000 caps per month.

**Required**

- Use the formulas in the chapter to compute the following:
  - Contribution margin per cap.
  - Break-even point in terms of the number of caps produced and sold.
  - Amount of net income at 30,000 caps sold per month (ignore taxes).
  - Amount of net income at 85,000 caps sold per month (ignore taxes).
  - Number of caps to be produced and sold to provide \$45,000 of after-tax income, assuming an income tax rate of 25%.
- Draw a CVP chart for the company, showing cap output on the horizontal axis. Identify (a) the break-even point and (b) the amount of pretax income when the level of cap production is 70,000. (Omit the fixed cost line.)
- Use the formulas in the chapter to compute the
  - Contribution margin ratio.
  - Break-even point in terms of sales dollars.
  - Amount of net income at \$250,000 of sales per month (ignore taxes).
  - Amount of net income at \$600,000 of sales per month (ignore taxes).
  - Dollars of sales needed to provide \$45,000 of after-tax income, assuming an income tax rate of 25%.

**Planning the Solution**

- Identify the formulas in the chapter for the required items expressed in units and solve them using the data given in the problem.

- Draw a CVP chart that reflects the facts in the problem. The horizontal axis should plot the volume in units up to 100,000, and the vertical axis should plot the total dollars up to \$800,000. Plot the total cost line as upward sloping, starting at the fixed cost level (\$150,000) on the vertical axis and increasing until it reaches \$650,000 at the maximum volume of 100,000 units. Verify that the break-even point (where the two lines cross) equals the amount you computed in part 1.
- Identify the formulas in the chapter for the required items expressed in dollars and solve them using the data given in the problem.

## Solution to Demonstration Problem

1. a. Contribution margin per cap = Selling price per unit – Variable cost per unit  
= \$8 – \$5 = \$3

b. Break-even point in caps =  $\frac{\text{Fixed costs}}{\text{Contribution margin per cap}} = \frac{\$150,000}{\$3} = \underline{50,000 \text{ caps}}$

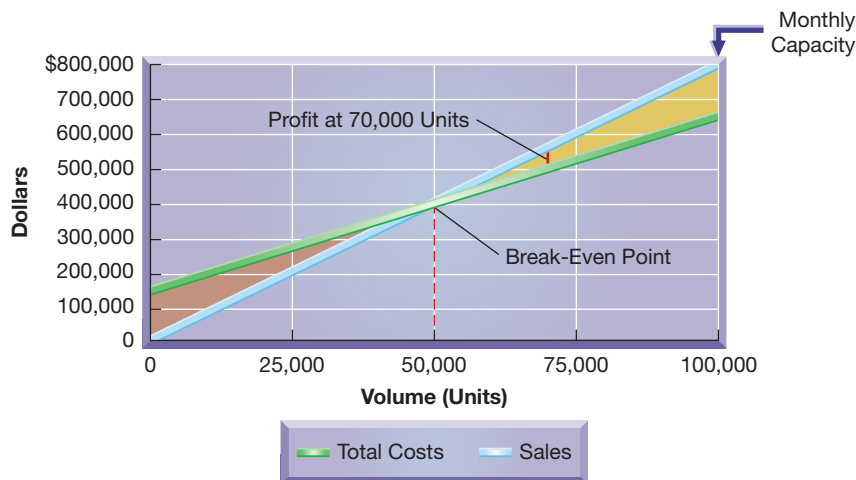
c. Net income at 30,000 caps sold = (Units × Contribution margin per unit) – Fixed costs  
= (30,000 × \$3) – \$150,000 = \$(60,000) loss

d. Net income at 85,000 caps sold = (Units × Contribution margin per unit) – Fixed costs  
= (85,000 × \$3) – \$150,000 = \$105,000 profit

e. Pretax income = \$45,000 / (1 – 0.25) = \$60,000  
Income taxes = \$60,000 × 25% = \$15,000

Units needed for \$45,000 income =  $\frac{\text{Fixed costs} + \text{Target pretax income}}{\text{Contribution margin per cap}}$   
=  $\frac{\$150,000 + \$60,000}{\$3} = \underline{70,000 \text{ caps}}$

### 2. CVP chart.



3. a. Contribution margin ratio =  $\frac{\text{Contribution margin per unit}}{\text{Selling price per unit}} = \frac{\$3}{\$8} = \underline{0.375}$ , or 37.5%

b. Break-even point in dollars =  $\frac{\text{Fixed costs}}{\text{Contribution margin ratio}} = \frac{\$150,000}{37.5\%} = \underline{\$400,000}$

c. Net income at sales of \$250,000 = (Sales × Contribution margin ratio) – Fixed costs  
= (\$250,000 × 37.5%) – \$150,000 = \$(56,250) loss

d. Net income at sales of \$600,000 = (Sales × Contribution margin ratio) – Fixed costs  
= (\$600,000 × 37.5%) – \$150,000 = \$75,000 income

e. Dollars of sales to yield \$45,000 after-tax income =  $\frac{\text{Fixed costs} + \text{Target pretax income}}{\text{Contribution margin ratio}}$   
=  $\frac{\$150,000 + \$60,000}{37.5\%} = \underline{\$560,000}$

## APPENDIX

## 5A

# Using Excel to Estimate Least-Squares Regression

Microsoft Excel® 2007 and other spreadsheet software can be used to perform least-squares regressions to identify cost behavior. In Excel®, the INTERCEPT and SLOPE functions are used. The following screen shot reports the data from Exhibit 5.3 in cells A1 through C13 and shows the cell contents to find the intercept (cell B16) and slope (cell B17). Cell B16 uses Excel® to find the intercept from a least-squares regression of total cost (shown as C2:C13 in cell B16) on units produced (shown as B2:B13 in cell B16). Spreadsheet software is useful in understanding cost behavior when many data points (such as monthly total costs and units produced) are available.

	A	B	C
1	<b>Month</b>	<b>Units Produced</b>	<b>Total Cost</b>
2	January	17500	20500
3	February	27500	21500
4	March	25000	25000
5	April	35000	21500
6	May	47500	25500
7	June	22500	18500
8	July	30000	23500
9	August	52500	28500
10	September	37500	26000
11	October	57500	26000
12	November	62500	31000
13	December	67500	29000
14			
15	<b>Intercept</b>	=INTERCEPT(C2:C13,B2:B13)	
16	<b>Slope</b>	=SLOPE(C2:C13,B2:B13)	
17			

Excel® can also be used to create scatter diagrams such as that in Exhibit 5.4. In contrast to visually drawing a line that “fits” the data, Excel® more precisely fits the regression line. To draw a scatter diagram with a line of fit, follow these steps:

1. Highlight the data cells you wish to diagram; in this example, start from cell C13 and highlight through cell B2.
2. Then select “Insert” and “Scatter” from the drop-down menus. Selecting the chart type in the upper left corner of the choices under Scatter will produce a diagram that looks like that in Exhibit 5.4, without a line of fit.
3. To add a line of fit (also called trend line), select “Layout” and “Trendline” from the drop-down menus. Selecting “Linear Trendline” will produce a diagram that looks like that in Exhibit 5.4, including the line of fit.

## Summary

### C1 Describe different types of cost behavior in relation to production and sales volume.

Cost behavior is described in terms of how its amount changes in relation to changes in volume of activity within a relevant range. Fixed costs remain constant to changes in volume. Total variable costs change in direct proportion to volume changes. Mixed costs display the effects of both fixed and variable components. Step-wise costs remain constant over a small volume range, then change by a lump sum and remain constant over another volume range, and so on. Curvilinear costs change in a nonlinear relation to volume changes.

### C2 Identify assumptions in cost-volume-profit analysis and explain their impact.

Conventional cost-volume-profit analysis is based on assumptions that the product's selling price remains constant and that variable and fixed costs behave in a manner consistent with their variable and fixed classifications.

### C3 Describe several applications of cost-volume-profit analysis.

Cost-volume-profit analysis can be used to predict what can happen under alternative strategies concerning sales volume, selling prices, variable costs, or fixed costs. Applications include "what-if" analysis, computing sales for a target income, and break-even analysis.

### A1 Compare the scatter diagram, high-low, and regression methods of estimating costs.

Cost estimates from a scatter diagram are based on a visual fit of the cost line. Estimates from the high-low method are based only on costs corresponding to the lowest and highest sales. The least-squares regression method is a statistical technique and uses all data points.

### A2 Compute the contribution margin and describe what it reveals about a company's cost structure.

Contribution margin per unit is a product's sales price less its total variable costs. Contribution margin ratio is a product's contribution margin per unit divided by its sales price. Unit contribution margin is the amount received from each sale that contributes to fixed costs and income.

The contribution margin ratio reveals what portion of each sales dollar is available as contribution to fixed costs and income.

### A3 Analyze changes in sales using the degree of operating leverage.

The extent, or relative size, of fixed costs in a company's total cost structure is known as *operating leverage*. One tool useful in assessing the effect of changes in sales on income is the degree of operating leverage, or DOL. DOL is the ratio of the contribution margin divided by pretax income. This ratio can be used to determine the expected percent change in income given a percent change in sales.

### P1 Determine cost estimates using three different methods.

Three different methods used to estimate costs are the scatter diagram, the high-low method, and least-squares regression. All three methods use past data to estimate costs.

### P2 Compute the break-even point for a single product company.

A company's break-even point for a period is the sales volume at which total revenues equal total costs. To compute a break-even point in terms of sales units, we divide total fixed costs by the contribution margin per unit. To compute a break-even point in terms of sales dollars, divide total fixed costs by the contribution margin ratio.

### P3 Graph costs and sales for a single product company.

The costs and sales for a company can be graphically illustrated using a CVP chart. In this chart, the horizontal axis represents the number of units sold and the vertical axis represents dollars of sales or costs. Straight lines are used to depict both costs and sales on the CVP chart.

### P4 Compute the break-even point for a multiproduct company.

CVP analysis can be applied to a multiproduct company by expressing sales volume in terms of composite units. A composite unit consists of a specific number of units of each product in proportion to their expected sales mix. Multiproduct CVP analysis treats this composite unit as a single product.

## Guidance Answers to **Decision Maker** and **Decision Ethics**



**Sales Manager** The contribution margin per unit for the first order is \$600 (60% of \$1,000); the contribution margin per unit for the second order is \$160 (20% of \$800). You are likely tempted to accept the first order based on its high contribution margin per unit, but you must compute the total contribution margin based on the number of units sold for each order. Total contribution margin is \$60,000 (\$600 per unit  $\times$  100 units) and \$80,000 (\$160 per unit  $\times$  500 units) for the two orders, respectively. The second order provides the largest return in absolute dollars and is the order you would accept. Another factor to consider in your selection is the potential for a long-term relationship with these customers including repeat sales and growth.

**Operations Manager** Without the availability of past data, none of the three methods described in the chapter can be used to measure cost behavior. Instead, the manager must investigate whether data from similar manufacturers can be accessed. This is likely difficult due to the sensitive nature of such data. In the absence of data, the manager should develop a list of the different production inputs and identify input-output relations. This provides guidance to the manager in measuring cost behavior. After several months, actual cost data will be available for analysis.

**Supervisor** Your dilemma is whether to go along with the suggestions to "manage" the numbers to make the project look like it will achieve sufficient profits. You should not succumb to these suggestions. Many people will likely be affected negatively if you manage the predicted numbers and the project eventually is unprofitable. Moreover, if it does fail, an investigation would likely reveal that data in the proposal were "fixed" to make it look good. Probably the only benefit from managing the numbers is the short-term payoff of pleasing those who proposed the product. One way to deal with this dilemma is to prepare several analyses showing results under different assumptions and then let senior management make the decision.

**Entrepreneur** You must first compute the level of sales required to achieve the desired net income. Then you must conduct sensitivity analysis by varying the price, sales mix, and cost estimates. Results from the sensitivity analysis provide information you can use to assess the possibility of reaching the target sales level. For instance, you might have to pursue aggressive marketing strategies to push the high-margin products, or you might have to cut prices to increase sales and profits, or another strategy might emerge.

Guidance Answers to **Quick Checks**

1. *b*
2. A fixed cost remains unchanged in total amount regardless of output levels. However, fixed *cost per unit* declines with increased output.
3. Such a cost is considered variable because the *total* cost changes in proportion to volume changes.
4. *b*
5. The high-low method ignores all costs and sales (activity base) volume data points except the costs corresponding to the highest and lowest (most extreme) sales (activity base) volume.
6. *c*
7. *a*
8.  $(\$90 - \$54)/\$90 = 40\%$
9.  $\$90,000/40\% = \$225,000$
10. Three basic CVP assumptions are that (1) selling price per unit is constant, (2) variable costs per unit are constant, and (3) total fixed costs are constant.
11. *a*; Two steps are required for explanation:
  - (1) Pretax income =  $\$120,000/(1 - 0.20) = \$150,000$
  - (2)  $\frac{\$50,000 + \$150,000}{25\%} = \$800,000$
12. If the contribution margin ratio decreases from 50% to 25%, unit sales would have to double.
13. A company's margin of safety is the excess of the predicted sales level over its break-even sales level.
14. *c*; Selling price of a composite unit:
 

2 units of X @ \$5 per unit	.....	\$10
1 unit of Y @ \$4 per unit	.....	<u>4</u>
Selling price of a composite unit	.....	\$14

Variable costs of a composite unit:

2 units of X @ \$2 per unit	.....	\$4
1 unit of Y @ \$2 per unit	.....	<u>2</u>
Variable costs of a composite unit	.....	\$6

Therefore, the contribution margin per composite unit is \$8.
15. It must be assumed that the sales mix remains unchanged at all sales levels in the relevant range.



**Key Terms**

[mhhe.com/wildMA2e](http://mhhe.com/wildMA2e)

Key Terms are available at the book's Website for learning and testing in an online Flashcard Format.

- |  |   |   |
|--|---|---|
| Break-even point (p. 175)                  | Degree of operating leverage (DOL) (p. 184) | Operating leverage (p. 184)                   |
| Composite unit (p. 182)                    | Estimated line of cost behavior (p. 172)    | Relevant range of operations (p. 177)         |
| Contribution margin per unit (p. 174)      | High-low method (p. 172)                    | Sales mix (p. 181)                            |
| Contribution margin ratio (p. 174)         | Least-squares regression (p. 173)           | Scatter diagram (p. 171)                      |
| Cost-volume-profit (CVP) analysis (p. 168) | Margin of safety (p. 180)                   | Step-wise cost (p. 170)                       |
| Cost-volume-profit (CVP) chart (p. 176)    | Mixed cost (p. 169)                         | Weighted-average contribution margin (p. 182) |
| Curvilinear cost (p. 170)                  |   |   |



**Multiple Choice Quiz**

Answers on p. 203

[mhhe.com/wildMA2e](http://mhhe.com/wildMA2e)

Additional Quiz Questions are available at the book's Website.






Quiz5

1. A company's only product sells for \$150 per unit. Its variable costs per unit are \$100, and its fixed costs total \$75,000. What is its contribution margin per unit?
  - a. \$50
  - b. \$250
  - c. \$100
  - d. \$150
  - e. \$25
2. Using information from question 1, what is the company's contribution margin ratio?
  - a. 66⅔%
  - b. 100%
  - c. 50%
  - d. 0%
  - e. 33⅓%
3. Using information from question 1, what is the company's break-even point in units?
  - a. 500 units
  - b. 750 units
  - c. 1,500 units
  - d. 3,000 units
  - e. 1,000 units
4. A company's forecasted sales are \$300,000 and its sales at break-even are \$180,000. Its margin of safety in dollars is
  - a. \$180,000.
  - b. \$120,000.

- c. \$480,000.  
 d. \$60,000.  
 e. \$300,000.
5. A product sells for \$400 per unit and its variable costs per unit are \$260. The company's fixed costs are \$840,000. If the company desires \$70,000 pretax income, what is the required dollar sales?
- a. \$2,400,000  
 b. \$200,000  
 c. \$2,600,000  
 d. \$2,275,000  
 e. \$1,400,000

Superscript letter <sup>A</sup> denotes assignments based on Appendix 5A.

## Discussion Questions

- How is cost-volume-profit analysis useful?
- What is a variable cost? Identify two variable costs.
- When output volume increases, do variable costs per unit increase, decrease, or stay the same within the relevant range of activity? Explain.
- When output volume increases, do fixed costs per unit increase, decrease, or stay the same within the relevant range of activity? Explain.
- How do step-wise costs and curvilinear costs differ?
- Define and describe *contribution margin* per unit.
- Define and explain the *contribution margin ratio*.
- Describe the contribution margin ratio in layperson's terms.
- In performing CVP analysis for a manufacturing company, what simplifying assumption is usually made about the volume of production and the volume of sales?
- What two arguments tend to justify classifying all costs as either fixed or variable even though individual costs might not behave exactly as classified?
- How does assuming that operating activity occurs within a relevant range affect cost-volume-profit analysis?
- List three methods to measure cost behavior.
- How is a scatter diagram used to identify and measure the behavior of a company's costs?
- In cost-volume-profit analysis, what is the estimated profit at the break-even point?
- Assume that a straight line on a CVP chart intersects the vertical axis at the level of fixed costs and has a positive slope that rises with each additional unit of volume by the amount of the variable costs per unit. What does this line represent?
- Why are fixed costs depicted as a horizontal line on a CVP chart?
- Each of two similar companies has sales of \$20,000 and total costs of \$15,000 for a month. Company A's total costs include \$10,000 of variable costs and \$5,000 of fixed costs. If Company B's total costs include \$4,000 of variable costs and \$11,000 of fixed costs, which company will enjoy more profit if sales double?
- \_\_\_\_\_ of \_\_\_\_\_ reflects expected sales in excess of the level of break-even sales.
-  **Apple** produces iPods for sale. Identify some of the variable and fixed product costs associated with that production. [*Hint: Limit costs to product costs.*]
-  Should **Best Buy** use single product or multi-product break-even analysis? Explain.
-  **Apple** is thinking of expanding sales of its most popular Macintosh model by 65%. Do you expect its variable and fixed costs for this model to stay within the relevant range? Explain.



**Denotes Discussion Questions that involve decision making.**

**connect** Most materials in this section are available in McGraw-Hill's Connect

Determine whether each of the following is best described as a fixed, variable, or mixed cost with respect to product units.

- Packaging expense.
- Factory supervisor's salary.
- Taxes on factory building.
- Depreciation expense of warehouse.
- Rubber used to manufacture athletic shoes.
- Maintenance of factory machinery.
- Wages of an assembly-line worker paid on the basis of acceptable units produced.

## QUICK STUDY

### QS 5-1

Cost behavior identification





**QS 5-2**

Cost behavior identification



Listed here are four series of separate costs measured at various volume levels. Examine each series and identify whether it is best described as a fixed, variable, step-wise, or curvilinear cost. (It can help to graph the cost series.)

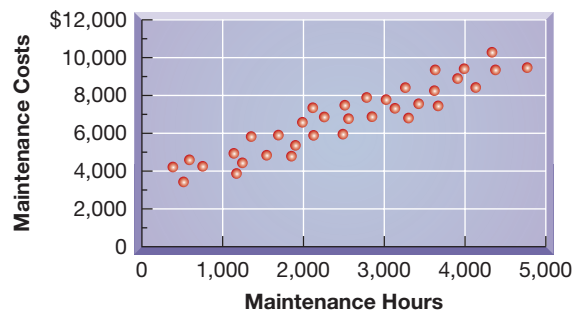
Volume (Units)	Series 1	Series 2	Series 3	Series 4
0	\$450	\$ 0	\$ 800	\$100
100	450	800	800	105
200	450	1,600	800	120
300	450	2,400	1,600	145
400	450	3,200	1,600	190
500	450	4,000	2,400	250
600	450	4,800	2,400	320

**QS 5-3**

Cost behavior estimation



This scatter diagram reflects past maintenance hours and their corresponding maintenance costs.



1. Draw an estimated line of cost behavior.
2. Estimate the fixed and variable components of maintenance costs.

**QS 5-4**

Cost behavior estimation—  
high-low method



The following information is available for a company's maintenance cost over the last seven months. Using the high-low method, estimate both the fixed and variable components of its maintenance cost.

Month	Maintenance Hours	Maintenance Cost
June . . . . .	18	\$5,450
July . . . . .	36	6,900
August . . . . .	24	5,100
September . . . . .	30	6,000
October . . . . .	42	6,900
November . . . . .	48	8,100
December . . . . .	12	3,600

**QS 5-5**

Contribution margin ratio



Compute and interpret the contribution margin ratio using the following data: sales, \$100,000; total variable cost, \$60,000.

**QS 5-6**

Contribution margin per unit  
and break-even units



BSD Phone Company sells its cordless phone for \$150 per unit. Fixed costs total \$270,000, and variable costs are \$60 per unit. Determine the (1) contribution margin per unit and (2) break-even point in units.

**QS 5-7**

Assumptions in CVP analysis



Refer to the information from QS 5-6. How will the break-even point in units change in response to each of the following independent changes in selling price per unit, variable cost per unit, or total fixed costs? Use I for increase and D for decrease. (It is not necessary to compute new break-even points.)

Change	Breakeven in Units Will
1. Variable cost to \$50 per unit . . . . .	_____
2. Total fixed cost to \$272,000 . . . . .	_____
3. Selling price per unit to \$145 . . . . .	_____
4. Total fixed cost to \$260,000 . . . . .	_____
5. Variable cost to \$67 per unit . . . . .	_____
6. Selling price per unit to \$160 . . . . .	_____

Refer to QS 5-6. Determine the (1) contribution margin ratio and (2) break-even point in dollars.

**QS 5-8**  
Contribution margin ratio and break-even dollars  
P2

Refer to QS 5-6. Assume that BSD Phone Co. is subject to a 30% income tax rate. Compute the units of product that must be sold to earn after-tax income of \$252,000.

**QS 5-9**  
CVP analysis and target income  
C3 P2

Which one of the following is an assumption that underlies cost-volume-profit analysis?

- For costs classified as variable, the costs per unit of output must change constantly.
- For costs classified as fixed, the costs per unit of output must remain constant.
- All costs have approximately the same relevant range.
- The selling price per unit must change in proportion to the number of units sold.

**QS 5-10**  
CVP assumptions  
C2

A high proportion of Company A's total costs are variable with respect to units sold; a high proportion of Company B's total costs are fixed with respect to units sold. Which company is likely to have a higher degree of operating leverage (DOL)? Explain.

**QS 5-11**  
Operating leverage analysis  
A3

Call Me Company manufactures and sells two products, green beepers and gold beepers, in the ratio of 5:3. Fixed costs are \$66,500, and the contribution margin per composite unit is \$95. What number of both green and gold beepers is sold at the break-even point?

**QS 5-12**  
Multiproduct break-even  
P4

**connect** Most materials in this section are available in McGraw-Hill's Connect


A company reports the following information about its sales and its cost of sales. Each unit of its product sells for \$1,000. Use these data to prepare a scatter diagram. Draw an estimated line of cost behavior and determine whether the cost appears to be variable, fixed, or mixed.

Period	Sales	Cost of Sales
1 . . . . .	\$45,000	\$30,300
2 . . . . .	34,500	22,500
3 . . . . .	31,500	21,000
4 . . . . .	22,500	16,500
5 . . . . .	27,000	18,000
6 . . . . .	37,500	28,500

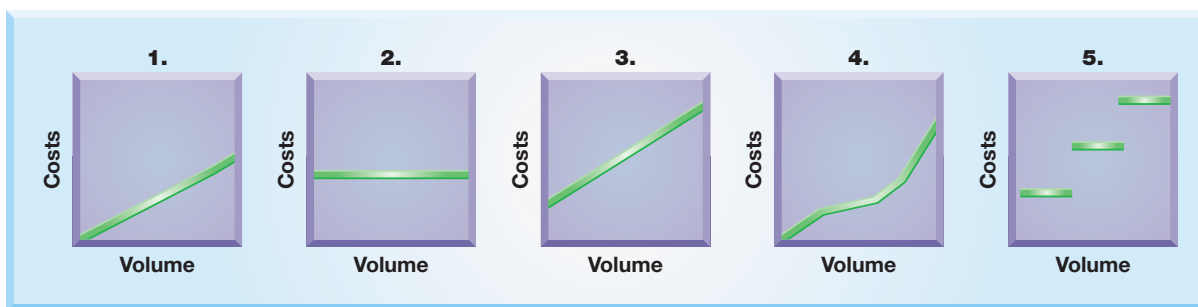
**EXERCISES**

**Exercise 5-1**  
Measurement of cost behavior using a scatter diagram  
P1

Following are five graphs representing various cost behaviors. (1) Identify whether the cost behavior in each graph is mixed, step-wise, fixed, variable, or curvilinear. (2) Identify the graph (by number) that best illustrates each cost behavior: (a) Factory policy requires one supervisor for every 30 factory workers; (b) real estate taxes on factory; (c) electricity charge that includes the standard monthly charge plus a charge for each kilowatt hour; (d) commissions to salespersons; and (e) costs of hourly paid workers [continued on next page]

**Exercise 5-2**  
Cost behavior in graphs  
C1 

that provide substantial gains in efficiency when a few workers are added but gradually smaller gains in efficiency when more workers are added.



**Exercise 5-3**

Cost behavior defined

C1

The left column lists several cost classifications. The right column presents short definitions of those costs. In the blank space beside each of the numbers in the right column, write the letter of the cost best described by the definition.

- |  |   |
|--|---|
| <p><b>A.</b> Total cost</p> <p><b>B.</b> Variable cost</p> <p><b>C.</b> Fixed cost</p> <p><b>D.</b> Mixed cost</p> <p><b>E.</b> Curvilinear cost</p> <p><b>F.</b> Step-wise cost</p> | <p>_____ 1. This cost is the combined amount of all the other costs.</p> <p>_____ 2. This cost remains constant over a limited range of volume; when it reaches the end of its limited range, it changes by a lump sum and remains at that level until it exceeds another limited range.</p> <p>_____ 3. This cost has a component that remains the same over all volume levels and another component that increases in direct proportion to increases in volume.</p> <p>_____ 4. This cost increases when volume increases, but the increase is not constant for each unit produced.</p> <p>_____ 5. This cost remains constant over all volume levels within the productive capacity for the planning period.</p> <p>_____ 6. This cost increases in direct proportion to increases in volume; its amount is constant for each unit produced.</p> |
|--|---|

**Exercise 5-4**

Cost behavior identification

C1

Following are five series of costs *A* through *E* measured at various volume levels. Examine each series and identify which is fixed, variable, mixed, step-wise, or curvilinear.

	Volume (Units)	Series A	Series B	Series C	Series D	Series E
1	0	\$5,000	\$ 0	\$1,000	\$2,500	\$ 0
2	400	5,000	3,600	1,000	3,100	6,000
3	800	5,000	7,200	2,000	3,700	6,600
4	1,200	5,000	10,800	2,000	4,300	7,200
5	1,600	5,000	14,400	3,000	4,900	8,200
6	2,000	5,000	18,000	3,000	5,500	9,600
7	2,400	5,000	21,600	4,000	6,100	13,500

**Exercise 5-5**

Predicting sales and variable costs using contribution margin

C3

Stewart Company management predicts that it will incur fixed costs of \$230,000 and earn pretax income of \$350,000 in the next period. Its expected contribution margin ratio is 25%. Use this information to compute the amounts of (1) total dollar sales and (2) total variable costs.

**Exercise 5-6**

Scatter diagram and measurement of cost behavior

P1

Use the following information about sales and costs to prepare a scatter diagram. Draw a cost line that reflects the behavior displayed by this cost. Determine whether the cost is variable, step-wise, fixed, mixed, or curvilinear.

Period	Sales	Costs	Period	Sales	Costs
1 .....	\$1,520	\$1,180	9 .....	\$1,160	\$ 780
2 .....	1,600	1,120	10 .....	640	480
3 .....	400	460	11 .....	480	460
4 .....	800	800	12 .....	1,440	1,100
5 .....	960	780	13 .....	560	520
6 .....	1,240	1,100	14 .....	880	820
7 .....	1,360	1,180	15 .....	760	520
8 .....	1,080	860			

A company reports the following information about its sales and cost of sales. Draw an estimated line of cost behavior using a scatter diagram, and compute fixed costs and variable costs per unit sold. Then use the high-low method to estimate the fixed and variable components of the cost of sales.

**Exercise 5-7**  
Cost behavior estimation—  
scatter diagram and high-low  
P1

Period	Units Sold	Cost of Sales	Period	Units Sold	Cost of Sales
1 .....	0	\$2,500	6 .....	2,000	5,500
2 .....	400	3,100	7 .....	2,400	6,100
3 .....	800	3,700	8 .....	2,800	6,700
4 .....	1,200	4,300	9 .....	3,200	7,300
5 .....	1,600	4,900	10 .....	3,600	7,900

Refer to the information from Exercise 5-7. Use spreadsheet software to use ordinary least-squares regression to estimate the cost equation, including fixed and variable cost amounts.

**Exercise 5-8<sup>A</sup>**  
Measurement of cost behavior  
using regression  
P1

Seton Company manufactures a single product that sells for \$360 per unit and whose total variable costs are \$270 per unit. The company's annual fixed costs are \$1,125,000. (1) Use this information to compute the company's (a) contribution margin, (b) contribution margin ratio, (c) break-even point in units, and (d) break-even point in dollars of sales. (2) Draw a CVP chart for the company.

**Exercise 5-9**  
Contribution margin, break-  
even, and CVP chart  
P2 P3 A2

Refer to Exercise 5-9. (1) Prepare a contribution margin income statement for Seton Company showing sales, variable costs, and fixed costs at the break-even point. (2) If the company's fixed costs increase by \$270,000, what amount of sales (in dollars) is needed to break even? Explain.

**Exercise 5-10**  
Income reporting and  
break-even analysis  
C3

Seton Company management (in Exercise 5-9) targets an annual after-tax income of \$1,620,000. The company is subject to a 20% income tax rate. Assume that fixed costs remain at \$1,125,000. Compute the (1) unit sales to earn the target after-tax net income and (2) dollar sales to earn the target after-tax net income.

**Exercise 5-11**  
Computing sales to achieve  
target income  
C3

Seton Company sales manager (in Exercise 5-9) predicts that annual sales of the company's product will soon reach 80,000 units and its price will increase to \$400 per unit. According to the production manager, the variable costs are expected to increase to \$280 per unit but fixed costs will remain at \$1,125,000. The income tax rate is 20%. What amounts of pretax and after-tax income can the company expect to earn from these predicted changes? (*Hint*: Prepare a forecasted contribution margin income statement as in Exhibit 5.20.)

**Exercise 5-12**  
Forecasted income statement  
C3

**Check** Forecasted income, \$6,780,000

**Exercise 5-13**

Predicting unit and dollar sales  
C3

Maya Company management predicts \$600,000 of variable costs, \$700,000 of fixed costs, and a pretax income of \$110,000 in the next period. Management also predicts that the contribution margin per unit will be \$9. Use this information to compute the (1) total expected dollar sales for next period and (2) number of units expected to be sold next period.

**Exercise 5-14**

Computation of variable and fixed costs; CVP chart  
P3

Corveau Company expects to sell 400,000 units of its product next year, which would generate total sales of \$34 million. Management predicts that pretax net income for next year will be \$2,500,000 and that the contribution margin per unit will be \$50. (1) Use this information to compute next year's total expected (a) variable costs and (b) fixed costs. (2) Prepare a CVP chart from this information.

**Exercise 5-15**

CVP analysis using composite units P4

Modern Home sells windows and doors in the ratio of 9:1 (windows:doors). The selling price of each window is \$90 and of each door is \$250. The variable cost of a window is \$60 and of a door is \$220. Fixed costs are \$450,000. Use this information to determine the (1) selling price per composite unit, (2) variable costs per composite unit, (3) break-even point in composite units, and (4) number of units of each product that will be sold at the break-even point.

**Check** (3) 1,500 units

**Exercise 5-16**

CVP analysis using weighted-average contribution margin  
P4

Refer to the information from Exercise 5-15. Use the information to determine the (1) weighted-average contribution margin, (2) break-even point in units, and (3) number of units of each product that will be sold at the break-even point.

**Exercise 5-17**

CVP analysis using composite units  
P4

Precision Tax Service offers tax and consulting services to individuals and small businesses. Data for fees and costs of three types of tax returns follow. Precision provides services in the ratio of 5:3:2 (easy, moderate, business). Fixed costs total \$18,000 for the tax season. Use this information to determine the (1) selling price per composite unit, (2) variable costs per composite unit, (3) break-even point in composite units, and (4) number of units of each product that will be sold at the break-even point.


Type of Return	Fee Charged	Variable Cost per Return
Easy (form 1040EZ) . . . . .	\$ 50	\$ 30
Moderate (form 1040) . . . . .	125	75
Business . . . . .	275	100

**Exercise 5-18**

CVP analysis using weighted-average contribution margin  
P4

Refer to the information from Exercise 5-17. Use the information to determine the (1) weighted-average contribution margin, (2) break-even point in units, and (3) number of units of each product that will be sold at the break-even point.

**Exercise 5-19**

Operating leverage computed and applied  
A3 

Company A is a manufacturer with current sales of \$1,500,000 and a 60% contribution margin. Its fixed costs equal \$650,000. Company B is a consulting firm with current service revenues of \$1,500,000 and a 25% contribution margin. Its fixed costs equal \$125,000. Compute the degree of operating leverage (DOL) for each company. Identify which company benefits more from a 20% increase in sales and explain why.

**connect** Most materials in this section are available in McGraw-Hill's Connect

The following costs result from the production and sale of 2,000 drum sets manufactured by Harris Drum Company for the year ended December 31, 2009. The drum sets sell for \$500 each. The company has a 25% income tax rate.

Variable production costs	
Plastic for casing . . . . .	\$ 34,000
Wages of assembly workers . . . . .	164,000
Drum stands . . . . .	52,000
Variable selling costs	
Sales commissions . . . . .	30,000
Fixed manufacturing costs	
Taxes on factory . . . . .	10,000
Factory maintenance . . . . .	20,000
Factory machinery depreciation . . . . .	80,000
Fixed selling and administrative costs	
Lease of equipment for sales staff . . . . .	20,000
Accounting staff salaries . . . . .	70,000
Administrative management salaries . . . . .	250,000

## PROBLEM SET A

### Problem 5-1A

Contribution margin income statement and contribution margin ratio

A2

**Check** (I) Net income, \$202,500

### Required

1. Prepare a contribution margin income statement for the company.
2. Compute its contribution margin per unit and its contribution margin ratio.

### Analysis Component

3. Interpret the contribution margin and contribution margin ratio from part 2.

Extreme Equipment Co. manufactures and markets a number of rope products. Management is considering the future of Product HG, a special rope for hang gliding, that has not been as profitable as planned. Since Product HG is manufactured and marketed independently of the other products, its total costs can be precisely measured. Next year's plans call for a \$200 selling price per 100 yards of HG rope. Its fixed costs for the year are expected to be \$330,000, up to a maximum capacity of 20,000,000 yards of rope. Forecasted variable costs are \$170 per 100 yards of HG rope.

### Problem 5-2A

CVP analysis and charting

P2 P3



[mhhe.com/wildMA2e](http://mhhe.com/wildMA2e)

### Required

1. Estimate Product HG's break-even point in terms of (a) sales units and (b) sales dollars.
2. Prepare a CVP chart for Product HG like that in Exhibit 5.14. Use 20,000,000 yards as the maximum number of sales units on the horizontal axis of the graph, and \$4,000,000 as the maximum dollar amount on the vertical axis.
3. Prepare a contribution margin income statement showing sales, variable costs, and fixed costs for Product HG at the break-even point.

**Check** (I) Break-even sales, 11,000 units or \$2,200,000

Alden Co.'s monthly sales and cost data for its operating activities of the past year follow. Management wants to use these data to predict future fixed and variable costs.

Period	Sales	Total Cost	Period	Sales	Total Cost
1 . . . . .	\$325,000	\$162,500	7 . . . . .	\$355,000	\$242,000
2 . . . . .	170,000	106,250	8 . . . . .	275,000	156,750
3 . . . . .	270,000	210,600	9 . . . . .	75,000	60,000
4 . . . . .	210,000	105,000	10 . . . . .	155,000	135,625
5 . . . . .	295,000	206,500	11 . . . . .	99,000	99,000
6 . . . . .	195,000	117,000	12 . . . . .	105,000	76,650

### Problem 5-3A

Scatter diagram and cost behavior estimation

P1

**Required**

1. Prepare a scatter diagram for these data with sales volume (in \$) plotted on the horizontal axis and total cost plotted on the vertical axis.
2. Estimate both the variable costs per sales dollar and the total monthly fixed costs using the high-low method. Draw the total costs line on the scatter diagram in part 1.
3. Use the estimated line of cost behavior and results from part 2 to predict future total costs when sales volume is (a) \$210,000 and (b) \$300,000.

**Check** (2) Variable costs, \$0.65 per sales dollar; fixed costs, \$11,250

**Problem 5-4A**

Break-even analysis; income targeting and forecasting

C3 P2

Teller Co. sold 20,000 units of its only product and incurred a \$70,000 loss (ignoring taxes) for the current year as shown here. During a planning session for year 2010's activities, the production manager notes that variable costs can be reduced 50% by installing a machine that automates several operations. To obtain these savings, the company must increase its annual fixed costs by \$210,000. The maximum output capacity of the company is 40,000 units per year.

<b>TELLER COMPANY</b>	
<b>Contribution Margin Income Statement</b>	
<b>For Year Ended December 31, 2009</b>	
Sales . . . . .	\$1,000,000
Variable costs . . . . .	800,000
Contribution margin . . . . .	200,000
Fixed costs . . . . .	270,000
Net loss . . . . .	<u>\$ (70,000)</u>

**Required**

1. Compute the break-even point in dollar sales for year 2009.
2. Compute the predicted break-even point in dollar sales for year 2010 assuming the machine is installed and there is no change in the unit sales price.
3. Prepare a forecasted contribution margin income statement for 2010 that shows the expected results with the machine installed. Assume that the unit sales price and the number of units sold will not change, and no income taxes will be due.
4. Compute the sales level required in both dollars and units to earn \$210,000 of after-tax income in 2010 with the machine installed and no change in the unit sales price. Assume that the income tax rate is 30%. (*Hint:* Use the procedures in Exhibits 5.21 and 5.23.)
5. Prepare a forecasted contribution margin income statement that shows the results at the sales level computed in part 4. Assume an income tax rate of 30%.

**Check** (3) Net income, \$120,000

(4) Required sales, \$1,300,000 or 26,000 units

(5) Net income, \$210,000

**Problem 5-5A**

Break-even analysis, different cost structures, and income calculations

C3 

Shol Co. produces and sells two products, T and O. It manufactures these products in separate factories and markets them through different channels. They have no shared costs. This year, the company sold 51,000 units of each product. Sales and costs for each product follow.

	<b>Product T</b>	<b>Product O</b>
Sales . . . . .	\$2,040,000	\$2,040,000
Variable costs . . . . .	<u>1,632,000</u>	<u>255,000</u>
Contribution margin . . . . .	408,000	1,785,000
Fixed costs . . . . .	<u>127,500</u>	<u>1,504,500</u>
Income before taxes . . . . .	280,500	280,500
Income taxes (34% rate) . . . . .	<u>95,370</u>	<u>95,370</u>
Net income . . . . .	<u>\$ 185,130</u>	<u>\$ 185,130</u>

**Required**

1. Compute the break-even point in dollar sales for each product.
2. Assume that the company expects sales of each product to decline to 40,000 units next year with no change in unit sales price. Prepare forecasted financial results for next year following the format of the contribution margin income statement as just shown with columns for each of the two products (assume a 34% tax rate). Also, assume that any loss before taxes yields a 34% tax savings.
3. Assume that the company expects sales of each product to increase to 65,000 units next year with no change in unit sales price. Prepare forecasted financial results for next year following the format of the contribution margin income statement shown with columns for each of the two products (assume a 34% tax rate).

**Check** (2) After-tax income:  
T, \$127,050; O, \$(68,970)

(3) After-tax income:  
T, \$259,050; O, \$508,530

**Analysis Component**

4. If sales greatly decrease, which product would experience a greater loss? Explain.
5. Describe some factors that might have created the different cost structures for these two products.

This year Calypso Company sold 60,000 units of its only product for \$20 per unit. Manufacturing and selling the product required \$97,500 of fixed manufacturing costs and \$157,500 of fixed selling and administrative costs. Its per unit variable costs follow.

Material . . . . .	\$8.00
Direct labor (paid on the basis of completed units) . . . . .	5.00
Variable overhead costs . . . . .	1.60
Variable selling and administrative costs . . . . .	0.40

Next year the company will use new material, which will reduce material costs by 50% and direct labor costs by 60% and will not affect product quality or marketability. Management is considering an increase in the unit sales price to reduce the number of units sold because the factory's output is nearing its annual output capacity of 65,000 units. Two plans are being considered. Under plan 1, the company will keep the price at the current level and sell the same volume as last year. This plan will increase income because of the reduced costs from using the new material. Under plan 2, the company will increase price by 25%. This plan will decrease unit sales volume by 15%. Under both plans 1 and 2, the total fixed costs and the variable costs per unit for overhead and for selling and administrative costs will remain the same.

**Required**

1. Compute the break-even point in dollar sales for both (a) plan 1 and (b) plan 2.
2. Prepare a forecasted contribution margin income statement with two columns showing the expected results of plan 1 and plan 2. The statements should report sales, total variable costs, contribution margin, total fixed costs, income before taxes, income taxes (30% rate), and net income.

**Check** (1) Breakeven: Plan 1, \$425,000; Plan 2, \$375,000

(2) Net income: Plan 1, \$325,500; Plan 2, \$428,400

Patriot Co. manufactures and sells three products: red, white, and blue. Their unit sales prices are red, \$74; white, \$108; and blue, \$99. The per unit variable costs to manufacture and sell these products are red, \$48; white, \$75; and blue, \$90. Their sales mix is reflected in a ratio of 5:4:2 (red:white:blue). Annual fixed costs shared by all three products are \$179,200. One type of raw material has been used to manufacture all three products. The company has developed a new material of equal quality for less cost. The new material would reduce variable costs per unit as follows: red, by \$10; white, by \$16; and blue, by \$13. However, the new material requires new equipment, which will increase annual fixed costs by \$22,400. (Round answers to whole composite units.)

**Required**

1. If the company continues to use the old material, determine its break-even point in both sales units and sales dollars of each individual product.
2. If the company uses the new material, determine its new break-even point in both sales units and sales dollars of each individual product.

**Problem 5-7A**  
Break-even analysis with composite units

P4 C3 

**Check** (1) Old plan breakeven, 640 composite units

(2) New plan breakeven, 480 composite units

**Analysis Component**

3. What insight does this analysis offer management for long-term planning?

**Problem 5-6A**  
Analysis of price, cost, and volume changes for contribution margin and net income

C3 P2

  
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## PROBLEM SET B

### Problem 5-1B

Contribution margin income statement and contribution margin ratio

A2

The following costs result from the production and sale of 240,000 CD sets manufactured by Jawan Company for the year ended December 31, 2009. The CD sets sell for \$9 each. The company has a 25% income tax rate.

Variable manufacturing costs	
Plastic for CD sets . . . . .	\$ 21,600
Wages of assembly workers . . . . .	300,000
Labeling . . . . .	43,200
Variable selling costs	
Sales commissions . . . . .	24,000
Fixed manufacturing costs	
Rent on factory . . . . .	100,000
Factory cleaning service . . . . .	75,000
Factory machinery depreciation . . . . .	125,000
Fixed selling and administrative costs	
Lease of office equipment . . . . .	120,000
Systems staff salaries . . . . .	600,000
Administrative management salaries . . . . .	300,000

### Required

**Check** (1) Net income, \$338,400

1. Prepare a contribution margin income statement for the company.
2. Compute its contribution margin per unit and its contribution margin ratio.

### Analysis Component

3. Interpret the contribution margin and contribution margin ratio from part 2.

### Problem 5-2B

CVP analysis and charting

P2 P3

Tip-Top Co. manufactures and markets several products. Management is considering the future of one product, electronic keyboards, that has not been as profitable as planned. Since this product is manufactured and marketed independently of the other products, its total costs can be precisely measured. Next year's plans call for a \$175 selling price per unit. The fixed costs for the year are expected to be \$420,000, up to a maximum capacity of 10,000 units. Forecasted variable costs are \$105 per unit.

### Required

**Check** (1) Break-even sales, 6,000 units or \$1,050,000

1. Estimate the keyboards' break-even point in terms of (a) sales units and (b) sales dollars.
2. Prepare a CVP chart for keyboards like that in Exhibit 5.14. Use 10,000 keyboards as the maximum number of sales units on the horizontal axis of the graph, and \$1,600,000 as the maximum dollar amount on the vertical axis.
3. Prepare a contribution margin income statement showing sales, variable costs, and fixed costs for keyboards at the break-even point.

### Problem 5-3B

Scatter diagram and cost behavior estimation

P1

Merdam Co.'s monthly sales and costs data for its operating activities of the past year follow. Management wants to use these data to predict future fixed and variable costs.

Period	Sales	Total Cost	Period	Sales	Total Cost
1 . . . . .	\$390	\$194	7 . . . . .	\$290	\$186
2 . . . . .	250	174	8 . . . . .	370	210
3 . . . . .	210	146	9 . . . . .	270	170
4 . . . . .	310	178	10 . . . . .	170	116
5 . . . . .	190	162	11 . . . . .	350	190
6 . . . . .	430	220	12 . . . . .	230	158

### Required

1. Prepare a scatter diagram for these data with sales volume (in \$) plotted on the horizontal axis and total costs plotted on the vertical axis.

- Estimate both the variable costs per sales dollar and the total monthly fixed costs using the high-low method. Draw the total costs line on the scatter diagram in part 1.
- Use the estimated line of cost behavior and results from part 2 to predict future total costs when sales volume is (a) \$200 and (b) \$340.

**Check** (2) Variable costs, \$0.40 per sales dollar; fixed costs, \$48

Noru Co. sold 30,000 units of its only product and incurred a \$75,000 loss (ignoring taxes) for the current year as shown here. During a planning session for year 2010's activities, the production manager notes that variable costs can be reduced 40% by installing a machine that automates several operations. To obtain these savings, the company must increase its annual fixed costs by \$220,000. The maximum output capacity of the company is 50,000 units per year.

**Problem 5-4B**

Break-even analysis; income targeting and forecasting

C3 P2

NORU COMPANY Contribution Margin Income Statement For Year Ended December 31, 2009	
Sales .....	\$1,125,000
Variable costs .....	<u>900,000</u>
Contribution margin .....	225,000
Fixed costs .....	<u>300,000</u>
Net loss .....	<u>\$ (75,000)</u>

**Required**

- Compute the break-even point in dollar sales for year 2009.
- Compute the predicted break-even point in dollar sales for year 2010 assuming the machine is installed and no change occurs in the unit sales price. (Round the change in variable costs to a whole number.)
- Prepare a forecasted contribution margin income statement for 2010 that shows the expected results with the machine installed. Assume that the unit sales price and the number of units sold will not change, and no income taxes will be due.
- Compute the sales level required in both dollars and units to earn \$104,000 of after-tax income in 2010 with the machine installed and no change in the unit sales price. Assume that the income tax rate is 20%. (*Hint:* Use the procedures in Exhibits 5.21 and 5.23.)
- Prepare a forecasted contribution margin income statement that shows the results at the sales level computed in part 4. Assume an income tax rate of 20%.

**Check** (3) Net income, \$65,000

(4) Required sales, \$1,250,000 or 33,334 units

(5) Net income, \$104,000 (rounded)

Best Co. produces and sells two products, BB and TT. It manufactures these products in separate factories and markets them through different channels. They have no shared costs. This year, the company sold 100,000 units of each product. Sales and costs for each product follow.

**Problem 5-5B**

Break-even analysis, different cost structures, and income calculations

C3 

	Product BB	Product TT
Sales .....	\$1,600,000	\$1,600,000
Variable costs .....	<u>1,120,000</u>	<u>200,000</u>
Contribution margin .....	480,000	1,400,000
Fixed costs .....	<u>200,000</u>	<u>1,120,000</u>
Income before taxes .....	280,000	280,000
Income taxes (32% rate) .....	<u>89,600</u>	<u>89,600</u>
Net income .....	<u>\$ 190,400</u>	<u>\$ 190,400</u>

**Required**

- Compute the break-even point in dollar sales for each product.
- Assume that the company expects sales of each product to decline to 67,000 units next year with no change in the unit sales price. Prepare forecasted financial results for next year following the format of the contribution margin income statement as shown here with columns for each of the two products (assume a 32% tax rate, and that any loss before taxes yields a 32% tax savings).
- Assume that the company expects sales of each product to increase to 125,000 units next year with no change in the unit sales prices. Prepare forecasted financial results for next year following the format of the contribution margin income statement as shown here with columns for each of the two products (assume a 32% tax rate).

**Check** (2) After-tax income: BB, \$82,688; TT, \$(123,760)

(3) After-tax income: BB, \$272,000; TT, \$428,400

**Analysis Component**

4. If sales greatly increase, which product would experience a greater increase in profit? Explain.
5. Describe some factors that might have created the different cost structures for these two products.

**Problem 5-6B**

Analysis of price, cost, and volume changes for contribution margin and net income

C3 P2

This year Blanko Company earned a disappointing 3.85% after-tax return on sales (Net income/Sales) from marketing 50,000 units of its only product. The company buys its product in bulk and repackages it for resale at the price of \$20 per unit. Blanko incurred the following costs this year.

Total variable unit costs . . . . .	\$400,000
Total variable packaging costs . . . . .	50,000
Fixed costs . . . . .	\$495,000
Income tax rate . . . . .	30%

The marketing manager claims that next year's results will be the same as this year's unless some changes are made. The manager predicts the company can increase the number of units sold by 60% if it reduces the selling price by 20% and upgrades the packaging. This change would increase variable packaging costs by 20%. Increased sales would allow the company to take advantage of a 25% quantity purchase discount on the cost of the bulk product. Neither the packaging change nor the volume discount would affect fixed costs, which provide an annual output capacity of 100,000 units.

**Required**

1. Compute the break-even point in dollar sales under the (a) existing business strategy and (b) new strategy that alters both unit sales price and variable costs.
2. Prepare a forecasted contribution margin income statement with two columns showing the expected results of (a) the existing strategy and (b) changing to the new strategy. The statements should report sales, total variable costs (unit and packaging), contribution margin, fixed costs, income before taxes, income taxes, and net income. Also determine the after-tax return on sales for these two strategies.

**Check** (1) Breakeven for new strategy, \$900,000  
 (2) Net income: Existing strategy, \$38,500; new strategy, \$146,300

**Problem 5-7B**

Break-even analysis with composite units

P4 C3 

Milagro Co. manufactures and sells three products: product 1, product 2, and product 3. Their unit sales prices are product 1, \$200; product 2, \$150; and product 3, \$100. The per unit variable costs to manufacture and sell these products are product 1, \$150; product 2, \$75; and product 3, \$40. Their sales mix is reflected in a ratio of 6:4:2. Annual fixed costs shared by all three products are \$5,400,000. One type of raw material has been used to manufacture products 1 and 2. The company has developed a new material of equal quality for less cost. The new material would reduce variable costs per unit as follows: product 1 by \$50, and product 2, by \$25. However, the new material requires new equipment, which will increase annual fixed costs by \$200,000.

**Required**

1. If the company continues to use the old material, determine its break-even point in both sales units and sales dollars of each individual product.
2. If the company uses the new material, determine its new break-even point in both sales units and sales dollars of each individual product.

**Analysis Component**

3. What insight does this analysis offer management for long-term planning?

**SERIAL PROBLEM**

(This serial problem began in Chapter 1 and continues through most of the book. If previous chapter segments were not completed, the serial problem can begin at this point. It is helpful, but not necessary, to use the working papers that accompany the book.)

Success Systems

**SP 5** Success Systems sells upscale modular desk units and office chairs in the ratio of 3:2 (desk unit:chair). The selling prices are \$1,250 per desk unit and \$500 per chair. The variable costs are \$750 per desk unit and \$250 per chair. Fixed costs are \$120,000.

**Required**

1. Compute the selling price per composite unit.
2. Compute the variable costs per composite unit.
3. Compute the break-even point in composite units.
4. Compute the number of units of each product that would be sold at the break-even point.

**Check** (3) 60 composite units

**BEYOND THE NUMBERS**

**BTN 5-1 Best Buy** offers services to customers that help them use products they purchase from Best Buy. One of these services is its Geek Squad, which is Best Buy’s 24-hour computer support task force. As you complete the following requirements, assume that the Geek Squad uses many of Best Buy’s existing resources such as its purchasing department and its buildings and equipment.

**REPORTING IN ACTION**



**Required**

1. Identify several of the variable, mixed, and fixed costs that the Geek Squad is likely to incur in carrying out its services.
2. Assume that Geek Squad revenues are expected to grow by 25% in the next year. How do you expect the costs identified in part 1 to change, if at all?
3. How is your answer to part 2 different from many of the examples discussed in the chapter? (*Hint:* Consider how the contribution margin ratio changes as volume—sales or customers served—increases.)

**BTN 5-2 Both Best Buy and Circuit City** sell numerous consumer products, and each of these companies has a different product mix.

**COMPARATIVE ANALYSIS**



**Required**

1. Assume the following data are available for both companies. Compute each company’s break-even point in unit sales. (Each company sells many products at many different selling prices, and each has its own variable costs. This assignment assumes an *average* selling price per unit and an *average* cost per item.)

	Best Buy	Circuit City
Average selling price per item sold . . . . .	\$90	\$40
Average variable cost per item sold . . . . .	\$64	\$30
Total fixed costs . . . . .	\$5,980 million	\$2,570 million

2. If unit sales were to decline, which company would experience the larger decline in operating profit? Explain.

**BTN 5-3** Labor costs of an auto repair mechanic are seldom based on actual hours worked. Instead, the amount paid a mechanic is based on an industry average of time estimated to complete a repair job. The repair shop bills the customer for the industry average amount of time at the repair center’s billable cost per hour. This means a customer can pay, for example, \$120 for two hours of work on a car when the actual time worked was only one hour. Many experienced mechanics can complete repair jobs faster than the industry average. The average data are compiled by engineering studies and surveys conducted in the auto repair business. Assume that you are asked to complete such a survey for a repair center. The survey calls for objective input, and many questions require detailed cost data and analysis. The mechanics and owners know you have the survey and encourage you to complete it in a way that increases the average billable hours for repair work.

**ETHICS CHALLENGE**



**Required**

Write a one-page memorandum to the mechanics and owners that describes the direct labor analysis you will undertake in completing this survey.

**COMMUNICATING  
IN PRACTICE**

C2

**BTN 5-4** Several important assumptions underlie CVP analysis. Assumptions often help simplify and focus our analysis of sales and costs. A common application of CVP analysis is as a tool to forecast sales, costs, and income.

**Required**

Assume that you are actively searching for a job. Prepare a one-half page report identifying (1) three assumptions relating to your expected revenue (salary) and (2) three assumptions relating to your expected costs for the first year of your new job. Be prepared to discuss your assumptions in class.

**TAKING IT TO  
THE NET**

C1 C3



**BTN 5-5** Access and review the entrepreneurial information at **Business Owner's Toolkit** [[Toolkit.cch.com](http://Toolkit.cch.com)]. Access and review its *New Business Cash Needs Estimate* under the Business Tools/Business Finance menu bar or similar worksheets related to controls of cash and costs.

**Required**

Write a one-half page report that describes the information and resources available at the Business Owner's Toolkit to help the owner of a start-up business to control and monitor its costs.

**TEAMWORK IN  
ACTION**

C2



**BTN 5-6** A local movie theater owner explains to you that ticket sales on weekends and evenings are strong, but attendance during the weekdays, Monday through Thursday, is poor. The owner proposes to offer a contract to the local grade school to show educational materials at the theater for a set charge per student during school hours. The owner asks your help to prepare a CVP analysis listing the cost and sales projections for the proposal. The owner must propose to the school's administration a charge per child. At a minimum, the charge per child needs to be sufficient for the theater to break even.

**Required**

Your team is to prepare two separate lists of questions that enable you to complete a reliable CVP analysis of this situation. One list is to be answered by the school's administration, the other by the owner of the movie theater.

**ENTREPRENEURIAL  
DECISION**

C1



**BTN 5-7** Martin Sprock is a diligent businessman. He continually searches for new menu items to further increase the profitability of **Moe's Southwest Grill**.

**Required**

1. What information should Sprock search for to help him decide whether to add new menu items or other products to existing Moe's product lines?
2. What managerial tools are available to Sprock to help make the decisions in part 1?

**HITTING THE  
ROAD**

P4



**BTN 5-8** Multiproduct break-even analysis is often viewed differently when actually applied in practice. You are to visit a local fast-food restaurant and count the number of items on the menu. To apply multiproduct break-even analysis to the restaurant, similar menu items must often be fit into groups. A reasonable approach is to classify menu items into approximately five groups. We then estimate average selling price and average variable cost to compute average contribution margin. (*Hint: For fast-food restaurants, the highest contribution margin is with its beverages, at about 90%.*)

**Required**

1. Prepare a one-year multiproduct break-even analysis for the restaurant you visit. Begin by establishing groups. Next, estimate each group's volume and contribution margin. These estimates are necessary to compute each group's contribution margin. Assume that annual fixed costs in total are \$500,000 per year. (*Hint:* You must develop your own estimates on volume and contribution margin for each group to obtain the break-even point and sales.)
2. Prepare a one-page report on the results of your analysis. Comment on the volume of sales necessary to break even at a fast-food restaurant.

**BTN 5-9** Access and review DSG's Website ([www.DSGiplc.com](http://www.DSGiplc.com)) to answer the following questions.

1. Do you believe that DSG's managers use single product CVP analysis or multiproduct break-even point analysis? Explain.
2. How does the addition of a new product line affect DSG's CVP analysis?
3. How does the addition of a new store affect DSG's CVP analysis?

**GLOBAL DECISION****DSG****ANSWERS TO MULTIPLE CHOICE QUIZ**

1. a;  $\$150 - \$100 = \$50$
2. e;  $(\$150 - \$100)/\$150 = 33\frac{1}{3}\%$
3. c;  $\$75,000/\$50 \text{ CM per unit} = 1,500 \text{ units}$
4. b;  $\$300,000 - \$180,000 = \$120,000$
5. c; Contribution margin ratio =  $(\$400 - \$260)/\$400 = 0.35$   
Targeted sales =  $(\$840,000 + \$70,000)/0.35 = \$2,600,000$