

CHAPTER 3

Analysis of Cost, Volume, and Pricing to Increase Profitability

LEARNING OBJECTIVES

After you have mastered the material in this chapter, you will be able to:

- 1 Use the equation method to determine the break-even point.
- 2 Use the contribution margin per unit method to determine the break-even point.
- 3 Use the contribution margin ratio method to determine the break-even point.
- 4 Determine the sales volume required to attain a desired profit.
- 5 Set selling prices by using cost-plus, prestige, and target costing.
- 6 Explain cost-volume-profit relationships.
- 7 Draw and interpret a cost-volume-profit graph.
- 8 Calculate and interpret the margin of safety.
- 9 Conduct sensitivity analysis for cost-volume-profit relationships.
- 10 Perform multiproduct cost-volume-profit analysis.

CHAPTER OPENING

The president of Bright Day Distributors recently completed a managerial accounting course. He was particularly struck by the operating leverage concept. His instructor had demonstrated how a small percentage increase in sales volume could produce a significantly higher percentage increase in profitability. Unfortunately, the discussion had been limited to the effects of changes in sales volume. In practice, changes in sales volume are often related to changes in sales price. For example, reducing selling prices often leads to increases in sales volume. Sales volume

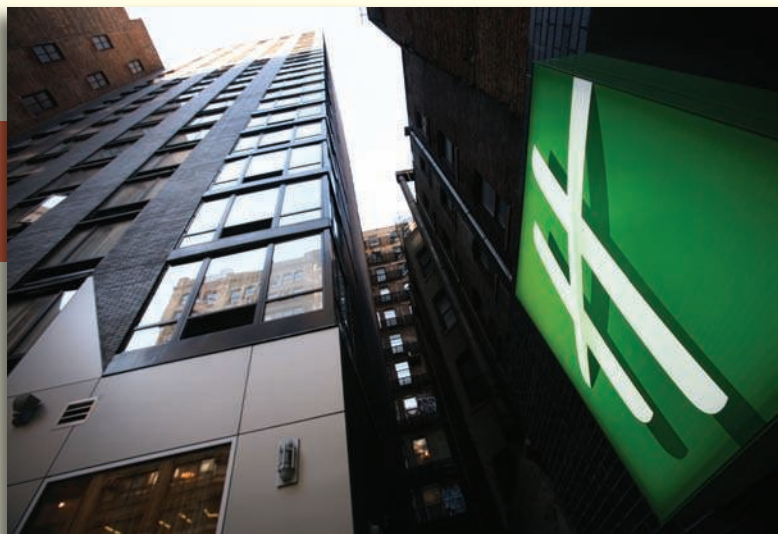
may also change in response to cost changes such as increasing the advertising budget. Furthermore, significant changes in sales volume could redefine the relevant range, changing the fixed and variable costs. Bright Day's president realized that understanding operating leverage was only one piece of understanding how to manage a business. He also needed to understand how changes in prices, costs, and volume affect profitability. Bright Day's president is interested in **cost-volume-profit (CVP) analysis**.

The Curious Accountant

At a meeting in November 2009, **InterContinental Hotels Group (IHG)** reminded its franchisees that they had until February 1, 2010, to complete renovations of their properties and install new corporate logos. If they did not comply by the deadline, they would no longer be allowed to call themselves Holiday Inns. IHC itself owns only 17 hotels, but it is the global franchisor of 4,400 hotels. These hotels operate under several brand names including **Holiday Inn, Holiday Inn Express**, and **Crown Plaza Hotels**, but most of its franchisees operate under the Holiday Inn name. At the time of the meeting, 300 of the 2,700 Holiday Inns in North America had not even started the process of renovation and were likely to lose their franchise rights.

In February, 2009, **American Express** began offering some of its cardholders a \$300 gift card if they would pay off their account balances and close their accounts. Remember that this is the same company that spends millions each year trying to attract new customers.

Why would a company like IHG that earns most of its revenues, and profits, from franchise fees collected from hotels it does not even own threaten to force 300 of them to take down their Holiday Inn signs? Would this not reduce IHG's revenues without significantly reducing its costs? At a time when the economy was slow and hotel occupancy was down, why would IHC take such action? Why would American Express pay some of its customers to leave? (Answers on page 115.)



DETERMINING THE BREAK-EVEN POINT

Bright Day Distributors sells nonprescription health food supplements including vitamins, herbs, and natural hormones in the northwestern United States. Bright Day recently obtained the rights to distribute the new herb mixture Delatine. Recent scientific research found that Delatine delayed aging in laboratory animals. The researchers hypothesized that the substance would have a similar effect on humans. Their theory could not be confirmed because of the relatively long human life span. The news media reported the research findings; as stories turned up on television and radio news, talk shows, and in magazines, demand for Delatine increased.

Bright Day plans to sell the Delatine at a price of \$36 per bottle. Delatine costs \$24 per bottle. Bright Day's management team suspects that enthusiasm for Delatine will abate quickly as the news media shift to other subjects. To attract customers immediately, the product managers consider television advertising. The marketing manager suggests running a campaign of several hundred cable channel ads at an estimated cost of \$60,000.

Bright Day's first concern is whether it can sell enough units to cover its costs. The president made this position clear when he said, "We don't want to lose money on this product. We have to sell at least enough units to break-even." In accounting terms, the **break-even point** is where profit (income) equals zero. So how many bottles of Delatine must be sold to produce a profit of zero? The break-even point is commonly computed using either the *equation method*, the *contribution margin per unit method*, or the *contribution margin ratio method*. All three of these approaches produce the same result. They are merely different ways to arrive at the same conclusion.

Equation Method

The **equation method** begins by expressing the income statement as follows:

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit (Net income)}$$

As previously stated, profit at the break-even point is zero. Therefore, the break-even point for Delatine is computed as follows:

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit}$$

$$\$36N - \$24N - \$60,000 = \$0$$

$$\$12N = \$60,000$$

$$N = \$60,000 \div \$12$$

$$N = 5,000 \text{ Units}$$

Where:

N = Number of units

\$36 = Sales price per unit

\$24 = Variable cost per unit

\$60,000 = Fixed costs

LO 1

Use the equation method to determine the break-even point.



CHECK YOURSELF 3.1

B-Shoc is an independent musician who is considering whether to independently produce and sell a CD. B-Shoc estimates fixed costs of \$5,400 and variable costs of \$2.00 per unit. The expected selling price is \$8.00 per CD. Use the equation method to determine B-Shoc's break-even point.

Answer

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit}$$

$$\$8N - \$2N - \$5,400 = \$0$$

$$\$6N = \$5,400$$

$$N = \$5,400 \div \$6$$

$$N = 900 \text{ Units (CDs)}$$

Where:

N = Number of units

\$8 = Sales price per unit

\$2 = Variable cost per unit

\$5,400 = Fixed costs

Contribution Margin per Unit Method

Recall that the *total contribution margin* is the amount of sales minus total variable cost. The **contribution margin per unit** is the sales price per unit minus the variable cost per unit. Therefore, the contribution margin per unit for Delatine is:

Sales price per unit	\$36
Less: Variable cost per unit	(24)
Contribution margin per unit	<u>\$12</u>

LO 2

Use the contribution margin per unit method to determine the break-even point.

For every bottle of Delatine it sells, Bright Day earns a \$12 contribution margin. In other words, every time Bright Day sells a bottle of Delatine, it receives enough money to pay \$24 to cover the variable cost of the bottle of Delatine and still has \$12 left to go toward paying the fixed cost. Bright Day will reach the break-even point when it sells enough bottles of Delatine to cover its fixed costs. Therefore the break-even point can be determined as follows:

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

$$\text{Break-even point in units} = \frac{\$60,000}{\$12}$$

$$\text{Break-even point in units} = 5,000 \text{ Units}$$

This result is the same as that determined under the equation method. Indeed, the contribution margin per unit method formula is an abbreviated version of the income statement formula used in the equation method. In other words both methods are simply different derivations of the same formula. The proof is provided in the footnote below.¹

¹The formula for the *contribution margin per unit method* is (where N is the number of units at the break-even point):

$$N = \text{Fixed costs} \div \text{Contribution margin per unit}$$

The income statement formula for the *equation method* produces the same result as shown below (where N is the number of units at the break-even point):

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit}$$

$$\text{Sales price per unit (N)} - \text{Variable cost per unit (N)} - \text{Fixed costs} = \text{Profit}$$

$$\text{Contribution margin per unit (N)} - \text{Fixed costs} = \text{Profit}$$

$$\text{Contribution margin per unit (N)} - \text{Fixed costs} = 0$$

$$\text{Contribution margin per unit (N)} = \text{Fixed costs}$$

$$N = \text{Fixed costs} \div \text{Contribution margin per unit}$$

Both the *equation method* and the *contribution margin per unit method* yield the amount of break-even sales measured *in units*. To determine the amount of break-even sales measured *in dollars*, multiply the number of units times the sales price per unit. For Delatine the break-even point measured in dollars is \$180,000 (5,000 units \times \$36 per unit). The following income statement confirms this result:

Sales revenue (5,000 units \times \$36)	\$180,000
Total variable expenses (5,000 units \times \$24)	(120,000)
Total contribution margin (5,000 units \times \$12)	60,000
Fixed expenses	(60,000)
Net income	\$ 0

Contribution Margin Ratio Method

The equation method and the contribution margin per unit method produce a break-even point measured *in units*. The break-even point expressed *in dollars* can be determined using the contribution margin ratio method. We begin by determining the **contribution margin ratio**, which is defined as follows.

$$\text{Contribution margin ratio} = \text{Contribution margin} \div \text{Sales}$$

The ratio can be computed using the total amount of the contribution margin and sales or by using per unit amounts. Either approach will yield the same result, as shown here.

Using total dollar values:

$$\text{Contribution margin ratio} = \text{Contribution margin in dollars} \div \text{Sales in dollars}$$

$$\text{Contribution margin ratio} = \$60,000 \div \$180,000 = .3333333$$

Using per unit values:

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

$$\text{Contribution margin ratio} = \$12 \div \$36 = .3333333$$

Using the *contribution margin ratio method* the break-even point in dollars is computed by dividing the fixed cost by the contribution margin ratio. The computations for Bright Day follow.

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

$$\text{Break-even point in dollars} = \frac{\$60,000}{.333333}$$

$$\text{Break-even point in dollars} = \$180,000 \text{ Sales revenue}$$

The break-even volume measured in units can be determined by dividing the total sales revenue by the sales price per unit as follows:

$$\text{Break-even point} = \$180,000 \text{ Sales revenue} \div \$36 = 5,000 \text{ Units}$$

The *contribution margin ratio method* yields the same results as the *contribution margin per unit method* and the *equation method*. The results are the same because all three methods are merely different derivations of the income statement formula.

LO 3

Use the contribution margin ratio method to determine the break-even point.

DETERMINING THE SALES VOLUME NECESSARY TO REACH A DESIRED PROFIT

Bright Day's president decides the ad campaign should produce a \$40,000 profit. He asks the accountant to determine the sales volume that is required to achieve this level of profitability. Using the *equation method*, the sales volume in units required to attain the desired profit is computed as follows:

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit}$$

$$\$36N - \$24N - \$60,000 = \$40,000$$

$$\$12N = \$60,000 + \$40,000$$

$$N = \$100,000 \div \$12$$

$$N = 8,333 \text{ Units}$$

Where:

N = Number of units

\$36 = Sales price per unit

\$24 = Variable cost per unit

\$60,000 = Fixed costs

\$40,000 = Desired profit

The accountant used the *contribution margin per unit method* to confirm these computations as follows:

$$\begin{aligned} \text{Sales volume in units} &= \frac{\text{Fixed costs} + \text{Desired profit}}{\text{Contribution margin per unit}} \\ &= \frac{\$60,000 + \$40,000}{\$12} = 8,333.33 \text{ Units} \end{aligned}$$

The required volume in sales dollars is this number of units multiplied by the sales price per unit (8,333.33 units \times \$36 = \$300,000). The following income statement confirms this result; all amounts are rounded to the nearest whole dollar.

Sales revenue (8,333.33 units \times \$36)	\$300,000
Total variable expenses (8,333.33 units \times \$24)	(200,000)
Total contribution margin (8,333.33 units \times \$12)	100,000
Fixed expenses	(60,000)
Net income	\$ 40,000

In practice, the company will not sell partial bottles of Delatine. The accountant rounds 8,333.33 bottles to whole units. For planning and decision making, managers frequently make decisions using approximate data. Accuracy is desirable, but it is not as important as relevance. Do not be concerned when computations do not produce whole numbers. Rounding and approximation are common characteristics of managerial accounting data.



CHECK YOURSELF 3.2

VolTech Company manufactures small engines that it sells for \$130 each. Variable costs are \$70 per unit. Fixed costs are expected to be \$100,000. The management team has established a target profit of \$188,000. Use the contribution margin per unit method to determine how many engines VolTech must sell to attain the target profit. Use the contribution margin ratio method to determine the amount of sales volume in dollars required to attain the desired profit.

LO 4

Determine the sales volume required to attain a desired profit.

Answer**Contribution margin per unit approach:**

$$\text{Sales volume in units} = \frac{\text{Fixed costs} + \text{Desired profit}}{\text{Contribution margin per unit}} = \frac{\$100,000 + \$188,000}{\$130 - \$70} = 4,800 \text{ Units}$$

Contribution margin ratio approach:

$$\text{Sales volume in \$} = \frac{\text{Fixed costs} + \text{Desired profit}}{\text{Contribution margin ratio}} = \frac{\$100,000 + \$188,000}{(\$60 \div \$130)} = \$624,000$$

Proof that the two approaches produce the same result:

$$\text{Sales price} \times \text{No. units} = \text{Sales in dollars}$$

$$\$130 \times 4,800 \text{ Units} = \$624,000$$

ASSESSING THE PRICING STRATEGY

LO 5

Set selling prices by using cost-plus, prestige, and target costing.

After reviewing the accountant's computations, the president asked the marketing manager, "What are our chances of reaching a sales volume of 8,334 units?" The manager replied, "Slim to none." She observed that no Bright Day product has ever sold more than 4,000 bottles when initially offered. Further, she feels the \$36 price is too high. She asked who set the \$36 price and how it was established.

The accountant explained that the price was established using a **cost-plus pricing** strategy. The normal policy is to price products at variable cost plus 50 percent of the variable cost. In this case the variable cost was \$24, resulting in a price of \$36 [$\$24 + (\$24 \times .5)$] The accountant knew the price was high but expected Delatine to sell anyway. Indeed, he supported his position by referencing a strategy known as **prestige pricing**. Many people will pay a premium to be the first to use a new product. Similarly, people will pay more for a product with a prestigious brand name. The accountant noted that the widespread news coverage coupled with Bright Day's brand identity makes Delatine a prime product for prestige pricing.

The marketing manager recognized the accountant's arguments, but contended that news coverage will fade rapidly, competitors will enter the market, and therefore, Delatine cannot support a \$36 price for an extended period of time. As an alternative, she suggested they use a strategy known as target costing. **Target costing** begins by determining the market price at which a product will sell. This becomes the target price. The focus then shifts to developing the product at a cost that will enable the company to be profitable while selling the product at the target price.

Market research indicates that Delatine could sustain long-term sales at a price of \$28 per bottle. At this price, the new contribution margin becomes a mere \$4 (\$28 Sales price – \$24 Variable cost per unit). Lowering the contribution margin per unit will dramatically increase the sales volume necessary to attain the desired profit. Using the *equation method*, the sales volume in units required to attain the desired profit when the sales price per unit is reduced to \$28 is as follows:

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit}$$

$$\$28N - \$24N - \$60,000 = \$40,000$$

$$\$4N = \$60,000 + \$40,000$$

$$N = \$100,000 \div \$4$$

$$N = 25,000 \text{ Units}$$

Where:

N = Number of units

\$28 = Sales price per unit

\$24 = Variable cost per unit

\$60,000 = Fixed costs

\$40,000 = Desired profit

The accountant used the *contribution margin per unit method* to confirm these computations as follows:

$$\begin{aligned} \text{Sales volume in units} &= \frac{\text{Fixed costs} + \text{Desired profit}}{\text{Contribution margin per unit}} \\ &= \frac{\$60,000 + \$40,000}{\$4} = 25,000 \text{ Units} \end{aligned}$$

The required sales volume *in dollars* is \$700,000 (25,000 units × \$28 per bottle). The following income statement confirms these results.

Sales revenue (25,000 units × \$28)	\$700,000
Total variable expenses (25,000 units × \$24)	<u>(600,000)</u>
Total contribution margin (25,000 units × \$4)	100,000
Fixed expenses	<u>(60,000)</u>
Net income	<u>\$ 40,000</u>

The marketing manager recognized that it would be impossible to sell 25,000 bottles of Delatine. She noted that this is where target costing enters the picture. Delatine must be made at a cost that will enable the company to earn the desired profit of \$40,000 while selling at a price of \$28 per bottle. Clearly, the cost structure must change, and the marketing manager has some suggestions for making the necessary changes.

ASSESSING THE EFFECTS OF CHANGES IN VARIABLE COSTS

The previously discussed \$24 cost is for a bottle of 100 capsules, each containing 90 milligrams (mg) of pure Delatine. The manufacturer is willing to provide Delatine to Bright Day in two alternative package sizes: (1) a bottle costing \$12 that contains 100 capsules of 30 mg strength pure Delatine and (2) a bottle costing \$3 that contains 100 capsules containing 5 mg of Delatine mixed with a vitamin C compound. The 5 mg dosage is the minimum required to permit a package label to indicate the product contains Delatine. The marketing manager observes that either option would enable Bright Day to sell Delatine at a price customers would be willing to pay.

The president vehemently rejected the second option, calling it a blatant attempt to deceive customers by suggesting they were buying Delatine when in fact they were getting vitamin C. *He considered the idea unethical and dangerous.* He vowed that he would not be seen on the six o'clock news trying to defend a fast buck scheme while his company's reputation went up in smoke. After calming down, he agreed that the first option had merit. The appropriate dosage for Delatine was uncertain; customers who wanted 90 mg per day could take three capsules instead of one. He asked the accountant, "What's the effect on the bottom line?"

The variable cost changes from \$24 to \$12 per bottle. The contribution margin per unit increases from \$4 per bottle (\$28 sales price – \$24 variable cost per bottle) to \$16 per bottle (\$28 sales price – \$12 variable cost per bottle). The significant increase in contribution margin per unit dramatically decreases the sales volume necessary to attain the target profit.

LO 6

Explain cost-volume-profit relationships.

FOCUS ON INTERNATIONAL ISSUES



COST-VOLUME-PROFIT ANALYSIS AT A GERMAN CHEMICAL COMPANY

The greater the percentage of a company's total costs that are fixed, the more sensitive the company's earnings are to changes in revenue or volume. Operating leverage, the relationship between the changes in revenue and changes in earnings, introduced earlier, applies to companies throughout the world, large or small.

Large chemical manufacturers have significant fixed costs. It takes a lot of buildings and equipment to produce chemicals. **BASF** claims to be the largest chemical company in the world. It has its headquarters in Ludwigshafen, Germany. From 2004 through 2006 BASF's revenues increased 40.2 percent, but its earnings increased 60.4 percent. In other words, its earnings grew one and one-half times faster than its revenues.

Studying BASF offers insight into a true global enterprise. Though headquartered in Germany, it has manufacturing facilities at 150 locations throughout the world. Only 21 percent of its 2006 revenue came from sales within Germany, which was 1 percent less than the revenue it earned in the United States. Although its financial statements are presented in euros and prepared in accordance with international financial accounting standards, its stock is traded on the New York Stock Exchange as well as on the Frankfurt Stock Exchange.

Using the *equation method*, the sales volume in units required to attain the desired profit when the variable cost per unit is reduced to \$12 per bottle is as follows:

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit}$$

$$\$28N - \$12N - \$60,000 = \$40,000$$

$$\$16N = \$60,000 + \$40,000$$

$$N = \$100,000 \div \$16$$

$$N = 6,250 \text{ Units}$$

Where:

N = Number of units

\$28 = Sales price per unit

\$12 = Variable cost per unit

\$60,000 = Fixed costs

\$40,000 = Desired profit

The accountant used the *contribution margin per unit method* to confirm these computations as follows:

$$\begin{aligned} \text{Sales volume in units} &= \frac{\text{Fixed costs} + \text{Desired profit}}{\text{Contribution margin per unit}} \\ &= \frac{\$60,000 + \$40,000}{\$16} = 6,250 \text{ Units} \end{aligned}$$

The required sales volume in sales dollars is \$175,000 (6,250 units \times \$28 per bottle). The following income statement confirms these amounts.

Sales revenue (6,250 units × \$28)	\$175,000
Total variable expenses (6,250 units × \$12)	<u>(75,000)</u>
Total contribution margin (6,250 units × \$16)	100,000
Fixed expenses	<u>(60,000)</u>
Net income	<u>\$ 40,000</u>

Although the drop in required sales from 25,000 units to 6,250 was significant, the marketing manager was still uneasy about the company's ability to sell 6,250 bottles of Delatine. She observed again that no other Bright Day product had produced sales of that magnitude. The accountant suggested reducing projected fixed costs by advertising on radio rather than television. While gathering cost data for the potential television ad campaign, the accountant had consulted radio ad executives who had assured him radio ads could equal the TV audience exposure at about half the cost. Even though the TV ads would likely be more effective, he argued that since radio advertising costs would be half those of TV, the desired profit could be attained at a significantly lower volume of sales. The company president was impressed with the possibilities. He asked the accountant to determine the required sales volume if advertising costs were \$30,000 instead of \$60,000.

Answers to The Curious Accountant

InterContinental Hotel Group (IHG)

obviously believed that the revenue it lost from dropping some hotels that did not meet its new image standards

would be more than offset by the fees it received from new franchisees. If the **Holiday Inn** brand was perceived as a low-quality lodging choice because of a few unattractive properties, new franchisees may not be eager to sign on. Also, existing hotels can charge higher prices if the brand is perceived as more upscale. Since IHG gets a piece of these higher fees, it was willing to eliminate some units in order to, it hopes, improve overall profitability. It would be more difficult for IHG to initiate a marketing campaign based on the quality of Holiday Inns if several of its franchisees were perceived poorly.

American Express (AMEX) was trying to get rid of a small percentage of customers who had relatively large account balances, but who were not using their cards very often. AMEX could receive at least two benefits if these customers left. First, the company could avoid the higher-than-average default risk associated with them. Second, AMEX could avoid the costs of servicing the accounts of these infrequent card users. These costs occur even though the customers do not generate much revenue for the company.

IHC and American Express made their decisions by focusing on multiple factors, not just revenues and not just cost. Their decisions were based on an analysis of the interactions of costs, revenues, and the volume of revenues that would be generated as cost and pricing strategies were altered. Traditionally accountants refer to the topics covered in this chapter as cost-volume-profit analysis, but more accurately it could be called *price-cost-volume-profit analysis*.

Sources: "Hotels Risk Losing Holiday Inn Brand," *The Wall Street Journal*, November 13, 2009, p. B-3, and "AmEx Encourages Cardholders to Leave," *The Wall Street Journal*, February 24, 2009, p. D-2.

LO 6

Explain cost-volume-profit relationships.

ASSESSING THE EFFECTS OF CHANGES IN FIXED COSTS

Changing the fixed costs from \$60,000 to \$30,000 will dramatically reduce the sales level required to earn the target profit. Using the *equation method* the sales volume in units required to attain the desired profit when fixed costs are reduced to \$30,000 is as follows.

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit}$$

$$\$28N - \$12N - \$30,000 = \$40,000$$

$$\$16N = \$30,000 + \$40,000$$

$$N = \$70,000 \div \$16$$

$$N = 4,375 \text{ Units}$$

Where:

N = Number of units

\$28 = Sales price per unit

\$12 = Variable cost per unit

\$30,000 = Fixed costs

\$40,000 = Desired profit

The accountant used the *contribution margin per unit method* to confirm these computations as follows.

$$\begin{aligned} \text{Sales volume in units} &= \frac{\text{Fixed costs} + \text{Desired profit}}{\text{Contribution margin per unit}} \\ &= \frac{\$30,000 + \$40,000}{\$16} = 4,375 \text{ units} \end{aligned}$$

The required sales volume in sales dollars is \$122,500 (4,375 units \times \$28). The following income statement confirms these amounts.

Sales revenue (4,375 units \times \$28)	\$122,500
Total variable expenses (4,375 units \times \$12)	(52,500)
Total contribution margin (4,375 units \times \$16)	70,000
Fixed expenses	(30,000)
Net income	<u>\$ 40,000</u>

The marketing manager supported using radio instead of television ads. Obviously, she could not guarantee any specific sales volume, but she felt confident that sales projections within a range of 4,000 to 5,000 units were reasonable.

The Effect of Cost Structure on the Break-Even Point

Reducing fixed cost from \$60,000 to \$30,000 also significantly reduces the break-even point. This conclusion is confirmed by computing the break-even point before and after the reduction of the fixed cost as follows:

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

$$\text{Break-even point before fixed cost reduction} = \$60,000 \div \$16 = 3,750 \text{ units}$$

$$\text{Break-even point after fixed cost reduction} = \$30,000 \div \$16 = 1,875 \text{ units}$$

The lower break-even point is consistent with the conclusion reached in Chapter 2 regarding operating leverage. Recall that higher risk exists for companies with high fixed

cost structures while variable cost structures limit risk. It follows that companies with high fixed cost structures will have higher break-even points than companies with low fixed cost structures. A high break-even point suggests that a company must attain a high sales volume or face operating losses. Indeed, failure to attain the required sales volume will result in leveraged losses. In other words, operating leverage will cause any change in sales revenue to have a disproportionately larger impact on net income.

USING THE COST-VOLUME-PROFIT GRAPH

To visually analyze the revised projections, Bright Day's accountant prepared a cost-volume-profit (CVP) graph that pictured CVP relationships over a range of sales activity from zero to 6,000 units. The accountant followed the steps below to produce the CVP graph (sometimes called a *break-even chart*) shown in Exhibit 3.1. The graph is drawn under the following assumptions.

LO 7

Draw and interpret a cost-volume-profit graph.

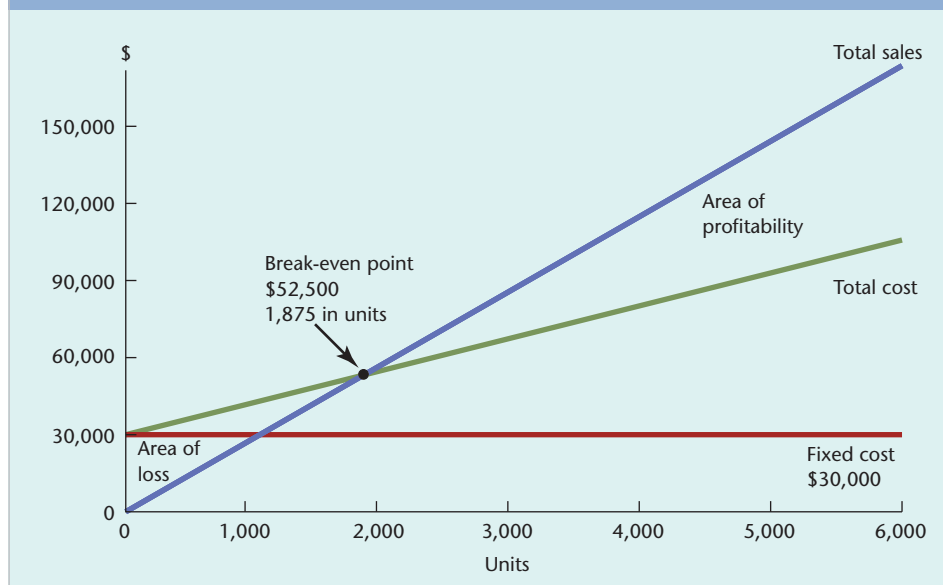
- The contribution margin is \$16 (sales price \$28 – variable cost \$12 per bottle).
- The fixed cost is \$30,000.
- The desired profit is \$40,000.

Procedures for Drawing the CVP Graph

1. *Draw and label the axes:* The horizontal axis represents activity (expressed in units) and the vertical axis represents dollars.
2. *Draw the fixed-cost line:* Total fixed costs are constant for all levels of activity. Draw a horizontal line representing the amount of fixed costs across the graph at \$30,000, the fixed-cost level.
3. *Draw the total cost line:* The total cost line representing the combination of fixed and variable costs is a diagonal line that rises as it moves from left to right. To draw the line, plot one point of the total cost line at the intersection of the fixed-cost line and the vertical axis. In this case, plot the first point at the zero level of activity and \$30,000 (fixed cost). Next, select an arbitrary activity level. In this case we assume

EXHIBIT 3.1

Cost-Volume-Profit Graph



REALITY BYTES

The relationship among the costs to produce goods, the volume of goods produced, the price charged for those goods, and the profit earned is relevant to all industries, but perhaps no industry demonstrates the effects of these relationships more dramatically than automobile manufacturing. First, the automobile industry is characterized by having a lot of fixed production-costs for things such as buildings, equipment, research, and development, but also financing costs associated with borrowed funds, such as the interest expense bonds. Second, the industry is globally competitive, and companies in the United States are often at a cost disadvantage. Some of this cost disadvantage comes from obvious sources, such as having to pay higher wages than do companies in countries such as South Korea. Finally, for many customers, price and quality are more important than brand loyalty.

Over the past decades, domestic auto makers, and in particular **General Motors (GM)**, have used different strategies to try to deal with the issues mentioned above. Early on it had a dominant market share. As long as it produced more cars than its competitors, its fixed cost per car was lower, resulting in better profits. In the 1980s, however, foreign manufactures began increasing their market share and decreasing GM's. As its relative levels of production fell, its fixed cost per unit increased. In response, GM and others tried to regain market share by lowering prices, largely through rebates. Unfortunately this did not work, so the lower prices, combined with the higher relative fixed costs, seriously eroded profits.

These problems reached a crisis in 2008 and 2009 when GM and **Chrysler** sought financial help from the government and entered expedited bankruptcy proceedings.

What did GM and Chrysler hope to achieve? Primarily they needed to lower their costs, especially their fixed costs. As a result of bankruptcy proceedings, they were able to greatly reduce interest and principal payments on their outstanding bonds (fixed costs), reduce the number of brands (fixed costs), shut down some plants (fixed costs), reduce health care costs to retirees (fixed costs), and reduce the number of dealers. While reducing the number of dealers did reduce some cost to the companies, it also reduced price competition among the dealers, which had the potential of allowing the companies to charge more for their cars. All of these changes, it was hoped, would allow the companies to return to profitability.

However, before a company can be profitable, it must break even. At one time GM's break-even point was estimated at around 16 million vehicles per year. GM's CEO until 2000, Rick Wagoner, had implemented changes that reduced the company's break-even point to 12 million units. On March 29, 2009, as a condition of receiving government support, the administration of President Barack Obama asked Mr. Wagoner to resign as GM's CEO. Perhaps lost by many in the news coverage of Mr. Wagoner's resignation were reports by several news organizations that officials at the U.S. Treasury Department would ask the new leadership at GM to take steps to reduce the company's break-even point to 10 million units.

It would be a major achievement if GM can reduce its break even from 16 million units to 10 million units in the span of a few years. This may not be enough, however. In 2008 GM sold only 8.8 million units, and its sales in the first quarter of 2009 were even lower than the same quarter of 2008. Furthermore, it should be remembered that the objective of businesses is not simply to break even, but to make a profit.



6,000 units. At this volume, the total cost is \$102,000 [(6,000 units \times \$12) + \$30,000 fixed cost]. Plot a point at the coordinates of 6,000 units and \$102,000. Draw a straight line through these two points.

4. *Draw the sales line:* Draw the revenue line using a procedure similar to that described for drawing the total cost line. Select some arbitrary level of activity and multiply that volume by the sales price per unit. Plot the result on the graph and draw a line from the origin (zero units, zero revenue) through this point. For example, at a volume of 6,000 units, the revenue is \$168,000 (6,000 units \times \$28). Plot a point at the coordinates of 6,000 units and \$168,000. Draw a line from the origin through the plotted point.

Trace these steps to the graph in Exhibit 3.1. After analyzing the graph, the president concludes that the sales volume of 4,375 units is well above the break-even point of 1,875 units. Still he wonders if the level of safety could be measured and compared with other investment opportunities.

CALCULATING THE MARGIN OF SAFETY

The final meeting of Bright Day's management team focused on the reliability of the data used to construct the CVP chart. The accountant called attention to the sales volume figures in the area of profitability. Recall that Bright Day must sell 4,375 bottles of Delatine to earn the desired profit. In dollars, budgeted sales are \$122,500 (4,375 bottles × \$28 per bottle). The accountant highlighted the large gap between these budgeted sales and break-even sales. The amount of this gap, called the *margin of safety*, can be measured in units or in sales dollars as shown here.

	In Units	In Dollars
Budgeted sales	4,375	\$122,500
Break-even sales	(1,875)	(52,500)
Margin of safety	<u>2,500</u>	<u>\$ 70,000</u>

LO 8

Calculate and interpret the margin of safety.

The **margin of safety** measures the cushion between budgeted sales and the break-even point. It quantifies the amount by which actual sales can fall short of expectations before the company will begin to incur losses.

To help compare diverse products or companies of different sizes, the margin of safety can be expressed as a percentage. Divide the margin of safety by the budgeted sales volume² as shown here.

$$\text{Margin of safety} = \frac{\text{Budgeted sales} - \text{Break-even sales}}{\text{Budgeted sales}}$$

$$\text{Margin of safety} = \frac{\$122,500 - \$52,500}{\$122,500} = 57.14\%$$

This analysis suggests actual sales would have to fall short of expected sales by more than 57 percent before Bright Day would experience a loss on Delatine. The large margin of safety suggests the proposed radio advertising program to market bottles of 30mg Delatine capsules has minimal risk. As a result, the project team recommends that Delatine be added to the company's line of products. The steps Bright Day's project team experienced to arrive at this decision are summarized in Exhibit 3.2.



CHECK YOURSELF 3.3

Suppose that Bright Day is considering the possibility of selling a protein supplement that will cost Bright Day \$5 per bottle. Bright Day believes that it can sell 4,000 bottles of the supplement for \$25 per bottle. Fixed costs associated with selling the supplement are expected to be \$42,000. Does the supplement have a wider margin of safety than Delatine?

Answer Calculate the break-even point for the protein supplement.

$$\text{Break-even volume in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}} = \frac{\$42,000}{\$25 - \$5} = 2,100 \text{ Units}$$

Calculate the margin of safety. Note that the margin of safety expressed as a percentage can be calculated using the number of units or sales dollars. Using either units or dollars yields the same percentage.

$$\text{Margin of safety} = \frac{\text{Budgeted sales} - \text{Break-even sales}}{\text{Budgeted sales}} = \frac{4,000 - 2,100}{4,000} = 47.5\%$$

The margin of safety for Delatine (57.14 percent) exceeds that for the protein supplement (47.5 percent). This suggests that Bright Day is less likely to incur losses selling Delatine than selling the supplement.

²The margin of safety percentage can be based on actual as well as budgeted sales. For example, an analyst could compare the margins of safety of two companies under current operating conditions by substituting actual sales for budgeted sales in the computation, as follows: [(Actual sales – Break-even sales) ÷ Actual sales].

EXHIBIT 3.2

Recap of Delatine Decision Process

Management considers a new product named Delatine. Delatine has a projected sales price of \$36 and variable cost of \$24 per bottle. Fixed cost is projected to be \$60,000. The break-even point is 5,000 units [$\$60,000 \div (\$36 - \$24) = 5,000$].



Management desires to earn a \$40,000 profit on Delatine. The sales volume required to earn the desired profit is 8,334 units [$(\$60,000 + \$40,000) \div (\$36 - \$24) = 8,334$].



The marketing manager advocates a target pricing approach that lowers the proposed selling price to \$28 per bottle. The sales volume required to earn a \$40,000 profit increases to 25,000 units [$(\$60,000 + \$40,000) \div (\$28 - \$24) = 25,000$].



Target costing is employed to reengineer the product, thereby reducing variable cost to \$12 per bottle. The sales volume required to earn a \$40,000 profit decreases to 6,250 units [$(\$60,000 + \$40,000) \div (\$28 - \$12) = 6,250$].



Target costing is applied further to reduce fixed cost to \$30,000. The sales volume required to earn a \$40,000 profit decreases to 4,375 units [$(\$30,000 + \$40,000) \div (\$28 - \$12) = 4,375$]. The new break-even point is 1,875 units [$\$30,000 \div (\$28 - \$12) = 1,875$].



In view of a 57.14% margin of safety [$(4,375 - 1,875) \div 4,375 = .5714$], management decides to add Delatine to its product line.



PERFORMING SENSITIVITY ANALYSIS USING SPREADSHEET SOFTWARE

While useful, the margin of safety offers only a one dimensional measure of risk—change in sales volume. Profitability is affected by multidimensional forces. Fixed or variable costs, as well as sales volume, could differ from expectations. Exhibit 3.3 uses data pertaining to Bright Day’s proposed project for marketing Delatine to illustrate an Excel spreadsheet showing the sensitivity of profits to simultaneous changes in fixed cost, variable cost, and sales volume. Recall the accountant estimated the radio ad campaign would cost \$30,000. The spreadsheet projects profitability if advertising costs are as low as \$20,000 or as high as \$40,000. The effects of potential simultaneous changes in variable cost and sales volume are similarly projected.

The range of scenarios illustrated in the spreadsheet represents only a few of the many alternatives management can analyze with a few quick keystrokes. The spreadsheet program recalculates profitability figures instantly when one of the variables changes. If the president asks what would happen if Bright Day sold 10,000 units, the accountant merely substitutes the new number for one of the existing sales volume figures, and revised profitability numbers are instantly available. By changing the variables, management can get a real feel for the sensitivity of profits to changes in cost and volume. Investigating a multitude of what-if possibilities involving simultaneous changes in fixed cost, variable cost, and volume is called **sensitivity analysis**.

After reviewing the spreadsheet analysis, Bright Day’s management team is convinced it should undertake radio advertising for Delatine. Only under the most dire circumstances (if actual sales are significantly below expectations while costs are well above expectations) will the company incur a loss.

LO 9

Conduct sensitivity analysis for cost-volume-profit relationships.

EXHIBIT 3.3

Spreadsheet Report to Facilitate “What-If” Analysis

Selling Price = \$ 28.00		And Sales Volume is				
Fixed Cost is	Variable Cost is	2,000	3,000	4,000	5,000	6,000
\$ 20,000	11	\$14,000	\$31,000	\$48,000	\$65,000	\$82,000
20,000	12	12,000	28,000	44,000	60,000	78,000
20,000	13	10,000	25,000	40,000	55,000	70,000
30,000	11	4,000	21,000	38,000	55,000	72,000
30,000	12	2,000	18,000	34,000	50,000	68,000
30,000	13	-	15,000	30,000	45,000	60,000
40,000	11	(8,000)	11,000	28,000	45,000	62,000
40,000	12	(8,000)	8,000	24,000	40,000	56,000
40,000	13	(10,000)	5,000	20,000	35,000	50,000

ASSESSING THE EFFECT OF SIMULTANEOUS CHANGES IN CVP VARIABLES

When spreadsheet software is not available, the effects of simultaneous changes in CVP variables can be examined using the equation method. To illustrate several possible scenarios, assume Bright Day has developed the budgeted income statement in Exhibit 3.4.

EXHIBIT 3.4**Budgeted Income Statement**

Sales revenue (4,375 units × \$28 sale price)	\$122,500
Total variable expenses (4,375 units × \$12 cost per bottle)	(52,500)
Total contribution margin (4,375 units × \$16)	70,000
Fixed expenses	(30,000)
Net income	<u>\$ 40,000</u>

A Decrease in Sales Price Accompanied by an Increase in Sales Volume

The marketing manager believes reducing the sales price per bottle to \$25 will increase sales volume by 625 units. The expected sales volume would become 5,000 (4,375 + 625). Variable cost per unit is expected to remain at \$12. Should Bright Day reduce the price? Compare the projected profit without these changes (\$40,000) with the projected profit if the sales price is \$25 and volume increases to 5,000 units.

$$\begin{aligned} \text{Sales} - \text{Variable costs} - \text{Fixed costs} &= \text{Profit} \\ (\$25 \times 5,000 \text{ units}) - (\$12 \times 5,000) - \$30,000 &= \text{Profit} \\ \$35,000 &= \text{Profit} \end{aligned}$$

Since budgeted income falls from \$40,000 to \$35,000, Bright Day should not reduce the sales price.

An Increase in Fixed Cost Accompanied by an Increase in Sales Volume

Return to the budgeted income statement in Exhibit 3.4. If the company buys an additional \$12,000 of advertising, management believes sales can increase to 6,000 units. The sales price remains at \$28 and variable cost per unit at \$12. Should Bright Day incur the additional advertising cost, increasing fixed costs to \$42,000 and sales volume to 6,000 units? The expected profit would be:

$$\begin{aligned} \text{Sales} - \text{Variable costs} - \text{Fixed costs} &= \text{Profit} \\ (\$28 \times 6,000 \text{ units}) - (\$12 \times 6,000) - \$42,000 &= \text{Profit} \\ \$54,000 &= \text{Profit} \end{aligned}$$

Since budgeted income increases from \$40,000 to \$54,000, Bright Day should seek to increase sales through additional advertising.

A Simultaneous Reduction in Sales Price, Fixed Costs, Variable Costs, and Sales Volume

Return again to the budgeted income statement in Exhibit 3.4. Suppose Bright Day negotiates a \$4 reduction in the cost of a bottle of Delatine. The management team considers passing some of the savings on to customers by reducing the sales price to \$25 per bottle. Furthermore, the team believes it could reduce advertising costs by \$8,000 and still achieve sales of 4,200 units. Should Bright Day adopt this plan to reduce prices and advertising costs?

The contribution margin would increase to \$17 per bottle (\$25 revised selling price – \$8 revised variable cost per bottle) and fixed cost would fall to \$22,000 (\$30,000 – \$8,000). Based on a sales volume of 4,200 units, the expected profit is:

$$\begin{aligned} \text{Sales} - \text{Variable costs} - \text{Fixed costs} &= \text{Profit} \\ (\$25 \times 4,200 \text{ units}) - (\$8 \times 4,200) - \$22,000 &= \text{Profit} \\ \$49,400 &= \text{Profit} \end{aligned}$$

Because budgeted income increases from \$40,000 to \$49,400, Bright Day should proceed with the revised operating strategy.

Many other possible scenarios could be considered. The contribution approach can be used to analyze independent or simultaneous changes in the CVP variables.

MULTIPRODUCT COST-VOLUME-PROFIT ANALYSIS

To this point we have simplified our discussion of CVP by assuming a company sells only one product. In the real world, most companies sell many products. Each product has an independent impact on the profitability of the company. Calculating the break-even point requires an analyst to consider the simultaneous impact of the contribution margins of all products. This impact can be easily measured by computing the weighted average contribution margin.

To illustrate we assume that Bright Day's management team is examining its annual Vitamin C Sales Days event. The sales event focuses on two products. One product is labeled Synthetic C; the other is called Organic C. The sales price, variable cost, and contribution margin for each bottle of each product is shown here.

	Synthetic C	Organic C
Sales price	\$7	\$9
Variable cost	<u>5</u>	<u>6</u>
Contribution margin	<u>\$2</u>	<u>\$3</u>

Due to its lower cost, Synthetic C has consistently outsold the Organic C. Indeed, Synthetic C historically accounts for approximately 80 percent of the total sales; with Organic C making up the remaining 20 percent. The fixed costs for the annual sales event are expected to be \$2,112. These fixed costs are largely composed of advertising and training expenses. Based on this information the management team begins its examination by determining the break-even point.

Determining the Break-Even Point

The first step in determining the break-even point is to compute the *weighted average contribution margin per unit*. The weighted average depends on each product's proportionate share of the total sales. In accounting terms, the relative proportions in which a company's products are sold is called the **sales mix**. The expected sales mix for the annual sales event is 80 percent for Synthetic C and 20 percent for Organic C. In other words, the two products in the event have an 80/20 sales mix. Base on this sales mix, the weighted average contribution margin per bottle is computed as follows.

	Contribution Margin	Times Proportionate Share	Weighted Average
Synthetic C	\$2	× .8	\$1.60
Organic C	3	× .2	<u>.60</u>
Weighted average contribution margin			<u>\$2.20</u>

LO 10

Perform multiproduct cost-volume-profit analysis.

Using the per unit contribution margin approach, the break-even point in total units can be determined by dividing the fixed cost by the weighted average contribution margin as follows.

$$\text{Break-even point} = \text{Fixed costs} \div \text{Weighted average contribution margin per unit}$$

$$\text{Break-even point} = \$2,112 \div \$2.20 = 960 \text{ Total units}$$

The 960 units represent the total number of bottles of both products combined. To determine the number of bottles of each product, multiply the total number of bottles times the proportionate share of the sales mix as follows.

$$\text{Break-even point} = \text{Total units} \times \text{Proportionate share of sales mix}$$

$$\text{Break-even point for Synthetic C} = 960 \text{ bottles} \times .8 \text{ share of sales mix} = 768 \text{ Bottles}$$

$$\text{Break-even point for Organic C} = 960 \text{ bottles} \times .2 \text{ share of sales mix} = 192 \text{ Bottles}$$

The following income statement confirms that these sales volume figures constitute the break-even point.

Sales of Synthetic C (768 bottles × \$7)	\$5,376
Sales of Organic C (192 bottles × \$9)	<u>1,728</u>
Total sales	7,104
Variable cost of Synthetic C (768 bottles × \$5)	(3,840)
Variable cost of Organic C (192 bottles × \$6)	<u>(1,152)</u>
Contribution margin	2,112
Fixed cost	<u>(2,112)</u>
Net income	<u>\$ 0</u>

Determining the Sales Volume Necessary to Reach a Desired Profit

Suppose Bright Day's president wants to know the number of bottles of each product that must be sold to earn a profit of \$264 from the sales event. This information can be easily determined by adding the amount of the desired profit to the amount of fixed cost and then dividing the total by the weighted average contribution margin per unit. The computations are as follows.

$$\begin{aligned} \text{Sales volume in units} &= \frac{\text{Fixed cost} + \text{Desired profit}}{\text{Weighted average contribution margin per unit}} \\ &= \frac{\$2,112 + \$264}{\$2.20} = 1,080 \text{ Total units} \end{aligned}$$

The 1,080 units represent the total number of bottles of both products combined. To determine the number of bottles of each product, multiply the total number of bottles times the proportionate share of the sales mix as follows.

$$\text{Break-even point} = \text{Total units} \times \text{Proportionate share of sales mix}$$

$$\text{Break-even point for Synthetic C} = 1,080 \text{ bottles} \times .8 \text{ share of sales mix} = 864 \text{ Bottles}$$

$$\text{Break-even point for Organic C} = 1,080 \text{ bottles} \times .2 \text{ share of sales mix} = 216 \text{ Bottles}$$

The following income statement confirms that these sales volume figures constitute the sales volumes necessary to earn a desired profit of \$264.

Sales of Synthetic C (864 bottles × \$7)	\$6,048
Sales of Organic C (216 bottles × \$9)	<u>1,944</u>
Total sales	7,992
Variable cost of Synthetic C (864 bottles × \$5)	(4,320)
Variable cost of Organic C (216 bottles × \$6)	<u>(1,296)</u>
Contribution margin	2,376
Fixed cost	<u>(2,112)</u>
Net income	<u>\$ 264</u>

Managing the Sales Mix

Bright Day's president asks the management team to consider possibilities for increasing profitability. The team first considers the possibility of increasing the total number of bottles of vitamins sold. The marketing manager is pessimistic about this possibility. She notes that there are only so many people buying vitamin C. Trying to convince the same number of customers to purchase more bottles of the vitamin is not likely. The accountant notes that it is not necessary to sell more bottles of vitamins. Indeed, he argues that profitability can be increased even if sales volume remains flat. His solution is to change the sales mix.

Since Organic C has a higher contribution margin, shifting customers from Synthetic C to Organic C will increase profitability. The accountant demonstrates his point by computing the level of profitability assuming the sales mix shifts from an 80/20 split to a 60/40 mix. The income statement for a total sales volume of 1,080 bottles under a 60/40 sales mix is developed as follows.

The 1,080 units represent the total number of bottles of both products combined. To determine the number of bottles of each product using the 60/40 sales mix, multiply the total number of bottles times the proportionate share of the sales mix as follows.

Break-even point = Total units × Proportionate share of sales mix

Break-even point for Synthetic C = 1,080 bottles × .6 share of sales mix = 648 Bottles

Break-even point for Organic C = 1,080 bottles × .4 share of sales mix = 432 Bottles

The following income statement confirms that revised sales mix produces a higher net income. Indeed, in this case net income increases from \$264 to \$480 given the same total sales volume of 1,080 total bottles of vitamin C.

Sales of Synthetic C (648 bottles × \$7)	\$4,536
Sales of Organic C (432 bottles × \$9)	<u>3,888</u>
Total sales	8,424
Variable cost of Synthetic C (648 bottles × \$5)	(3,240)
Variable cost of Organic C (432 bottles × \$6)	<u>(2,592)</u>
Contribution margin	2,592
Fixed cost	<u>(2,112)</u>
Net income	<u>\$ 480</u>

The president is very impressed with this potential increase in profitability. His immediate response is to ask, how do we change the sales mix? A number of possibilities are examined, including slanting the advertising to emphasize Organic C and training the sales staff to promote the product. After careful consideration the team implements the most promising ideas. Ultimately, the team would compare the expected income statement with actual results to evaluate and fine tune the strategy. Variance analysis and performance evaluation are important subjects that will be covered in coming chapters.

It is important to note that the sales mix affects all aspects of CVP analysis. For example, the new break-even point for a sales mix of 60/40 is computed as discussed here. The first step is to compute the weighted average contribution margin per unit as follows.

	Contribution Margin	Times Proportionate Share	Weighted Average
Synthetic C	\$2	× .6	\$1.20
Organic C	3	× .4	<u>1.20</u>
Weighted average contribution margin			<u>\$2.40</u>

Using the per unit contribution margin approach, the break-even point in total units can be determined by dividing the fixed cost by the weighted average contribution margin as follows:

$$\text{Break-even point} = \text{Fixed costs} \div \text{Weighted average contribution margin per unit}$$

$$\text{Break-even point} = \$2,112 \div \$2.40 = 880 \text{ Total units}$$

Note that the break-even point is 80 units less (960 units – 880 units) than when the sales mix was 80/20. This demonstrates that shifting the sales mix not only increases net income but also reduces the break-even point. The 880 units represent the total number of bottles of both products combined that must be sold under an 60/40 sales mix for the company to break even. To determine the number of bottles of each product, multiply the total number of bottles times the proportionate share of the sales mix as follows:

$$\text{Break-even point} = \text{Total units} \times \text{Proportionate share of sales mix}$$

$$\text{Break-even point for Synthetic C} = 880 \text{ bottles} \times .6 \text{ share of sales mix} = 528 \text{ Bottles}$$

$$\text{Break-even point for Organic C} = 880 \text{ bottles} \times .4 \text{ share of sales mix} = 352 \text{ Bottles}$$

The following income statement confirms that these sales volume figures constitute the break-even point.

Sales of Synthetic C (528 bottles × \$7)	\$3,696
Sales of Organic C (352 bottles × \$9)	<u>3,168</u>
Total sales	6,864
Variable cost of Synthetic C (528 bottles × \$5)	(2,640)
Variable cost of Organic C (352 bottles × \$6)	<u>(2,112)</u>
Contribution margin	2,112
Fixed cost	<u>(2,112)</u>
Net income	<u>\$ 0</u>

The contribution margin per unit formula can be used to determine the number of units required to attain a target profit. Simply add the desired profit to the fixed costs and then divide by the weighted average contribution margin per unit. The resulting formula is:

$$\text{Sales volume in units} = \frac{\text{Fixed costs} + \text{Desired profit}}{\text{Weighted average contribution margin per unit}}$$

COST-VOLUME-PROFIT LIMITATIONS

CVP is limited by a number of underlying assumptions. These assumptions include:

1. The selling price is constant. It does not increase or decrease regardless of changes in sales volume.
2. Costs are linear.
 - a. The variable cost per unit is constant and moves in direct proportion with changes in sales volume.
 - b. Total fixed costs do not change with changes in sales volume.
 - c. Efficiency and productivity are constant.
3. The sales mix in multiproduct companies is constant.
4. Inventory levels in manufacturing companies are constant.
5. All CVP variables are within the relevant range.

Violating these assumptions will produce inaccuracies in CVP analysis. Unfortunately some violations are unavoidable in practice. For example, some companies may offer a discounted sales price for large orders, thereby violating the first assumption. Similarly, managers may desire to analyze operations at levels of sales volume that are outside the relevant range. Fortunately, many violations are insignificant. Further, accountants can make appropriate adjustments if serious violations are unavoidable. The widespread use of CVP in the real world suggests that the benefits of the analysis exceed the minor inaccuracies that inevitably occur. Even so, accountants must remain vigilant to avoid inaccuracies in the advice they render.



A Look Back



Profitability is affected by changes in sales price, costs, and the volume of activity. The relationship among these variables is examined using *cost-volume-profit (CVP) analysis*. The *contribution margin*, determined by subtracting variable costs from the sales price, is a useful variable in CVP analysis. The *contribution margin per unit* is the amount each unit sold provides to cover fixed costs. Once fixed costs have been covered, each additional unit sold increases net income by the amount of the per-unit contribution margin.

The *break-even point* (the point where total revenue equals total cost) can be determined by the equation method, the contribution margin method, or the contribution margin ratio method. All three methods produce the same result because all three methods are derivations of the income statement formula:

$$\text{Sales} - \text{Variable costs} - \text{Fixed costs} = \text{Profit}$$

Beyond determining the break-even point, all three methods can also be used to assess the effects in other CVP relationships.

Many methods are available to determine the prices at which products should sell. In *cost-plus pricing*, the sales price per unit is determined by adding a percentage markup to the cost per unit. In contrast, *target costing* begins with an estimated market price customers would be willing to pay for the product and then develops the product at a cost that will enable the company to earn its desired profit.

A *break-even graph* can depict cost-volume-profit relationships for a product over a range of sales activity. The horizontal axis represents volume of activity and the vertical axis represents dollars. Lines for fixed costs, total costs, and sales are drawn based on the sales price per unit, variable cost per unit, and fixed costs. The graph can be used to determine the break-even point in units and sales dollars.

The *margin of safety* is the number of units or the amount of sales dollars by which actual sales can fall below expected sales before a loss is incurred. The margin of safety can also be expressed as a percentage to permit comparing different size companies. The margin of safety can be computed as a percentage by dividing the difference between budgeted sales and break-even sales by the amount of budgeted sales.

Spreadsheet software as well as the contribution margin approach can be used to conduct sensitivity analysis of cost-volume-profit relationships. *Sensitivity analysis* predicts the effect on profitability of different scenarios of fixed costs, variable costs, and sales volumes. The effects of simultaneous changes in all three variables can be assessed.

Cost-volume-profit analysis is built upon certain simplifying assumptions. The analysis assumes true linearity among the CVP variables and a constant level of inventory. Although these assumptions are not literally valid in actual practice, CVP analysis nevertheless provides managers with helpful insights for decision making.

>> A Look Forward

The next chapter introduces a new cost classification scheme. Specifically, you will learn how to classify costs as being either direct or indirect costs. Direct costs are directly traceable to cost objects. Cost objects are items for which management needs to determine their cost. For example, a manager may need to determine the cost of making a product, providing a service, or operating a department. In these cases the cost object is the product, the service or the department. Indirect costs are those costs that cannot be directly traced to a cost object. The chapter will discuss the techniques such as cost tracing and cost allocation which are used to assign indirect costs to various objects.



A step-by-step audio-narrated series of slides is provided on the text website at www.mhhe.com/edmonds2011.



SELF-STUDY REVIEW PROBLEM

Sharp Company makes and sells pencil sharpeners. The variable cost of each sharpener is \$20. The sharpeners are sold for \$30 each. Fixed operating expenses amount to \$40,000.

Required

- Determine the break-even point in units and sales dollars.
- Determine the sales volume in units and dollars that is required to attain a profit of \$12,000. Verify your answer by preparing an income statement using the contribution margin format.
- Determine the margin of safety between sales required to attain a profit of \$12,000 and break-even sales.
- Prepare a break-even graph using the cost and price assumptions outlined above.

Solution to Requirement a

Formula for Computing Break-even Point in Units

$$\begin{aligned} \text{Sales} - \text{Variable costs} - \text{Fixed costs} &= \text{Profit} \\ \text{Sales price per unit (N)} - \text{Variable cost per unit (N)} - \text{Fixed costs} &= \text{Profit} \\ \text{Contribution margin per unit (N)} - \text{Fixed costs} &= \text{Profit} \\ N &= (\text{Fixed costs} + \text{Profit}) \div \text{Contribution profit per unit} \\ N &= (\$40,000 + 0) \div (\$30 - \$20) = 4,000 \text{ Units} \end{aligned}$$

Break-even Point in Sales Dollars	
Sales price	\$ 30
× Number of units	<u>4,000</u>
Sales volume in dollars	<u>\$120,000</u>

Solution to Requirement b

Formula for Computing Unit Sales Required to Attain Desired Profit
Sales – Variable costs – Fixed costs = Profit
Sales price per unit (N) – Variable cost per unit (N) – Fixed costs = Profit
Contribution margin per unit (N) – Fixed costs = Profit
$N = (\text{Fixed costs} + \text{Profit}) \div \text{Contribution profit per unit}$
$N = (\$40,000 + 12,000) \div (\$30 - \$20) = 5,200 \text{ Units}$

Sales Dollars Required to Attain Desired Profit	
Sales price	\$ 30
× Number of units	<u>5,200</u>
Sales volume in dollars	<u>\$156,000</u>

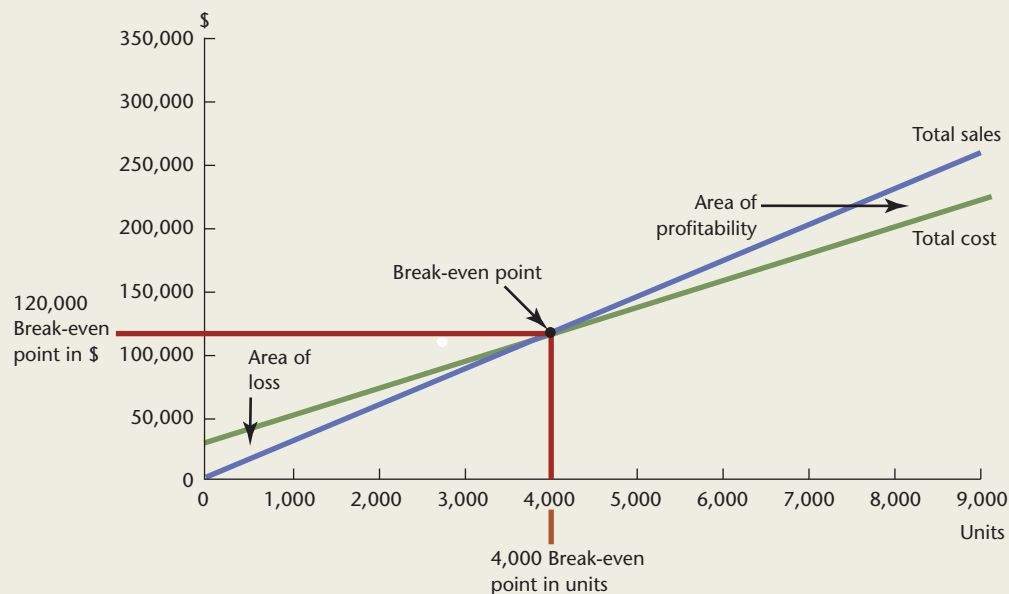
Income Statement	
Sales volume in units (a)	<u>5,200</u>
Sales revenue (a × \$30)	\$156,000
Variable costs (a × \$20)	<u>(104,000)</u>
Contribution margin	52,000
Fixed costs	<u>(40,000)</u>
Net income	<u>\$ 12,000</u>

Solution to Requirement c

Margin of Safety Computations	Units	Dollars
Budgeted sales	5,200	\$156,000
Break-even sales	<u>(4,000)</u>	<u>(120,000)</u>
Margin of safety	<u>1,200</u>	<u>\$ 36,000</u>

Percentage Computation	
$\frac{\text{Margin of safety in \$}}{\text{Budgeted sales}} = \frac{\$36,000}{\$156,000} = 23.08\%$	

Solution to Requirement d



KEY TERMS

Break-even point 108

Contribution margin per unit 109

Contribution margin ratio 110

Cost-plus pricing 112

Cost-volume-profit (CVP) analysis 107

Equation method 108

Margin of safety 119

Prestige pricing 112

Sales mix 123

Sensitivity analysis 121

Target costing 112

QUESTIONS

1. What does the term *break-even point* mean? Name the two ways it can be measured.
2. How does a contribution margin income statement differ from the income statement used in financial reporting?
3. In what three ways can the contribution margin be useful in cost-volume-profit analysis?
4. If Company A has a projected margin of safety of 22 percent while Company B has a margin of safety of 52 percent, which company is at greater risk when actual sales are less than budgeted?
5. What variables affect profitability? Name two methods for determining profitability when simultaneous changes occur in these variables.
6. When would the customer be willing to pay a premium price for a product or service? What pricing strategy would be appropriate under these circumstances?
7. What are three alternative approaches to determine the break-even point? What do the results of these approaches show?
8. What is the equation method for determining the break-even point? Explain how the results of this method differ from those of the contribution margin approach.
9. If a company is trying to find the break-even point for multiple products that sell simultaneously, what consideration must be taken into account?
10. What assumptions are inherent in cost-volume-profit analysis? Since these assumptions are usually not wholly valid, why do managers still use the analysis in decision making?
11. Mary Hartwell and Jane Jamail, college roommates, are considering the joint purchase of a computer that they can share to prepare class assignments. Ms. Hartwell wants a particular model that costs \$2,000; Ms. Jamail prefers a more economical model that costs \$1,500. In fact, Ms. Jamail is adamant about her position, refusing to contribute more than \$750 toward the purchase. If Ms. Hartwell is also adamant about her position, should she accept Ms. Jamail's \$750 offer and apply that amount toward the purchase of the more expensive computer?
12. How would the algebraic formula used to compute the break-even point under the equation method be changed to solve for a desired target profit?
13. Setting the sales price is easy: Enter cost information and desired profit data into

one of the cost-volume-profit formulas, and the appropriate sales price can be computed mathematically. Do you agree with this line of reasoning? Explain.

14. What is the relationship between cost-volume-profit analysis and the relevant range?



MULTIPLE-CHOICE QUESTIONS

Multiple-choice questions are provided on the text website at www.mhhe.com/edmonds2011.



EXERCISES—SERIES A

All applicable Exercises in Series A are available with McGraw-Hill's *Connect Accounting*.



Exercise 3-1A *Equation method*

LO 1

Adair Corporation produces products that it sells for \$12 each. Variable costs per unit are \$5, and annual fixed costs are \$140,000. Adair desires to earn a profit of \$21,000.

Required

- Use the equation method to determine the break-even point in units and dollars.
- Determine the sales volume in units and dollars required to earn the desired profit.

Exercise 3-2A *Per-unit contribution margin approach*

LO 2

Connor Corporation sells products for \$25 each that have variable costs of \$13 per unit. Connor's annual fixed cost is \$264,000.

Required

Use the per-unit contribution margin approach to determine the break-even point in units and dollars.

Exercise 3-3A *Contribution margin ratio*

LO 3

Garcia Company incurs annual fixed costs of \$60,000. Variable costs for Garcia's product are \$22.75 per unit, and the sales price is \$35.00 per unit. Garcia desires to earn an annual profit of \$45,000.

Required

Use the contribution margin ratio approach to determine the sales volume in dollars and units required to earn the desired profit.

Exercise 3-4A *Cost structure, risk, and the break-even point*

LO 1, 4, 6

Kennedy Company produces a product that sells for \$37 per unit and has a variable cost of \$22 per unit. Kennedy incurs annual fixed costs of \$75,000.

Required

- Determine the sales volume in units and dollars required to break even.
- Calculate the break-even point assuming fixed costs increase to \$120,000.
- Explain how a fixed cost structure affects risk and the break-even point.

Exercise 3-5A *Target costing*

LO 5

Mote Enterprises produces a product with fixed costs of \$36,000 and variable cost of \$2.50 per unit. The company desires to earn a \$20,000 profit and believes it can sell 10,000 units of the product.

Required

- Based on this information, determine the target sales price.
- Assume a competitor is currently selling a similar product for \$6.80 per unit. Explain how Mote can use target costing to maintain its desired profitability.

LO 6 **Exercise 3-6A** *Determining variable cost from incomplete cost data*

Laya Corporation produced 200,000 watches that it sold for \$16 each during 2012. The company determined that fixed manufacturing cost per unit was \$7 per watch. The company reported an \$800,000 gross margin on its 2012 financial statements.

Required

Determine the variable cost per unit, the total variable, and the total contribution margin.

LO 2, 4 **Exercise 3-7A** *Contribution margin per unit approach for break-even and desired profit*

Information concerning a product produced by Salter Company appears here:

Sales price per unit	\$175
Variable cost per unit	\$75
Total annual fixed manufacturing and operating costs	\$600,000

Required

Determine the following:

- Contribution margin per unit.
- Number of units that Salter must sell to break even.
- Sales level in units that Salter must reach to earn a profit of \$200,000.

LO 6 **Exercise 3-8A** *Changing sales price*

Pettigrew Company produces a product that has a variable cost of \$13 per unit; the product sells for \$28 per unit. The company's annual fixed costs total \$375,000; it had net income of \$75,000 in the previous year. In an effort to increase the company's market share, management is considering lowering the selling price to \$25 per unit.

Required

If Pettigrew desires to maintain net income of \$75,000, how many additional units must it sell to justify the price decline?

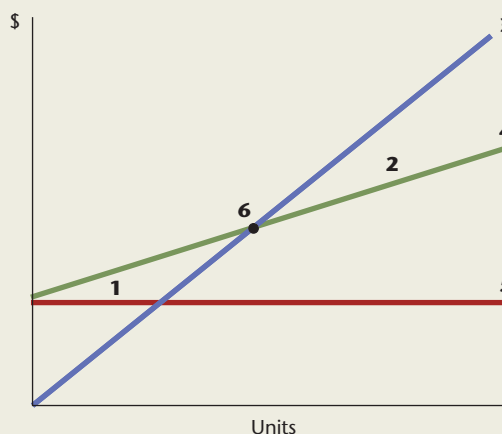
LO 4, 6 **Exercise 3-9A** *Simultaneous change in sales price and desired profit*

Use the cost data presented in Exercise 3-8A but assume that in addition to increasing its market share by lowering its selling price to \$25, Pettigrew desires to increase its net income by \$36,000.

Required

Determine the number of units the company must sell to earn the desired income.

LO 1, 7 **Exercise 3-10A** *Components of break-even graph*



Required

Match the numbers shown in the graph with the following items.

- | | |
|---------------------|-------------------|
| a. Fixed cost line | d. Area of profit |
| b. Total cost line | e. Revenue line |
| c. Break-even point | f. Area of loss |

Exercise 3-11A *Evaluating simultaneous changes in fixed and variable costs***LO 6**

Naylor Company currently produces and sells 6,400 units annually of a product that has a variable cost of \$18 per unit and annual fixed costs of \$161,400. The company currently earns a \$69,000 annual profit. Assume that Naylor has the opportunity to invest in new labor-saving production equipment that will enable the company to reduce variable costs to \$16 per unit. The investment would cause fixed costs to increase by \$9,000 because of additional depreciation cost.

Required

- Use the equation method to determine the sales price per unit under existing conditions (current equipment is used).
- Prepare a contribution margin income statement, assuming that Naylor invests in the new production equipment. Recommend whether Naylor should invest in the new equipment.

Exercise 3-12A *Margin of safety***LO 8**

Jensen Company makes a product that sells for \$38 per unit. The company pays \$16 per unit for the variable costs of the product and incurs annual fixed costs of \$176,000. Jensen expects to sell 21,000 units of product.

Required

Determine Jensen's margin of safety expressed as a percentage.

Exercise 3-13A *Cost-volume-profit relationship***LO 1, 2, 4, 6**

Feskin Corporation is a manufacturing company that makes small electric motors it sells for \$36 per unit. The variable costs of production are \$22 per motor, and annual fixed costs of production are \$196,000.

Required

- How many units of product must Feskin make and sell to break even?
- How many units of product must Feskin make and sell to earn a \$56,000 profit?
- The marketing manager believes that sales would increase dramatically if the price were reduced to \$34 per unit. How many units of product must Feskin make and sell to earn a \$56,000 profit, if the sales price is set at \$34 per unit?

Exercise 3-14A *Complexities of CVP Analysis in Multinational Companies***LO 6**

Pinero Barrels, Inc. (PBI), manufactures oak barrels for the wine industry at its facility in the United States. One of the raw materials used for some of its barrels is French oak lumber. The company fabricates the oak lumber into the appropriate-sized staves and assembles these staves, along with other components, into barrels. In January 2009, the company signed a contract to buy oak lumber from a French supplier for the coming two years. The contract calls for PBI to pay the supplier in euros (€), although all other costs that PBI incurs are paid for in dollars. A summary of the production cost for one barrel, based on the expected production level, follows:

Variable costs:	
French oak	\$100*
All other variable costs	150
Fixed costs:	50

*Based on the exchange rate at the time the contract with the French supplier was signed. The cost of lumber in euros was €77.50 as of January 2009.

The exchange rate between the dollar and the euro was $\$1.33 = \text{€}1.00$ in January 2009 when the contract was signed. By September 2009, the exchange rate had changed to $\$1.48 = \text{€}1.00$.

Required

- CVP analysis is based on several assumptions. Explain which of these assumptions would be violated as a result of PBI having to pay for one of its raw materials in euros while its other costs and revenues are priced in dollars.
- What effect, if any, would the change in the exchange rate have on PBI's variable cost per unit for September versus January 2009?
- What effect, if any, would the change in the exchange rate have on PBI's contribution margin per unit for September versus January 2009?
- What effect, if any, would the change in the exchange rate have on PBI's fixed cost per unit for September versus January 2009?

LO 5

Exercise 3-15A Target costing

The marketing manager of Ross Corporation has determined that a market exists for a telephone with a sales price of \$19 per unit. The production manager estimates the annual fixed costs of producing between 40,000 and 80,000 telephones would be \$344,000.

Required

Assume that Ross desires to earn a \$116,000 profit from the phone sales. How much can Ross afford to spend on variable cost per unit if production and sales equal 46,000 phones?

LO 10

Exercise 3-16A Multiple product break-even analysis

Eaton Company manufactures two products. The budgeted per-unit contribution margin for each product follows:

	Super	Supreme
Sales price	\$100	\$125
Variable cost per unit	(65)	(74)
Contribution margin per unit	<u>\$ 35</u>	<u>\$ 51</u>

Eaton expects to incur annual fixed costs of \$145,160. The relative sales mix of the products is 80 percent for Super and 20 percent for Supreme.

Required

- Determine the total number of products (units of Super and Supreme combined) Eaton must sell to break even.
- How many units each of Super and Supreme must Eaton sell to break even?

PROBLEMS—SERIES A

All applicable Problems in Series A are available with McGraw-Hill's *Connect Accounting*.



LO 1, 2, 3



Problem 3-17A Determining the break-even point and preparing a contribution margin income statement

Inman Manufacturing Company makes a product that it sells for \$60 per unit. The company incurs variable manufacturing costs of \$24 per unit. Variable selling expenses are \$12 per unit, annual fixed manufacturing costs are \$189,000, and fixed selling and administrative costs are \$141,000 per year.

Required

Determine the break-even point in units and dollars using each of the following approaches:

- Equation method.
- Contribution margin per unit.

CHECK FIGURE

- 13,750 units

- c. Contribution margin ratio.
- d. Confirm your results by preparing a contribution margin income statement for the break-even sales volume.

Problem 3-18A *Determining the break-even point and preparing a break-even graph***LO 1, 2, 3, 7**

Whitaker Company is considering the production of a new product. The expected variable cost is \$48.75 per unit. Annual fixed costs are expected to be \$650,000. The anticipated sales price is \$65 each.

CHECK FIGURE

a. \$2,600,000

Required

Determine the break-even point in units and dollars using each of the following:

- a. Equation method.
- b. Contribution margin per unit approach.
- c. Contribution margin ratio approach.
- d. Prepare a break-even graph to illustrate the cost-volume-profit relationships.

Problem 3-19A *Effect of converting variable to fixed costs***LO 2, 4, 6**

Yule Manufacturing Company reported the following data regarding a product it manufactures and sells. The sales price is \$42.

CHECK FIGURE

b. 19,000 units

Variable costs	
Manufacturing	\$18 per unit
Selling	6 per unit
Fixed costs	
Manufacturing	\$150,000 per year
Selling and administrative	66,000 per year

Required

- a. Use the per-unit contribution margin approach to determine the break-even point in units and dollars.
- b. Use the per-unit contribution margin approach to determine the level of sales in units and dollars required to obtain a profit of \$126,000.
- c. Suppose that variable selling costs could be eliminated by employing a salaried sales force. If the company could sell 20,000 units, how much could it pay in salaries for salespeople and still have a profit of \$126,000? (*Hint*: Use the equation method.)

Problem 3-20A *Analyzing change in sales price using the contribution margin ratio***LO 3, 6**

Hugh Company reported the following data regarding the product it sells:

CHECK FIGURE

c. 9,000 units

Sales price	\$40
Contribution margin ratio	15%
Fixed costs	\$144,000

Required

Use the contribution margin ratio approach and consider each requirement separately.

- a. What is the break-even point in dollars? In units?
- b. To obtain a profit of \$36,000, what must the sales be in dollars? In units?
- c. If the sales price increases to \$50 and variable costs do not change, what is the new break-even point in dollars? In units?

LO 1, 6



Problem 3-21A Analyzing sales price and fixed cost using the equation method

Tainan Company is considering adding a new product. The cost accountant has provided the following data.

Expected variable cost of manufacturing	\$47 per unit
Expected annual fixed manufacturing costs	\$78,000

The administrative vice president has provided the following estimates.

Expected sales commission	\$3 per unit
Expected annual fixed administrative costs	\$42,000

The manager has decided that any new product must at least break even in the first year.

Required

Use the equation method and consider each requirement separately.

- If the sales price is set at \$65, how many units must Tainan sell to break even?
- Tainan estimates that sales will probably be 10,000 units. What sales price per unit will allow the company to break even?
- Tainan has decided to advertise the product heavily and has set the sales price at \$66. If sales are 9,000 units, how much can the company spend on advertising and still break even?

LO 8



Problem 3-22A Margin of safety and operating leverage

Santiago Company is considering the addition of a new product to its cosmetics line. The company has three distinctly different options: a skin cream, a bath oil, or a hair coloring gel. Relevant information and budgeted annual income statements for each of the products follow.

CHECK FIGURES

- b. NI:
- | | |
|------------|----------|
| Skin Cream | \$60,000 |
| Bath Oil | \$60,000 |
| Color Gel | \$40,000 |

	Relevant Information		
	Skin Cream	Bath Oil	Color Gel
Budgeted sales in units (a)	50,000	90,000	30,000
Expected sales price (b)	\$7.00	\$4.00	\$13.00
Variable costs per unit (c)	\$4.00	\$1.50	\$9.00
Income statements			
Sales revenue (a × b)	\$350,000	\$360,000	\$390,000
Variable costs (a × c)	(200,000)	(135,000)	(270,000)
Contribution margin	150,000	225,000	120,000
Fixed costs	(120,000)	(210,000)	(104,000)
Net income	<u>\$ 30,000</u>	<u>\$ 15,000</u>	<u>\$ 16,000</u>

Required

- Determine the margin of safety as a percentage for each product.
- Prepare revised income statements for each product, assuming a 20 percent increase in the budgeted sales volume.
- For each product, determine the percentage change in net income that results from the 20 percent increase in sales. Which product has the highest operating leverage?
- Assuming that management is pessimistic and risk averse, which product should the company add to its cosmetic line? Explain your answer.
- Assuming that management is optimistic and risk aggressive, which product should the company add to its cosmetics line? Explain your answer.

LO 2, 4, 6, 7, 8

Problem 3-23A Comprehensive CVP analysis

Borysko Company makes and sells products with variable costs of \$47 each. Borysko incurs annual fixed costs of \$22,400. The current sales price is \$63.

Required

The following requirements are interdependent. For example, the \$4,800 desired profit introduced in Requirement *c* also applies to subsequent requirements. Likewise, the \$55 sales price introduced in Requirement *d* applies to the subsequent requirements.

- Determine the contribution margin per unit.
- Determine the break-even point in units and in dollars. Confirm your answer by preparing an income statement using the contribution margin format.
- Suppose that Borysko desires to earn a \$4,800 profit. Determine the sales volume in units and dollars required to earn the desired profit. Confirm your answer by preparing an income statement using the contribution margin format.
- If the sales price drops to \$55 per unit, what level of sales is required to earn the desired profit? Express your answer in units and dollars. Confirm your answer by preparing an income statement using the contribution margin format.
- If fixed costs drop to \$16,800, what level of sales is required to earn the desired profit? Express your answer in units and dollars. Confirm your answer by preparing an income statement using the contribution margin format.
- If variable cost drops to \$39 per unit, what level of sales is required to earn the desired profit? Express your answer in units and dollars. Confirm your answer by preparing an income statement using the contribution margin format.
- Assume that Borysko concludes that it can sell 1,350 units of product for \$55 each. Recall that variable costs are \$39 each and fixed costs are \$16,800. Compute the margin of safety in units and dollars and as a percentage.
- Draw a break-even graph using the cost and price assumptions described in Requirement *g*.

CHECK FIGURES

- 1,400 units
- 1,700 units
- 2,700 units

Problem 3-24A *Assessing simultaneous changes in CVP relationships*

LO 6, 7, 8, 9

Braun Corporation sells hammocks; variable costs are \$75 each, and the hammocks are sold for \$125 each. Braun incurs \$240,000 of fixed operating expenses annually.

CHECK FIGURES

- \$750,000
- 6,250 units

Required

- Determine the sales volume in units and dollars required to attain a \$60,000 profit. Verify your answer by preparing an income statement using the contribution margin format.
- Braun is considering implementing a quality improvement program. The program will require a \$10 increase in the variable cost per unit. To inform its customers of the quality improvements, the company plans to spend an additional \$10,000 for advertising. Assuming that the improvement program will increase sales to a level that is 4,000 units above the amount computed in Requirement *a*, should Braun proceed with plans to improve product quality? Support your answer by preparing a budgeted income statement.
- Determine the new break-even point in units and sales dollars as well as the margin of safety percentage, assuming that the quality improvement program is implemented.
- Prepare a break-even graph using the cost and price assumptions outlined in Requirement *c*.

Problem 3-25A *Determining the break-even point and margin of safety for a company with multiple products*

LO 10



Tottori Company produces two products. Budgeted annual income statements for the two products are provided here:

	Power			Lite			Total	
	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Budgeted Amount
Sales	160	@ \$500	= \$80,000	640	@ \$450	= \$288,000	800	\$368,000
Variable cost	160	@ 320	= (51,200)	640	@ 330	= (211,200)	800	(262,400)
Contribution margin	160	@ 180	= 28,800	640	@ 120	= 76,800	800	105,600
Fixed cost			(12,000)			(54,000)		(66,000)
Net income			<u>\$16,800</u>			<u>\$ 22,800</u>		<u>\$ 39,600</u>

CHECK FIGURES

- d. Power: 100 units
Lite: 400 units

Required

- Based on budgeted sales, determine the relative sales mix between the two products.
- Determine the weighted-average contribution margin per unit.
- Calculate the break-even point in total number of units.
- Determine the number of units of each product Tottori must sell to break even.
- Verify the break-even point by preparing an income statement for each product as well as an income statement for the combined products.
- Determine the margin of safety based on the combined sales of the two products.

EXERCISES—SERIES B

LO 1

Exercise 3-1B *Equation method*

Jade Corporation manufactures products that it sells for \$57 each. Variable costs are \$32 per unit, and annual fixed costs are \$750,000. Jade desires to earn a profit of \$200,000.

Required

- Use the equation method to determine the break-even point in units and dollars.
- Determine the sales volume in units and dollars required to earn the desired profit.

LO 2

Exercise 3-2B *Per-unit contribution margin approach*

Kemeth Corporation manufactures products that have variable costs of \$43 per unit. Its fixed cost amounts to \$84,000. It sells the products for \$78 each.

Required

Use the per-unit contribution margin approach to determine the break-even point in units and dollars.

LO 3

Exercise 3-3B *Contribution margin ratio*

Lambert Company incurs annual fixed costs of \$960,000. Variable costs for Lambert's product are \$36 per-unit, and the sales price is \$60 per unit. Lambert desires to earn a profit of \$240,000.

Required

Use the contribution margin ratio approach to determine the sales volume in dollars and units required to earn the desired profit.

LO 4, 6

Exercise 3-4B *Cost structure, risk, and the break-even point*

Wava Company manufactures a product that sells for \$125 per unit. It incurs fixed costs of \$198,000. Variable cost for its product is \$81 per unit.

Required

- Determine the sales volume in units and dollars required to earn the desired profit.
- Calculate the break-even point assuming fixed costs increase to \$308,000.
- Explain how a fixed cost structure affects risk and the break-even point.

LO 5

Exercise 3-5B *Prestige pricing*

Weng Company is considering the production and sale of a new product with fixed costs of \$35,000 and variable cost of \$4 per unit. Based on its normal profit margins, Weng desires to earn a \$40,000 profit and believes it can sell 5,000 units of the product.

Required

- Based on this information determine the target sales price.
- Explain how prestige pricing could be used to increase profitability.

Exercise 3-6B *Determining variable cost from incomplete data***LO 6**

Sohail Corporation produced 80,000 tires and sold them for \$100 each during 2011. The company determined that fixed manufacturing cost per unit was \$25 per tire. The company reported gross profit of \$1,440,000 on its 2011 financial statements.

Required

Determine the variable cost per unit, the total variable cost, and the total contribution margin.

Exercise 3-7B *Contribution margin per unit approach for break-even and desired profit***LO 2, 4**

Information concerning a product produced by Agar Company appears here:

Sales price per unit	\$420
Variable cost per unit	\$270
Total fixed manufacturing and operating costs	\$750,000

Required

Determine the following:

- Contribution margin per unit.
- Number of units Agar must sell to break even.
- Sales level in units that Agar must reach in order to earn a profit of \$150,000.

Exercise 3-8B *Changing sales price***LO 6**

Mendez Company manufactures a product that has a variable cost of \$30 per unit. The company's fixed costs total \$750,000. Mendez had net income of \$90,000 in the previous year. Its product sells for \$50 per unit. In an effort to increase the company's market share, management is considering lowering the product's selling price to \$46 per unit.

Required

If Mendez desires to maintain net income of \$90,000, how many additional units must it sell in order to justify the price decline?

Exercise 3-9B *Simultaneous change in sales price and desired profit***LO 4, 6**

Use the cost data presented in Exercise 3-8B but assume that in addition to increasing its market share by lowering its selling price to \$46, Mendez desires to increase its net income by \$42,000.

Required

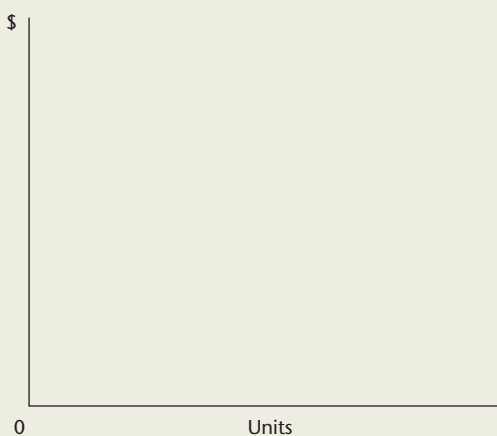
Determine the number of units that Mendez must sell to earn the desired income.

Exercise 3-10B *Components of break-even graph***LO 1, 7**

Jimmy, a 10-year-old boy, wants to sell lemonade on a hot summer day. He hopes to make enough money to buy a new iPod. Sam, his elder brother, tries to help him compute his prospect of doing so. The following is the relevant information:

Variable costs	
Lemonade	\$0.30 per cup
Paper cups	\$0.10 per cup
Fixed costs	
Table and chair	\$36.00
Price	\$1.00 per cup

The following graph depicts the dollar amount of cost or revenue on the vertical axis and the number of lemonade cups sold on the horizontal axis.

**Required**

- Draw a line that depicts the total cost.
- Draw a line that depicts the total revenue.
- Identify the break-even point.
- Identify the area representing profit.
- Identify the area representing loss.

LO 6**Exercise 3-11B** *Evaluating simultaneous changes in fixed and variable costs*

Kasmira Company currently produces and sells 10,000 units of a telephone per year that has a variable cost of \$13 per unit and a fixed cost of \$380,000. The company currently earns a \$120,000 annual profit. Assume that Kasmira has the opportunity to invest in a new machine that will enable the company to reduce variable costs to \$10 per unit. The investment would cause fixed costs to increase by \$15,000.

Required

- Use the equation method to determine the sales price per unit under existing conditions (current machine is used).
- Prepare a contribution margin income statement assuming Kasmira invests in the new technology. Recommend whether Kasmira should invest in the new technology.

LO 8**Exercise 3-12B** *Margin of safety*

Conway Company manufactures scanners that sell for \$250 each. The company pays \$130 per unit for the variable costs of the product and incurs fixed costs of \$3,600,000. Conway expects to sell 54,000 scanners.

Required

Determine Conway's margin of safety expressed as a percentage.

LO 1, 2, 4, 6**Exercise 3-13B** *Cost-volume-profit relationship*

Dalton Corporation manufactures faucets. The variable costs of production are \$27 per faucet. Fixed costs of production are \$600,000. Dalton sells the faucets for a price of \$52 per unit.

Required

- How many faucets must Dalton make and sell to break even?
- How many faucets must Dalton make and sell to earn a \$180,000 profit?
- The marketing manager believes that sales would increase dramatically if the price were reduced to \$47 per unit. How many faucets must Dalton make and sell to earn a \$180,000 profit, assuming the sales price is set at \$47 per unit?

LO 6**Exercise 3-14B** *Complexities of CVP analysis in multinational companies*

Castillo Wood Products (CWP) manufactures disposable chopsticks for the restaurant industry at its highly automated production facility in China. The main raw material used to produce the chopsticks is wood that is purchased in bulk from suppliers in the United States. In September

2007, the company signed a contract to buy wood from a U.S. supplier for the coming two years. The contract calls for CWP to pay the supplier in dollars, although all other costs CWP incurs are paid for in Chinese Renminbi (¥). A summary of the production costs for a box of 1,000 sets of chopsticks, based on the expected production level, follows:

Variable costs:	
Wood	¥6,000*
All other variable costs	600
Fixed costs:	5,400
*Based on the exchange rate at the time the contract with the U.S. supplier was signed. The cost of wood in dollars was \$50 as of January 2007.	

The exchange rate between the yen and the dollar was ¥100 = \$13.24 in September 2007 when the contract was signed. By September 2009, the exchange rate had changed to ¥100 = \$14.65. (Exchange rates are rounded to the nearest cent.)

Required

- CVP analysis is based on several assumptions. Explain which of these assumptions would be violated as a result of CWP having to pay for one of its raw materials in dollars while its other costs and revenues are priced in yen.
- What effect, if any, would the change in the exchange rate have on CWP's variable cost per unit for September 2007 versus September 2009?
- What effect, if any, would the change in the exchange rate have on CWP's contribution margin per unit for September 2007 versus September 2009?
- What effect, if any, would the change in the exchange rate have on CWP's fixed cost per unit for September 2007 versus September 2009?

Exercise 3-15B Target costing

LO 5

After substantial marketing research, Ewing Corporation management believes that it can make and sell a new battery with a prolonged life for laptop computers. Management expects the market demand for its new battery to be 12,000 units per year if the battery is priced at \$90 per unit. A team of engineers and accountants determines that the fixed costs of producing 8,000 units to 16,000 units is \$480,000.

Required

Assume that Ewing desires to earn a \$240,000 profit from the battery sales. How much can it afford to spend on the variable cost per unit if production and sales equal 12,000 batteries?

Exercise 3-16B Multiple product break-even analysis

LO 10

Harvey Company makes two products. The budgeted per-unit contribution margin for each product follows:

	Deluxe	Luxury
Sales price	\$48	\$75
Variable cost per unit	<u>33</u>	<u>40</u>
Contribution margin per unit	<u>\$15</u>	<u>\$35</u>

Harvey expects to incur fixed costs of \$115,000. The relative sales mix of the products is 60 percent for Deluxe and 40 percent for Luxury.

Required

- Determine the total number of products (units of Deluxe and Luxury combined) Harvey must sell to break even.
- How many units each of Deluxe and Luxury must Harvey sell to break even?

PROBLEMS—SERIES B**LO 1, 2, 3****Problem 3-17B** *Determining the break-even point and preparing a contribution margin income statement*

Nickolas Company manufactures radio and cassette players and sells them for \$100 each. According to the company's records, the variable costs, including direct labor and direct materials, are \$50. Factory depreciation and other fixed manufacturing costs are \$192,000 per year. Nickolas pays its salespeople a commission of \$18 per unit. Annual fixed selling and administrative costs are \$128,000.

Required

Determine the break-even point in units and dollars, using each of the following:

- Equation method.
- Contribution margin per unit approach.
- Contribution margin ratio approach.
- Confirm your results by preparing a contribution margin income statement for the break-even point sales volume.

LO 1, 2, 3, 7**Problem 3-18B** *Determining the break-even point and preparing a break-even graph*

Executive officers of Vaclar Company are assessing the profitability of a potential new product. They expect that the variable cost of making the product will be \$54 per unit and fixed manufacturing cost will be \$720,000. The executive officers plan to sell the product for \$72 per unit.

Required

Determine the break-even point in units and dollars using each of the following approaches:

- Contribution margin per unit.
- Equation method.
- Contribution margin ratio.
- Prepare a break-even graph to illustrate the cost-volume-profit relationships.

LO 2, 3, 4, 6**Problem 3-19B** *Effect of converting variable to fixed costs*

Souta Company manufactures and sells its own brand of digital cameras. It sells each camera for \$32. The company's accountant prepared the following data:

Manufacturing costs	
Variable	\$15 per unit
Fixed	\$150,000 per year
Selling and administrative expenses	
Variable	\$9 per unit
Fixed	\$50,000 per year

Required

- Use the per-unit contribution margin approach to determine the break-even point in units and dollars.
- Use the per-unit contribution margin approach to determine the level of sales in units and dollars required to obtain a \$60,000 profit.
- Suppose that variable selling and administrative costs could be eliminated by employing a salaried sales force. If the company could sell 32,000 units, how much could it pay in salaries for the salespeople and still have a profit of \$60,000? (*Hint*: Use the equation method.)

Problem 3-20B *Analyzing change in sales price using the contribution margin ratio***LO 3, 6**

Kaito Company reported the following data regarding the one product it sells:

Sales price	\$16
Contribution margin ratio	20%
Fixed costs	\$360,000 per year

Required

Use the contribution margin ratio approach and consider each requirement separately.

- What is the break-even point in dollars? In units?
- To obtain a \$80,000 profit, what must the sales be in dollars? In units?
- If the sales price increases to \$20 and variable costs do not change, what is the new break-even point in units? In dollars?

Problem 3-21B *Analyzing sales price and fixed cost using the equation method***LO 1, 6**

Salazar Company is analyzing whether its new product will be profitable. The following data are provided for analysis:

Expected variable cost of manufacturing	\$30 per unit
Expected fixed manufacturing costs	\$48,000 per year
Expected sales commission	\$6 per unit
Expected fixed administrative costs	\$12,000 per year

The company has decided that any new product must at least break even in the first year.

Required

Use the equation method and consider each requirement separately.

- If the sales price is set at \$48, how many units must Salazar sell to break even?
- Salazar estimates that sales will probably be 6,000 units. What sales price per unit will allow the company to break even?
- Salazar has decided to advertise the product heavily and has set the sales price at \$54. If sales are 9,000 units, how much can the company spend on advertising and still break even?

Problem 3-22B *Margin of safety and operating leverage***LO 8**

Meier Company has three distinctly different options available as it considers adding a new product to its automotive division: engine oil, coolant, or windshield washer. Relevant information and budgeted annual income statements for each product follow:



	Relevant Information		
	Engine Oil	Coolant	Windshield Washer
Budgeted sales in units (a)	20,000	30,000	125,000
Expected sales price (b)	\$2.40	\$2.85	\$1.15
Variable costs per unit (c)	\$1.00	\$1.25	\$0.35
	Income Statements		
Sales revenue (a × b)	\$48,000	\$85,500	\$143,750
Variable costs (a × c)	(20,000)	(37,500)	(43,750)
Contribution margin	28,000	48,000	100,000
Fixed costs	(21,000)	(32,000)	(50,000)
Net income	<u>\$ 7,000</u>	<u>\$16,000</u>	<u>\$ 50,000</u>

Required

- Determine the margin of safety as a percentage for each product.
- Prepare revised income statements for each product, assuming 20 percent growth in the budgeted sales volume.
- For each product, determine the percentage change in net income that results from the 20 percent increase in sales. Which product has the highest operating leverage?
- Assuming that management is pessimistic and risk averse, which product should the company add? Explain your answer.
- Assuming that management is optimistic and risk aggressive, which product should the company add? Explain your answer.

LO 2, 4, 6, 7, 8**Problem 3-23B** *Comprehensive CVP analysis*

Dunlop Company makes a product that it sells for \$200. Dunlop incurs annual fixed costs of \$250,000 and variable costs of \$160 per unit.

Required

The following requirements are interdependent. For example, the \$50,000 desired profit introduced in Requirement *c* also applies to subsequent requirements. Likewise, the \$180 sales price introduced in Requirement *d* applies to the subsequent requirements.

- Determine the contribution margin per unit.
- Determine the break-even point in units and in dollars. Confirm your answer by preparing an income statement using the contribution margin format.
- Suppose that Dunlop desires to earn a \$50,000 profit. Determine the sales volume in units and dollars required to earn the desired profit. Confirm your answer by preparing an income statement using the contribution margin format.
- If the sales price drops to \$180 per unit, what level of sales is required to earn the desired profit? Express your answer in units and dollars. Confirm your answer by preparing an income statement using the contribution margin format.
- If fixed costs drop to \$200,000, what level of sales is required to earn the desired profit? Express your answer in units and dollars. Confirm your answer by preparing an income statement using the contribution margin format.
- If variable costs drop to \$130 per unit, what level of sales is required to earn the desired profit? Express your answer in units and dollars. Confirm your answer by preparing an income statement using the contribution margin format.
- Assume that Dunlop concludes that it can sell 5,000 units of product for \$180 each. Recall that variable costs are \$130 each and fixed costs are \$200,000. Compute the margin of safety in units and dollars and as a percentage.
- Draw a break-even graph using the cost and price assumptions described in Requirement *g*.

LO 6, 7, 8, 9**Problem 3-24B** *Assessing simultaneous changes in CVP relationships*

Haas Company sells tennis racquets; variable costs for each are \$45, and each is sold for \$135. Haas incurs \$540,000 of fixed operating expenses annually.

Required

- Determine the sales volume in units and dollars required to attain a \$270,000 profit. Verify your answer by preparing an income statement using the contribution margin format.
- Haas is considering establishing a quality improvement program that will require a \$15 increase in the variable cost per unit. To inform its customers of the quality improvements, the company plans to spend an additional \$150,000 for advertising. Assuming that the improvement program will increase sales to a level that is 5,000 units above the amount computed in Requirement *a*, should Haas proceed with plans to improve product quality? Support your answer by preparing a budgeted income statement.
- Determine the new break-even point and the margin of safety percentage, assuming Haas adopts the quality improvement program.
- Prepare a break-even graph using the cost and price assumptions outlined in Requirement *c*.

Problem 3-25B *Determining the break-even point and margin of safety for a company with multiple products***LO 10**

Executive officers of Pena Company have prepared the annual budgets for its two products, Washer and Dryer, as follows.

	Washer			Dryer			Total	
	Budgeted Quantity	Per Unit	Budgeted Amount	Budgeted Quantity	Per Unit	Budgeted Amount	Budgeted Quantity	Budgeted Amount
Sales	400	@ \$540 =	\$216,000	1,200	@ \$300 =	\$360,000	1,600	\$576,000
Variable cost	400	@ 300 =	(120,000)	1,200	@ 180 =	(216,000)	1,600	(336,000)
Contribution margin	400	@ 240 =	96,000	1,200	@ 120 =	144,000	1,600	240,000
Fixed costs			(34,000)			(44,000)		(78,000)
Net income			<u>\$ 62,000</u>			<u>\$100,000</u>		<u>\$162,000</u>

Required

- Based on the number of units budgeted to be sold, determine the relative sales mix between the two products.
- Determine the weighted-average contribution margin per unit.
- Calculate the break-even point in total number of units.
- Determine the number of units of each product Pena must sell to break even.
- Verify the break-even point by preparing an income statement for each product as well as an income statement for the combined products.
- Determine the margin of safety based on the combined sales of the two products.

ANALYZE, THINK, COMMUNICATE**ATC 3-1 Business Applications** *Cost-volume-profit behavior at Apple Inc.*

In July 2009, **Apple Inc.** announced that its revenues for the third quarter of its 2009 fiscal year rose 11.7 percent, causing its earnings to increase by 14.6 percent compared with the third quarter of 2008. Sales for this period were \$8.34 billion.

In July 2007, the company had announced that a 24 percent increase in revenue had produced a 73 percent increase in earnings, compared to the same quarter of the previous year. Sales for the second quarter of 2007 were \$5.41 billion.

**Required**

- What concept explains how Apple's net income could rise by 14.6 percent when its revenue rose only 11.7 percent?
- Does the concept identified in Requirement *a* result from fixed costs or variable costs?
- Notice that in the third quarter of 2007, Apple's percentage increase in earnings was over three times the percentage increase in revenue ($73 \div 24 = 3.04$). In the third quarter of 2009, however, Apple's percentage increase in earnings was only about 1.25 times its increase in revenue ($14.6 \div 11.7 = 1.25$). Explain why the ratio of increase in earnings to increase in revenue was lower in 2009 than in 2007. Assume Apple's general pricing policies and cost structure did not change.

ATC 3-2 Group Assignment *Effect of changes in fixed and variable cost on profitability*

In a month when it sold 200 units of product, Queen Manufacturing Company (QMC) produced the following internal income statement:



Revenue	\$8,000
Variable costs	(4,800)
Contribution margin	3,200
Fixed costs	(2,400)
Net income	<u>\$ 800</u>

QMC has the opportunity to alter its operations in one of the following ways:

1. Increasing fixed advertising costs by \$1,600, thereby increasing sales by 120 units.
2. Lowering commissions paid to the sales staff by \$8 per unit, thereby reducing sales by 10 units.
3. Decreasing fixed inventory holding cost by \$800, thereby decreasing sales by 20 units.

Required

- a. The instructor will divide the class into groups and then organize the groups into two sections. For a large class (12 or more groups), four sections may be necessary. At least three groups in each section are needed. Having more groups in one section than another section is acceptable because offsetting advantages and disadvantages exist. Having more groups is advantageous because more people will work on the task but is disadvantageous because having more people complicates communication.

Group Task

The sections are to compete with each other to see which section can identify the most profitable alternative in the shortest period of time. No instruction is provided regarding how the sections are to proceed with the task. In other words, each section is required to organize itself with respect to how to accomplish the task of selecting the best alternative. A total quality management (TQM) constraint is imposed that requires zero defects. A section that turns in a wrong answer is disqualified. Once an answer has been submitted to the instructor, it cannot be changed. Sections continue to turn in answers until all sections have submitted a response. The first section to submit the correct answer wins the competition.

- b. If any section submits a wrong answer, the instructor or a spokesperson from the winning group should explain how the right answer was determined.
- c. Discuss the dynamics of group interaction. How was the work organized? How was leadership established?

ATC 3-3 Research Assignment *Using real world data from Southwest Airlines*



Use the 2008 Form 10-K for [Southwest Airlines](http://www.southwest.com) to complete the requirements below. To obtain the Form 10-K you can use either the EDGAR system following the instructions in Appendix A, or it can be found under “Investor Relations” which is under the “About Southwest” link on the company’s corporate website, www.southwest.com. The company includes its Form 10-K as a part of its 2008 Annual Report. Be sure to read carefully the “Item 6. Selected Financial Data” section of the document.

Required

- a. “Item 6. Selected Financial Data,” list data for several measures of activity. List the items from this table that might be used by Southwest as an activity base for CVP analysis.
- b. Of the activity bases that you identified for Requirement *a*, which do you think would work best for performing CVP at Southwest? Explain the rationale for your choice.
- c. Use the “Operating expense” and the “Revenue passenger miles” data from Item 6, to compute the variable cost and fixed cost components of operating expense using the high-low method presented in Chapter 2. *Warning:* the results you get will not seem reasonable, but perform the calculations and report your results.
- d. Try to explain the peculiar results you obtained for Requirement *c*. This will require careful thought, and you may wish to review the *Cost-Volume-Profit Limitations* section of this chapter.
- e. “Item 6.” reports that in 2008 Southwest’s “Load factor” was 71.2%. If this load factor could have been increased by 10% to 78.3%, do you think the company’s net earnings would have increased by less than 10%, 10%, or more than 10%? Explain.

ATC 3-4 Writing Assignment *Operating leverage, margin of safety, and cost behavior*

In the early years of the 21st century the housing market in the United States was booming. Housing prices were increasing rapidly, new houses were being constructed at a record pace, and companies doing business in the construction and home improvement industry were enjoying rising profits. In 2006 the real estate market had slowed considerably, and the slump continued through 2007.

Home Depot was one major company in the building supplies industry that was adversely affected by the slowdown in the housing market. On August 14, 2007, it announced that its revenues for the first half of the year were 3 percent lower than revenues were for the first six months of 2006. Of even greater concern was the fact that its earnings for the first half of 2007 were 21 percent lower than for the same period in the prior year.

**Required**

Write a memorandum that explains how a 3 percent decline in sales could cause a 21 percent decline in profits. Your memo should address the following:

- An identification of the accounting concept involved.
- A discussion of how various major types of costs incurred by Home Depot were likely affected by the decline in its sales.
- The effect of the decline in sales on Home Depot's margin of safety.

ATC 3-5 Ethical Dilemma *Opportunity to manipulate earnings*

Sherwin-Williams and **PPG Industries** are both companies that produce wall coverings, such as paint, among other products. Although they use similar assets to conduct their businesses, the estimated lives they use to depreciate those assets vary, as shown in the following table:



Asset Category	Estimated Useful Lives	
	PPG Industries	Sherwin-Williams
Buildings	20–40 years	5–40 years
Machinery and equipment	5–25	5–20
Other	3–20	3–10

Managers have significant flexibility in setting the estimated useful lives of depreciable assets, and as the table shows, PPG Industries uses longer estimated lives for its assets than does Sherwin-Williams.

Required

- How does using a longer estimated life for a depreciable asset potentially affect its earnings?
- Would using a longer estimated life for a depreciable asset be more likely to affect a company's fixed or variable costs?
- In the past, some companies, not PPG, have been accused of deliberately overestimating the useful lives of their companies' depreciable assets. Speculate as to what would cause them to do this.
- Review the standards of ethical conduct shown in Exhibit 1.15 of Chapter 1 and comment on which, if any, of the ethical standards are violated by deliberately overestimating the useful lives of depreciable assets.
- Comment on the provisions of the Sarbanes-Oxley Act that are designed to prevent a company's executives from deliberately overestimating the useful lives of depreciable assets.

ATC 3-6 Spreadsheet Assignment *Using Excel*

Bishop Company has provided the estimated data that appear in rows 4 to 8 of the following spreadsheet:

The screenshot shows a Microsoft Excel spreadsheet with the following data:

Bishop Company Forecast for December, 2010	
Selling price per unit	\$ 18.00
Variable costs per unit	\$ 12.00
Fixed costs	\$ 60,000
Units sold	20,000

Bishop Company Income Statement For the month of December, 2010	
Sales	\$ 360,000
Variable costs	240,000
Contribution margin	120,000
Fixed costs	60,000
Net income	\$ 60,000

Break even in units	10,000
Operating leverage	2.00

Required

Construct a spreadsheet as follows that would allow you to determine net income, break-even in units, and operating leverage for the estimates at the top of the spreadsheet, and to see the effects of changes to the estimates. Set up this spreadsheet so that any change in the estimates will automatically be reflected in the calculation of net income, break-even, and operating leverage.

Spreadsheet Tip

To center a heading across several columns, such as the Income Statement title, highlight the area to be centered (Columns B, C, and D), choose **Format**, then choose **Cells**, and click on the tab titled **Alignment**. Near the bottom of the alignment window, place a check mark in the box titled **Merge cells**. The shortcut method to merge cells is to click on the icon near the middle of the top icons that contains an *a* in a box.

ATC 3-7 Spreadsheet Assignment *Mastering Excel***Required**

Build the spreadsheet pictured in Exhibit 3.3. Be sure to use formulas that will automatically calculate profitability if fixed cost, variable cost, or sales volume is changed.

Spreadsheet Tip

1. The shading in column D and in row 6 can be inserted by first highlighting a section to be shaded, choosing **Format** from the main menu, then **Cells**, and then clicking on the tab titled **Patterns**, and then choosing a color for the shading. The shortcut method to accomplish the shading is to click on the fill color icon (it looks like a tipped bucket and is in the upper right area of the screen).

Selling Price = \$ 28.00			And Sales Volume is				
If Fixed Cost is	While Variable Cost is		2,000	3,000	4,000	5,000	6,000
			Then Profitability Will Be				
\$ 20,000	11		\$14,000	\$31,000	\$48,000	\$65,000	\$82,000
20,000	12		12,000	28,000	44,000	60,000	76,000
20,000	13		10,000	25,000	40,000	55,000	70,000
30,000	11		4,000	21,000	38,000	55,000	72,000
30,000	12		2,000	18,000	34,000	50,000	66,000
30,000	13		-	15,000	30,000	45,000	60,000
40,000	11		(6,000)	11,000	28,000	45,000	62,000
40,000	12		(8,000)	8,000	24,000	40,000	56,000
40,000	13		(10,000)	5,000	20,000	35,000	50,000

- Similar to basic math rules, the order of calculation within a formula is multiplication and division before addition and subtraction. Therefore, if you wish to subtract variable cost from selling price and multiply the difference by units sold, the formula must be $= (28 - C8)*E5$.
- The quickest way to get the correct formulas in the area of E8 to I16 is to place the proper formula in cell E8 and then copy this formula to the entire block of E8:I16. However, the formulas must use the \$ around the cell addresses to lock either the row or the column, or both. For example, the formula $= 2*$B8 can be copied to any other cell and the cell reference will remain B8 because the \$ symbol locks the row and column. Likewise, \$B8 indicates that only the column is locked, and B\$8 indicates that only the row is locked.

COMPREHENSIVE PROBLEM

Use the same transaction data for Magnificent Modems, Inc., as was used in Chapter 1. (See page 52.)

Required

- Use the following partially completed form to prepare an income statement using the contribution margin format.

Sales revenue	\$600,000
Variable costs:	
Contribution margin	225,000
Fixed costs	
Net income	\$31,050

- Determine the break-even point in units and in dollars.
- Assume that next year's sales are budgeted to be the same as the current year's sales. Determine the margin of safety expressed as a percentage.