

LEARNING OBJECTIVES

BUSINESS FOCUS



Chip Conley is CEO of *Joie de Vivre Hospitality*, a company that owns and operates 28 hospitality businesses in northern California. Conley summed up the company's experience after the dot.com crash and 9/11 as follows: "In the history of American hotel markets, no hotel market has ever seen a drop in revenues as precipitous as the one in San Francisco and Silicon Valley in the last two years. On average, hotel revenues . . . dropped 40% to 45%. . . . We've been fortunate that our breakeven point is lower than our competition's. . . . But the problem is that the hotel business is a fixed-cost business. So in an environment where you have those precipitous drops and our costs are moderately fixed, our net incomes—well, they're not incomes anymore, they're losses." ■

Source: Karen Dillon, "Shop Talk," *Inc.* magazine, December 2002, pp. 111–114.

After studying Chapter 6, you should be able to:

- L01** Explain how changes in activity affect contribution margin and net operating income.
- L02** Prepare and interpret a cost-volume-profit (CVP) graph and a profit graph.
- L03** Use the contribution margin ratio (CM ratio) to compute changes in contribution margin and net operating income resulting from changes in sales volume.
- L04** Show the effects on contribution margin of changes in variable costs, fixed costs, selling price, and volume.
- L05** Determine the level of sales needed to achieve a desired target profit.
- L06** Determine the break-even point.
- L07** Compute the margin of safety and explain its significance.
- L08** Compute the degree of operating leverage at a particular level of sales and explain how it can be used to predict changes in net operating income.
- L09** Compute the break-even point for a multiproduct company and explain the effects of shifts in the sales mix on contribution margin and the break-even point.

Cost-volume-profit (CVP) analysis is a powerful tool that helps managers understand the relationships among cost, volume, and profit. CVP analysis focuses on how profits are affected by the following five factors:

1. Selling prices.
2. Sales volume.
3. Unit variable costs.
4. Total fixed costs.
5. Mix of products sold.

Because CVP analysis helps managers understand how profits are affected by these key factors, it is a vital tool in many business decisions. These decisions include what products and services to offer, what prices to charge, what marketing strategy to use, and what cost structure to implement. To help understand the role of CVP analysis in business decisions, consider the case of Acoustic Concepts, Inc., a company founded by Prem Narayan.

MANAGERIAL ACCOUNTING IN ACTION
The Issue



Prem, who was a graduate student in engineering at the time, started Acoustic Concepts to market a radical new speaker he had designed for automobile sound systems. The speaker, called the Sonic Blaster, uses an advanced microprocessor and proprietary software to boost amplification to awesome levels. Prem contracted with a Taiwanese electronics manufacturer to produce the speaker. With seed money provided by his family, Prem placed an order with the manufacturer and ran advertisements in auto magazines.

The Sonic Blaster was an almost immediate success, and sales grew to the point that Prem moved the company's headquarters out of his apartment and into rented quarters in a nearby industrial park. He also hired a receptionist, an accountant, a sales manager, and a small sales staff to sell the speakers to retail stores. The accountant, Bob Luchinni, had worked for several small companies where he had acted as a business advisor as well as accountant and bookkeeper. The following discussion occurred soon after Bob was hired:

Prem: Bob, I've got a lot of questions about the company's finances that I hope you can help answer.

Bob: We're in great shape. The loan from your family will be paid off within a few months.

Prem: I know, but I am worried about the risks I've taken on by expanding operations.

What would happen if a competitor entered the market and our sales slipped? How far could sales drop without putting us into the red? Another question I've been trying to resolve is how much our sales would have to increase to justify the big marketing campaign the sales staff is pushing for.

Bob: Marketing always wants more money for advertising.

Prem: And they are always pushing me to drop the selling price on the speaker. I agree with them that a lower price will boost our volume, but I'm not sure the increased volume will offset the loss in revenue from the lower price.

Bob: It sounds like these questions are all related in some way to the relationships among our selling prices, our costs, and our volume. I shouldn't have a problem coming up with some answers.

Prem: Can we meet again in a couple of days to see what you have come up with?

Bob: Sounds good. By then I'll have some preliminary answers for you as well as a model you can use for answering similar questions in the future.

The Basics of Cost-Volume-Profit (CVP) Analysis

Bob Luchinni's preparation for his forthcoming meeting with Prem begins where our study of cost behavior in the preceding chapter left off—with the contribution income statement. The contribution income statement emphasizes the behavior of costs and therefore is extremely helpful to managers in judging the impact on profits of changes in selling price,

cost, or volume. Bob will base his analysis on the following contribution income statement he prepared last month:

Acoustic Concepts, Inc. Contribution Income Statement For the Month of June		
	Total	Per Unit
Sales (400 speakers)	\$100,000	\$250
Variable expenses	60,000	150
Contribution margin	40,000	\$100
Fixed expenses	35,000	
Net operating income	\$ 5,000	

Notice that sales, variable expenses, and contribution margin are expressed on a per unit basis as well as in total on this contribution income statement. The per unit figures will be very helpful to Bob in some of his calculations. Note that this contribution income statement has been prepared for management's use inside the company and would not ordinarily be made available to those outside the company.

Contribution Margin

As explained in the previous chapter, contribution margin is the amount remaining from sales revenue after variable expenses have been deducted. Thus, it is the amount available to cover fixed expenses and then to provide profits for the period. Notice the sequence here—contribution margin is used *first* to cover the fixed expenses, and then whatever remains goes toward profits. If the contribution margin is not sufficient to cover the fixed expenses, then a loss occurs for the period. To illustrate with an extreme example, assume that Acoustic Concepts sells only one speaker during a particular month. The company's income statement would appear as follows:

Contribution Income Statement Sales of 1 Speaker		
	Total	Per Unit
Sales (1 speaker)	\$ 250	\$250
Variable expenses	150	150
Contribution margin	100	\$100
Fixed expenses	35,000	
Net operating loss	\$(34,900)	

LEARNING OBJECTIVE 1

Explain how changes in activity affect contribution margin and net operating income.



For each additional speaker the company sells during the month, \$100 more in contribution margin becomes available to help cover the fixed expenses. If a second speaker is sold, for example, then the total contribution margin will increase by \$100 (to a total of \$200) and the company's loss will decrease by \$100, to \$34,800:

Contribution Income Statement Sales of 2 Speakers		
	Total	Per Unit
Sales (2 speakers)	\$ 500	\$250
Variable expenses	300	150
Contribution margin	200	\$100
Fixed expenses	35,000	
Net operating loss	\$(34,800)	

If enough speakers can be sold to generate \$35,000 in contribution margin, then all of the fixed expenses will be covered and the company will *break even* for the month—that is, it will show neither profit nor loss but just cover all of its costs. To reach the break-even point, the company will have to sell 350 speakers in a month because each speaker sold yields \$100 in contribution margin:

Contribution Income Statement Sales of 350 Speakers		
	Total	Per Unit
Sales (350 speakers)	\$87,500	\$250
Variable expenses	52,500	150
Contribution margin	35,000	\$100
Fixed expenses	35,000	<u><u></u></u>
Net operating income	\$ 0	<u><u></u></u>

Computation of the break-even point is discussed in detail later in the chapter; for the moment, note that the **break-even point** is the level of sales at which profit is zero.

Once the break-even point has been reached, net operating income will increase by the amount of the unit contribution margin for each additional unit sold. For example, if 351 speakers are sold in a month, then the net operating income for the month will be \$100 because the company will have sold 1 speaker more than the number needed to break even:

Contribution Income Statement Sales of 351 Speakers		
	Total	Per Unit
Sales (351 speakers)	\$87,750	\$250
Variable expenses	52,650	150
Contribution margin	35,100	\$100
Fixed expenses	35,000	<u><u></u></u>
Net operating income	\$ 100	<u><u></u></u>

If 352 speakers are sold (2 speakers above the break-even point), the net operating income for the month will be \$200. If 353 speakers are sold (3 speakers above the break-even point), the net operating income for the month will be \$300, and so forth. To estimate the profit at any sales volume above the break-even point, simply multiply the number of units sold in excess of the break-even point by the unit contribution margin. The result represents the anticipated profits for the period. Or, to estimate the effect of a planned increase in sales on profits, simply multiply the increase in units sold by the unit contribution margin. The result will be the expected increase in profits. To illustrate, if Acoustic Concepts is currently selling 400 speakers per month and plans to increase sales to 425 speakers per month, the anticipated impact on profits can be computed as follows:

Increased number of speakers to be sold	25
Contribution margin per speaker	$\times \$100$
Increase in net operating income	<u><u>\$2,500</u></u>

These calculations can be verified as follows:

	Sales Volume		Difference (25 Speakers)	Per Unit
	400 Speakers	425 Speakers		
Sales (@ \$250 per speaker)	\$100,000	\$106,250	\$6,250	\$250
Variable expenses (@ \$150 per speaker)	60,000	63,750	3,750	150
Contribution margin	40,000	42,500	2,500	\$100
Fixed expenses	35,000	35,000	0	
Net operating income	\$ 5,000	\$ 7,500	\$2,500	

To summarize, if sales are zero, the company's loss would equal its fixed expenses. Each unit that is sold reduces the loss by the amount of the unit contribution margin. Once the break-even point has been reached, each additional unit sold increases the company's profit by the amount of the unit contribution margin.

CVP Relationships in Equation Form

The contribution format income statement can be expressed in equation form as follows:

$$\text{Profit} = (\text{Sales} - \text{Variable expenses}) - \text{Fixed expenses}$$

For brevity, we use the term profit to stand for net operating income in equations.

When a company has only a *single* product, as at Acoustic Concepts, we can further refine the equation as follows:

$$\text{Sales} = \text{Selling price per unit} \times \text{Quantity sold} = P \times Q$$

$$\text{Variable expenses} = \text{Variable expenses per unit} \times \text{Quantity sold} = V \times Q$$

$$\text{Profit} = (P \times Q - V \times Q) - \text{Fixed expenses}$$

We can do all of the calculations of the previous section using this simple equation. For example, on page 236 we computed that the net operating income (profit) at sales of 351 speakers would be \$100. We can arrive at the same conclusion using the above equation as follows:

$$\text{Profit} = (P \times Q - V \times Q) - \text{Fixed expenses}$$

$$\text{Profit} = (\$250 \times 351 - \$150 \times 351) - \$35,000$$

$$= (\$250 - \$150) \times 351 - \$35,000$$

$$= (\$100) \times 351 - \$35,000$$

$$= \$35,100 - \$35,000 = \$100$$

It is often useful to express the simple profit equation in terms of the unit contribution margin (Unit CM) as follows:

$$\text{Unit CM} = \text{Selling price per unit} - \text{Variable expenses per unit} = P - V$$

$$\text{Profit} = (P \times Q - V \times Q) - \text{Fixed expenses}$$

$$\text{Profit} = (P - V) \times Q - \text{Fixed expenses}$$

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$

We could also have used this equation to determine the profit at sales of 351 speakers as follows:

$$\begin{aligned}\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ &= \$100 \times 351 - \$35,000 \\ &= \$35,100 - \$35,000 = \$100\end{aligned}$$

For those who are comfortable with algebra, the quickest and easiest approach to solving the problems in this chapter may be to use the simple profit equation in one of its forms.

CVP Relationships in Graphic Form

LEARNING OBJECTIVE 2

Prepare and interpret a cost-volume-profit (CVP) graph and a profit graph.



The relationships among revenue, cost, profit, and volume are illustrated on a **cost-volume-profit (CVP) graph**. A CVP graph highlights CVP relationships over wide ranges of activity. To help explain his analysis to Prem Narayan, Bob Luchinni prepared a CVP graph for Acoustic Concepts.

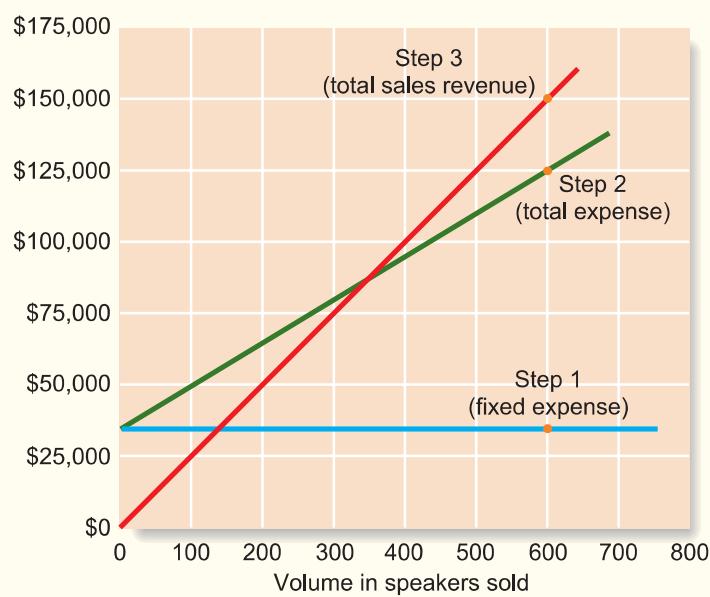
Preparing the CVP Graph In a CVP graph (sometimes called a *break-even chart*), unit volume is represented on the horizontal (X) axis and dollars on the vertical (Y) axis. Preparing a CVP graph involves three steps as depicted in Exhibit 6–1:

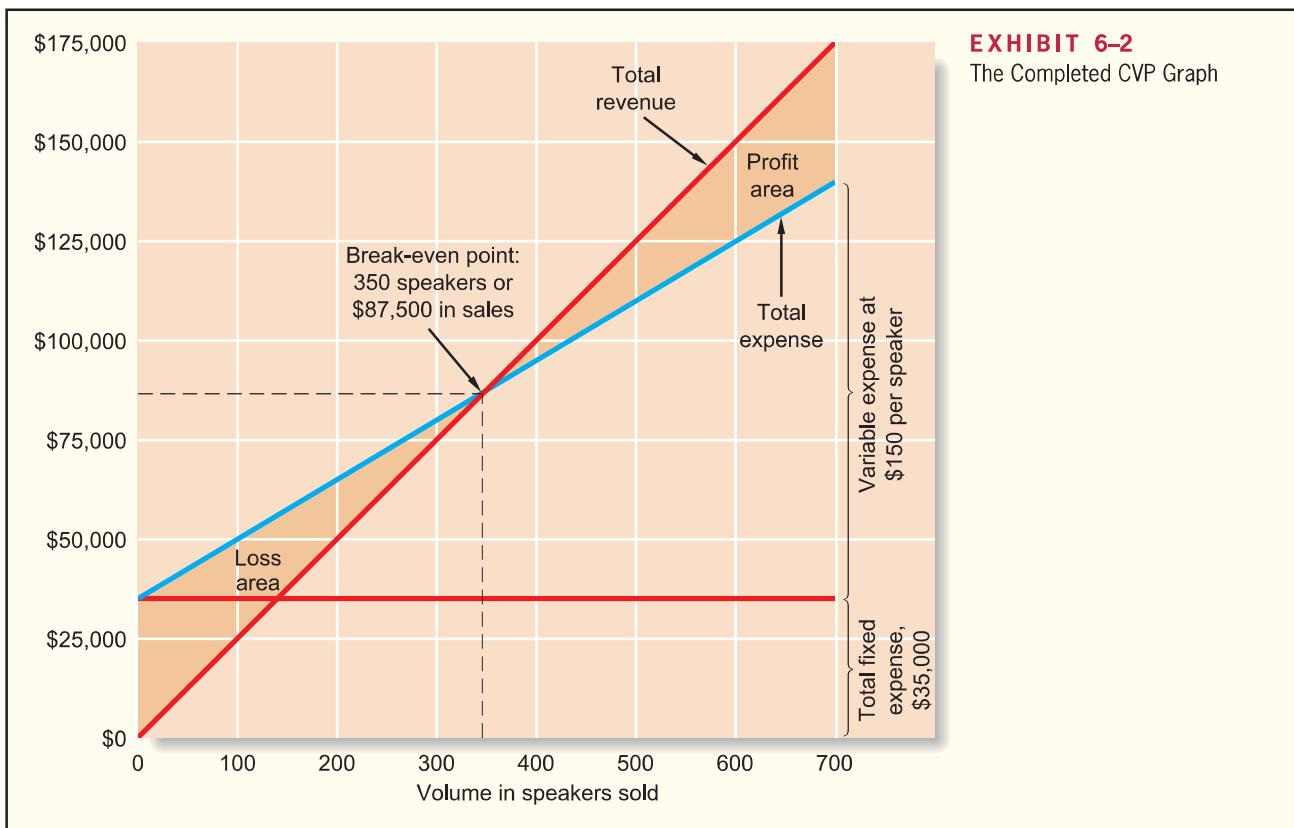
1. Draw a line parallel to the volume axis to represent total fixed expense. For Acoustic Concepts, total fixed expenses are \$35,000.
2. Choose some volume of unit sales and plot the point representing total expense (fixed and variable) at the sales volume you have selected. In Exhibit 6–1, Bob Luchinni chose a volume of 600 speakers. Total expense at that sales volume is:

Fixed expense	\$ 35,000
Variable expense (600 speakers \times \$150 per speaker)	90,000
Total expense	<u><u>\$125,000</u></u>

EXHIBIT 6–1

Preparing the CVP Graph





After the point has been plotted, draw a line through it back to the point where the fixed expense line intersects the dollars axis.

- Again choose some sales volume and plot the point representing total sales dollars at the activity level you have selected. In Exhibit 6–1, Bob Luchinni again chose a volume of 600 speakers. Sales at that sales volume total \$150,000 ($600 \text{ speakers} \times \250 per speaker). Draw a line through this point back to the origin.

The interpretation of the completed CVP graph is given in Exhibit 6–2. The anticipated profit or loss at any given level of sales is measured by the vertical distance between the total revenue line (sales) and the total expense line (variable expense plus fixed expense).

The break-even point is where the total revenue and total expense lines cross. The break-even point of 350 speakers in Exhibit 6–2 agrees with the break-even point computed earlier.

As discussed earlier, when sales are below the break-even point—in this case, 350 units—the company suffers a loss. Note that the loss (represented by the vertical distance between the total expense and total revenue lines) gets bigger as sales decline. When sales are above the break-even point, the company earns a profit and the size of the profit (represented by the vertical distance between the total revenue and total expense lines) increases as sales increase.

An even simpler form of the CVP graph, which we call a profit graph, is presented in Exhibit 6–3. That graph is based on the following equation:

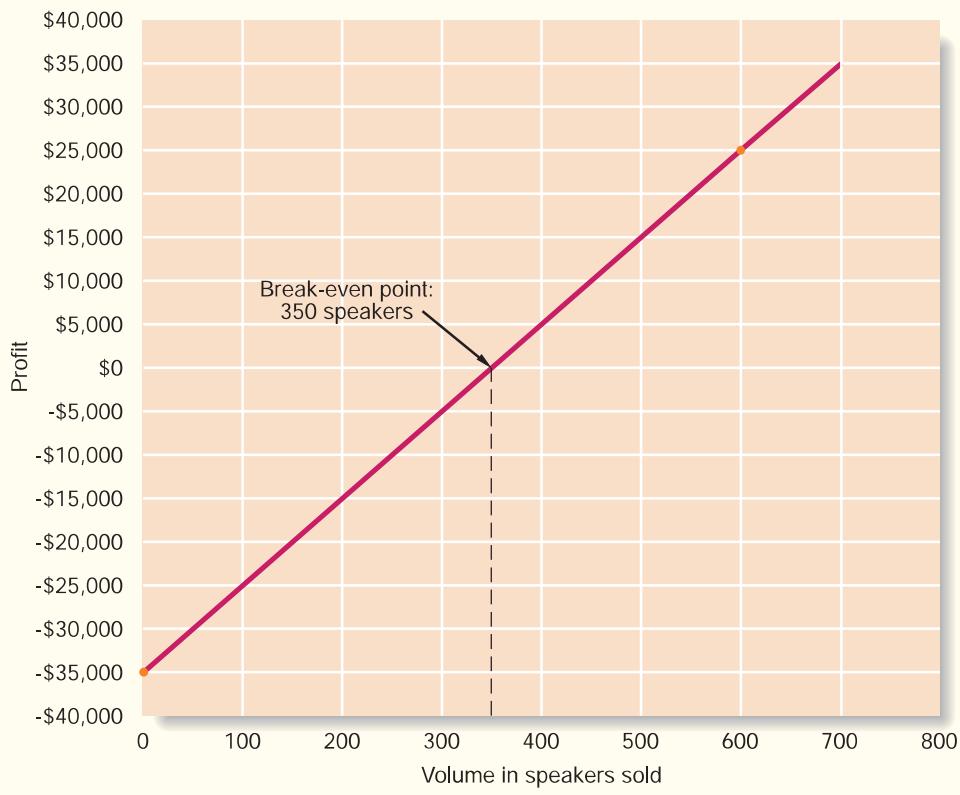
$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$

In the case of Acoustic Concepts, the equation can be expressed as:

$$\text{Profit} = \$100 \times Q - \$35,000$$

EXHIBIT 6-3

The Profit Graph



Because this is a linear equation, it plots as a single straight line. To plot the line, compute the profit at two different sales volumes, plot the points, and then connect them with a straight line. For example, when the sales volume is zero (i.e., $Q = 0$), the profit is $-\$35,000$ ($= \$100 \times 0 - \$35,000$). When Q is 600, the profit is $\$25,000$ ($= \$100 \times 600 - \$35,000$). These two points are plotted in Exhibit 6-3 and a straight line has been drawn through them.

The break-even point on the profit graph is the volume of sales at which profit is zero and is indicated by the dashed line on the graph. Note that the profit steadily increases to the right of the break-even point as the sales volume increases and that the loss becomes steadily worse to the left of the break-even point as the sales volume decreases.

Contribution Margin Ratio (CM Ratio)

LEARNING OBJECTIVE 3

Use the contribution margin ratio (CM ratio) to compute changes in contribution margin and net operating income resulting from changes in sales volume.



In the previous section, we explored how cost-volume-profit relationships can be visualized. In this section, we show how the *contribution margin ratio* can be used in cost-volume-profit calculations. As the first step, we have added a column to Acoustic Concepts' contribution format income statement in which sales revenues, variable expenses, and contribution margin are expressed as a percentage of sales:

	Total	Per Unit	Percent of Sales
Sales (400 speakers)	\$100,000	\$250	100%
Variable expenses	60,000	150	60%
Contribution margin	40,000	\$100	40%
Fixed expenses	35,000	<u> </u>	<u> </u>
Net operating income	\$ 5,000	<u> </u>	<u> </u>

The contribution margin as a percentage of sales is referred to as the **contribution margin ratio (CM ratio)**. This ratio is computed as follows:

$$\text{CM ratio} = \frac{\text{Contribution margin}}{\text{Sales}}$$

For Acoustic Concepts, the computations are:

$$\text{CM ratio} = \frac{\text{Total contribution margin}}{\text{Total sales}} = \frac{\$40,000}{\$100,000} = 40\%$$

In a company such as Acoustic Concepts that has only one product, the CM ratio can also be computed on a per unit basis as follows:

$$\text{CM ratio} = \frac{\text{Unit contribution margin}}{\text{Unit selling price}} = \frac{\$100}{\$250} = 40\%$$

The CM ratio shows how the contribution margin will be affected by a change in total sales. Acoustic Concepts' CM ratio of 40% means that for each dollar increase in sales, total contribution margin will increase by 40 cents ($\$1 \text{ sales} \times \text{CM ratio of } 40\%$). Net operating income will also increase by 40 cents, assuming that fixed costs are not affected by the increase in sales.

As this illustration suggests, *the impact on net operating income of any given dollar change in total sales can be computed by simply applying the CM ratio to the dollar change*. For example, if Acoustic Concepts plans a \$30,000 increase in sales during the coming month, the contribution margin should increase by \$12,000 ($\$30,000 \text{ increase in sales} \times \text{CM ratio of } 40\%$). As we noted above, net operating income will also increase by \$12,000 if fixed costs do not change. This is verified by the following table:

	Sales Volume			Percent of Sales
	Present	Expected	Increase	
Sales	\$100,000	\$130,000	\$30,000	100%
Variable expenses	60,000	78,000*	18,000	60%
Contribution margin	40,000	52,000	12,000	40%
Fixed expenses	35,000	35,000	0	—
Net operating income	\$ 5,000	\$ 17,000	\$12,000	

*\$130,000 expected sales ÷ \$250 per unit = 520 units. 520 units × \$150 per unit = \$78,000.

The relation between profit and the CM ratio can also be expressed using the following equation:

$$\text{Profit} = \text{CM ratio} \times \text{Sales} - \text{Fixed expenses}^1$$

For example, at sales of \$130,000, the profit is expected to be \$17,000 as shown below:

$$\begin{aligned}\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ &= 0.40 \times \$130,000 - \$35,000 \\ &= \$52,000 - \$35,000 = \$17,000\end{aligned}$$

¹ This equation can be derived using the basic profit equation and the definition of the CM ratio as follows:

$$\text{Profit} = (\text{Sales} - \text{Variable expenses}) - \text{Fixed expenses}$$

$$\text{Profit} = \text{Contribution margin} - \text{Fixed expenses}$$

$$\text{Profit} = \frac{\text{Contribution margin}}{\text{Sales}} \times \text{Sales} - \text{Fixed expense}$$

$$\text{Profit} = \text{CM ratio} \times \text{Sales} - \text{Fixed expenses}$$

Again, if you are comfortable with algebra, this approach will often be quicker and easier than constructing contribution format income statements.

The CM ratio is particularly valuable in situations where the dollar sales of one product must be traded off against the dollar sales of another product. In this situation, products that yield the greatest amount of contribution margin per dollar of sales should be emphasized.

Some Applications of CVP Concepts

LEARNING OBJECTIVE 4

Show the effects on contribution margin of changes in variable costs, fixed costs, selling price, and volume.



	Per Unit	Percent of Sales
Selling price	\$250	100%
Variable expenses	150	60%
Contribution margin	<u>\$100</u>	<u>40%</u>

Recall that fixed expenses are \$35,000 per month. Bob Luchinni will use these data to show the effects of changes in variable costs, fixed costs, sales price, and sales volume on the company's profitability in a variety of situations.

Before proceeding further, however, we need to introduce another concept—the *variable expense ratio*. The **variable expense ratio** is the ratio of variable expenses to sales. It can be computed by dividing the total variable expenses by the total sales, or in a single product analysis, it can be computed by dividing the variable expenses per unit by the unit selling price. In the case of Acoustic Concepts, the variable expense ratio is 0.60; that is, variable expense is 60% of sales.

Change in Fixed Cost and Sales Volume Acoustic Concepts is currently selling 400 speakers per month at \$250 per speaker for total monthly sales of \$100,000. The sales manager feels that a \$10,000 increase in the monthly advertising budget would increase monthly sales by \$30,000 to a total of 520 units. Should the advertising budget be increased? The following table shows the financial impact of the proposed change in the monthly advertising budget:

	Current Sales	Sales with Additional Advertising Budget	Difference	Percent of Sales
Sales	\$100,000	\$130,000	\$30,000	100%
Variable expenses	60,000	78,000*	18,000	60%
Contribution margin	40,000	52,000	12,000	40%
Fixed expenses	35,000	45,000†	10,000	
Net operating income	<u>\$ 5,000</u>	<u>\$ 7,000</u>	<u>\$ 2,000</u>	

*520 units × \$150 per unit = \$78,000.
†\$35,000 + additional \$10,000 monthly advertising budget = \$45,000.

Assuming no other factors need to be considered, the increase in the advertising budget should be approved because it would increase net operating income by \$2,000. There are two shorter ways to arrive at this solution. The first alternative solution follows:

Alternative Solution 1

Expected total contribution margin:	
\$130,000 × 40% CM ratio	\$52,000
Present total contribution margin:	
\$100,000 × 40% CM ratio	40,000
Incremental contribution margin	12,000
Change in fixed expenses:	
Less incremental advertising expense	10,000
Increased net operating income	\$ 2,000

Because in this case only the fixed costs and the sales volume change, the solution can be presented in an even shorter format, as follows:

Alternative Solution 2

Incremental contribution margin:	
\$30,000 × 40% CM ratio	\$12,000
Less incremental advertising expense	10,000
Increased net operating income	\$ 2,000

Notice that this approach does not depend on knowledge of previous sales. Also note that it is unnecessary under either shorter approach to prepare an income statement. Both of the alternative solutions involve an **incremental analysis**—they consider only those items of revenue, cost, and volume that will change if the new program is implemented. Although in each case a new income statement could have been prepared, the incremental approach is simpler and more direct and focuses attention on the specific changes that would occur as a result of the decision.

Change in Variable Costs and Sales Volume Refer to the original data. Recall that Acoustic Concepts is currently selling 400 speakers per month. Prem is considering the use of higher-quality components, which would increase variable costs (and thereby reduce the contribution margin) by \$10 per speaker. However, the sales manager predicts that using higher-quality components would increase sales to 480 speakers per month. Should the higher-quality components be used?

The \$10 increase in variable costs would decrease the unit contribution margin by \$10—from \$100 down to \$90.

Solution

Expected total contribution margin with higher-quality components:	
480 speakers × \$90 per speaker	\$43,200
Present total contribution margin:	
400 speakers × \$100 per speaker	40,000
Increase in total contribution margin	\$ 3,200

According to this analysis, the higher-quality components should be used. Because fixed costs would not change, the \$3,200 increase in contribution margin shown above should result in a \$3,200 increase in net operating income.

IN BUSINESS

GROWING SALES AT AMAZON.COM

Amazon.com was deciding between two tactics for growing sales and profits. The first approach was to invest in television advertising. The second approach was to offer free shipping on larger orders. To evaluate the first option, Amazon.com invested in television ads in two markets—Minneapolis, Minnesota, and Portland, Oregon. The company quantified the profit impact of this choice by subtracting the increase in fixed advertising costs from the increase in contribution margin. The profit impact of television advertising paled in comparison to the free “super saver shipping” program, which the company introduced on orders over \$99. In fact, the free shipping option proved to be so popular and profitable that within two years Amazon.com dropped its qualifying threshold to \$49 and then again to a mere \$25. At each stage of this progression, Amazon.com used cost-volume-profit analysis to determine whether the extra volume from liberalizing the free shipping offer more than offset the associated increase in shipping costs.

Source: Rob Walker, “Because ‘Optimism is Essential,’” *Inc.* magazine, April 2004 pp. 149–150.

Change in Fixed Cost, Sales Price, and Sales Volume Refer to the original data and recall again that Acoustic Concepts is currently selling 400 speakers per month. To increase sales, the sales manager would like to cut the selling price by \$20 per speaker and increase the advertising budget by \$15,000 per month. The sales manager believes that if these two steps are taken, unit sales will increase by 50% to 600 speakers per month. Should the changes be made?

A decrease in the selling price of \$20 per speaker would decrease the unit contribution margin by \$20 down to \$80.

Solution

Expected total contribution margin with lower selling price:	
600 speakers × \$80 per speaker	\$48,000
Present total contribution margin:	
400 speakers × \$100 per speaker	40,000
Incremental contribution margin	8,000
Change in fixed expenses:	
Less incremental advertising expense	15,000
Reduction in net operating income	\$ (7,000)

According to this analysis, the changes should not be made. The \$7,000 reduction in net operating income that is shown above can be verified by preparing comparative income statements as follows:

	Present 400 Speakers per Month		Expected 600 Speakers per Month		Difference
	Total	Per Unit	Total	Per Unit	
Sales	\$100,000	\$250	\$138,000	\$230	\$38,000
Variable expenses	60,000	150	90,000	150	30,000
Contribution margin	40,000	\$100	48,000	\$ 80	8,000
Fixed expenses	35,000		50,000*		15,000
Net operating income (loss) \$	5,000		(2,000)		\$ (7,000)

*\$35,000 + Additional monthly advertising budget of \$15,000 = \$50,000.

IN BUSINESS

DELTA ATTEMPTS TO BOOST TICKET SALES

The United States Transportation Department ranked the Cincinnati/Northern Kentucky International Airport (CNK) as the second most expensive airport in the country. Because of its high ticket prices, CNK airport officials estimated that they were losing 28% of Cincinnati-area travelers—about 2,500 people per day—to five surrounding airports that offered lower fares. **Delta Airlines**, which has 90% of the traffic at CNK, attempted to improve the situation by introducing SimpliFares. The program, which Delta touted with a \$2 million media campaign, not only lowered fares but also reduced the ticket change fee from \$100 to \$50. From a cost-volume-profit standpoint, Delta was hoping that the increase in discretionary fixed advertising costs and the decrease in sales revenue realized from lower ticket prices would be more than offset by an increase in sales volume.

Source: James Pilcher, "New Delta Fares Boost Ticket Sales," *The Cincinnati Enquirer*, September 3, 2004, pp. A1 and A12.

Change in Variable Cost, Fixed Cost, and Sales Volume Refer to Acoustic Concepts' original data. As before, the company is currently selling 400 speakers per month. The sales manager would like to pay salespersons a sales commission of \$15 per speaker sold, rather than the flat salaries that now total \$6,000 per month. The sales manager is confident that the change would increase monthly sales by 15% to 460 speakers per month. Should the change be made?

Solution Changing the sales staff's compensation from salaries to commissions would affect both fixed and variable expenses. Fixed expenses would decrease by \$6,000, from \$35,000 to \$29,000. Variable expenses per unit would increase by \$15, from \$150 to \$165, and the unit contribution margin would decrease from \$100 to \$85.

Expected total contribution margin with sales staff on commissions:	
460 speakers × \$85 per speaker	\$39,100
Present total contribution margin:	
400 speakers × \$100 per speaker	<u>40,000</u>
Decrease in total contribution margin	(900)
Change in fixed expenses:	
Add salaries avoided if a commission is paid	<u>6,000</u>
Increase in net operating income	<u><u>\$ 5,100</u></u>

According to this analysis, the changes should be made. Again, the same answer can be obtained by preparing comparative income statements:

	Present 400 Speakers per Month		Expected 460 Speakers per Month		Difference
	Total	Per Unit	Total	Per Unit	
Sales.	\$100,000	\$250	\$115,000	\$250	\$15,000
Variable expenses.	<u>60,000</u>	<u>150</u>	<u>75,900</u>	<u>165</u>	<u>15,900</u>
Contribution margin.	40,000	\$100	39,100	\$ 85	900
Fixed expenses.	<u>35,000</u>	<u> </u>	<u>29,000</u>	<u> </u>	<u>(6,000)*</u>
Net operating income	<u><u>\$ 5,000</u></u>		<u><u>\$ 10,100</u></u>		<u><u>\$ 5,100</u></u>

*Note: A reduction in fixed expenses has the effect of increasing net operating income.

Change in Selling Price Refer to the original data where Acoustic Concepts is currently selling 400 speakers per month. The company has an opportunity to make a bulk sale of 150 speakers to a wholesaler if an acceptable price can be negotiated. This sale would not disturb the company's regular sales and would not affect the company's total fixed expenses. What price per speaker should be quoted to the wholesaler if Acoustic Concepts wants to increase its total monthly profits by \$3,000?

Solution

Variable cost per speaker	\$150
Desired profit per speaker:	
$\$3,000 \div 150 \text{ speakers}$	<u>20</u>
Quoted price per speaker.	<u><u>\$170</u></u>

Notice that fixed expenses are not included in the computation. This is because fixed expenses are not affected by the bulk sale, so all of the additional contribution margin increases the company's profits.

Target Profit and Break-Even Analysis

Target profit analysis and break-even analysis are used to answer questions such as how much would we have to sell to make a profit of \$10,000 per month or how much would we have to sell to avoid incurring a loss?

Target Profit Analysis

LEARNING OBJECTIVE 5
Determine the level of sales needed to achieve a desired target profit.

One of the key uses of CVP analysis is called *target profit analysis*. In **target profit analysis**, we estimate what sales volume is needed to achieve a specific target profit. For example, suppose that Prem Narayan of Acoustic Concepts would like to know what sales would have to be to attain a target profit of \$40,000 per month. To answer this question, we can proceed using the equation method or the formula method.



The Equation Method We can use a basic profit equation to find the sales volume required to attain a target profit. In the case of Acoustic Concepts, the company has only one product so we can use the contribution margin form of the equation. Remembering that the target profit is \$40,000, the unit contribution margin is \$100, and the fixed expense is \$35,000, we can solve as follows:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expense} \\ \$40,000 &= \$100 \times Q - \$35,000 \\ \$100 \times Q &= \$40,000 + \$35,000 \\ Q &= (\$40,000 + \$35,000) \div \$100 \\ Q &= 750 \end{aligned}$$

Thus, the target profit can be achieved by selling 750 speakers per month.

The Formula Method The formula method is a short-cut version of the equation method. Note that in the next to the last line of the above solution, the sum of the target profit of \$40,000 and the fixed expense of \$35,000 is divided by the unit contribution margin of \$100. In general, in a single-product situation, we can compute

the sales volume required to attain a specific target profit using the following formula:

$$\text{Unit sales to attain the target profit} = \frac{\text{Target profit} + \text{Fixed expenses}^2}{\text{Unit CM}}$$

In the case of Acoustic Concepts, the formula yields the following answer:

$$\begin{aligned}\text{Unit sales to attain the target profit} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit CM}} \\ &= \frac{\$40,000 + \$35,000}{\$100} \\ &= 750\end{aligned}$$

Note that this is the same answer we got when we used the equation method—and it always will be. The formula method simply skips a few steps in the equation method.

Target Profit Analysis in Terms of Sales Dollars Instead of unit sales, we may want to know what dollar sales are needed to attain the target profit. We can get this answer using several methods. First, we could solve for the unit sales to attain the target profit using the equation method or the formula method and then multiply the result by the selling price. In the case of Acoustic Concepts, the required sales volume using this approach would be computed as $750 \text{ speakers} \times \250 per speaker or \$187,500 in total sales.

We can also solve for the required sales volume to attain the target profit of \$40,000 at Acoustic Concepts using the basic equation stated in terms of the contribution margin ratio:

$$\begin{aligned}\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \$40,000 &= 0.40 \times \text{Sales} - \$35,000 \\ 0.40 \times \text{Sales} &= \$40,000 + \$35,000 \\ \text{Sales} &= (\$40,000 + \$35,000) \div 0.40 \\ \text{Sales} &= \$187,500\end{aligned}$$

Note that in the next to the last line of the above solution, the sum of the target profit of \$40,000 and the fixed expense of \$35,000 is divided by the contribution margin ratio of 0.40. In general, we can compute dollar sales to attain a target profit as follows:

$$\text{Dollar sales to attain a target profit} = \frac{\text{Target profit} + \text{Fixed expenses}^3}{\text{CM ratio}}$$

² This equation can be derived as follows:

$$\begin{aligned}\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \text{Target profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \text{Unit CM} \times Q &= \text{Target profit} + \text{Fixed expenses} \\ Q &= (\text{Target profit} + \text{Fixed expenses}) \div \text{Unit CM}\end{aligned}$$

³ This equation can be derived as follows:

$$\begin{aligned}\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \text{Target profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \text{CM ratio} \times \text{Sales} &= \text{Target profit} + \text{Fixed expenses} \\ \text{Sales} &= (\text{Target profit} + \text{Fixed expenses}) \div \text{CM ratio}\end{aligned}$$

At Acoustic Concepts, the formula yields the following answer:

$$\begin{aligned}\text{Dollar sales to attain a target profit} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{CM ratio}} \\ &= \frac{\$40,000 + \$35,000}{\$0.40} \\ &= \$187,500\end{aligned}$$

Again, you get exactly the same answer whether you use the equation method or just use the formula.

In companies with multiple products, sales volume is more conveniently expressed in terms of total sales dollars than in terms of unit sales. The contribution margin ratio approach to target profit analysis is particularly useful for such companies.

Break-Even Analysis

LEARNING OBJECTIVE 6

Determine the break-even point.



Earlier in the chapter we defined the break-even point as the level of sales at which the company's profit is zero. What we call *break-even analysis* is really just a special case of target profit analysis in which the target profit is zero. We can use either the equation method or the formula method to solve for the break-even point, but for brevity we will illustrate just the formula method. The equation method works exactly like it did in target profit analysis. The only difference is that the target profit is zero in break-even analysis.

Break-Even in Unit Sales In a single product situation, recall that the formula for the unit sales to attain a specific target profit is:

$$\text{Unit sales to attain the target profit} = \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit CM}}$$

To compute the unit sales to break even, all we have to do is to set the target profit to zero in the above equation as follows:

$$\text{Unit sales to break even} = \frac{\$0 + \text{Fixed expenses}}{\text{Unit CM}}$$

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit CM}}$$

In the case of Acoustic Concepts, the break-even point can be computed as follows:

$$\begin{aligned}\text{Unit sales to break even} &= \frac{\text{Fixed expenses}}{\text{Unit CM}} \\ &= \frac{\$35,000}{\$100} \\ &= 350\end{aligned}$$

Thus, as we determined earlier in the chapter, Acoustic Concepts breaks even at sales of 350 speakers per month.

IN BUSINESS

COSTS ON THE INTERNET



The company [eToys](#), which sells toys over the Internet, lost \$190 million in 1999 on sales of \$151 million. One big cost was advertising. eToys spent about \$37 on advertising for each \$100 of sales. (Other e-tailers were spending even more—in some cases, up to \$460 on advertising for each \$100 in sales!)

eToys did have some advantages relative to bricks-and-mortar stores such as Toys "R" Us. eToys had much lower inventory costs because it only needed to keep on hand one or two of a slow-moving item, whereas a traditional store has to fully stock its shelves. And bricks-and-mortar retail spaces in malls and elsewhere do cost money—on average, about 7% of sales. However, e-tailers such as eToys have their own set of disadvantages. Customers "pick and pack" their own items at a bricks-and-mortar outlet, but e-tailers have to pay employees to carry out this task. This costs eToys about \$33 for every \$100 in sales. And the technology to sell over the Internet is not free. eToys spent about \$29 on its website and related technology for every \$100 in sales. However, many of these costs of selling over the Internet are fixed. Toby Lenk, the CEO of eToys, estimated that the company would pass its break-even point somewhere between \$750 and \$900 million in sales—representing less than 1% of the market for toys. eToys did not make this goal and laid off 70% of its employees in January 2001. Subsequently, eToys was acquired by KBToys.com.

Sources: Erin Kelly, "The Last e-Store on the Block," *Fortune*, September 18, 2000, pp. 214–220; Jennifer Couzin, *The Industry Standard*, January 4, 2001.

Break-Even in Sales Dollars We can find the break-even point in sales dollars using several methods. First, we could solve for the break-even point in unit sales using the equation method or the formula method and then multiply the result by the selling price. In the case of Acoustic Concepts, the break-even point in sales dollars using this approach would be computed as $350 \text{ speakers} \times \$250 \text{ per speaker} = \$87,500$ in total sales.

We can also solve for the break-even point in sales dollars at Acoustic Concepts using the basic profit equation stated in terms of the contribution margin ratio or we can use the formula for the target profit. Again, for brevity, we will use the formula.

$$\text{Dollar sales to attain a target profit} = \frac{\text{Target profit} + \text{Fixed expenses}}{\text{CM ratio}}$$

$$\text{Dollar sales to break even} = \frac{\$0 + \text{Fixed expenses}}{\text{CM ratio}}$$

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

The break-even point at Acoustic Concepts would be computed as follows:

$$\begin{aligned}\text{Dollar sales to break even} &= \frac{\text{Fixed expenses}}{\text{CM ratio}} \\ &= \frac{\$35,000}{0.40} \\ &= \$87,500\end{aligned}$$

COST OVERRUNS INCREASE THE BREAK-EVEN POINT

When **Airbus** launched the A380 555-seat jetliner in 2000 the company said it would need to sell 250 units to break even on the project. By 2006, Airbus was admitting that more than \$3 billion of cost overruns had raised the project's break-even point to 420 airplanes. Although Airbus has less than 170 orders for the A380, the company remains optimistic that it will sell 751 units over the next 20 years. Given that Airbus rival **Boeing** predicts the total market size for all airplanes with more than 400 seats will not exceed 990 units, it remains unclear if Airbus will ever break even on its investment in the A380 aircraft.

Source: Daniel Michaels, "Embattled Airbus Lifts Sales Target for A380 to Profit," *The Wall Street Journal*, October 20, 2006, p. A6.

IN BUSINESS



The Margin of Safety

LEARNING OBJECTIVE 7

Compute the margin of safety and explain its significance.



$$\text{Margin of safety in dollars} = \text{Total budgeted (or actual) sales} - \text{Break-even sales}$$

The margin of safety can also be expressed in percentage form by dividing the margin of safety in dollars by total dollar sales:

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Total budgeted (or actual) sales in dollars}}$$

The calculation of the margin of safety for Acoustic Concepts is:

Sales (at the current volume of 400 speakers) (a)	\$100,000
Break-even sales (at 350 speakers)	87,500
Margin of safety in dollars (b)	\$ 12,500
Margin of safety percentage, (b) ÷ (a)	12.5%

This margin of safety means that at the current level of sales and with the company's current prices and cost structure, a reduction in sales of \$12,500, or 12.5%, would result in just breaking even.

In a single-product company like Acoustic Concepts, the margin of safety can also be expressed in terms of the number of units sold by dividing the margin of safety in dollars by the selling price per unit. In this case, the margin of safety is 50 speakers ($\$12,500 \div \250 per speaker = 50 speakers).

IN BUSINESS



COMPUTING MARGIN OF SAFETY FOR A SMALL BUSINESS

Sam Calagione owns **Dogfish Head Craft Brewery**, a microbrewery in Rehoboth Beach, Delaware. He charges distributors as much as \$100 per case for his premium beers such as World Wide Stout. The high-priced microbrews bring in \$800,000 in operating income on revenue of \$7 million. Calagione reports that his raw ingredients and labor costs for one case of World Wide Stout are \$30 and \$16, respectively. Bottling and packaging costs are \$6 per case. Gas and electric costs are about \$10 per case.

If we assume that World Wide Stout is representative of all Dogfish microbrews, then we can compute the company's margin of safety in five steps. First, variable cost as a percentage of sales is 62% $[(\$30 + \$16 + \$6 + \$10) / \$100]$. Second, the contribution margin ratio is 38% $(1 - 0.62)$. Third, Dogfish's total fixed cost is \$1,860,000 $[(\$7,000,000 \times 0.38) - \$800,000]$. Fourth, the break-even point in sales dollars is \$4,894,737 $(\$1,860,000 / 0.38)$. Fifth, the margin of safety is \$2,105,263 $(\$7,000,000 - \$4,894,737)$.

Source: Patricia Huang, "Château Dogfish," *Forbes*, February 28, 2005, pp. 57–59.

Prem Narayan and Bob Luchinni met to discuss the results of Bob's analysis.

Prem: Bob, everything you have shown me is pretty clear. I can see what impact some of the sales manager's suggestions would have on our profits. Some of those suggestions

are quite good and others are not so good. I am concerned that our margin of safety is only 50 speakers. What can we do to increase this number?

Bob: Well, we have to increase total sales or decrease the break-even point or both.

Prem: And to decrease the break-even point, we have to either decrease our fixed expenses or increase our unit contribution margin?

Bob: Exactly.

Prem: And to increase our unit contribution margin, we must either increase our selling price or decrease the variable cost per unit?

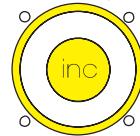
Bob: Correct.

Prem: So what do you suggest?

Bob: Well, the analysis doesn't tell us which of these to do, but it does indicate we have a potential problem here.

Prem: If you don't have any immediate suggestions, I would like to call a general meeting next week to discuss ways we can work on increasing the margin of safety. I think everyone will be concerned about how vulnerable we are to even small downturns in sales.

ACOUSTIC concepts



CVP Considerations in Choosing a Cost Structure

Cost structure refers to the relative proportion of fixed and variable costs in an organization. Managers often have some latitude in trading off between these two types of costs. For example, fixed investments in automated equipment can reduce variable labor costs. In this section, we discuss the choice of a cost structure. We also introduce the concept of *operating leverage*.

Cost Structure and Profit Stability

Which cost structure is better—high variable costs and low fixed costs, or the opposite? No single answer to this question is possible; each approach has its advantages. To show what we mean, refer to the contribution format income statements given below for two blueberry farms. Bogside Farm depends on migrant workers to pick its berries by hand, whereas Sterling Farm has invested in expensive berry-picking machines. Consequently, Bogside Farm has higher variable costs, but Sterling Farm has higher fixed costs:

	Bogside Farm		Sterling Farm	
	Amount	Percent	Amount	Percent
Sales	\$100,000	100%	\$100,000	100%
Variable expenses	60,000	60%	30,000	30%
Contribution margin	40,000	40%	70,000	70%
Fixed expenses	30,000	<u><u> </u></u>	60,000	<u><u> </u></u>
Net operating income	\$ 10,000		\$ 10,000	

Which farm has the better cost structure? The answer depends on many factors, including the long-run trend in sales, year-to-year fluctuations in the level of sales, and the attitude of the owners toward risk. If sales are expected to exceed \$100,000 in the future, then Sterling Farm probably has the better cost structure. The reason is that its CM ratio is higher, and its profits will therefore increase more rapidly as sales increase.

To illustrate, assume that each farm experiences a 10% increase in sales without any increase in fixed costs. The new income statements would be as follows:

	Bogside Farm		Sterling Farm	
	Amount	Percent	Amount	Percent
Sales	\$110,000	100%	\$110,000	100%
Variable expenses	66,000	60%	33,000	30%
Contribution margin	44,000	40%	77,000	70%
Fixed expenses	30,000	<u> </u>	60,000	<u> </u>
Net operating income.....	\$ 14,000		\$ 17,000	

Sterling Farm has experienced a greater increase in net operating income due to its higher CM ratio even though the increase in sales was the same for both farms.

What if sales drop below \$100,000? What are the farms' break-even points? What are their margins of safety? The computations needed to answer these questions are shown below using the contribution margin method:

	Bogside Farm	Sterling Farm
Fixed expenses	\$ 30,000	\$ 60,000
Contribution margin ratio	÷ 0.40	÷ 0.70
Dollar sales to break even	\$ 75,000	\$ 85,714
Total current sales (a).....	\$100,000	\$100,000
Break-even sales	75,000	85,714
Margin of safety in sales dollars (b)	\$ 25,000	\$ 14,286
Margin of safety percentage (b) ÷ (a)	25.0%	14.3%

Bogside Farm's margin of safety is greater and its contribution margin ratio is lower than Sterling Farm. Therefore, Bogside Farm is less vulnerable to downturns than Sterling Farm. Due to its lower contribution margin ratio, Bogside Farm will not lose contribution margin as rapidly as Sterling Farm when sales decline. Thus, Bogside Farm's profit will be less volatile. We saw earlier that this is a drawback when sales increase, but it provides more protection when sales drop. And because its break-even point is lower, Bogside Farm can suffer a larger sales decline before losses emerge.

To summarize, without knowing the future, it is not obvious which cost structure is better. Both have advantages and disadvantages. Sterling Farm, with its higher fixed costs and lower variable costs, will experience wider swings in net operating income as sales fluctuate, with greater profits in good years and greater losses in bad years. Bogside Farm, with its lower fixed costs and higher variable costs, will enjoy greater profit stability and will be more protected from losses during bad years, but at the cost of lower net operating income in good years.

IN BUSINESS

A LOSING COST STRUCTURE

Both JetBlue and United Airlines use an Airbus 235 to fly from Dulles International Airport near Washington, DC, to Oakland, California. Both planes have a pilot, copilot, and four flight attendants. That is where the similarity ends. Based on 2002 data, the pilot on the United flight earned \$16,350 to \$18,000 a month compared to \$6,800 per month for the JetBlue pilot. United's senior flight attendants on the plane earned more than \$41,000 per year; whereas the JetBlue attendants were paid \$16,800 to \$27,000 per year. Largely because of the higher labor costs at United, its costs of operating the flight were more than 60% higher than JetBlue's costs. Due to intense fare competition from JetBlue and other low-cost carriers, United was unable to cover its higher operating costs on this and many other flights. Consequently, United went into bankruptcy at the end of 2002.

Source: Susan Carey, "Costly Race in the Sky," *The Wall Street Journal*, September 9, 2002, pp. B1 and B3.

Operating Leverage

A lever is a tool for multiplying force. Using a lever, a massive object can be moved with only a modest amount of force. In business, *operating leverage* serves a similar purpose. **Operating leverage** is a measure of how sensitive net operating income is to a given percentage change in dollar sales. Operating leverage acts as a multiplier. If operating leverage is high, a small percentage increase in sales can produce a much larger percentage increase in net operating income.

Operating leverage can be illustrated by returning to the data for the two blueberry farms. We previously showed that a 10% increase in sales (from \$100,000 to \$110,000 in each farm) results in a 70% increase in the net operating income of Sterling Farm (from \$10,000 to \$17,000) and only a 40% increase in the net operating income of Bogside Farm (from \$10,000 to \$14,000). Thus, for a 10% increase in sales, Sterling Farm experiences a much greater percentage increase in profits than does Bogside Farm. Therefore, Sterling Farm has greater operating leverage than Bogside Farm.

The **degree of operating leverage** at a given level of sales is computed by the following formula:

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}$$

The degree of operating leverage is a measure, at a given level of sales, of how a percentage change in sales volume will affect profits. To illustrate, the degree of operating leverage for the two farms at \$100,000 sales would be computed as follows:

$$\text{Bogside Farm: } \frac{\$40,000}{\$10,000} = 4$$

$$\text{Sterling Farm: } \frac{\$70,000}{\$10,000} = 7$$

Because the degree of operating leverage for Bogside Farm is 4, the farm's net operating income grows four times as fast as its sales. In contrast, Sterling Farm's net operating income grows seven times as fast as its sales. Thus, if sales increase by 10%, then we can expect the net operating income of Bogside Farm to increase by four times this amount, or by 40%, and the net operating income of Sterling Farm to increase by seven times this amount, or by 70%.

LEARNING OBJECTIVE 8

Compute the degree of operating leverage at a particular level of sales and explain how it can be used to predict changes in net operating income.



	Percent Increase in Sales (1)	Degree of Operating Leverage (2)	Percent Increase in Net Operating Income (1) × (2)
Bogside Farm	10%	4	40%
Sterling Farm	10%	7	70%

What is responsible for the higher operating leverage at Sterling Farm? The only difference between the two farms is their cost structure. If two companies have the same total revenue and same total expense but different cost structures, then the company with the higher proportion of fixed costs in its cost structure will have higher operating leverage. Referring back to the original example on page 251, when both farms have sales of \$100,000 and total expenses of \$90,000, one-third of Bogside Farm's costs are fixed but two-thirds of Sterling Farm's costs are fixed. As a consequence, Sterling's degree of operating leverage is higher than Bogside's.

The degree of operating leverage is not a constant; it is greatest at sales levels near the break-even point and decreases as sales and profits rise. The following table shows the degree of operating leverage for Bogside Farm at various sales levels. (Data used earlier for Bogside Farm are shown in color.)

Sales	\$75,000	\$80,000	\$100,000	\$150,000	\$225,000
Variable expenses	45,000	48,000	60,000	90,000	135,000
Contribution margin (a)	30,000	32,000	40,000	60,000	90,000
Fixed expenses	30,000	30,000	30,000	30,000	30,000
Net operating income (b)	\$ 0	\$ 2,000	\$ 10,000	\$ 30,000	\$ 60,000
Degree of operating leverage, (a) ÷ (b)	∞	16	4	2	1.5

Thus, a 10% increase in sales would increase profits by only 15% ($10\% \times 1.5$) if sales were previously \$225,000, as compared to the 40% increase we computed earlier at the \$100,000 sales level. The degree of operating leverage will continue to decrease the farther the company moves from its break-even point. At the break-even point, the degree of operating leverage is infinitely large ($\$30,000 \text{ contribution margin} \div \$0 \text{ net operating income} = \infty$).

IN BUSINESS

OPERATING LEVERAGE: A KEY TO PROFITABLE E-COMMERCE

Did you ever wonder why [Expedia](#) and [eBay](#) were among the first Internet companies to become profitable? One big reason is because they sell information products rather than physical products. For example, when somebody buys a physical product, such as a book from [Amazon.com](#), the company needs to purchase a copy of the book from the publisher, process it, and ship it; hence, Amazon.com's gross margins are around 26%. However, once Expedia covers its fixed overhead costs, the extra expense incurred to provide service to one more customer is practically zero; therefore, the incremental revenue provided by that customer "falls to the bottom line."

In the first quarter of 2002, Expedia doubled its sales to \$116 million and reported net income of \$5.7 million compared to a loss of \$17.6 million in the first quarter of 2001. This is the beauty of having a high degree of operating leverage. Sales growth can quickly translate to profit growth when variable costs are negligible. Of course, operating leverage has a dark side—if Expedia's sales plummet, its profits will nosedive as well.

Source: Timothy J. Mullaney and Robert D. Hof, "Finally, the Pot of Gold," *BusinessWeek*, June 24, 2002, pp. 104–106.

The degree of operating leverage can be used to quickly estimate what impact various percentage changes in sales will have on profits, without the necessity of preparing detailed income statements. As shown by our examples, the effects of operating leverage can be dramatic. If a company is near its break-even point, then even small percentage increases in sales can yield large percentage increases in profits. *This explains why management will often work very hard for only a small increase in sales volume.* If the degree of operating leverage is 5, then a 6% increase in sales would translate into a 30% increase in profits.

Structuring Sales Commissions

Companies usually compensate salespeople by paying them a commission based on sales, a salary, or a combination of the two. Commissions based on sales dollars can lead to lower profits. To illustrate, consider Pipeline Unlimited, a producer of surfing equipment. Salespersons sell the company's products to retail sporting goods stores throughout North America and the Pacific Basin. Data for two of the company's surfboards, the XR7 and Turbo models, appear below:

	Model	
	XR7	Turbo
Selling price	\$695	\$749
Variable expenses	344	410
Contribution margin	<u>\$351</u>	<u>\$339</u>

Which model will salespeople push hardest if they are paid a commission of 10% of sales revenue? The answer is the Turbo because it has the higher selling price and hence the larger commission. On the other hand, from the standpoint of the company, profits will be greater if salespeople steer customers toward the XR7 model because it has the higher contribution margin.

To eliminate such conflicts, commissions can be based on contribution margin rather than on selling price. If this is done, the salespersons will want to sell the mix of products that maximizes contribution margin. Providing that fixed costs are not affected by the sales mix, maximizing the contribution margin will also maximize the company's profit.⁴ In effect, by maximizing their own compensation, salespersons will also maximize the company's profit.

IN BUSINESS

AN ALTERNATIVE APPROACH TO SALES COMMISSIONS

Thrive Networks, located in Concord, Massachusetts, used to pay its three salesmen based on individually earned commissions. This system seemed to be working fine as indicated by the company's sales growth from \$2.7 million in 2002 to \$3.6 million in 2003. However, the company felt there was a better way to motivate and compensate its salesmen. It pooled commissions across the three salesmen and compensated them collectively. The new approach was designed to build teamwork and leverage each salesman's individual strengths. Jim Lippie, the director of business development, was highly skilled at networking and generating sales leads. John Barrows, the sales director, excelled at meeting with prospective clients and producing compelling proposals. Nate Wolfson, the CEO and final member of the sales team, was the master at closing the deal. The new approach has worked so well that Wolfson plans to use three-person sales teams in his offices nationwide.

Source: Cara Cannella, "Kill the Commissions," *Inc.* magazine, August 2004, p. 38.

⁴ This also assumes the company has no production constraint. If it does, the sales commissions should be modified. See the Profitability Appendix at the end of the book.

Sales Mix

LEARNING OBJECTIVE 9

Compute the break-even point for a multiproduct company and explain the effects of shifts in the sales mix on contribution margin and the break-even point.



Before concluding our discussion of CVP concepts, we need to consider the impact of changes in *sales mix* on a company's profit.

The Definition of Sales Mix

The term **sales mix** refers to the relative proportions in which a company's products are sold. The idea is to achieve the combination, or mix, that will yield the greatest amount of profits. Most companies have many products, and often these products are not equally profitable. Hence, profits will depend to some extent on the company's sales mix. Profits will be greater if high-margin rather than low-margin items make up a relatively large proportion of total sales.

Changes in the sales mix can cause perplexing variations in a company's profits. A shift in the sales mix from high-margin items to low-margin items can cause total profits to decrease even though total sales may increase. Conversely, a shift in the sales mix from low-margin items to high-margin items can cause the reverse effect—total profits may increase even though total sales decrease. It is one thing to achieve a particular sales volume; it is quite another to sell the most profitable mix of products.

IN BUSINESS



WAL-MART ATTEMPTS TO SHIFT ITS SALES MIX

Almost 130 million customers shop at Wal-Mart's 3,200 U.S. stores each week. However, less than half of them shop the whole store—choosing to buy only low-margin basics while skipping higher-margin departments such as apparel. In an effort to shift its sales mix toward higher-margin merchandise, Wal-Mart has reduced spending on advertising and plowed the money into remodeling the clothing departments within its stores. The company hopes this remodeling effort will entice its customers to add clothing to their shopping lists while bypassing the apparel offerings of competitors such as Kohl's and Target.

Source: Robert Berner, "Fashion Emergency at Wal-Mart," *BusinessWeek*, July 31, 2006, p. 67.

Sales Mix and Break-Even Analysis

If a company sells more than one product, break-even analysis is more complex than discussed to this point. The reason is that different products will have different selling prices, different costs, and different contribution margins. Consequently, the break-even point depends on the mix in which the various products are sold. To illustrate, consider Virtual Journeys Unlimited, a small company that imports DVDs from France. At present, the company sells two DVDs: the Le Louvre DVD, a tour of the famous art museum in Paris; and the Le Vin DVD, which features the wines and wine-growing regions of France. The company's September sales, expenses, and break-even point are shown in Exhibit 6-4.

As shown in the exhibit, the break-even point is \$60,000 in sales, which was computed by dividing the company's fixed expenses of \$27,000 by its overall CM ratio of 45%. However, this is the break-even only if the company's sales mix does not change. Currently, the Le Louvre DVD is responsible for 20% and the Le Vin DVD for 80% of the company's dollar sales. Assuming this sales mix does not change, if total sales are \$60,000, the sales of the Le Louvre DVD would be \$12,000 (20% of \$60,000) and the sales of the Le Vin DVD would be \$48,000 (80% of \$60,000). As shown in Exhibit 6-4, at these levels of sales, the company would indeed break even. But \$60,000 in sales represents the break-even point for the company only if the sales mix does not change. *If the sales mix changes, then the break-even point will also usually change.* This is illustrated by the results for October in which the sales mix shifted away from the more profitable Le Vin DVD (which has a 50% CM ratio) toward the less profitable Le Louvre CD (which has a 25% CM ratio). These results appear in Exhibit 6-5.

EXHIBIT 6-4

Multiproduct Break-Even Analysis

Virtual Journeys Unlimited Contribution Income Statement For the Month of September						
	Le Louvre DVD		Le Vin DVD		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales	\$20,000	100%	\$80,000	100%	\$100,000	100%
Variable expenses	15,000	75%	40,000	50%	55,000	55%
Contribution margin	\$ 5,000	25%	\$40,000	50%	45,000	45%
Fixed expenses					27,000	
Net operating income.....					\$ 18,000	

Computation of the break-even point:

$$\frac{\text{Fixed expenses}}{\text{Overall CM ratio}} = \frac{\$27,000}{0.45} = \$60,000$$

Verification of the break-even point:

	Le Louvre DVD	Le Vin DVD	Total
Current dollar sales	\$20,000	\$80,000	\$100,000
Percentage of total dollar sales	20%	80%	100%
Sales at the break-even point	\$12,000	\$48,000	\$60,000

	Le Louvre DVD		Le Vin DVD		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales	\$12,000	100%	\$48,000	100%	\$ 60,000	100%
Variable expenses	9,000	75%	24,000	50%	33,000	55%
Contribution margin	\$ 3,000	25%	\$24,000	50%	27,000	45%
Fixed expenses					27,000	
Net operating income.....					\$ 0	

EXHIBIT 6-5

Multiproduct Break-Even Analysis: A Shift in Sales Mix (see Exhibit 6-4)

Virtual Journeys Unlimited Contribution Income Statement For the Month of October						
	Le Louvre DVD		Le Vin DVD		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales	\$80,000	100%	\$20,000	100%	\$100,000	100%
Variable expenses	60,000	75%	10,000	50%	70,000	70%
Contribution margin	\$20,000	25%	\$10,000	50%	30,000	30%
Fixed expenses					27,000	
Net operating income.....					\$ 3,000	

Computation of the break-even point:

$$\frac{\text{Fixed expenses}}{\text{Overall CM ratio}} = \frac{\$27,000}{0.30} = \$90,000$$

Although sales have remained unchanged at \$100,000, the sales mix is exactly the reverse of what it was in Exhibit 6–4, with the bulk of the sales now coming from the less profitable Le Louvre DVD. Notice that this shift in the sales mix has caused both the overall CM ratio and total profits to drop sharply from the prior month even though total sales are the same. The overall CM ratio has dropped from 45% in September to only 30% in October, and net operating income has dropped from \$18,000 to only \$3,000. In addition, with the drop in the overall CM ratio, the company's break-even point is no longer \$60,000 in sales. Because the company is now realizing less average contribution margin per dollar of sales, it takes more sales to cover the same amount of fixed costs. Thus, the break-even point has increased from \$60,000 to \$90,000 in sales per year.

In preparing a break-even analysis, an assumption must be made concerning the sales mix. Usually the assumption is that it will not change. However, if the sales mix is expected to change, then this must be explicitly considered in any CVP computations.

IN BUSINESS

PLAYING THE CVP GAME

In 2002, General Motors (GM) gave away almost \$2,600 per vehicle in customer incentives such as price cuts and 0% financing. “The pricing sacrifices have been more than offset by volume gains, most of which have come from trucks and SUVs, like the Chevy Suburban and the GMC Envoy, which generate far more profit for the company than cars. Lehman Brothers analysts estimate that GM will sell an additional 395,000 trucks and SUVs and an extra 75,000 cars in 2002. The trucks, however, are the company’s golden goose, hauling in an average [contribution margin] . . . of about \$7,000, compared with just \$4,000 for the cars. All told, the volume gains could bring in an additional \$3 billion [in profits].”

Source: Janice Revell, “GM’s Slow Leak,” *Fortune*, October 28, 2002, pp. 105–110.

Assumptions of CVP Analysis

A number of assumptions commonly underlie CVP analysis:

1. Selling price is constant. The price of a product or service will not change as volume changes.
2. Costs are linear and can be accurately divided into variable and fixed elements. The variable element is constant per unit, and the fixed element is constant in total over the entire relevant range.
3. In multiproduct companies, the sales mix is constant.
4. In manufacturing companies, inventories do not change. The number of units produced equals the number of units sold.

While these assumptions may be violated in practice, the results of CVP analysis are often “good enough” to be quite useful. Perhaps the greatest danger lies in relying on simple CVP analysis when a manager is contemplating a large change in volume that lies outside of the relevant range. For example, a manager might contemplate increasing the level of sales far beyond what the company has ever experienced before. However, even in these situations the model can be adjusted as we have done in this chapter to take into account anticipated changes in selling prices, fixed costs, and the sales mix that would otherwise violate the assumptions mentioned above. For example, in a decision that would affect fixed costs, the change in fixed costs can be explicitly taken into account as illustrated earlier in the chapter in the Acoustic Concepts example on pages 242–245.

Summary

CVP analysis is based on a simple model of how profits respond to prices, costs, and volume. This model can be used to answer a variety of critical questions such as what is the company's break-even volume, what is its margin of safety, and what is likely to happen if specific changes are made in prices, costs, and volume.

A CVP graph depicts the relationships between unit sales on the one hand and fixed expenses, variable expenses, total expenses, total sales, and profits on the other hand. The profit graph is simpler than the CVP graph and shows how profits depend on sales. The CVP and profit graphs are useful for developing intuition about how costs and profits respond to changes in sales.

The contribution margin ratio is the ratio of the total contribution margin to total sales. This ratio can be used to quickly estimate what impact a change in total sales would have on net operating income. The ratio is also useful in break-even analysis.

Target profit analysis is used to estimate how much sales would have to be to attain a specified target profit. The unit sales required to attain the target profit can be estimated by dividing the sum of the target profit and fixed expense by the unit contribution margin. Break-even analysis is a special case of target profit analysis that is used to estimate how much sales would have to be to just break even. The unit sales required to break even can be estimated by dividing the fixed expense by the unit contribution margin.

The margin of safety is the amount by which the company's current sales exceeds break-even sales.

The degree of operating leverage allows quick estimation of what impact a given percentage change in sales would have on the company's net operating income. The higher the degree of operating leverage, the greater is the impact on the company's profits. The degree of operating leverage is not constant—it depends on the company's current level of sales.

The profits of a multiproduct company are affected by its sales mix. Changes in the sales mix can affect the break-even point, margin of safety, and other critical factors.

Review Problem: CVP Relationships

Voltar Company manufactures and sells a specialized cordless telephone for high electromagnetic radiation environments. The company's contribution format income statement for the most recent year is given below:

	Total	Per Unit	Percent of Sales
Sales (20,000 units)	\$1,200,000	\$60	100%
Variable expenses	900,000	45	? %
Contribution margin	300,000	\$15	? %
Fixed expenses	240,000	==	==
Net operating income	\$ 60,000		

Management is anxious to increase the company's profit and has asked for an analysis of a number of items.

Required:

1. Compute the company's CM ratio and variable expense ratio.
2. Compute the company's break-even point in both units and sales dollars. Use the equation method.
3. Assume that sales increase by \$400,000 next year. If cost behavior patterns remain unchanged, by how much will the company's net operating income increase? Use the CM ratio to compute your answer.
4. Refer to the original data. Assume that next year management wants the company to earn a profit of at least \$90,000. How many units will have to be sold to meet this target profit?
5. Refer to the original data. Compute the company's margin of safety in both dollar and percentage form.

6.
 - a. Compute the company's degree of operating leverage at the present level of sales.
 - b. Assume that through a more intense effort by the sales staff, the company's sales increase by 8% next year. By what percentage would you expect net operating income to increase? Use the degree of operating leverage to obtain your answer.
 - c. Verify your answer to (b) by preparing a new contribution format income statement showing an 8% increase in sales.
7. In an effort to increase sales and profits, management is considering the use of a higher-quality speaker. The higher-quality speaker would increase variable costs by \$3 per unit, but management could eliminate one quality inspector who is paid a salary of \$30,000 per year. The sales manager estimates that the higher-quality speaker would increase annual sales by at least 20%.
 - a. Assuming that changes are made as described above, prepare a projected contribution format income statement for next year. Show data on a total, per unit, and percentage basis.
 - b. Compute the company's new break-even point in both units and dollars of sales. Use the formula method.
 - c. Would you recommend that the changes be made?

Solution to Review Problem

1.

$$\text{CM ratio} = \frac{\text{Unit contribution margin}}{\text{Unit selling price}} = \frac{\$15}{\$60} = 25\%$$

$$\text{Variable expense ratio} = \frac{\text{Variable expense}}{\text{Selling price}} = \frac{\$45}{\$60} = 75\%$$

2.

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$

$$\$0 = (\$60 - \$45) \times Q - \$240,000$$

$$\$15Q = \$240,000$$

$$Q = \$240,000 \div \$15$$

$$Q = 16,000 \text{ units; or at } \$60 \text{ per unit, } \$960,000$$

3.

Increase in sales	\$400,000
Multiply by the CM ratio	× 25%
Expected increase in contribution margin	<u><u>\$100,000</u></u>

Because the fixed expenses are not expected to change, net operating income will increase by the entire \$100,000 increase in contribution margin computed above.

4. Equation method:

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$

$$\$90,000 = (\$60 - \$45) \times Q - \$240,000$$

$$\$15Q = \$90,000 + \$240,000$$

$$Q = \$330,000 \div \$15$$

$$Q = 22,000 \text{ units}$$

Formula method:

$$\text{Unit sales to attain the target profit} = \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Contribution margin per unit}} = \frac{\$90,000 + \$240,000}{\$15 \text{ per unit}} = 22,000 \text{ units}$$

5. Margin of safety in dollars = Total sales – Break-even sales
 $= \$1,200,000 - \$960,000 = \$240,000$

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Total sales}} = \frac{\$240,000}{\$1,200,000} = 20\%$$

6. a. Degree of operating leverage = $\frac{\text{Contribution margin}}{\text{Net operating income}} = \frac{\$300,000}{\$60,000} = 5$
 b.

Expected increase in sales	8%
Degree of operating leverage	$\times 5$
Expected increase in net operating income.....	<u><u>40%</u></u>

- c. If sales increase by 8%, then 21,600 units ($20,000 \times 1.08 = 21,600$) will be sold next year. The new contribution format income statement would be as follows:

	Total	Per Unit	Percent of Sales
Sales (21,600 units)	\$1,296,000	\$60	100%
Variable expenses	<u>972,000</u>	<u>45</u>	<u>75%</u>
Contribution margin	324,000	<u><u>\$15</u></u>	<u><u>25%</u></u>
Fixed expenses	<u>240,000</u>		
Net operating income	<u><u>\$ 84,000</u></u>		

Thus, the \$84,000 expected net operating income for next year represents a 40% increase over the \$60,000 net operating income earned during the current year:

$$\frac{\$84,000 - \$60,000}{\$60,000} = \frac{\$24,000}{\$60,000} = 40\% \text{ increase}$$

Note from the income statement above that the increase in sales from 20,000 to 21,600 units has increased *both* total sales and total variable expenses.

7. a. A 20% increase in sales would result in 24,000 units being sold next year: $20,000 \text{ units} \times 1.20 = 24,000 \text{ units}$.

	Total	Per Unit	Percent of Sales
Sales (24,000 units)	\$1,440,000	\$60	100%
Variable expenses	<u>1,152,000</u>	<u>48*</u>	<u>80%</u>
Contribution margin	288,000	<u><u>\$12</u></u>	<u><u>20%</u></u>
Fixed expenses	<u>210,000[†]</u>		
Net operating income	<u><u>\$ 78,000</u></u>		

*\$45 + \$3 = \$48; \$48 ÷ \$60 = 80%.
[†]\$240,000 – \$30,000 = \$210,000.

Note that the change in per unit variable expenses results in a change in both the per unit contribution margin and the CM ratio.

b. Unit sales to break even = $\frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$
 $= \frac{\$210,000}{\$12 \text{ per unit}} = 17,500 \text{ units}$

Dollar sales to break even = $\frac{\text{Fixed expenses}}{\text{CM ratio}}$
 $= \frac{\$210,000}{0.20} = \$1,050,000$

- c. Yes, based on these data the changes should be made. The changes increase the company's net operating income from the present \$60,000 to \$78,000 per year. Although the changes also result in a higher break-even point (17,500 units as compared to the present 16,000 units), the company's margin of safety actually becomes greater than before:

$$\begin{aligned}\text{Margin of safety in dollars} &= \text{Total sales} - \text{Break-even sales} \\ &= \$1,440,000 - \$1,050,000 = \$390,000\end{aligned}$$

As shown in (5) on the prior page, the company's present margin of safety is only \$240,000. Thus, several benefits will result from the proposed changes.

Glossary

- Break-even point** The level of sales at which profit is zero. (p. 236)
- Contribution margin ratio (CM ratio)** A ratio computed by dividing contribution margin by dollar sales. (p. 241)
- Cost-volume-profit (CVP) graph** A graphical representation of the relationships between an organization's revenues, costs, and profits on the one hand and its sales volume on the other hand. (p. 238)
- Degree of operating leverage** A measure, at a given level of sales, of how a percentage change in sales will affect profits. The degree of operating leverage is computed by dividing contribution margin by net operating income. (p. 253)
- Incremental analysis** An analytical approach that focuses only on those costs and revenues that change as a result of a decision. (p. 243)
- Margin of safety** The excess of budgeted (or actual) dollar sales over the break-even dollar sales. (p. 250)
- Operating leverage** A measure of how sensitive net operating income is to a given percentage change in dollar sales. (p. 253)
- Sales mix** The relative proportions in which a company's products are sold. Sales mix is computed by expressing the sales of each product as a percentage of total sales. (p. 256)
- Target profit analysis** Estimating what sales volume is needed to achieve a specific target profit. (p. 246)
- Variable expense ratio** A ratio computed by dividing variable expenses by dollar sales (p. 242)

Questions

- 6–1** What is meant by a product's contribution margin ratio? How is this ratio useful in planning business operations?
- 6–2** Often the most direct route to a business decision is an incremental analysis. What is meant by an *incremental analysis*?
- 6–3** In all respects, Company A and Company B are identical except that Company A's costs are mostly variable, whereas Company B's costs are mostly fixed. When sales increase, which company will tend to realize the greatest increase in profits? Explain.
- 6–4** What is meant by the term *operating leverage*?
- 6–5** What is meant by the term *break-even point*?
- 6–6** In response to a request from your immediate supervisor, you have prepared a CVP graph portraying the cost and revenue characteristics of your company's product and operations. Explain how the lines on the graph and the break-even point would change if (a) the selling price per unit decreased, (b) fixed cost increased throughout the entire range of activity portrayed on the graph, and (c) variable cost per unit increased.
- 6–7** What is meant by the margin of safety?
- 6–8** What is meant by the term *sales mix*? What assumption is usually made concerning sales mix in CVP analysis?
- 6–9** Explain how a shift in the sales mix could result in both a higher break-even point and a lower net income.



Multiple-choice questions are provided on the text website at www.mhhe.com/garrison13e.

Exercises connect

EXERCISE 6–1 Preparing a Contribution Format Income Statement [LO1]

Whirly Corporation's most recent income statement is shown below:

	Total	Per Unit
Sales (10,000 units)	\$350,000	\$35.00
Variable expenses	<u>200,000</u>	<u>20.00</u>
Contribution margin	150,000	<u>\$15.00</u>
Fixed expenses.	<u>135,000</u>	<u><u></u></u>
Net operating income	<u><u>\$ 15,000</u></u>	

Required:

Prepare a new contribution format income statement under each of the following conditions (consider each case independently):

1. The sales volume increases by 100 units.
2. The sales volume decreases by 100 units.
3. The sales volume is 9,000 units.

EXERCISE 6–2 Prepare a Cost-Volume-Profit (CVP) Graph [LO2]

Karlik Enterprises distributes a single product whose selling price is \$24 and whose variable expense is \$18 per unit. The company's monthly fixed expense is \$24,000.



Required:

1. Prepare a cost-volume-profit graph for the company up to a sales level of 8,000 units.
2. Estimate the company's break-even point in unit sales using your cost-volume-profit graph.

EXERCISE 6–3 Prepare a Profit Graph [LO2]

Jaffre Enterprises distributes a single product whose selling price is \$16 and whose variable expense is \$11 per unit. The company's fixed expense is \$16,000 per month.



Required:

1. Prepare a profit graph for the company up to a sales level of 4,000 units.
2. Estimate the company's break-even point in unit sales using your profit graph.

EXERCISE 6–4 Computing and Using the CM Ratio [LO3]

Last month when Holiday Creations, Inc., sold 50,000 units, total sales were \$200,000, total variable expenses were \$120,000, and fixed expenses were \$65,000.



Required:

1. What is the company's contribution margin (CM) ratio?
2. Estimate the change in the company's net operating income if it were to increase its total sales by \$1,000.

EXERCISE 6–5 Changes in Variable Costs, Fixed Costs, Selling Price, and Volume [LO4]

Data for Hermann Corporation are shown below:

	Per Unit	Percent of Sales
Selling price	\$90	100%
Variable expenses	<u>63</u>	<u>70</u>
Contribution margin	<u><u>\$27</u></u>	<u><u>30%</u></u>

Fixed expenses are \$30,000 per month and the company is selling 2,000 units per month.

Required:

1. The marketing manager argues that a \$5,000 increase in the monthly advertising budget would increase monthly sales by \$9,000. Should the advertising budget be increased?
2. Refer to the original data. Management is considering using higher-quality components that would increase the variable cost by \$2 per unit. The marketing manager believes the higher-quality product would increase sales by 10% per month. Should the higher-quality components be used?

EXERCISE 6–6 Compute the Level of Sales Required to Attain a Target Profit [LO5]

Lin Corporation has a single product whose selling price is \$120 and whose variable expense is \$80 per unit. The company's monthly fixed expense is \$50,000.

Required:

1. Using the equation method, solve for the unit sales that are required to earn a target profit of \$10,000.
2. Using the formula method, solve for the unit sales that are required to earn a target profit of \$15,000.

**EXERCISE 6–7 Compute the Break-Even Point [LO6]**

Mauro Products distributes a single product, a woven basket whose selling price is \$15 and whose variable expense is \$12 per unit. The company's monthly fixed expense is \$4,200.

Required:

1. Solve for the company's break-even point in unit sales using the equation method.
2. Solve for the company's break-even point in sales dollars using the equation method and the CM ratio.
3. Solve for the company's break-even point in unit sales using the formula method.
4. Solve for the company's break-even point in sales dollars using the formula method and the CM ratio.

**EXERCISE 6–8 Compute the Margin of Safety [LO7]**

Molander Corporation is a distributor of a sun umbrella used at resort hotels. Data concerning the next month's budget appear below:

Selling price	\$30 per unit
Variable expenses	\$20 per unit
Fixed expenses	\$7,500 per month
Unit sales	1,000 units per month

Required:

1. Compute the company's margin of safety.
2. Compute the company's margin of safety as a percentage of its sales.

**EXERCISE 6–9 Compute and Use the Degree of Operating Leverage [LO8]**

Engberg Company installs lawn sod in home yards. The company's most recent monthly contribution format income statement follows:

	Amount	Percent of Sales
Sales.	\$80,000	100%
Variable expenses	<u>32,000</u>	<u>40%</u>
Contribution margin	48,000	60%
Fixed expenses.	<u>38,000</u>	<u>=</u>
Net operating income	<u><u>\$10,000</u></u>	

Required:

1. Compute the company's degree of operating leverage.
2. Using the degree of operating leverage, estimate the impact on net operating income of a 5% increase in sales.
3. Verify your estimate from part (2) above by constructing a new contribution format income statement for the company assuming a 5% increase in sales.

**EXERCISE 6–10 Compute the Break-Even Point for a Multiproduct Company [LO9]**

Lucido Products markets two computer games: Claimjumper and Makeover. A contribution format income statement for a recent month for the two games appears on the following page:

	Claimjumper	Makeover	Total
Sales.....	\$30,000	\$70,000	\$100,000
Variable expenses	<u>20,000</u>	<u>50,000</u>	<u>70,000</u>
Contribution margin	<u><u>\$10,000</u></u>	<u><u>\$20,000</u></u>	<u><u>30,000</u></u>
Fixed expenses			<u>24,000</u>
Net operating income			<u><u>\$ 6,000</u></u>

Required:

1. Compute the overall contribution margin (CM) ratio for the company.
2. Compute the overall break-even point for the company in sales dollars.
3. Verify the overall break-even point for the company by constructing a contribution format income statement showing the appropriate levels of sales for the two products.

EXERCISE 6–11 Using a Contribution Format Income Statement [LO1, LO4]

Miller Company's most recent contribution format income statement is shown below:

	Total	Per Unit
Sales (20,000 units)	\$300,000	\$15.00
Variable expenses	<u>180,000</u>	<u>9.00</u>
Contribution margin	<u>120,000</u>	<u>\$ 6.00</u>
Fixed expenses.....	<u>70,000</u>	<u>—</u>
Net operating income	<u><u>\$ 50,000</u></u>	

Required:

Prepare a new contribution format income statement under each of the following conditions (consider each case independently):

1. The number of units sold increases by 15%.
2. The selling price decreases by \$1.50 per unit, and the number of units sold increases by 25%.
3. The selling price increases by \$1.50 per unit, fixed expenses increase by \$20,000, and the number of units sold decreases by 5%.
4. The selling price increases by 12%, variable expenses increase by 60 cents per unit, and the number of units sold decreases by 10%.

EXERCISE 6–12 Target Profit and Break-Even Analysis; Margin of Safety; CM Ratio [LO1, LO3, LO5, LO6, LO7]

Menlo Company distributes a single product. The company's sales and expenses for last month follow:



	Total	Per Unit
Sales.....	\$450,000	\$30
Variable expenses	<u>180,000</u>	<u>12</u>
Contribution margin	<u>270,000</u>	<u>\$18</u>
Fixed expenses.....	<u>216,000</u>	<u>—</u>
Net operating income	<u><u>\$ 54,000</u></u>	

Required:

1. What is the monthly break-even point in units sold and in sales dollars?
2. Without resorting to computations, what is the total contribution margin at the break-even point?
3. How many units would have to be sold each month to earn a target profit of \$90,000? Use the formula method. Verify your answer by preparing a contribution format income statement at the target sales level.

4. Refer to the original data. Compute the company's margin of safety in both dollar and percentage terms.
5. What is the company's CM ratio? If sales increase by \$50,000 per month and there is no change in fixed expenses, by how much would you expect monthly net operating income to increase?



EXERCISE 6-13 Target Profit and Break-Even Analysis [LO3, LO4, LO5, LO6]

Lindon Company is the exclusive distributor for an automotive product that sells for \$40 per unit and has a CM ratio of 30%. The company's fixed expenses are \$180,000 per year. The company plans to sell 16,000 units this year.

Required:

1. What are the variable expenses per unit?
2. Using the equation method:
 - a. What is the break-even point in units and sales dollars?
 - b. What sales level in units and in sales dollars is required to earn an annual profit of \$60,000?
 - c. Assume that by using a more efficient shipper, the company is able to reduce its variable expenses by \$4 per unit. What is the company's new break-even point in units and sales dollars?
3. Repeat (2) above using the formula method.

EXERCISE 6-14 Missing Data; Basic CVP Concepts [LO1, LO9]

Fill in the missing amounts in each of the eight case situations below. Each case is independent of the others. (*Hint:* One way to find the missing amounts would be to prepare a contribution format income statement for each case, enter the known data, and then compute the missing items.)

- a. Assume that only one product is being sold in each of the four following case situations:

Case	Units Sold	Sales	Variable Expenses	Contribution Margin per Unit	Fixed Expenses	Net Operating Income (Loss)
1	15,000	\$180,000	\$120,000	?	\$50,000	?
2	?	\$100,000	?	\$10	\$32,000	\$8,000
3	10,000	?	\$70,000	\$13	?	\$12,000
4	6,000	\$300,000	?	?	\$100,000	\$(10,000)

- b. Assume that more than one product is being sold in each of the four following case situations:

Case	Sales	Variable Expenses	Average Contribution Margin Ratio	Fixed Expenses	Net Operating Income (Loss)
1	\$500,000	?	20%	?	\$7,000
2	\$400,000	\$260,000	?	\$100,000	?
3	?	?	60%	\$130,000	\$20,000
4	\$600,000	\$420,000	?	?	\$(5,000)



EXERCISE 6-15 Operating Leverage [LO4, LO8]

Magic Realm, Inc., has developed a new fantasy board game. The company sold 15,000 games last year at a selling price of \$20 per game. Fixed costs associated with the game total \$182,000 per year, and variable costs are \$6 per game. Production of the game is entrusted to a printing contractor. Variable costs consist mostly of payments to this contractor.

Required:

1. Prepare a contribution format income statement for the game last year and compute the degree of operating leverage.

2. Management is confident that the company can sell 18,000 games next year (an increase of 3,000 games, or 20%, over last year). Compute:
 - a. The expected percentage increase in net operating income for next year.
 - b. The expected total dollar net operating income for next year. (Do not prepare an income statement; use the degree of operating leverage to compute your answer.)

EXERCISE 6-16 Target Profit and Break-Even Analysis [LO4, LO5, LO6]

Outback Outfitters sells recreational equipment. One of the company's products, a small camp stove, sells for \$50 per unit. Variable expenses are \$32 per stove, and fixed expenses associated with the stove total \$108,000 per month.



Required:

1. Compute the break-even point in number of stoves and in total sales dollars.
2. If the variable expenses per stove increase as a percentage of the selling price, will it result in a higher or a lower break-even point? Why? (Assume that the fixed expenses remain unchanged.)
3. At present, the company is selling 8,000 stoves per month. The sales manager is convinced that a 10% reduction in the selling price would result in a 25% increase in monthly sales of stoves. Prepare two contribution format income statements, one under present operating conditions, and one as operations would appear after the proposed changes. Show both total and per unit data on your statements.
4. Refer to the data in (3) above. How many stoves would have to be sold at the new selling price to yield a minimum net operating income of \$35,000 per month?

EXERCISE 6-17 Break-Even Analysis and CVP Graphing [LO2, LO4, LO6]

The Hartford Symphony Guild is planning its annual dinner-dance. The dinner-dance committee has assembled the following expected costs for the event:



Dinner (per person)	\$18
Favors and program (per person)	\$2
Band	\$2,800
Rental of ballroom	\$900
Professional entertainment during intermission	\$1,000
Tickets and advertising	\$1,300

The committee members would like to charge \$35 per person for the evening's activities.

Required:

1. Compute the break-even point for the dinner-dance (in terms of the number of persons who must attend).
2. Assume that last year only 300 persons attended the dinner-dance. If the same number attend this year, what price per ticket must be charged in order to break even?
3. Refer to the original data (\$35 ticket price per person). Prepare a CVP graph for the dinner-dance from zero tickets up to 600 tickets sold.

EXERCISE 6-18 Multiproduct Break-Even Analysis [LO9]

Olongapo Sports Corporation is the distributor in the Philippines of two premium golf balls—the Flight Dynamic and the Sure Shot. Monthly sales, expressed in pesos (P), and the contribution margin ratios for the two products follow:



Product		Total	
Flight Dynamic	Sure Shot		
Sales	P150,000	P250,000	P400,000
CM ratio	80%	36%	?

Fixed expenses total P183,750 per month.

Required:

1. Prepare a contribution format income statement for the company as a whole. Carry computations to one decimal place.
2. Compute the break-even point for the company based on the current sales mix.
3. If sales increase by P100,000 a month, by how much would you expect net operating income to increase? What are your assumptions?

Problems connect



PROBLEM 6-19 Basics of CVP Analysis [LO1, LO3, LO4, LO6, LO8]

Feather Friends, Inc., distributes a high-quality wooden birdhouse that sells for \$20 per unit. Variable costs are \$8 per unit, and fixed costs total \$180,000 per year.

Required:

Answer the following independent questions:

1. What is the product's CM ratio?
2. Use the CM ratio to determine the break-even point in sales dollars.
3. Due to an increase in demand, the company estimates that sales will increase by \$75,000 during the next year. By how much should net operating income increase (or net loss decrease) assuming that fixed costs do not change?
4. Assume that the operating results for last year were:

Sales	\$400,000
Variable expenses	160,000
Contribution margin.....	240,000
Fixed expenses	180,000
Net operating income	\$ 60,000

- a. Compute the degree of operating leverage at the current level of sales.
- b. The president expects sales to increase by 20% next year. By what percentage should net operating income increase?
5. Refer to the original data. Assume that the company sold 18,000 units last year. The sales manager is convinced that a 10% reduction in the selling price, combined with a \$30,000 increase in advertising, would cause annual sales in units to increase by one-third. Prepare two contribution format income statements, one showing the results of last year's operations and one showing the results of operations if these changes are made. Would you recommend that the company do as the sales manager suggests?
6. Refer to the original data. Assume again that the company sold 18,000 units last year. The president does not want to change the selling price. Instead, he wants to increase the sales commission by \$1 per unit. He thinks that this move, combined with some increase in advertising, would increase annual sales by 25%. By how much could advertising be increased with profits remaining unchanged? Do not prepare an income statement; use the incremental analysis approach.


PROBLEM 6-20 Sales Mix; Multiproduct Break-Even Analysis [LO9]

Gold Star Rice, Ltd., of Thailand exports Thai rice throughout Asia. The company grows three varieties of rice—Fragrant, White, and Loonzain. (The currency in Thailand is the baht, which is denoted by B.) Budgeted sales by product and in total for the coming month are shown below:

	Product					Total
	White		Fragrant		Loonzain	
Percentage of total sales	20%		52%		28%	100%
Sales	B150,000	100%	B390,000	100%	B210,000	100%
Variable expenses	108,000	72%	78,000	20%	84,000	40%
Contribution margin	B 42,000	28%	B312,000	80%	B126,000	60%
Fixed expenses						449,280
Net operating income.....						B30,720

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{B449,280}{0.64} = B702,000$$

As shown by these data, net operating income is budgeted at B30,720 for the month and break-even sales at B702,000.

Assume that actual sales for the month total \$750,000 as planned. Actual sales by product are: White, \$300,000; Fragrant, \$180,000; and Loonzain, \$270,000.

Required:

1. Prepare a contribution format income statement for the month based on actual sales data. Present the income statement in the format shown on the prior page.
2. Compute the break-even point in sales dollars for the month based on your actual data.
3. Considering the fact that the company met its \$750,000 sales budget for the month, the president is shocked at the results shown on your income statement in (1) above. Prepare a brief memo for the president explaining why both the operating results and the break-even point in sales dollars are different from what was budgeted.

PROBLEM 6-21 Basic CVP Analysis; Graphing [LO1, LO2, LO4, LO6]

The Fashion Shoe Company operates a chain of women's shoe shops around the country. The shops carry many styles of shoes that are all sold at the same price. Sales personnel in the shops are paid a substantial commission on each pair of shoes sold (in addition to a small basic salary) in order to encourage them to be aggressive in their sales efforts.

The following worksheet contains cost and revenue data for Shop 48 and is typical of the company's many outlets:



Microsoft Excel		
<input type="button" value="File"/> <input type="button" value="Edit"/> <input type="button" value="View"/> <input type="button" value="Insert"/> <input type="button" value="Format"/> <input type="button" value="Tools"/> <input type="button" value="Data"/> <input type="button" value="Window"/> <input type="button" value="Help"/>		
12	A	B
1		<i>Per Pair of Shoes</i>
2	Selling price	\$ 30.00
3		
4	Variable expenses:	
5	Invoice cost	\$ 13.50
6	Sales commission	4.50
7	Total variable expenses	\$ 18.00
8		
9		<i>Annual</i>
10	Fixed expenses:	
11	Advertising	\$ 30,000
12	Rent	20,000
13	Salaries	100,000
14	Total fixed expenses	\$ 150,000
15		

Required:

1. Calculate the annual break-even point in dollar sales and in unit sales for Shop 48.
2. Prepare a CVP graph showing cost and revenue data for Shop 48 from zero shoes up to 17,000 pairs of shoes sold each year. Clearly indicate the break-even point on the graph.
3. If 12,000 pairs of shoes are sold in a year, what would be Shop 48's net operating income or loss?
4. The company is considering paying the store manager of Shop 48 an incentive commission of 75 cents per pair of shoes (in addition to the salesperson's commission). If this change is made, what will be the new break-even point in dollar sales and in unit sales?
5. Refer to the original data. As an alternative to (4) above, the company is considering paying the store manager 50 cents commission on each pair of shoes sold in excess of the break-even point. If this change is made, what will be the shop's net operating income or loss if 15,000 pairs of shoes are sold?
6. Refer to the original data. The company is considering eliminating sales commissions entirely in its shops and increasing fixed salaries by \$31,500 annually. If this change is made, what will be the new break-even point in dollar sales and in unit sales for Shop 48? Would you recommend that the change be made? Explain.

eXcel**PROBLEM 6–22 Basics of CVP Analysis; Cost Structure [LO1, LO3, LO4, LO5, LO6]**

Due to erratic sales of its sole product—a high-capacity battery for laptop computers—PEM, Inc., has been experiencing difficulty for some time. The company's contribution format income statement for the most recent month is given below:

Sales (19,500 units × \$30 per unit)	\$585,000
Variable expenses	<u>409,500</u>
Contribution margin	175,500
Fixed expenses	<u>180,000</u>
Net operating loss	\$ (4,500)
	<u><u> </u></u>

Required:

1. Compute the company's CM ratio and its break-even point in both units and dollars.
2. The president believes that a \$16,000 increase in the monthly advertising budget, combined with an intensified effort by the sales staff, will result in an \$80,000 increase in monthly sales. If the president is right, what will be the effect on the company's monthly net operating income or loss? (Use the incremental approach in preparing your answer.)
3. Refer to the original data. The sales manager is convinced that a 10% reduction in the selling price, combined with an increase of \$60,000 in the monthly advertising budget, will cause unit sales to double. What will the new contribution format income statement look like if these changes are adopted?
4. Refer to the original data. The Marketing Department thinks that a fancy new package for the laptop computer battery would help sales. The new package would increase packaging costs by 75 cents per unit. Assuming no other changes, how many units would have to be sold each month to earn a profit of \$9,750?
5. Refer to the original data. By automating certain operations, the company could reduce variable costs by \$3 per unit. However, fixed costs would increase by \$72,000 each month.
 - a. Compute the new CM ratio and the new break-even point in both units and dollars.
 - b. Assume that the company expects to sell 26,000 units next month. Prepare two contribution format income statements, one assuming that operations are not automated and one assuming that they are. (Show data on a per unit and percentage basis, as well as in total, for each alternative.)
 - c. Would you recommend that the company automate its operations? Explain.

**PROBLEM 6–23 Sales Mix; Break-Even Analysis; Margin of Safety [LO7, LO9]**

Island Novelties, Inc., of Palau makes two products, Hawaiian Fantasy and Tahitian Joy. Present revenue, cost, and sales data for the two products follow:

	Hawaiian Fantasy	Tahitian Joy
Selling price per unit	\$15	\$100
Variable expenses per unit	\$9	\$20
Number of units sold annually	20,000	5,000

Fixed expenses total \$475,800 per year. The Republic of Palau uses the U.S. dollar as its currency.

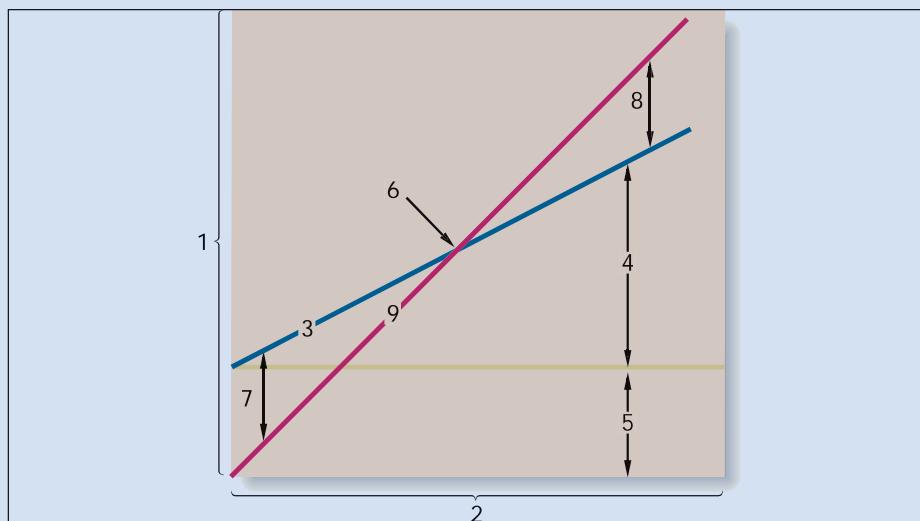
Required:

1. Assuming the sales mix given above, do the following:
 - a. Prepare a contribution format income statement showing both dollar and percent columns for each product and for the company as a whole.
 - b. Compute the break-even point in dollars for the company as a whole and the margin of safety in both dollars and percent.

2. The company has developed a new product to be called Samoan Delight. Assume that the company could sell 10,000 units at \$45 each. The variable expenses would be \$36 each. The company's fixed expenses would not change.
 - a. Prepare another contribution format income statement, including sales of the Samoan Delight (sales of the other two products would not change).
 - b. Compute the company's new break-even point in dollars and the new margin of safety in both dollars and percent.
3. The president of the company examines your figures and says, "There's something strange here. Our fixed expenses haven't changed and you show greater total contribution margin if we add the new product, but you also show our break-even point going up. With greater contribution margin, the break-even point should go down, not up. You've made a mistake somewhere." Explain to the president what has happened.

PROBLEM 6-24 Interpretive Questions on the CVP Graph [LO2, LO6]

A CVP graph such as the one shown below is a useful technique for showing relationships among an organization's costs, volume, and profits.



Required:

1. Identify the numbered components in the CVP graph.
2. State the effect of each of the following actions on line 3, line 9, and the break-even point. For line 3 and line 9, state whether the action will cause the line to:

- Remain unchanged.
- Shift upward.
- Shift downward.
- Have a steeper slope (i.e., rotate upward).
- Have a flatter slope (i.e., rotate downward).
- Shift upward *and* have a steeper slope.
- Shift upward *and* have a flatter slope.
- Shift downward *and* have a steeper slope.
- Shift downward *and* have a flatter slope.

In the case of the break-even point, state whether the action will cause the break-even point to:

- Remain unchanged.
- Increase.
- Decrease.

Probably change, but the direction is uncertain.

Treat each case independently.

- x. Example. Fixed costs are reduced by \$5,000 per period.

Answer (see choices above): Line 3: Shift downward.

Line 9: Remain unchanged.

Break-even: Decrease.

- a. The unit selling price is increased from \$18 to \$20.
- b. Unit variable costs are decreased from \$12 to \$10.
- c. Fixed costs are increased by \$3,000 per period.
- d. Two thousand more units are sold during the period than were budgeted.
- e. Due to paying salespersons a commission rather than a flat salary, fixed costs are reduced by \$8,000 per period and unit variable costs are increased by \$3.
- f. Due to an increase in the cost of materials, both unit variable costs and the selling price are increased by \$2.
- g. Advertising costs are increased by \$10,000 per period, resulting in a 10% increase in the number of units sold.
- h. Due to automating an operation previously done by workers, fixed costs are increased by \$12,000 per period and unit variable costs are reduced by \$4.



PROBLEM 6-25 Sales Mix; Commission Structure; Multiproduct Break-Even Analysis [LO9]

Carbex, Inc., produces cutlery sets out of high-quality wood and steel. The company makes a standard cutlery set and a deluxe set and sells them to retail department stores throughout the country. The standard set sells for \$60, and the deluxe set sells for \$75. The variable expenses associated with each set are given below.

	Standard	Deluxe
Production costs	\$15.00	\$30.00
Sales commissions (15% of sales price).....	\$9.00	\$11.25

The company's fixed expenses each month are:

Advertising	\$105,000
Depreciation.....	\$21,700
Administrative.....	\$63,000

Salespersons are paid on a commission basis to encourage them to be aggressive in their sales efforts. Mary Parsons, the financial vice president, watches sales commissions carefully and has noted that they have risen steadily over the last year. For this reason, she was shocked to find that even though sales have increased, profits for the current month—May—are down substantially from April. Sales, in sets, for the last two months are given below:

	Standard	Deluxe	Total
April	4,000	2,000	6,000
May	1,000	5,000	6,000

Required:

1. Prepare contribution format income statements for April and May. Use the following headings:

	Standard		Deluxe		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales						
Etc						

Place the fixed expenses only in the Total column. Do not show percentages for the fixed expenses.

2. Explain the difference in net operating incomes between the two months, even though the same *total* number of sets was sold in each month.

3. What can be done to the sales commissions to improve the sales mix?
 - a. Using April's sales mix, what is the break-even point in sales dollars?
 - b. Without doing any calculations, explain whether the break-even points would be higher or lower with May's sales mix than April's sales mix.

PROBLEM 6-26 Break-Even Analysis; Pricing [LO1, LO4, LO6]

Minden Company introduced a new product last year for which it is trying to find an optimal selling price. Marketing studies suggest that the company can increase sales by 5,000 units for each \$2 reduction in the selling price. The company's present selling price is \$70 per unit, and variable expenses are \$40 per unit. Fixed expenses are \$540,000 per year. The present annual sales volume (at the \$70 selling price) is 15,000 units.



Required:

1. What is the present yearly net operating income or loss?
2. What is the present break-even point in units and in dollar sales?
3. Assuming that the marketing studies are correct, what is the *maximum* profit that the company can earn yearly? At how many units and at what selling price per unit would the company generate this profit?
4. What would be the break-even point in units and in sales dollars using the selling price you determined in (3) above (e.g., the selling price at the level of maximum profits)? Why is this break-even point different from the break-even point you computed in (2) above?

PROBLEM 6-27 Various CVP Questions: Break-Even Point; Cost Structure; Target Sales [LO1, LO3, LO4, LO5, LO6, LO8]

Northwood Company manufactures basketballs. The company has a ball that sells for \$25. At present, the ball is manufactured in a small plant that relies heavily on direct labor workers. Thus, variable costs are high, totaling \$15 per ball, of which 60% is direct labor cost.



Last year, the company sold 30,000 of these balls, with the following results:

Sales (30,000 balls)	\$750,000
Variable expenses	<u>450,000</u>
Contribution margin	300,000
Fixed expenses	<u>210,000</u>
Net operating income	<u><u>\$ 90,000</u></u>

Required:

1. Compute (a) the CM ratio and the break-even point in balls, and (b) the degree of operating leverage at last year's sales level.
2. Due to an increase in labor rates, the company estimates that variable costs will increase by \$3 per ball next year. If this change takes place and the selling price per ball remains constant at \$25, what will be the new CM ratio and break-even point in balls?
3. Refer to the data in (2) above. If the expected change in variable costs takes place, how many balls will have to be sold next year to earn the same net operating income (\$90,000) as last year?
4. Refer again to the data in (2) above. The president feels that the company must raise the selling price of its basketballs. If Northwood Company wants to maintain *the same CM ratio as last year*, what selling price per ball must it charge next year to cover the increased labor costs?
5. Refer to the original data. The company is discussing the construction of a new, automated manufacturing plant. The new plant would slash variable costs per ball by 40%, but it would cause fixed costs per year to double. If the new plant is built, what would be the company's new CM ratio and new break-even point in balls?
6. Refer to the data in (5) above.
 - a. If the new plant is built, how many balls will have to be sold next year to earn the same net operating income, \$90,000, as last year?
 - b. Assume the new plant is built and that next year the company manufactures and sells 30,000 balls (the same number as sold last year). Prepare a contribution format income statement and compute the degree of operating leverage.
 - c. If you were a member of top management, would you have been in favor of constructing the new plant? Explain.

**PROBLEM 6–28 Graphing; Incremental Analysis; Operating Leverage [LO2, LO4, LO5, LO6, LO8]**

Angie Silva has recently opened The Sandal Shop in Brisbane, Australia, a store that specializes in fashionable sandals. Angie has just received a degree in business and she is anxious to apply the principles she has learned to her business. In time, she hopes to open a chain of sandal shops. As a first step, she has prepared the following analysis for her new store:

Sales price per pair of sandals	\$40
Variable expenses per pair of sandals.....	<u>16</u>
Contribution margin per pair of sandals.....	<u><u>\$24</u></u>
Fixed expenses per year:	
Building rental	\$15,000
Equipment depreciation.....	7,000
Selling	20,000
Administrative	<u>18,000</u>
Total fixed expenses	<u><u>\$60,000</u></u>

Required:

- How many pairs of sandals must be sold each year to break even? What does this represent in total sales dollars?
- Prepare a CVP graph or a profit graph for the store from zero pairs up to 4,000 pairs of sandals sold each year. Indicate the break-even point on your graph.
- Angie has decided that she must earn at least \$18,000 the first year to justify her time and effort. How many pairs of sandals must be sold to reach this target profit?
- Angie now has two salespersons working in the store—one full time and one part time. It will cost her an additional \$8,000 per year to convert the part-time position to a full-time position. Angie believes that the change would bring in an additional \$25,000 in sales each year. Should she convert the position? Use the incremental approach. (Do not prepare an income statement.)
- Refer to the original data. During the first year, the store sold only 3,000 pairs of sandals and reported the following operating results:

Sales (3,000 pairs)	\$120,000
Variable expenses	<u>48,000</u>
Contribution margin.....	<u>72,000</u>
Fixed expenses	<u>60,000</u>
Net operating income	<u><u>\$ 12,000</u></u>

- What is the store's degree of operating leverage?
- Angie is confident that with a more intense sales effort and with a more creative advertising program she can increase sales by 50% next year. What would be the expected percentage increase in net operating income? Use the degree of operating leverage to compute your answer.

**PROBLEM 6–29 Changes in Cost Structure; Break-Even Analysis; Operating Leverage; Margin of Safety [LO4, LO6, LO7, LO8]**

Morton Company's contribution format income statement for last month is given below:

Sales (15,000 units × \$30 per unit).....	\$450,000
Variable expenses	<u>315,000</u>
Contribution margin.....	<u>135,000</u>
Fixed expenses	<u>90,000</u>
Net operating income	<u><u>\$ 45,000</u></u>

The industry in which Morton Company operates is quite sensitive to cyclical movements in the economy. Thus, profits vary considerably from year to year according to general economic conditions. The company has a large amount of unused capacity and is studying ways of improving profits.

Required:

1. New equipment has come onto the market that would allow Morton Company to automate a portion of its operations. Variable costs would be reduced by \$9 per unit. However, fixed costs would increase to a total of \$225,000 each month. Prepare two contribution format income statements, one showing present operations and one showing how operations would appear if the new equipment is purchased. Show an Amount column, a Per Unit column, and a Percent column on each statement. Do not show percentages for the fixed costs.
2. Refer to the income statements in (1) above. For both present operations and the proposed new operations, compute (a) the degree of operating leverage, (b) the break-even point in dollars, and (c) the margin of safety in both dollar and percentage terms.
3. Refer again to the data in (1) above. As a manager, what factor would be paramount in your mind in deciding whether to purchase the new equipment? (Assume that enough funds are available to make the purchase.)
4. Refer to the original data. Rather than purchase new equipment, the marketing manager argues that the company's marketing strategy should be changed. Rather than pay sales commissions, which are currently included in variable expenses, the company would pay salespersons fixed salaries and would invest heavily in advertising. The marketing manager claims this new approach would increase unit sales by 30% without any change in selling price; the company's new monthly fixed expenses would be \$180,000; and its net operating income would increase by 20%. Compute the break-even point in dollar sales for the company under the new marketing strategy. Do you agree with the marketing manager's proposal?

PROBLEM 6-30 Target Profit and Break-Even Analysis [LO5, LO6]

The Shirt Works sells a large variety of tee shirts and sweatshirts. Steve Hooper, the owner, is thinking of expanding his sales by hiring local high school students, on a commission basis, to sell sweatshirts bearing the name and mascot of the local high school.



These sweatshirts would have to be ordered from the manufacturer six weeks in advance, and they could not be returned because of the unique printing required. The sweatshirts would cost Mr. Hooper \$8 each with a minimum order of 75 sweatshirts. Any additional sweatshirts would have to be ordered in increments of 75.

Since Mr. Hooper's plan would not require any additional facilities, the only costs associated with the project would be the costs of the sweatshirts and the costs of the sales commissions. The selling price of the sweatshirts would be \$13.50 each. Mr. Hooper would pay the students a commission of \$1.50 for each shirt sold.

Required:

1. To make the project worthwhile, Mr. Hooper would require a \$1,200 profit for the first three months of the venture. What level of sales in units and in dollars would be required to reach this target net operating income? Show all computations.
2. Assume that the venture is undertaken and an order is placed for 75 sweatshirts. What would be Mr. Hooper's break-even point in units and in sales dollars? Show computations and explain the reasoning behind your answer.

PROBLEM 6-31 Changes in Fixed and Variable Costs; Target Profit and Break-Even Analysis [LO4, LO5, LO6]

Neptune Company produces toys and other items for use in beach and resort areas. A small, inflatable toy has come onto the market that the company is anxious to produce and sell. The new toy will sell for \$3 per unit. Enough capacity exists in the company's plant to produce 16,000 units of the toy each month. Variable costs to manufacture and sell one unit would be \$1.25, and fixed costs associated with the toy would total \$35,000 per month.

The company's Marketing Department predicts that demand for the new toy will exceed the 16,000 units that the company is able to produce. Additional manufacturing space can be rented from another company at a fixed cost of \$1,000 per month. Variable costs in the rented facility would total \$1.40 per unit, due to somewhat less efficient operations than in the main plant.