

Analysis of Cost, Volume, and Pricing to Increase Profitability

Learning Objectives

After completing this chapter, you should be able to:

- 1** Determine the sales price of a product using a cost-plus-pricing approach.
- 2** Use the contribution-per-unit approach to calculate the break-even point.
- 3** Use the contribution-per-unit approach to calculate the sales volume required to attain a target profit.
- 4** Use the contribution-per-unit approach to assess the effects of changes in sales price, variable costs, and fixed costs.
- 5** Understand the concept of target pricing.
- 6** Consider the ethical considerations associated with misleading advertising.
- 7** Draw and interpret a cost-volume-profit graph.
- 8** Calculate the margin of safety in units, dollars, and percentages.
- 9** Understand how spreadsheet software can be used to conduct sensitivity analysis for cost-volume-profit relationships.
- 10** Conduct cost-volume-profit analysis using the contribution margin ratio and the equation method.
- 11** Identify the limitations associated with cost-volume-profit analysis.
- 12** Perform multiple-product break-even analysis.

the *curious* manager



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Barbara Malki, owner of Cahaba Cycles, is considering the possibility of establishing a racing team to promote her stores. She plans to sponsor two riders, each of whom will be given a \$1,200 bicycle, \$200 of decorative clothing, and a \$100 racing helmet. In addition, Ms. Malki plans to pay each rider \$2,000 to cover the costs of travel and race entry fees. Finally, she plans to spend \$5,000 for banners, water bottles, and other promotional items that will be displayed and distributed at races. The average price and costs of bicycles sold at Cahaba Cycles are \$900 and \$600, respectively. In trying to decide whether she should establish the team, Ms. Malki needs to know how many bicycles her company must sell to cover the costs of the promotional program. Can you provide the information she needs?

Suppose that Ms. Malki finds a bike manufacturer who agrees to co-sponsor the bike team by providing free bicycles to the team members. The manufacturer's advertising decals will be displayed on the bikes, and Cahaba's decals will be displayed on the clothing. All other costs remain constant. Under these circumstances, how many bicycles must Cahaba sell to recover the cost of co-sponsoring the team?

The president of Bright Day Distributors recently took a managerial accounting course. He was fascinated 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, cutting prices often causes increases in sales volume. Costs as well as sales frequently change. For example, increases in

*the advertising budget often result in increases in sales volume. Further, higher levels of sales can exceed the relevant range, thereby leading to increases in the fixed costs, such as the inventory holding costs incurred for warehouse space, personnel, and interest. Indeed, Bright Day's president discovered that increases in sales volume may even affect the company's variable costs. By increasing the size of its inventory purchases, the company could attain volume discounts that would lower its variable cost per unit. Bright Day's president quickly realized that operating leverage represented only one aspect of the business environment. He needed to know more. He needed to understand how changes in prices and costs as well as volume affects profitability. In accounting terms, Bright Day's president is interested in what is commonly called **cost-volume-profit (CVP) analysis**.*

■ Determining the Contribution Margin per Unit

LO1

Determine the sales price of a product using a cost-plus-pricing approach.

The contribution margin approach for constructing an income statement introduced in the previous chapter is an extremely useful mechanism for analyzing the relationships between the CVP (cost-volume-profit) variables. Recall from Chapter 2 that the *contribution margin* is the difference between sales revenue and variable costs. It is a measure of the amount available to cover fixed costs and thereafter to provide profits for the enterprise. To illustrate, consider the following scenario.

Bright Day Distributors is a medium-sized health food sales company. The company distributes non-prescription health food supplements, including vitamins, herbs, and natural hormones, through a tele-marketing program in Central Canada. Bright Day recently obtained the rights to distribute the new herb mixture Delatine. A recent research report found that Delatine slowed the aging process in laboratory animals. The research scientists speculated that the substance would have a similar effect on human subjects. Their hypothesis could not be confirmed because of the relatively long span of the human life cycle. The news media picked up the findings of the research report; as stories appeared on network news, on talk shows, and in magazines, the demand for Delatine increased.

Delatine costs \$24 per bottle. Bright Day uses a **cost-plus-pricing strategy**; it sets prices at cost plus a markup equal to 50 percent of cost. Accordingly, a bottle of Delatine is priced at \$36 per bottle ($\$24 + [.50 \times \$24]$). The **contribution margin per unit** can be computed as follows:

Sales revenue per unit	\$36
Variable cost per unit	24
Contribution margin per unit	<u>\$12</u>

For every bottle of Delatine it sells, Bright Day earns a \$12 contribution margin. Bright Day's first concern is whether it can sell enough units to produce a total contribution margin sufficient to cover fixed costs. If fixed costs were \$120, it would have to sell 10 bottles ($10 \text{ bottles} \times \$12 \text{ per bottle} = \120). The president made the point clear when he said, "We don't want to lose money on this product. We have to sell enough units to pay for our fixed costs." After the fixed costs have been covered, the \$12 contribution margin represents the amount of dollars added to profits each time a bottle of Delatine is sold. The per unit contribution margin can be used to analyze a variety of cost-volume-profit relationships.

Determining the Break-Even Point

Bright Day's management team believes that enthusiasm for the product will diminish rapidly as the attention of the news media shifts to other subjects. The team is concerned about the capacity of the company's telemarketing department to reach large segments of the population rapidly. The company simply has too few sales operators to enable rapid market penetration. Furthermore, time constraints will not permit the company to employ and train additional sales staff. Bright Day needs to reach customers immediately. Accordingly, the managers decided to investigate an immediate television advertising campaign. The company's marketing manager believes that several hundred ads running on various local cable channels would be required to inform customers that they could purchase Delatine through Bright Day. The chief accountant estimates the cost of the proposed campaign to be \$60,000. The company president immediately asks, "How many bottles of Delatine would have to be sold to *break even*?"

The **break-even point** is the point where *total revenue equals total costs*. A company neither earns a profit nor incurs a loss at the break-even point. Net income at breakeven is zero. Bright Day's president wants to know what sales volume (i.e., number of bottles of Delatine sold) would be required to *equate sales revenue with total cost*. The cost of the advertising campaign is fixed relative to the level of sales. The cost remains at \$60,000, regardless of the number of bottles of Delatine that Bright Day sells. Since Bright Day expects to earn a \$12 contribution margin for each bottle it sells, the sales volume required to break even can be calculated by dividing the fixed costs by the contribution margin per unit. The appropriate computations follow:

$$\begin{aligned} \text{Break-even volume in units} &= \frac{\text{Fixed costs}}{\text{Contribution margin per unit}} \\ &= \frac{\$60,000}{\$12} = 5,000 \text{ Units} \end{aligned}$$

The break-even point expressed in *sales dollars* can be determined by multiplying the number of units that must be sold to break even by the sales price per unit. Accordingly, the break-even point expressed in dollars is \$180,000 (5,000 units × \$36). The following income statement confirms these results:

Sales Revenue (5,000 units × \$36)	\$ 180,000
Total Variable Expenses (5,000 units × \$24)	(120,000)
Total Contribution Margin (5,000 units × \$12)	<u>60,000</u>
Fixed Expenses	(60,000)
Net Income	<u>\$ 0</u>

Once fixed costs have been covered (i.e., 5,000 units have been sold), net income will increase by the amount of the *per-unit contribution margin* for each additional unit sold. In other words, every bottle of Delatine sold in excess of the break-even point will add \$12 to net income. Similarly, each lost sale below the break-even point will reduce the company's net income by \$12. Test your comprehension of the effect of the per-unit contribution margin on profitability by studying the following income statements:

	Number of Units Sold (a)				
	4,998	4,999	5,000	5,001	5,002
Sales Revenue (\$36 per unit × a)	\$ 179,928	\$ 179,964	\$ 180,000	\$ 180,036	\$ 180,072
Total Variable Expenses (\$24 per unit × a)	(119,952)	(119,976)	(120,000)	(120,024)	(120,048)
Total Contribution Margin (\$12 per unit × a)	<u>\$ 59,976</u>	<u>\$ 59,988</u>	<u>\$ 60,000</u>	<u>\$ 60,012</u>	<u>\$ 60,024</u>
Fixed Expenses	(60,000)	(60,000)	(60,000)	(60,000)	(60,000)
Net Income	<u>\$ (24)</u>	<u>\$ (12)</u>	<u>\$ 0</u>	<u>\$ 12</u>	<u>\$ 24</u>

LO2

Use the contribution-per-unit approach to calculate the break-even point.

As sales increase from 5,000 to 5,001, net income increases from zero to \$12. When sales increase by one additional unit, net income again rises by \$12 (i.e., moves from \$12 to \$24). Income continues to increase by the \$12 per-unit contribution margin each time an additional unit is sold. This pattern suggests that beyond the break-even point, the effect of an increase in sales on net income can be computed quickly by multiplying the amount of the change times the contribution margin per unit. Suppose sales increase from 5,400 units to 5,600 units. How will this change affect profitability? Profits will increase by \$2,400 $([5,600 - 5,400] \times \$12)$. The following comparative income statements illustrate this result:

	Number of Units Sold (b)		
	5,400	5,600	200 Unit Difference
Sales Revenue (\$36 per unit)	\$ 194,400	\$ 201,600	\$ 7,200
Total Variable Expenses (\$24 per unit)	(129,600)	(134,400)	(4,800)
Total Contribution Margin (\$12 per unit)	64,800	67,200	2,400
Fixed Expenses	(60,000)	(60,000)	0
Net Income	\$ 4,800	\$ 7,200	\$ 2,400

■ Using the Contribution Approach to Estimate the Sales Volume Necessary to Attain a Target Profit

LO3

Use the contribution-per-unit approach to calculate the sales volume required to attain a target profit.

After considering Bright Day's usual return on investment target, its president decides that the campaign should produce a \$40,000 profit. He asks the accountant to determine the sales volume that would be required to achieve this level of profitability. In this case, the contribution margin must be sufficient to cover the fixed cost and to provide the desired profit. The required sales volume expressed in units can be computed by dividing the amount of the fixed costs plus the desired profit by the contribution margin per unit. The appropriate computations are shown here:

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

The required sales volume expressed in sales dollars can be determined by multiplying this number of units by the sales price per unit. Accordingly, the level of required sales expressed in dollars is \$300,000 $(8,333.33 \text{ units} \times \$36)$. The following income statement confirms these results; all amounts are rounded to the nearest whole dollar:

Sales Revenue $(8,333.33 \text{ units} \times \$36)$	\$ 300,000
Total Variable Expenses $(8,333.33 \text{ units} \times \$24)$	(200,000)
Total Contribution Margin $(8,333.33 \text{ units} \times \$12)$	100,000
Fixed Expenses	(60,000)
Net Income	\$ 40,000

In practice, the company does not sell a partial bottle of Delatine. Accordingly, the accountant rounds the 8,333.33 bottles to the nearest whole unit. Recall that we are working with estimated data used for planning and decision making. Accuracy is desirable, but it is not as important as relevance. Accordingly, you should not be concerned when computations do not produce whole numbers. Rounding and approximation are common characteristics of managerial accounting data.

After reviewing the accountant's computations, the president turns to the marketing manager and asks, "What are our chances of reaching a sales volume of 8,333 units?" The manager replies, "Slim to none." Indeed, the marketing manager is concerned about the possibility of reaching the 5,000 unit break-even point. She notes that Bright Day has never had a product that sold more than 4,000 bottles during its initial offering. Also, tests conducted by the telemarketing staff indicated that customers are resistant to a \$36 per bottle price. The test group included many customers who had heard about the product and expressed an interest in buying it, but when they were told the price, they consistently rejected the offer. On the basis of experience with similar products, the marketing manager believes that customers would be willing to pay \$28 per bottle for Delatine. The company president immediately asks how the change in sales price will affect the sales volume required to produce the \$40,000 target profit.

Using the Contribution Approach to Estimate the Effects of Changes in Sales Price

Changing the sales price from \$36 to \$28 will have a significant effect on the contribution margin. Recall that the original contribution margin was \$12 per unit (\$36 – \$24). The contribution margin will drop to a mere \$4 per unit if the sales price is reduced to \$28 per bottle (\$28 sales price – \$24 cost per bottle = \$4 contribution margin per bottle). The significant drop in contribution margin per unit will cause a dramatic increase in the sales volume necessary to attain the target profit. The appropriate computations are shown here:

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

The required sales volume expressed in sales dollars can be determined by multiplying the above number of units by the sales price per unit. Accordingly, the required sales volume *expressed in dollars* is \$700,000 (25,000 units × \$28). 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 concludes that it would be impossible to sell 25,000 bottles of Delatine at any price. She suggests that the company drop its cost-plus-pricing strategy and replace it with a new approach called *target pricing*. **Target pricing** begins with the determination of a price at which a product will sell and then focuses on developing that product with a cost structure that will satisfy market demands. Since the target price leads to a target cost, this market-based pricing strategy is also called **target costing**. It focuses on the design stage of product development. Given the target price of \$28 per

LO4

Use the contribution-per-unit approach to assess the effects of changes in sales price, variable costs, and fixed costs.

LO5

Understand the concept of target pricing.

Lisa de Wilde does not look like a mafiosa. And you would never mistake the president and CEO of Astral Media's pay-TV channels for a modern mob-moll character in *The Sopranos*, which airs on Astral's The Movie Network (TMN) from Ontario to Newfoundland. (Western viewers are out of luck, since Superchannel, the region's pay-TV station, does not air the crime drama.) However, if de Wilde has her way, every time Canadians think of the mobster melodrama, they will think of the pay-TV network. Astral is hoping the opportunity to watch new episodes of the award-winning television series, and its Hollywood movies, will be an offer TV junkies cannot refuse, convincing them to fork over the extra \$12.95 a month subscription fee.

Source: John Gray, "Mob Makeover," *Canadian Business*: Feb. 19, 2001.

bottle, the issue is how to design the product *at a cost* that will enable Bright Day to earn its desired profit of \$40,000. Fortunately, the marketing manager had some suggestions.

■ Use of the Contribution Approach to Estimate the Effects of Changes in Variable Costs

LO4

Use the contribution-per-unit approach to assess the effects of changes in sales price, variable costs, and fixed costs.

LO6

Consider the ethical considerations associated with misleading advertising.

The manufacturer has agreed to provide Delatine to Bright Day in two additional packaging formats. The current cost is \$24 for a bottle containing 100 capsules of 90 milligram (mg) strength. The two new alternatives are: (1) a bottle costing \$12 that contains 100 capsules of 30 mg strength, and (2) a bottle costing \$3 that contains 100 capsules of only 5 mg of Delatine mixed with a vitamin C compound. This dosage is the minimum allowable to support a packaging label indicating that the product contains Delatine. The marketing manager observes that both options would enable Bright Day to sell Delatine at a price that customers would be willing to pay.

The president vehemently rejected the second option. He called the proposal a blatant attempt to deceive customers by suggesting they were buying Delatine when, in fact, they were getting vitamin C. *He considered the idea to be unethical and dangerous.* He ended his tirade with the statement 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 allowing himself a few minutes to calm down, he said that the first option appeared to have some merit. The appropriate dosage for Delatine was uncertain; customers who wanted to take 90 mg per day could take three capsules instead of one. He turned to the accountant and asked, "What's the effect on the bottom line?"

The change in the variable cost (cost per bottle) from \$24 to \$12 per bottle has a dramatic effect on the level of sales volume required to produce the target profit. The contribution margin per unit shifts 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 results in a dramatic decrease in the sales volume necessary to attain the target profit. The appropriate computations are shown here:

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

Healthy people or healthy profits? If you were president of a major drug manufacturing company, which would you choose? Long-term studies for the treatment of high blood pressure suggest that the cheapest medications available (beta blockers and diuretics) are more effective and safer than more expensive ones. Even so, a survey of drug ads in the *New England Journal of Medicine* reveals an advertising program that advocates the use of more expensive medications (calcium-channel blockers and ACE inhibitors). The most aggressively marketed are the high-priced, high-profit calcium channel blockers. This marketing effort persists despite the fact that studies have linked these drugs to an increased risk of heart attack, cancer, and suicide. Why are the drug companies interested in selling these drugs? Could it have something to do with the fact that calcium channel blockers have a price more than three times that of diuretics? The marketing campaign appears to be working. Between 1992 and 1995, sales of calcium channel blockers increased by approximately 15 percent while that of diuretics dropped by 50 percent. One study suggests that the shift to the more expensive drugs is adding approximately \$3 billion in unnecessary expenditures to the national medical bill. Healthy people or healthy profits? Practising high ethical standards in business is not always an easy task. Keep in mind, however, that shortcuts to high profitability are filled with booby traps. A class action lawsuit could easily wipe out any benefit attained by unscrupulous business practices. The demise of the silicone breast implant industry stands as a clear example.



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Source: Catherine Arnst, "Is Good Marketing Bad Medicine?" *Business Week*, April 13, 1998, p. 62. The opinions regarding the ethical implications are those of the authors of this text. © SuperStock

The required sales volume expressed in sales dollars can be determined by multiplying this number of units by the sales price per unit. Accordingly, the level of sales *expressed in dollars* required to produce the desired profit is \$175,000 (6,250 units \times \$28). The following income statement confirms these amounts:

Sales Revenue (6,250 units \times \$28)	\$ 175,000
Total Variable Expenses (6,250 units \times \$12)	(75,000)
Total Contribution Margin (6,250 units \times \$16)	<u>100,000</u>
Fixed Expenses	(60,000)
Net Income	<u>\$ 40,000</u>

Although the drop in required sales from 25,000 units to 6,250 was truly significant, the marketing manager still felt uneasy about the company's ability to sell 6,250 bottles of Delatine. She restated the argument that the company had no other product that produced sales of that magnitude. The accountant suggested that considerable savings could be obtained by using a series of radio, rather than television, commercials. While gathering cost data for the TV campaign, the accountant had conferred with account executives of radio companies who had assured him that they could equal the TV audience exposure at about half the cost of the televised ads. 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, assuming that advertising costs were cut from \$60,000 to \$30,000.

Using the Contribution Approach to Estimate the Effects of Changes in Fixed Costs

LO4

Use the contribution-per-unit approach to assess the effects of changes in sales price, variable costs, and fixed costs.

Changing the fixed costs from \$60,000 to \$30,000 will dramatically affect the sales level required to earn the target profit. Since the contribution margin will cover a lower amount of fixed costs, the sales volume required to reach the desired profit is significantly reduced. The appropriate computations are shown here:

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

The required sales volume expressed in sales dollars can be determined by multiplying this number of units by the sales price per unit. Accordingly, the level of sales *expressed in dollars* required to produce the desired profit 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)	<u>(52,500)</u>
Total Contribution Margin (4,375 units \times \$16)	70,000
Fixed Expenses	<u>(30,000)</u>
Net Income	<u>\$ 40,000</u>

The marketing manager voiced her approval. Obviously, she could not guarantee any specific sales volume, but she felt confident that sales figures would fall within a range of 4,000 to 5,000 units.

Using the Cost-Volume-Profit Graph

LO7

Draw and interpret a cost-volume-profit graph.

To further analyze the revised expectations, the accountant had his staff prepare a chart to depict cost-volume-profit relationships over the range of sales activity from zero to 6,000 units. The accountant gave his staff the following instructions that were used to produce the CVP graph (sometimes called a *break-even chart*) shown in Exhibit 3–1:

1. **Draw the Axis:** The sales activity is expressed in units along the horizontal axis and in dollars along the vertical axis.
2. **Draw the Fixed Cost Line:** Fixed costs are constant for all levels of activity. To represent this relationship, a horizontal line is drawn across the graph at the dollar amount of fixed cost. In this case, the horizontal line is drawn at the \$30,000 level.
3. **Draw the Total Cost Line:** A diagonal line representing total cost is drawn by selecting some arbitrary level of activity expressed in units and making the following computations: To determine the total variable cost, multiply the selected volume of activity by the variable cost per unit. Add the total variable cost to the total fixed cost. The result is the amount of total cost at the selected level of activity. This point is plotted on the graph. A line starting from the vertical axis at the level of fixed cost is drawn through this point. For example, using a volume of activity of 6,000 units, the total cost amounts to \$102,000 [(6,000 units \times \$12) + \$30,000 fixed cost]. A point is plotted at the coordinates of \$102,000 and 6,000 units. Another point is plotted at the level of fixed cost and the zero level of activity (\$30,000 at zero units). A straight line representing total cost is drawn through these two points.

an answer for the *curious* manager

The number of bikes that must be sold to cover the cost of sponsoring the bike team can be determined by dividing the fixed cost of the promotional campaign by the contribution margin per bike. The contribution margin per bike is \$300 (\$900 – 600). In the first case, in which Cahaba Cycles acts as the sole sponsor, the number of bikes that must be sold to cover the cost of the promotional campaign is computed as follows:

Bicycle	\$1,200
Clothing	200
Helmet	100
Travel and fees	<u>2,000</u>
Cost per biker	\$3,500 × 2 = \$ 7,000
Promotional items.....	<u>5,000</u>
Total fixed cost.....	\$12,000 ÷ \$300
	Contribution margin
	= 40 bikes

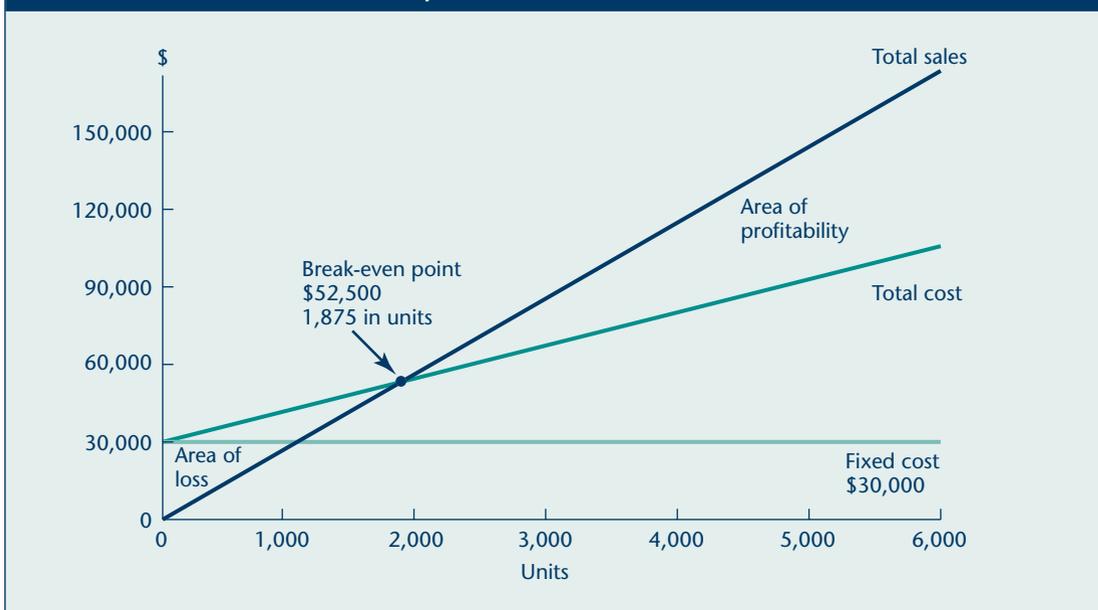
If the team is co-sponsored, Cahaba will save the fixed cost of two bicycles (\$1,200 × 2 = \$2,400). Accordingly, total fixed cost will drop to \$9,600 (\$12,000 – \$2,400). Since the price and variable cost of bikes sold to customers do not change, the contribution margin remains constant at \$300. The number of bikes that must be sold to cover the new level of fixed cost is as follows:

$$\begin{aligned} \text{Total fixed cost} &= \$9,600 \div \$300 \text{ Contribution margin} \\ &= 32 \text{ bikes} \end{aligned}$$

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

You should trace these procedures to the graph shown in Exhibit 3–1 to ensure your understanding of how to construct a CVP chart.

Exhibit 3-1 Cost-Volume-Profit Graph



■ Calculating the Margin of Safety

LO8

Calculate the margin of safety in units, dollars, and percentages.

The final meeting of the management team focused on a discussion of the reliability of the data used to construct the CVP chart. The accountant opened the discussion by calling attention to the sales volume figures under the area of profitability. Recall that 4,375 bottles of Delatine must be sold to earn the company's desired profit. Measured in dollars, budgeted sales amount to \$122,500 (4,375 bottles × \$28 per bottle). The accountant highlighted the wide gap between this level of budgeted sales and the break-even point. The amount of this gap, called the *margin of safety*, can be measured in number of units or in sales dollars. The appropriate computations are shown in the table below:

The **margin of safety** is defined as the number of units, or the amount of sales dollars, by which *actual sales* can fall below *budgeted sales* before a loss is incurred. If the margin of safety is high, as in this case, profitability can be expected even if actual sales fall significantly below expectations.

	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>

To facilitate comparisons between products or companies of different sizes, the margin of safety can be expressed as a percentage by dividing the margin of safety by the amount of the budgeted sales volume.¹ The appropriate computations are shown here:

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

$$\text{Margin of safety} = \frac{\$122,500 - \$52,500 \times 100}{\$122,500} = 57.14\%$$

This analysis suggests that actual sales would have to fall short of expected sales by more than 57.14 percent before Bright Day would experience a loss. This large a margin of safety suggests that undertaking the proposed radio advertising program for bottles of the 30 mg Delatine capsules has minimal risk.

■ Performing Sensitivity Analysis Using Spreadsheet Software

LO9

Understand how spreadsheet software can be used to conduct sensitivity analysis for cost-volume-profit relationships.

The *margin of safety* focuses on the vulnerability of profits to a decline in sales volume. Other factors could threaten profitability as well. For example, profits decline if costs increase. Safety margins could be determined for fixed and variable costs as well as sales volume. The disadvantage of the margin of safety approach is that it constitutes a unidimensional analysis when profits are subject to multidimensional forces. What happens to profitability if the level of fixed cost is higher than expected but variable costs are lower than expected? What if sales volume is higher than expected as are costs? Fortunately, spreadsheet software is highly efficient for analyzing “what if” questions, such as these. Exhibit 3–2 provides an example of an *Excel* spreadsheet report that permits management to assess the sensitivity of profits to simultaneous changes in fixed cost, variable cost, and sales volume. The report is based on data regarding Bright Day's proposed project for marketing Delatine. Recall that the accountant estimated the cost of the radio campaign to be \$30,000. The report provides profitability projections that permit considering conditions in which advertising costs fall to \$20,000 or rise to \$40,000. Likewise, the effects of potential changes in variable cost and sales volume can be investigated.

¹ The margin of safety percentage can be computed for existing as well as budgeted sales. For example, an analyst may want to compare the margins of safety of two companies under current operating conditions. In this case, existing sales would be substituted for budgeted sales. The formula for computing the margin of safety percentages would be $([\text{Actual sales} - \text{Break-even sales}] \div \text{Actual sales})$.

The range of scenarios described in the report is impressive, but it represents only a few of the many alternatives that can be analyzed with a few quick keystrokes. The spreadsheet program recalculates profitability figures instantly when one of the variables changes. Suppose that someone asks, “What would happen if we sold 10,000 units?” The accountant merely replaces one of the sales volume figures with the new number, and revised profitability numbers appear instantly. By changing the variables, management can get a real feel for the sensitivity of profits to changes in cost and volume for the project that is under consideration. Investigating a multitude of what-if questions regarding simultaneous changes in fixed cost, variable cost, and volume is called **sensitivity analysis**.

Exhibit 3-2 Spreadsheet Report to Facilitate “What-if” Analysis

	If	While	And Sales Volume Is				
	Fixed Cost	Variable Cost	2,000	3,000	4,000	5,000	6,000
	Is	Is	Then Profitability Will Be				
	\$20,000	11	14000	31000	48000	65000	82000
	20,000	12	12000	28000	44000	60000	76000
	20,000	13	10000	25000	40000	55000	70000
	30,000	11	4000	21000	38000	55000	72000
	30,000	12	2000	18000	34000	50000	66000
	30,000	13	0	15000	30000	45000	60000
	40,000	11	-6000	11000	28000	45000	62000
	40,000	12	-8000	8000	24000	40000	56000
	40,000	13	-10000	5000	20000	35000	50000

■ Assessing the Pricing Strategy

After reviewing the spreadsheet report, Bright Day’s management team is convinced that it should proceed with the radio campaign for Delatine. Only under the most dire circumstances (i.e., if actual sales fall significantly below expectations while costs increase at rates well above expectations) will the company incur a loss. Indeed, the president feels uneasy because the figures simply look too good to be true. If Bright Day pays \$12 per bottle for Delatine and sells it for \$28 per bottle as projected, the effective markup on cost would be 133 percent ($[\$28 - \$12] \div \$12$). Recall that the company’s normal markup is only 50 percent of cost. The president asks the marketing manager, “Are you sure people will buy this stuff at that price?”

The marketing manager explains that the pricing practice she is advocating is a recognized strategy known as **prestige pricing**. According to this concept, many people are fascinated with new technologies. They are willing to pay a premium to be the first to obtain and use a new product, especially when

its introduction receives widespread media attention, as is the case with Delatine. Similarly, people may be willing to pay more for a product because it carries a prestigious brand name. The marketing manager reminds the president that although the price spread for Delatine is unusually wide, the company has introduced other products at cost-plus margins that were considerably higher than the average 50 percent markup. Indeed, many of its current products sell at above average margins. Certainly, news coverage for Delatine will dissipate, competitors will offer alternatives, and customer interest will wane. That will be the time to reduce prices. The marketing manager is confident that the product will sell initially at the proposed price.

■ Using the Contribution Approach to Assess the Effect of Simultaneous Changes in CVP Variables

LO4

Use the contribution-per-unit approach to assess the effects of changes in sales price, variable costs, and fixed costs.

In a previous section of this chapter, we discussed the use of sensitivity analysis as a means to analyze the effects of simultaneous changes in CVP variables. On occasion, managers may desire to analyze the impact of simultaneous changes without the availability of computer technology. The contribution approach that has been illustrated to analyze unidimensional CVP relationships can also be used to study the effects of simultaneous changes in CVP variables. The approach offers simple and quick results in a low-technology environment. To illustrate several possible scenarios, assume that Bright Day has developed the following budgeted income statement:

Sales Revenue (4,375 units × \$28 sales price)	\$ 122,500
Total Variable Expenses (4,375 units × \$12 cost per bottle)	<u>(52,500)</u>
Total Contribution Margin (4,375 units × \$16)	70,000
Fixed Expenses	<u>(30,000)</u>
Net Income	<u>\$ 40,000</u>

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

Suppose that the marketing manager believes that sales will increase by 625 units if the price per bottle of Delatine is reduced to \$25. Should Bright Day reduce the price? Under these circumstances, the per-unit contribution margin drops to \$13 (\$25 sales price – \$12 cost per bottle). The expected number of units sold increases to 5,000 (4,375 + 625). On the basis of these figures, the expected profit is as follows:

Total Contribution Margin (5,000 units × \$13)	\$ 65,000
Less: Contribution Margin Used to Cover Fixed Expenses	<u>(30,000)</u>
Expected Profit	<u>\$ 35,000</u>

The following revised income statement confirms these amounts:

Sales Revenue (5,000 units × \$25 sales price)	\$ 125,000
Total Variable Expenses (5,000 units × \$12 cost per bottle)	<u>(60,000)</u>
Total Contribution Margin (5,000 units × \$13)	65,000
Fixed Expenses	<u>(30,000)</u>
Net Income	<u>\$ 35,000</u>

Since budgeted income falls from \$40,000 to \$35,000, the suggestion to reduce the sales price should be rejected.

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

Return to the original data set for the budgeted income statement. In summary, the company expects to sell 4,375 units of Delatine for \$28 per bottle. Variable costs are expected to be \$12 per bottle, and fixed costs are budgeted at \$30,000. Suppose that the management team believes that sales can be increased to 6,000 units if the company pays an additional \$12,000 to advertise its product. The contribution margin per unit will remain unchanged at \$16 (i.e., \$28 – \$12). Should the company incur the additional advertising cost, thereby increasing fixed costs to \$42,000? On the basis of these figures, the expected profit is as follows:

Total Contribution Margin (6,000 units × \$16)	\$ 96,000
Less: Contribution Margin Used to Cover Fixed Expenses	<u>(42,000)</u>
Expected Profit	<u>\$ 54,000</u>

The following revised income statement confirms these amounts:

Sales Revenue (6,000 units × \$28 sales price)	\$ 168,000
Total Variable Expenses (6,000 units × \$12 cost per bottle)	<u>(72,000)</u>
Total Contribution Margin (6,000 units × \$16)	96,000
Fixed Expenses	<u>(42,000)</u>
Net Income	<u>\$ 54,000</u>

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 data set for the original budget. Recall that the company expects to sell 4,375 units of Delatine for \$28 per bottle, and variable cost are expected to be \$12 per bottle. Fixed costs are budgeted at \$30,000. Suppose that Bright Day is able to negotiate a \$4 reduction in the cost of a bottle of Delatine. The management team wants to consider passing on some of the savings to its customers by reducing the sales price to \$25 per bottle. Furthermore, the team believes that advertising costs can be reduced by \$8,000 without seriously affecting sales volume. Sales are expected to fall to 4,200 units because of the reduction in advertising. Additional reductions in demand are not expected, however, because the decrease in the sales price is expected to increase demand by some customers. Should Bright Day proceed with the plan to reduce prices and advertising costs?

Under the revised operating scenario, sales volume would decline to 4,200 units. The contribution margin would increase to \$17 per bottle (\$25 new selling price – \$8 new variable cost per bottle), and fixed cost would fall to \$22,000 (\$30,000 – \$8,000). On the basis of these figures, the expected profit is as follows:

Total Contribution Margin (4,200 units × \$17)	\$ 71,400
Less: Contribution Margin Used to Cover Fixed Expenses	<u>(22,000)</u>
Expected Profit	<u>\$ 49,400</u>

The following revised income statement confirms these amounts:

Sales Revenue (4,200 units × \$25 sales price)	\$ 105,000
Total Variable Expenses (4,200 units × \$8 cost per bottle)	<u>(33,600)</u>
Total Contribution Margin (4,200 units × \$17)	71,400
Fixed Expenses	<u>(22,000)</u>
Net Income	<u>\$ 49,400</u>

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

Many other possible scenarios could be considered. However, it should be clear at this point that the contribution approach can be used to analyze independent or simultaneous changes in the CVP variables. Two alternative approaches to CVP analysis, the contribution margin ratio approach and the equation approach, will be introduced in the following sections of this chapter.

■ Calculating Cost-Volume-Profit (CVP) Analysis Using the Contribution Margin Ratio

Lo10

Conduct cost-volume-profit analysis using the contribution margin ratio and the equation method.

When the contribution margin is expressed as a percentage of the sales price, the result is called the **contribution margin ratio**. To illustrate, assume that Bright Day is considering the possibility of selling a new product called Multi Minerals. The expected sales price, variable cost, and contribution margin per unit are shown here:

Sales revenue per unit	\$20
Variable cost per unit	12
Contribution margin per unit	<u>\$ 8</u>

On the basis of these data, the *contribution margin ratio* for Multi Minerals is 40 percent ($\$8 \div \20). This ratio suggests that every dollar of sales provides 40 cents ($\$1 \times .40$) to cover fixed costs. After fixed costs have been covered, each dollar of sales provides 40 cents of profit. Like the *per-unit contribution margin*, the *contribution margin ratio* can be used to analyze CVP relationships. The results are identical with the exception that the per-unit contribution margin produces a sales volume measured in units while the contribution margin ratio yields a sales volume figure measured in dollars. As such, the two approaches merely represent different means of arriving at the same conclusion. To demonstrate, we calculate the break-even point, assuming that the company expects to incur \$24,000 of fixed expenses to market the product. The computations under the alternative approaches follow:

Per-Unit-Contribution Approach Break-Even in Units	Contribution-Ratio Approach Break-Even in Dollars
$\frac{\text{Fixed costs}}{\text{Contribution margin per unit}} = \text{Units}$	$\frac{\text{Fixed costs}}{\text{Contribution margin ratio}} = \text{Dollars}$
$\frac{\$24,000}{\$8} = 3,000 \text{ units}$	$\frac{\$24,000}{40\%} = \$60,000$

Converting the break-even point expressed in units to one expressed in sales dollars demonstrates that the two approaches lead to the same results. Mathematically, $3,000 \text{ units} \times \$20 = \$60,000$. Likewise, the break-even point expressed in sales dollars can be converted to units ($\$60,000 \div \$20 = 3,000$). Accordingly, it should be clear that the two approaches represent different views of the same data set. The similarities and differences between the two approaches hold when other CVP variables are added or changed. For example, the sales volume necessary to reach a target profit of \$8,000 under the two approaches is computed as follows:

Per-Unit-Contribution Approach Break-Even in Units	Contribution-Ratio Approach Break-Even in Dollars
$\frac{\text{Fixed costs} + \text{Desired profit}}{\text{Contribution margin per unit}} = \text{Units}$	$\frac{\text{Fixed costs} + \text{Desired profit}}{\text{Contribution margin ratio}} = \text{Dollars}$
$\frac{\$24,000 + \$8,000}{\$8} = 4,000 \text{ units}$	$\frac{\$24,000 + \$8,000}{40\%} = \$80,000$

Once again, multiplying the \$20 sales price by the sales volume expressed in units equates to the sales volume expressed in dollars ($\$20 \times 4,000 = \$80,000$). Because both approaches yield the same results, the method to use is a matter of personal preference. However, to ensure your ability to communicate in a variety of potential circumstances, we encourage you to experiment with both approaches. Indeed, you should also master a third alternative, the *equation method*, which is discussed in the following section.

■ Cost-Volume-Profit Analysis Using the Equation Method

The **equation method** begins with the expression of the break-even point in terms of an algebraic equation. This equation is shown here:²

$$\text{Sales} = \text{Variable cost} + \text{Fixed cost}$$

The break-even point expressed in terms of sales volume (i.e., number of units) can be determined by restating the formula as indicated here:

$$\begin{aligned} & \text{Selling price per unit} \times \text{No. of units sold} \\ &= (\text{Variable cost per unit} \times \text{No. of units sold}) + \text{Fixed cost} \end{aligned}$$

Using the Multi Minerals \$20 sales price, \$12 variable cost, and \$24,000 fixed cost, the *break-even point* computed *in number of units* is as follows:

$$\begin{aligned} \$20 \times \text{Units} &= \$12 \times \text{Units} + \$24,000 \\ \$8 \times \text{Units} &= \$24,000 \\ \text{Units} &= 3,000 \end{aligned}$$

The break-even sales volume expressed in units can be converted into break-even sales volume expressed in dollars by multiplying the sales price per unit times the number of units sold. The *break-even point* for Bright Day expressed *in number of dollars* is as follows:

$$\begin{array}{rcccc} \text{Sales price per unit} & \times & \text{Number of units sold} & = & \text{Sales volume in dollars} \\ \$20 & \times & 3,000 & = & \$60,000 \end{array}$$

² The equation method results in the same computation as the per-unit-contribution-margin approach. As proof, consider the following: Under the per-unit-contribution-margin approach, the break-even point is determined as follows (X equals the break-even point in units):

$$X = \text{Fixed cost} \div \text{Per unit contribution margin}$$

Under the equation method, the break-even point is determined as follows (X equals the break-even point in units):

$$\begin{aligned} \text{Unit sales price (X)} &= \text{Variable cost per unit (X)} + \text{Fixed cost} \\ (\text{Unit sales price} - \text{Variable cost per unit}) X &= \text{Fixed cost} \end{aligned}$$

Since:

$$\begin{aligned} \text{Unit sales price} - \text{Variable cost per unit} &= \text{Per unit contribution margin} \\ \text{Per unit contribution margin (X)} &= \text{Fixed cost} \\ X &= \text{Fixed cost} \div \text{Per unit contribution margin} \end{aligned}$$

Lo10

Conduct cost-volume-profit analysis using the contribution margin ratio and the equation method.

The equation method can also be used to analyze additional CVP relationships. For example, the sales volume necessary to attain a target profit of \$8,000 can be computed as follows:

$$\begin{aligned} & \text{Selling price per unit} \times \text{No. of units sold} \\ &= (\text{Variable cost per unit} \times \text{No. of units sold}) + \text{Fixed cost} + \text{Desired Profit} \end{aligned}$$

The computations are shown here:

$$\begin{aligned} \$20 \times \text{Units} &= \$12 \times \text{Units} + \$24,000 + \$8,000 \\ \$8 \times \text{Units} &= \$32,000 \\ \text{Units} &= 4,000 \end{aligned}$$

By comparing these results with those determined using the per-unit-contribution approach and the contribution margin ratio approach, it should be apparent that the equation method is simply another way to achieve the same result. Again, the method you use will depend on your personal preferences and those of the management team you encounter on the job. As a student seeking entry into an unknown work environment, you should familiarize yourself with as many of the alternatives as possible.

■ Recognizing Cost-Volume-Profit Limitations

LO11

Identify the limitations associated with cost-volume-profit analysis.

The accuracy of cost-volume-profit analysis is limited because it assumes a strictly *linear* relationship among the variables. True linearity among actual CVP variables is the exception rather than the norm. For example, suppose that a business receives a volume discount on materials that it purchases. The more material it purchases, the lower its cost per unit is. In this case, the cost varies but not in direct proportion to the amount of material purchased. The relationship is not linear. Similarly, fixed costs can change. A supervisor's salary that is thought to be fixed may change if the supervisor receives a raise. Likewise, amounts charged for telephone, rent, insurance, taxes, and so on may increase or decrease. In practice, fixed costs frequently fluctuate. Accordingly, the relationships are not strictly linear.

CVP assumes that such factors as worker efficiency are constant over the range of the activity analyzed. Businesses frequently are able to increase productivity, thereby reducing variable or fixed costs, but CVP formulas are not constructed to allow for such changes in efficiency.

Finally, the analytical techniques assume that the level of inventory does not change during the period. In other words, sales and production are assumed to be equal. CVP formulas are used to provide the estimated number of units that must be *produced and sold* to attain break-even status or to achieve some designated target profit. Producing or acquiring inventory that is not sold generates costs without producing corresponding revenue. This condition undoubtedly affects the CVP relationships. Accordingly, the assumptions associated with CVP are frequently violated in business practice. Within the relevant range of activity, however, violations of the basic assumptions are normally insignificant. A prudent business manager who exercises good judgment will certainly find the data generated by cost-volume-profit analysis to be useful, regardless of its limitations.

a look back

Profitability is affected by changes in the sale price, costs, and the volume of activity. The relationship between these variables is known as *cost-volume-profit analysis*. One important variable in the analysis of these relationships is the *contribution margin*, which is determined by subtracting the variable costs from the sales price. The *contribution margin per unit* is the amount from each unit sold available 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* (i.e., the point where total revenue equals total cost) in units can be determined by dividing fixed costs by the contribution margin per unit. The break-even point expressed in sales dollars can be determined by multiplying the number of break-even units by the sales price per unit. To

determine sales in units to obtain a designated profit, the sum of fixed costs and desired profit is divided by the contribution margin per unit. The contribution margin per unit can also be used to assess the effects of changes in sales price, variable costs, and fixed costs on the company's profitability.

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. *Target pricing (target costing)* begins with an estimate of market price that 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 be drawn to depict cost-volume-profit relationships for a product over a range of sales activity. Units are expressed along the horizontal axis and sales along the vertical axis. Lines for fixed costs, total costs, and sales can be drawn on the basis of 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 comparison among companies of different sizes. 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* is used to determine 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.

A *contribution margin ratio* can be used to determine the break-even point in sales dollars. The ratio is a percentage expression determined by dividing the contribution margin per unit by the sales price per unit. Once the contribution ratio has been determined, the break-even volume expressed in dollars can be determined by dividing the total fixed costs by the ratio. Cost-volume-profit relationships can also be examined by using the following algebraic equation:

$$\text{Sales} = \text{Variable cost} + \text{Fixed cost}$$

Assumptions are made in using cost-volume analysis. The analysis assumes true linearity among the CVP variables, a constant level of worker efficiency, and a constant level of inventory. Violating these assumptions compromises the accuracy of the analysis.

The next chapter will introduce a new concept known as *cost relevance*. Applying the concepts you have learned to real-world business problems can be challenging. Frequently, so much information is available that it is difficult to distinguish the important from the useless. The next chapter will help you learn to identify information that is relevant in a variety of short-term decision-making scenarios, including special offers, outsourcing, segment elimination, and asset replacement.

**a look
forward**

APPENDIX

Multiple-Product Break-Even Analysis

When a company analyzes CVP relationships for multiple products that are sold simultaneously, the break-even point can be affected by the relative number (i.e., sales mix) of the products sold. For example, suppose that Bright Day decides to run a special sale on its two leading antioxidants, vitamins C and E. The income statements presented in Exhibit 3-1A illustrate these results.

LO12
Perform multiple-product break-even analysis.

Exhibit 3-1A Budgeted Data for Antioxidant Special

	Vitamin C			Vitamin E			Total	
	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Budgeted Amount
Sales	2,100	7.20 =	\$ 15,120	700 @	11.00 =	\$ 7,700	2,800	\$ 22,820
Variable cost	2,100	6.00 =	(12,600)	700 @	7.00 =	(4,900)	2,800	(17,500)
Contribution margin	2,100	1.20 =	2,520	700 @	4.00 =	2,800	2,800	5,320
Fixed cost			(2,520)			(2,800)		(5,320)
Net income			\$ 0			\$ 0		\$ 0

Recall that the break-even point is the point where total sales equal total costs. Accordingly, net income equals zero at that point. The data in Exhibit 3-1A indicate that the budgeted break-even sales volume for the antioxidant special is 2,800 bottles of vitamins with a sales mix consisting of 2,100 bottles of vitamin C and 700 bottles of vitamin E. What happens if the relative sales mix changes? Exhibit 3-2A depicts the expected condition if total sales remain at 2,800 units but the sales mix changes to 2,200 bottles of vitamin C and 600 bottles of vitamin E.

Exhibit 3-2A Budgeted Data for Antioxidant Special

	Vitamin C			Vitamin E			Total	
	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Budgeted Amount
Sales	2,200	7.20 =	\$ 15,840	600 @	11.00 =	\$ 6,600	2,800	\$ 22,440
Variable cost	2,200	6.00 =	(13,200)	600 @	7.00 =	(4,200)	2,800	(17,400)
Contribution margin	2,200	1.20 =	2,640	600 @	4.00 =	2,400	2,800	5,040
Fixed cost			(2,520)			(2,800)		(5,320)
Net income			\$ 120			\$ (400)		\$ (280)

Although the total number of bottles sold remains at 2,800 units, profitability shifts from breaking even to a \$280 loss because of the change in the sales mix of the two products, that is, selling more vitamin C than expected and less vitamin E. Because vitamin C has a lower contribution margin (i.e., \$1.20 per bottle) than vitamin E (i.e., \$4.00 per bottle), selling more of C and less of E reduces profitability. The opposite impact occurs if Bright Day sells more E and less C. Exhibit 3-3A depicts the expected condition if total sales remain at 2,800 units but the sales mix changes to 1,400 bottles each of vitamin C and vitamin E.

Exhibit 3-3A Budgeted Data for Antioxidant Special

	Vitamin C			Vitamin E			Total	
	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Budgeted Amount
Sales	1,400	7.20 =	\$ 10,080	1,400 @	11.00 =	\$ 15,400	2,800	\$ 25,480
Variable cost	1,400	6.00 =	(8,400)	1,400 @	7.00 =	(9,800)	2,800	(18,200)
Contribution margin	1,400	1.20 =	1,680	1,400 @	4.00 =	5,600	2,800	7,280
Fixed cost			(2,400)			(2,800)		(5,200)
Net income			\$ (720)			\$ 2,800		\$ 2,080

Clearly, companies must consider sales mix when they perform break-even analysis for multi-product business ventures. The multiple product break-even point can be determined using the per-unit contribution margin approach. However, it is necessary to use a weighted average to determine the per unit contribution margin. The contribution margin of each product must be weighted by its proportionate share of units sold. For example, in the preceding case, the relative sales mix between the two products is 1:1 (one unit Vitamin C to one unit Vitamin E). What is the break-even point given a relative sales mix of 1:1? To answer this question, the companies must first determine the weighted average per-unit contribution margin by multiplying the contribution margin of each product by its weighting. The required computation is shown here:

Vitamin C (\$1.20 × 1)	\$1.20
Vitamin E (\$4.00 × 1)	<u>4.00</u>
Weighted average per-unit contribution margin	<u>\$5.20</u>

The break-even point in total units at a 1:1 sales mix is computed as follows:

$$\begin{aligned} \text{Break-even point} &= \text{Fixed costs} \\ &\quad \div \text{Weighted average per-unit contribution margin} \\ \text{Break-even point} &= \$5,200 \div \$5.20 = 1,000 \text{ sales mixes} \end{aligned}$$

Next, divide the total units to breakeven in proportion to the relative sales mix. In other words, the break-even point occurs at 1,000 bottles of vitamin C (1,000 × 1) and 1,000 bottles of vitamin E (1,000 × 1). The income statements presented in Exhibit 3–4A illustrate these results:

Exhibit 3-4A Budgeted Data for Antioxidant Special								
	Vitamin C			Vitamin E			Total	
	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Budgeted Amount
Sales	1,000	7.20 =	\$ 7,200	1,000 @	11.00 =	\$11,000	2,000	\$ 18,200
Variable cost	1,000	6.00 =	<u>(6,000)</u>	1,000 @	7.00 =	<u>(7,000)</u>	2,000	<u>(13,000)</u>
Contribution margin	1,000	1.20 =	1,200	1,000 @	4.00 =	4,000	2,000	5,200
Fixed cost			<u>(2,400)</u>			<u>(2,800)</u>		<u>(5,200)</u>
Net income			<u>\$ (1,200)</u>			<u>\$ 1,200</u>		<u>\$ 0</u>

KEY TERMS

Break-even point The point where total revenue equals total cost; can be expressed in units or sales dollars. (p. 87)

Contribution margin per unit The difference between the sales price and the variable costs per unit; represents the amount available from each unit sold to cover fixed costs and to provide a profit. The per-unit contribution margin can be used in

cost-volume-profit analysis to determine the amount of the break-even sales volume expressed in units or to determine the level of sales required to attain a desired profit. (p. 86)

Contribution margin ratio The result of dividing the contribution margin per unit by the sales price; can be used in cost-volume-profit analysis to determine the amount of the break-even sales volume

expressed in dollars or to determine the dollar level of sales required to attain a desired profit. (p. 98)

Cost-plus-pricing strategy A pricing strategy that sets the price at cost plus a markup equal to a percentage of the cost. (p. 86)

Cost-volume-profit (CVP) analysis An analysis that shows the interrelationships among sales prices, volume, fixed, and variable costs; an important tool in

determining the break-even point or the most profitable combination of these variables. (p. 86)

Equation method A cost-volume-profit analysis technique that uses a basic mathematical relationship among sales, variable costs, fixed costs, and desired net income before taxes and provides a solution in terms of units. (p. 99)

Margin of safety The difference between budgeted

sales and break-even sales expressed in units, dollars, or as a percentage; the amount by which actual sales can fall below budgeted sales before a loss is incurred. (p. 94)

Prestige pricing A pricing strategy that sets the price

at a premium (above average markup above cost) under the assumption that people will pay more for the product because of its prestigious brand name, media attention, or some other reason that has piqued the interest of the public. (p. 95)

Sensitivity analysis A spreadsheet technique that analyzes “what-if” questions to assess the sensitivity of profits to simultaneous changes in fixed cost, variable cost, and sales volume. (p. 95)

Target pricing (target costing) A pricing strategy that begins with the determination of a price at which a product will sell and then focuses on the development of that product with a cost structure that will satisfy market demands. (p. 89)

QUESTIONS

1. What does the term *breakeven* 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 breakeven? Explain how the results of this method differ from those of the contribution-margin approach.
9. Before the break-even point is reached, what strategy probably would be most effective in increasing profitability, and why? After breakeven, what strategies should be considered?
10. If a company is trying to find the break-even point for multiple products that sell simultaneously, what consideration must be taken into account?
11. What assumptions are necessary for cost-volume-profit analysis to be completely accurate? Since these assumptions are usually violated, why do managers still use the analysis in decision making?
12. Mary Hartwell and Jane Jamail are college roommates who 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 has become adamant about her position, stating that she refuses 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?
13. How would the algebraic formula used to compute the break-even point under the equation method be changed to consider a desired target profit?
14. Setting the sales price is easy: Just enter cost information and the 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.
15. What is the relationship between cost-volume-profit analysis and the relevant range?

EXERCISES

L.O. 2 EXERCISE 3-1 *Per-Unit Contribution Margin Approach*



CLK Corporation sells a product for \$6 each that has variable costs of \$4.50 per unit. CLK’s annual fixed cost amounts to \$120,000.

Required

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

L.O. 2 EXERCISE 3-2 *Equation Method*

Saylor Corporation produces a product that it sells for \$8 each. Its variable costs per unit are \$5.50, and annual fixed costs are \$125,000.

Required

Use the equation method to determine the break-even point in units and dollars.

EXERCISE 3-3 *Contribution Margin Ratio* **L.O. 3**

Sigma Company incurs annual fixed cost of \$70,000, variable costs for its product amount to \$3.20 per unit, and the sales price per unit is \$8. Sigma desires to earn an annual profit of \$26,000.

Required

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

EXERCISE 3-4 *Equation Method* **L.O. 3**

Westside Company produces a product that sells for \$12 per unit and has a variable cost of \$4.20 per unit. Westside incurs annual fixed cost of \$80,000. It desires to earn a target profit of \$37,000.

Required

Use the equation method to determine the amount of the sales volume in units and dollars required to earn the desired profit.

EXERCISE 3-5 *Fixed and Variable Cost per Unit* **L.O. 3**

Toro-Blade Corporation produced and sold 24,000 units of product during September. It earned a contribution margin of \$60,000 on sales of \$180,000 and determined that cost per unit of product was \$8.

Required

On the basis of this information, determine the variable and fixed cost per unit of the product.

EXERCISE 3-6 *Determination of Variable Cost from Incomplete Cost Data* **L.O. 3**

Quartz Corporation produced 60,000 watches that it sold for \$10 each during its 2006 accounting period. The company determined that fixed manufacturing cost per unit was \$5 per watch. The company showed \$120,000 of gross margin on its financial statements.

Required

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

EXERCISE 3-7 *Contribution Margin per Unit Approach for Break-Even and Desired Profit* **L.O. 2, 3**

Information concerning a product produced by Drew Company appears here:

Sales price per unit	\$160
Variable cost per unit	90
Total annual fixed manufacturing & operating costs	620,200

Required

Determine the following:

- Contribution margin per unit.
- Number of units that must be sold to break even.
- Sales level in units that must be reached to earn a profit of \$300,300.

EXERCISE 3-8 *Change in Sales Price* **L.O. 4**

Kimberly Company produces a product that has a variable cost of \$2 per unit; it sells for \$3 per unit. The company's annual fixed costs total \$250,000; it had net income of \$80,000 during the previous year. In an effort to increase the company's market share, management is considering lowering the selling price to \$2.75 per unit.

Required

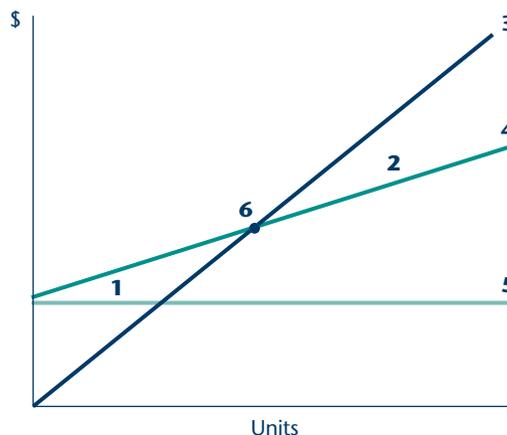
If Kimberly desires to maintain its current income level, how many additional units must it sell to justify the price decline?

L.O. 4 EXERCISE 3-9 *Simultaneous Change in Sales Price and Desired Profit*

Use the same data as presented in Exercise 3–8 but assume that in addition to increasing its market share by lowering its selling price to \$2.75, Kimberly desires to increase its net income by \$7,500.

Required

Determine the number of units the company must sell to satisfy these requirements.

L.O. 2, 3, 7 EXERCISE 3-10 *Components of Break-Even Graph***Required**

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

- Fixed cost line
- Total cost line
- Break-even point
- Area of profit
- Revenue line
- Area of loss

L.O. 4 EXERCISE 3-11 *Evaluation of Simultaneous Changes in Fixed and Variable Costs*

Hancock Company currently produces and sells 5,000 units annually of a product that has a variable cost of \$22 per unit and an annual fixed cost of \$180,000. The company currently earns \$20,000 annual profit. Assume that Hancock has the opportunity to invest in new labour-saving production equipment that will enable the company to reduce variable costs to \$19 per unit. The investment would cause fixed costs to increase by \$10,000 because of additional amortization cost.

Required

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

EXERCISE 3-12 *Margin of Safety***L.O. 8**

Firmin Company makes a product that sells for \$5 per unit. The company pays \$3 per unit for the variable costs of the product and incurs annual fixed costs of \$50,000. Firmin expects to sell 30,000 units of product.

Required

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

EXERCISE 3-13 *Cost-Volume-Profit Relationship***L.O. 1, 2, 3**

Bellview, Inc. is a manufacturing company that makes small electric motors it sells for \$18 per unit. The variable costs of production amount to \$12 per motor, and annual fixed costs of production amount to \$36,000.

Required

- How many units of product must Bellview make and sell to break even?
- How many units of product must Bellview make and sell to earn a \$12,000 profit?
- The marketing manager believes that sales would increase dramatically if the price were reduced to \$15 per unit. How many units of product must Bellview make and sell to earn a \$12,000 profit, assuming that the sales price is set at \$15 per unit?

EXERCISE 3-14 *Understanding of the Global Economy through CVP Relationships***L.O. 4**

An article published in the December 8, 1997, issue of *U.S. News & World Report* summarized several factors likely to support a continuing decline in the rate of inflation over the next decade. Specifically, the article stated that "global competition has...fostered an environment of cheap labor, cost cutting, and increased efficiency." The article notes that these developments in the global economy have led to a condition in which "the production of goods is outpacing the number of consumers able to buy them." Even so, the level of production is not likely to decline because factories have been built in the developing countries where labour is cheap. The recent decline in the strength of the Asian economies is likely to have a snowballing effect so that within the foreseeable future, there will "be too many goods chasing too few buyers."

**Required**

- Identify the production cost factor(s) referred to that exhibit variable cost behaviour. Has (have) the cost factor(s) increased or decreased? Provide logical explanations as to why the variable costs have increased or decreased.
- Identify the production cost factor(s) referred to that exhibit fixed cost behaviour. Has (have) the cost factor(s) increased or decreased? Provide logical explanations as to why the fixed costs have increased or decreased.
- The article implies that production levels are likely to remain high even though demand is expected to be weak. Explain the logic behind this implication.
- The article suggests that manufacturers will continue to produce goods even though they may have to sell goods at a price that is below the total cost of production. Considering what you know about fixed versus variable cost, speculate on how low manufacturers would permit prices to drop before they would stop production.

EXERCISE 3-15 *Target Costing***L.O. 5**

The marketing manager of TelCo., Inc. has determined that a market exists for a telephone with a sales price of \$10 per unit. The production manager suggests that the fixed cost of producing between 10,000 and 30,000 telephones is \$72,000.

Required

Assume that TelCo desires to earn a \$40,000 profit from the phone sales. How much can TelCo afford to spend on variable cost per unit if production and sales equal 25,000 phones?

APPENDIX**L.O. 12 EXERCISE 3-16** *Multiple Product Break-Even Analysis*

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

	Product A	Product B
Sales price	\$25	\$45
Variable cost per unit	(15)	(25)
Contribution margin per unit	<u>\$10</u>	<u>\$20</u>

Tracy expects to incur fixed costs amounting to \$10,000. The relative sales mix of the products is 3 Product A and 1 Product B.

Required

- Determine the total number of products (units of A and B combined) that must be sold to break even.
- How many units each of Product A and Product B must be sold to break even?

PROBLEMS—SERIES A**L.O. 2 PROBLEM 3-1A** *Determination of the Break-Even Point and Preparation of a Contribution Margin Income Statement*

Maletta Manufacturing Company makes a product that it sells for \$30 per unit. The company incurred variable manufacturing costs of \$14 per unit. Variable selling expenses totalled \$4 per unit, annual fixed manufacturing costs were \$87,000, and fixed selling and administrative costs totalled \$45,000 per year.

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.
- Confirm your results by preparing a contribution margin income statement when sales volume is at the break-even point.

L.O. 2, 7 PROBLEM 3-2A *Determination of the Break-Even Point and Preparation of a Break-Even Graph*

Conduit Company is considering the production of a new product. The expected variable cost is \$8 per unit. Annual fixed costs are expected to amount to \$280,000. The anticipated sales price is \$15 each.

Required

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

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

L.O. 2, 3, 4 PROBLEM 3-3A *Effect of Converting Variable to Fixed Costs*

Highland Manufacturing Company reported the following data regarding a product it manufactures and sells. The sales price is \$16.

Variable costs:	
Manufacturing	\$7.50 per unit
Selling	4.50 per unit
Fixed costs:	
Manufacturing	\$80,000 per year
Selling and administrative	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 profit of \$62,000.
- Suppose that variable selling costs could be eliminated by having a salaried sales force. If the company could sell 50,000 units, how much could it pay in salaries for salespeople and still have a profit of \$62,000? (*Hint:* Use the equation method.)

PROBLEM 3-4A *Analysis of Change in Sales Price Using the Contribution Margin Ratio***L.O. 2, 3, 4**

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

Sales price	\$6.00
Contribution margin ratio	20%
Fixed costs	\$8,400

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 profit of \$1,800, what must the sales be in dollars? in units?
- If the sales price increases to \$6.40 and variable costs do not change, what will be the new break-even point in dollars? in units?

PROBLEM 3-5A *Analysis of Sales Price and Fixed Cost Using the Equation Method***L.O. 2, 3, 4**

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

Expected variable cost of manufacturing	\$10 per unit
Expected annual fixed manufacturing costs	\$16,400

The administrative vice-president has provided the following estimates:

Expected sales commission	\$2.50 per unit
Expected annual fixed administrative costs	\$8,200

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 \$15, how many units must be sold to break even?
- Shim has determined that sales will probably be 12,000 units. What sales price per unit will allow the company to break even?
- Shim has decided to advertise the product heavily and has set the sales price at \$16. If sales are 10,000 units, how much can the company spend on advertising and still break even?

L.O. 8 PROBLEM 3-6A *Margin of Safety and Operating Leverage*

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

	Relevant Information		
	Skin Cream	Bath Oil	Colour Gel
Budgeted Sales in Units (a)	25,000	45,000	15,000
Expected Sales Price (b)	\$ 3.50	\$ 2.00	\$ 6.50
Variable Costs per Unit (c)	\$ 2.00	\$ 0.75	\$ 4.50
Income Statements			
Sales Revenue (a × b)	\$ 87,500	\$ 90,000	\$ 97,500
Variable Costs (a × c)	(50,000)	(33,750)	(67,500)
Contribution Margin	\$ 37,500	\$ 56,250	\$ 30,000
Fixed Cost	(30,000)	(52,500)	(26,000)
Net Income	\$ 7,500	\$ 3,750	\$ 4,000

Required

- Determine the margin of safety as a percentage for each product.
- Prepare a revised income statement for each product, assuming a 25 percent increase in the budgeted sales volume.
- For each product, determine the percentage of change in net income that results from the 25 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 line of products? Support your answer with appropriate commentary.
- Assuming that management is optimistic and risk aggressive, which product should the company add to its line of products? Support your answer with appropriate commentary.

L.O. 2, 3, 4, 7, 8 PROBLEM 3-7A *Comprehensive CVP Analysis*

Kirk Company makes and sells a product with variable costs in the amount of \$20 each. Kirk incurs annual fixed costs of \$16,000. The current sales price is set at \$30.

Required

The requirements listed here are interdependent. For example, the \$4,000 desired profit introduced in Requirement *c* also applies to subsequent requirements. Likewise, the \$25 sales price introduced in Requirement *d* applies to the subsequent requirements.

- Determine the amount of 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 Kirk desires to earn a \$4,000 profit. Determine the sales volume expressed 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 \$25 per unit, how will reducing the sales price affect the level of sales 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 cost drops to \$12,000, how will the reduction affect the level of sales 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 \$15 per unit, how will the reduction affect the level of sales 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.

- g. Assume that Kirk concludes that it can sell 1,600 units of product for \$25 each. Recall that variable costs are \$15 each and fixed costs amount to \$12,000. Compute the margin of safety in terms of units and dollars and as a percentage.
- h. Draw a break-even graph using the cost and price assumptions described in Requirement *g*.

PROBLEM 3-8A *Assessment of Simultaneous Changes in CVP Relationships*

**L.O. 2, 3, 4,
7, 8**

Lazy Days, Inc. (LDI) sells hammocks; variable costs are \$40 each, and the hammocks are sold for \$60 each. LDI incurs \$95,000 of fixed operating expenses annually.

Required

- Determine the sales volume in units and dollars that would be required to attain a \$25,000 profit. Verify your answer by preparing an income statement using the contribution-margin format.
- LDI is considering the implementation of a quality improvement program. The program will require a \$5 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 3,000 units above the amount computed in Requirement *a*, should LDI proceed with plans to improve product quality? Support your answer by preparing a budgeted income statement.
- Determine the new break-even point volume of units and sales dollars as well as the margin of safety percentage, assuming that the quality improvement program is initiated.
- Prepare a break-even graph using the cost and price assumptions outlined in Requirement *b*.

APPENDIX

PROBLEM 3-9A *Determination of the Break-Even Point and Margin of Safety for a Company with Multiple Products*

L.O. 2, 8

Shank Company makes two products. Budgeted annual income statements for the two products are provided here:

	Product A			Product B			Total	
	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Budgeted Amount
Sales	320	@ \$580 =	\$ 185,600	1,280	@ \$430 =	\$ 550,400	1,600	\$ 736,000
Variable cost	320	@ \$400 =	(128,000)	1,280	@ \$320 =	(409,600)	1,600	(537,600)
Contribution Margin	320	@ \$180 =	\$ 57,600	1,280	@ \$110 =	\$ 140,800	1,600	\$ 198,400
Fixed cost			(22,320)			(126,480)		(148,800)
Net income			<u>\$ 35,280</u>			<u>\$ 14,320</u>		<u>\$ 49,600</u>

Required

- On the basis of the 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 that must be sold 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 on the basis of the combined sales of the two products.

PROBLEMS—SERIES B

L.O. 2 **PROBLEM 3-1B** *Determination of the Break-Even Point and Preparation of a Contribution Margin Income Statement*

Dandy Company manufactures radio and cassette players and sells them for \$50 each. According to the company's records, the variable costs, including direct labour and direct materials, amounted to \$25. Factory amortization and other fixed manufacturing costs were \$96,000 per year. Dandy paid its salespeople a commission of \$9 per unit. Annual fixed selling and administrative costs were \$64,000.

Required

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

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

L.O. 2, 7 **PROBLEM 3-2B** *Determination of the Break-Even Point and Preparation of a Break-Even Graph*

Executive officers of Homer Company are assessing the profitability of a potential new product. They expect that the variable cost of making the product is \$24 per unit and fixed manufacturing cost will be \$480,000. The executive officers plan to sell the product at the price of \$48 each.

Required

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

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

L.O. 2, 3, 4 **PROBLEM 3-3B** *Effect of Converting Variable to Fixed Costs*

Phillips Company manufactures and sells its own brand of cameras. It sells each camera for \$28. The company's accountant prepared the following data:

Manufacturing costs		
Variable		\$12 per unit
Fixed		\$100,000 per year
Selling and administrative expenses		
Variable		\$4 per unit
Fixed		\$44,000 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 an \$84,000 profit.
- Suppose that variable selling and administrative costs could be eliminated by having a salaried sales force. If the company could sell 20,000 units, how much could it pay in salaries for the salespeople and still have a profit of \$84,000? (*Hint:* Use the equation method.)

PROBLEM 3-4B *Analysis of Change in Sales Price Using the Contribution Margin Ratio***L.O. 2, 3, 4**

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

Sales price	\$20
Contribution margin ratio	15%
Fixed costs	\$72,000 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 an \$18,000 profit, what must the sales be in dollars? in units?
- If the sales price increases to \$25 and variable costs do not change, what will be the new break-even point in units? in dollars?

PROBLEM 3-5B *Analysis of Sales Price and Fixed Cost Using the Equation Method***L.O. 2, 3, 4**

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

Expected variable cost of manufacturing	\$15 per unit
Expected fixed manufacturing costs	\$24,000 per year
Expected sales commission	\$3 per unit
Expected fixed administrative costs	\$6,000 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 \$24, how many units must be sold to break even?
- Baxter has determined that sales will probably be 6,000 units. What sales price per unit will allow the company to break even?
- Baxter has decided to heavily advertise the product and has set the sales price at \$27. If sales are 9,000 units, how much can the company spend on advertising and still break even?

PROBLEM 3-6B *Margin of Safety and Operating Leverage***L.O. 8**

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



	Relevant Information		
	Engine Oil	Coolant	Windshield Washer
Budgeted Sales in Units (a)	35,000	57,000	225,000
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)	\$ 84,000	\$ 162,450	\$ 258,750
Variable Costs (a × c)	(35,000)	(71,250)	(78,750)
Contribution Margin	\$ 49,000	\$ 91,200	\$ 180,000
Fixed Cost	(35,000)	(60,000)	(120,000)
Net Income	\$ 14,000	\$ 31,200	\$ 60,000

Required

- Determine the margin of safety as a percentage for each product.
- Prepare a revised income statement for each product, assuming 20 percent growth in the budgeted sales volume.
- For each product, determine the percentage of 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? Support your answer with appropriate commentary.
- Assuming that management is optimistic and risk aggressive, which product should the company add? Support your answer with appropriate commentary.

L.O. 2, 3, 4, 7, 8 **PROBLEM 3-7B** *Comprehensive CVP Analysis*

Earl Company makes a product that it sells for \$75. Earl incurs annual fixed costs of \$80,000 and variable costs of \$50 each.

Required

The following requirements are interdependent: (For example, the \$20,000 desired profit introduced in Requirement *c* also applies to subsequent requirements. Likewise, the \$70 sales price introduced in Requirement *d* applies to the subsequent requirements.)

- Determine the amount of 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 Earl desires to earn a \$20,000 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 \$70 per unit, how will the reduction of sales price affect the level of sales 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 cost drops to \$70,000, how will the reduction affect the level of sales 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 \$40 per unit, how will reducing the sales price affect the level of sales 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 Earl concludes that it can sell 4,800 units of product for \$68 each. Recall that variable costs are \$40 each and fixed costs amount to \$70,000. Compute the margin of safety in terms of units, dollars, and as a percentage.
- Draw a break-even graph using the cost and price assumptions described in Requirement *g*.

L.O. 2, 3, 4, 7, 8 **PROBLEM 3-8B** *Assessment of Simultaneous Changes in CVP Relationships*

Floyd Company sells tennis racquets; variable costs for each are \$75 and each is sold for \$105. Floyd incurs \$270,000 of fixed operating expenses annually.

Required

- Determine the sales volume in units and dollars required to attain a \$120,000 profit. Verify your answer by preparing an income statement using the contribution-margin format.
- Floyd is considering the possibility of establishing a quality improvement program that 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 \$60,000 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 Floyd 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 that the quality improvement program is initiated.
- Prepare a break-even graph using the cost and price assumptions outlined in Requirement *b*.

APPENDIX

PROBLEM 3-9B *Determination of the Break-Even Point and Margin of Safety for a Company with Multiple Products*

Executive officers of Greta Company have prepared the annual budgets for its two products, X and Y, as follows:

	Product X			Product Y			Total	
	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Per Unit	Budgeted Amount	Budgeted Number	Budgeted Amount
Sales	500	@ \$450 =	\$ 225,000	1,500	@ \$285 =	\$ 427,500	2,000	\$ 652,500
Variable cost	500	@ \$250 =	(125,000)	1,500	@ \$145 =	(217,500)	2,000	(342,500)
Contribution Margin	500	@ \$200 =	\$ 100,000	1,500	@ \$140 =	\$ 210,000	2,000	\$ 310,000
Fixed cost			(31,000)			(124,000)		(155,000)
Net income			\$ 69,000			\$ 86,000		\$ 155,000

Required

- On the basis of the number of units 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 that must be sold 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 on the basis of the combined sales of the two products.

ANALYZE, THINK, COMMUNICATE**BUSINESS APPLICATIONS CASE** *Sales Required to Achieve a Desired Profit*

Peggy Grear just fulfilled a dream as she completed her first season as the owner of a rafting company. Unfortunately, her operation was not profitable. She has enough savings to get her through another season or two, but she realizes that she will have to start making a profit or give up the dream. Her company's income statement for the first year of operation follows.

ACT 3-1

Grear Rafting Company Income Statements For the Year Ended December 31, 2003	
Revenue	\$1,048,000
Rental Cost of Rafts and Camping Equipment	(208,600)
Meals Provided to Rafters	(314,400)
Advertising Expenses	(50,000)
Compensation Paid to Guides	(471,600)
Salary of Office Manager	(16,500)
T-shirts and Hats Provided to Rafters	(31,440)
Office Utility Expense	(3,850)
Net Income (Loss)	\$ (48,390)

Additional Information: Equipment is rented on an annual basis. Additional equipment is not available, nor is an allowance provided for early returns. Guides are paid on a commission basis. Ms. Gear's company served 1,048 rafters during the year.

Required

- Identify the fixed and variable costs relative to the number of rafters.
- Reconstruct the income statement using the contribution-margin approach.
- How many rafters are required for Ms. Gear to earn a \$50,000 profit?
- In discussions with her accountant, Ms. Gear was told to expect a 10 percent increase in fixed cost during the following year. She responded with this question, "If these costs are fixed, why are they going to increase?" Assume that you are the accountant; respond to Ms. Gear's question.
- In addition to the expected increase in fixed cost, the accountant told Ms. Gear to plan for a 20 percent increase in variable cost. On the basis of these increases, how many rafters would be required to earn the \$50,000 desired profit if the price per rafter remains the same?
- Assume that Ms. Gear believes that it is unlikely that she will be able to attract the number of rafters identified in Part *e*. Explain how *sensitivity analysis* could be used to investigate how to attain a \$50,000 profit.

ACT 3-2

GROUP ASSIGNMENT *The Effect of Changes in Fixed and Variable Costs on Profitability*



In a period when sales amounted to 100 units of product, King Manufacturing Company (KMC) produced the following internal income statement:

Revenue	\$ 2,000
Variable Costs	(1,200)
Contribution Margin	<u>\$ 800</u>
Fixed Cost	(600)
Net Income	<u>\$ 200</u>

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

- Increasing fixed advertising costs by \$400, thereby increasing sales by 60 units.
- Lowering commissions paid to the sales staff by \$2 per unit, thereby reducing sales by 5 units.
- Decreasing fixed inventory holding cost by \$200, thereby decreasing sales by 10 units.

Required

- The instructor will divide the class into groups and then organize the groups into two sections. For a large class (e.g., 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 has a disadvantage because having more people complicates communication.

Group Task

The sections are to compete with each other to see which section can determine 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 requires zero defects. A section that turns in a wrong answer is disqualified. Once an answer is 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.

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

WRITING ASSIGNMENT *Operating Leverage, Margin of Safety, and Cost Behaviour***ACT 3-3**

The article “Up Front: More Condensing at the Digest?” in the October 19, 1998, issue of *Business Week* reported that Thomas Ryder, CEO of Reader’s Digest Association, was considering a spinoff of Reader’s Digest’s direct-marketing operations into a joint venture with Time Warner. The article’s author, Robert McNatt, noted that the direct marketing of books, music, and videos is a far larger part of the Reader’s Digest business than is its namesake magazine. Further, the article stated that 1998 direct-marketing sales of \$1.6 billion were down 11 percent from 1997. The decline in revenue caused the division’s operating profits to decline by 58 percent. The article stated that the contemplated alliance with Time Warner could provide some fast help. Gerald Levin, Time Warner chairman, has said that his company’s operations provide customer service and product fulfillment far better than other Web sellers do because of Time Warner’s established 250 Web sites.

Required

- Write a memo explaining how an 11 percent decrease in sales could result in a 58 percent decline in operating profits.
- Provide a brief explanation as to how the decline in revenue will affect the company’s margin of safety.
- Provide a logical explanation as to why a joint venture between Reader’s Digest’s direct-marketing division and Time Warner could work to the advantage of both companies. (*Hint: Consider the effects of fixed-cost behaviour in formulating your response.*)

ETHICAL DILEMMA *Manipulation of Amount of Reported Earnings***ACT 3-4**

The article “Garbage In, Garbage Out” (*Fortune*, May 25, 1998, pp. 130–138) describes a litany of questionable accounting practices that ultimately led to the demise of Waste Management, Inc. Under pressure to retain its reputation on Wall Street as a growth company, Waste Management extended its estimates of the lives of its garbage trucks by two to four years beyond the standard used in the industry. It also began to use a \$25,000 expected salvage value on each truck when the industry standard was to recognize a zero salvage value. Because Waste Management owned approximately 20,000 trucks, these moves had a significant impact on the company’s earnings. Extended lives and exaggerated salvage values were also applied to the company’s 1.5 million steel dumpsters and its landfill facilities. These accounting practices boosted reported earnings by approximately \$110 million per year. The long-term effect on real earnings was disastrous, however; maintenance costs began to soar, and the company was forced to spend millions to keep broken-down trucks on the road. Overvalued assets failed to generate expected revenues. The failure to maintain earnings growth ultimately led to the replacement of management. When the new managers discovered the misstated accounting figures, the company was forced to recognize a pretax charge of \$3.54 billion in its 1997 income statement. The stock price plummeted, and the company was ultimately merged out of existence.

Required

- Did Waste Management manipulate the recognition of fixed or variable costs?
- Explain how extending the life estimates of assets will increase earnings and the book values of assets.
- Explain how inflating the salvage values of assets will increase earnings and the book values of assets.
- Speculate as to what motive would cause executives to manipulate earnings.

ACT 3-5 **SPREADSHEET ASSIGNMENT** *Using Excel*

Ferrell Company has provided the estimated data that appear in Rows 4 to 8 of the following spreadsheet.

Required

Construct a spreadsheet as below that would allow you to determine net income, break-even in units, and the 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.

	A	B	C	D	E	F	G	H	I
1	Chapter 3 - Working with Excel				Name:				
2									
3									
4		Ferrell company forecast for December, 2000							
5		Selling price per unit		\$	12.00				
6		Variable costs per unit			8.00				
7		Fixed costs		\$	40,000				
8		Units sold			20,000				
9									
10		Ferrell Company							
11		Income Statement							
12		For the month of December, 2000							
13									
14		Sales		\$	240,000				
15		Variable costs			160,000				
16		Contribution margin			80,000				
17		Fixed costs			40,000				
18		Net income		\$	40,000				
19									
20									
21		Breakeven in units			10,000				
22		Operating leverage			2.00				
23									

Spreadsheet Tip

To centre a heading across several columns, such as the Income Statement title, highlight the area to be centred (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.

