

Chapter

6

Cost-Volume-Profit Relationships

LEARNING OBJECTIVES

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.
- 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** Compute the break-even point in unit sales and sales dollars.
- L06** Determine the level of sales needed to achieve a desired target profit.
- 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 the degree of operating leverage can be used to predict changes in net operating income.
- L09** Compute the break-even point for a multiple product company and explain the effects of shifts in the sales mix on contribution margin and the break-even point.



What Happened to the Profit?

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." ■

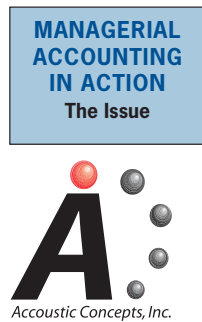
Source: Karen Dillon, "Shop Talk," *Inc.*, December 2002, pp. 111–114.

BUSINESS FOCUS

Cost-volume-profit (CVP) analysis is one of the most powerful tools that managers have at their command. It helps them understand the relationships among cost, volume, and profit by focusing on interactions among the following five elements:

1. Prices of products.
2. Volume or level of activity.
3. Per unit variable costs.
4. Total fixed costs.
5. Mix of products sold.

Because CVP analysis helps managers understand the interrelationships among cost, volume, and profit, it is a vital tool in many business decisions. These decisions include what products and services to offer, what pricing policy to follow, what marketing strategy to employ, and what basic cost structure to use. To help understand the role of CVP analysis in business decisions, consider the case of Acoustic Concepts, Inc., a company founded by Prem Narayan.



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. We shouldn't have a problem coming up with some answers. I'll need a day or two, though, to gather some data.
- Prem:** Why don't we set up a meeting for three days from now? That would be Thursday.
- Bob:** That'll be fine. I'll have some preliminary answers for you as well as a model you can use for answering similar questions in the future.
- Prem:** Good. I'll be looking forward to seeing what you come up with.

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

Bob Luchinni's preparation for the Thursday meeting 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 a manager 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
Less variable expenses	60,000	150
Contribution margin	40,000	\$100
Less 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 in the work we will be doing in the following pages. 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:

	Total	Per Unit
Sales (1 speaker)	\$ 250	\$250
Less variable expenses	150	150
Contribution margin	100	\$100
Less 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 that the company is able to sell during the month, \$100 more in contribution margin will become 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:

	Total	Per Unit
Sales (2 speakers)	\$ 500	\$250
Less variable expenses	300	150
Contribution margin	200	\$100
Less fixed expenses	35,000	
Net operating loss	<u><u>\$(34,800)</u></u>	

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, since each speaker sold yields \$100 in contribution margin:

	Total	Per Unit
Sales (350 speakers)	\$87,500	\$250
Less variable expenses	52,500	150
Contribution margin	35,000	\$100
Less fixed expenses	35,000	
Net operating income	<u><u>\$ 0</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 we can expect that the net operating income for the month will be \$100, since the company will have sold 1 speaker more than the number needed to break even:

	Total	Per Unit
Sales (351 speakers)	\$87,750	\$250
Less variable expenses	52,650	150
Contribution margin	35,100	\$100
Less fixed expenses	35,000	
Net operating income	<u><u>\$ 100</u></u>	

If 352 speakers are sold (2 speakers above the break-even point), then we can expect that the net operating income for the month will be \$200, and so forth. It is not necessary to prepare a whole series of income statements to estimate profits at various activity levels. Rather, profits can be estimated by simply taking the number of units to be sold over the break-even point and multiplying that number 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	× \$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	\$100,000	\$106,250	\$6,250	\$250
Less variable expenses	60,000	63,750	3,750	150
Contribution margin	40,000	42,500	2,500	\$100
Less fixed expenses	35,000	35,000	0	
Net operating income	\$ 5,000	\$ 7,500	\$2,500	

To summarize these examples, if there were no sales, 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 Graphic Form

The relationships among revenue, cost, profit, and volume can be expressed graphically by preparing a **cost-volume-profit (CVP) graph**. A CVP graph highlights CVP relationships over wide ranges of activity and can give managers a perspective that can be obtained in no other way. To help explain his analysis to Prem Narayan, Bob Luchinni decided to prepare a CVP graph for Acoustic Concepts.

LEARNING OBJECTIVE 2

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

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

1. Draw a line parallel to the volume axis to represent total fixed expenses. For Acoustic Concepts, total fixed expenses are \$35,000.

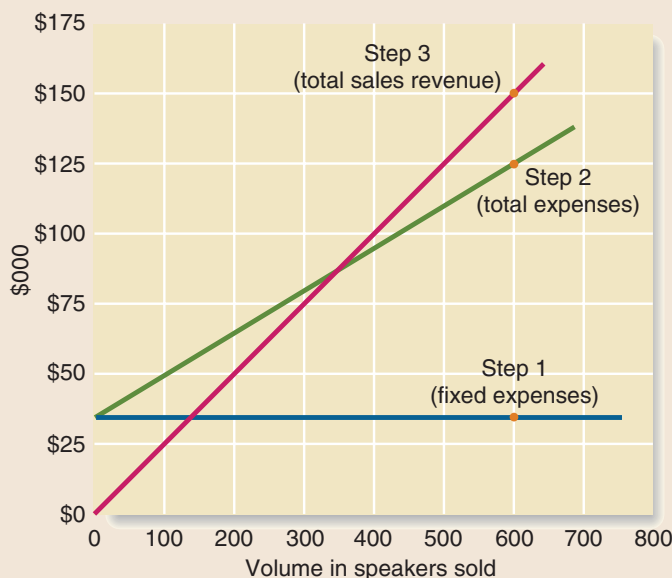


EXHIBIT 6–1
Preparing the CVP Graph

2. Choose some volume of unit sales and plot the point representing total expenses (fixed and variable) at the activity level you have selected. In Exhibit 6–1, Bob Luchinni chose a volume of 600 speakers. Total expenses at that activity level would be as follows:

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

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

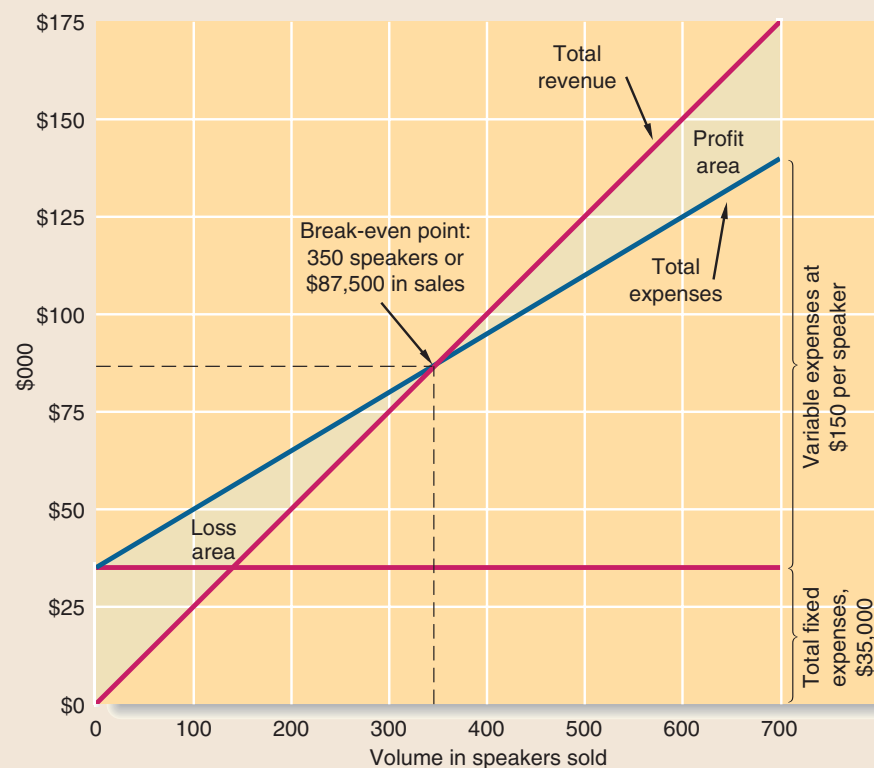
3. Again choose some volume of unit sales and plot the point representing total sales dollars at the activity level you have selected. In Exhibit 6–1, Bob Luchinni again chose a volume of 600 speakers. Sales at that activity level total \$150,000 (600 speakers \times \$250 per speaker). Draw a line through 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 expenses line (variable expenses plus fixed expenses).

The break-even point is where the total revenue and total expenses 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) worsens 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.

EXHIBIT 6–2
The Completed CVP Graph



Contribution Margin Ratio (CM Ratio)

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 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%
Less variable expenses	60,000	150	60%
Contribution margin	40,000	\$100	40%
Less fixed expenses	35,000		
Net operating income	\$ 5,000		

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.

The contribution margin as a percentage of total 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 as follows:

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

The CM ratio is extremely useful since it shows how the contribution margin will be affected by a change in total sales. To illustrate, notice that Acoustic Concepts has a CM ratio of 40%. This means that for each dollar increase in sales, total contribution margin will increase by 40 cents (\$1 sales \times CM ratio of 40%). Net operating income will also increase by 40 cents, assuming that fixed costs do not change.

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 increase in sales \times 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%
Less variable expenses	60,000	78,000*	18,000	60%
Contribution margin	40,000	52,000	12,000	40%
Less fixed expenses	35,000	35,000	0	
Net operating income	\$ 5,000	\$ 17,000	\$12,000	

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

The CM ratio is particularly valuable in situations where trade-offs must be made between more dollar sales of one product versus more dollar sales of another. Generally

speaking, when trying to increase sales, 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.

Bob Luchinni, the accountant at Acoustic Concepts, wanted to demonstrate to the company's president Prem Narayan how the concepts developed on the preceding pages can be used in planning and decision making. Bob gathered the following basic data:

	Per Unit	Percent of Sales
Selling price	\$250	100%
Less 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.

Change in Fixed Cost and Sales Volume Acoustic Concepts is currently selling 400 speakers per month (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 effect 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%
Less variable expenses	60,000	78,000*	18,000	60%
Contribution margin	40,000	52,000	12,000	40%
Less 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 since it would increase net operating income by \$2,000. There are two shorter ways to present this solution. The first alternative solution follows:

Alternative Solution 1



6-1

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	<u>\$ 2,000</u>

Since 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 \times 40% CM ratio	\$12,000
Less incremental advertising expense	10,000
Increased net operating income	<u>\$2,000</u>

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 above 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 involved in 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. Management 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 the higher overall quality would increase sales to 480 speakers per month. Should the higher-quality components be used?

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

Solution

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

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

Change in Fixed Cost, Sales Price, and Sales Volume Refer to the original data and recall again that the company 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 of \$20 per speaker in the selling price will cause the unit contribution margin to decrease from \$100 to \$80.

Solution

Expected total contribution margin with lower selling price:	
600 speakers \times \$80 per speaker	\$48,000
Present total contribution margin:	
400 speakers \times \$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	<u>\$(7,000)</u>

According to this analysis, the changes should not be made. The same solution can be obtained by preparing comparative income statements as follows:

	Present 400 Speakers per Month		Expected 600 Speakers per Month		
	Total	Per Unit	Total	Per Unit	Difference
Sales	\$100,000	\$250	\$138,000	\$230	\$38,000
Less variable expenses . . .	60,000	150	90,000	150	30,000
Contribution margin	40,000	\$100	48,000	\$ 80	8,000
Less 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.

Notice that the effect on net operating income is the same as that obtained by the incremental analysis above.

Change in Variable Cost, Fixed Cost, and Sales Volume Refer to the original data. As before, the company is currently selling 400 speakers per month. The sales manager would like to pay 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 will increase monthly sales by 15% to 460 speakers per month. Should the change be made?

Solution Changing the sales staff from a salaried basis to a commission basis will affect both fixed and variable expenses. Fixed expenses will decrease by \$6,000, from \$35,000 to \$29,000. Variable expenses will increase by \$15, from \$150 to \$165, and the unit contribution margin will 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	40,000
Decrease in total contribution margin	(900)
Change in fixed expenses:	
Add salaries avoided if a commission is paid	6,000
Increase in net operating income	\$ 5,100

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		
	Total	Per Unit	Total	Per Unit	Difference
Sales	\$100,000	\$250	\$115,000	\$250	\$15,000
Less variable expenses . . .	60,000	150	75,900	165	15,900
Contribution margin	40,000	\$100	39,100	\$85	900
Less fixed expenses	35,000		29,000		(6,000)*
Net operating income	\$5,000		\$10,100		\$5,100

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

Change in Regular Sales 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 agreed on. 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 monthly profits by \$3,000?

Solution

Variable cost per speaker	\$150
Desired profit per speaker:	
\$3,000 ÷ 150 speakers	20
Quoted price per speaker	<u>\$170</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 revenue that is in excess of variable costs increases the company's profits.

Break-Even Analysis

CVP analysis is sometimes referred to simply as break-even analysis. This is unfortunate because break-even analysis is only one element of CVP analysis—although an important element. Break-even analysis is designed to answer questions such as, how far could sales drop before the company begins to lose money?



6-2

Break-Even Computations

Earlier in the chapter we defined the break-even point as the level of sales at which the company's profit is zero. The break-even point can be computed using either the *equation method* or the *contribution margin method*—the two methods are equivalent.

The Equation Method The **equation method** centers on the contribution approach to the income statement illustrated earlier in the chapter. The format of this income statement can be expressed in equation form as follows:

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

Rearranging this equation slightly yields the following equation, which is widely used in CVP analysis:

$$\text{Sales} = \text{Variable expenses} + \text{Fixed expenses} + \text{Profits}$$

At the break-even point, profits are zero. Therefore, the break-even point can be computed by finding that point where sales equal the total of the variable expenses plus the fixed expenses. For Acoustic Concepts, the break-even point in unit sales, Q , can be computed as follows:

$$\begin{aligned}
 \text{Sales} &= \text{Variable expenses} + \text{Fixed expenses} + \text{Profits} \\
 \swarrow \quad \searrow \quad \downarrow \quad \swarrow \\
 \$250Q &= \$150Q + \$35,000 + \$0 \\
 \$100Q &= \$35,000 \\
 Q &= \$35,000 \div \$100 \text{ per speaker} \\
 Q &= 350 \text{ speakers}
 \end{aligned}$$

LEARNING OBJECTIVE 5

Compute the break-even point in unit sales and sales dollars.

where:

Q = Quantity of speakers sold

\$250 = Unit selling price

\$150 = Unit variable expenses

\$35,000 = Total fixed expenses

The break-even point in total sales dollars can be computed by multiplying the break-even level of unit sales by the selling price per unit:

$$350 \text{ speakers} \times \$250 \text{ per speaker} = \$87,500$$

The break-even point in total sales dollars, X , can also be computed as follows:

$$\text{Sales} = \text{Variable expenses} + \text{Fixed expenses} + \text{Profits}$$

$$X = 0.60X + \$35,000 + \$0$$

$$0.40X = \$35,000$$

$$X = \$35,000 \div 0.40$$

$$X = \$87,500$$

where:

X = Total sales dollars

0.60 = Variable expense ratio (Variable expenses \div Sales)

\$35,000 = Total fixed expenses

Organizations often have data available only in percentage or ratio form, and the approach we have just illustrated must then be used to find the break-even point. Notice that use of ratios in the equation yields a break-even point in sales dollars rather than in units sold. The break-even point in units sold is the following:

$$\$87,500 \div \$250 \text{ per speaker} = 350 \text{ speakers}$$

IN BUSINESS

BUYING ON THE GO—A DOT.COM TALE

*CD is a company set up by two young engineers, George Searle and Humphrey Chen, to allow customers to order music CDs on their cell phones. Suppose you hear a cut from a CD on your car radio that you would like to own. Pick up your cell phone, punch “*CD,” enter the radio station’s frequency, and the time you heard the song, and the CD will soon be on its way to you.

*CD charges about \$17 for a CD, including shipping. The company pays its supplier about \$13, leaving a contribution margin of \$4 per CD. Because of the fixed costs of running the service, Searle expects the company to lose \$1.5 million on sales of \$1.5 million in its first year of operations. That assumes the company sells 88,000 CDs.



What is the company’s break-even point? Working backwards, the company’s fixed expenses would appear to be about \$1,850,000 per year. Since the contribution margin per CD is \$4, the company would have to sell over 460,000 CDs per year just to break even!

Source: Peter Kafka, “Play It Again,” *Forbes*, July 26, 1999, p. 94.

The Contribution Margin Method The **contribution margin method** is just a shortcut version of the equation method already described. The approach centers on the idea discussed earlier that each unit sold provides a certain amount of contribution margin that goes toward covering fixed costs. To find how many units must be sold to break even, divide the total fixed expenses by the unit contribution margin:

$$\text{Break-even point in units sold} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$

Each speaker generates a contribution margin of \$100 (\$250 selling price, less \$150 variable expenses). Since the total fixed expenses are \$35,000, the break-even point in units is computed as follows:

$$\frac{\text{Fixed expenses}}{\text{Unit contribution margin}} = \frac{\$35,000}{\$100 \text{ per speaker}} = 350 \text{ speakers}$$

A variation of this method uses the CM ratio instead of the unit contribution margin. The result is the break-even point in total sales dollars rather than in total units sold.

$$\text{Break-even point in total sales dollars} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

In the Acoustic Concepts example, the calculation is as follows:

$$\frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$35,000}{0.40} = \$87,500$$

This approach, based on the CM ratio, is particularly useful when a company has multiple product lines and wishes to compute a single break-even point for the company as a whole. More is said on this point in a later section titled The Concept of Sales Mix.

Target Profit Analysis

CVP formulas can be used to determine the sales volume needed to achieve a target profit. Suppose that Prem Narayan of Acoustic Concepts would like to earn a target profit of \$40,000 per month. How many speakers would have to be sold?

The CVP Equation One approach is to use the equation method. Instead of solving for the unit sales where profits are zero, you instead solve for the unit sales where profits are \$40,000.

LEARNING OBJECTIVE 6

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

$$\begin{aligned}\text{Sales} &= \text{Variable expenses} + \text{Fixed expenses} + \text{Profits} \\ \$250Q &= \$150Q + \$35,000 + \$40,000 \\ \$100Q &= \$75,000 \\ Q &= \$75,000 \div \$100 \text{ per speaker} \\ Q &= 750 \text{ speakers}\end{aligned}$$

where:

$$\begin{aligned}Q &= \text{Quantity of speakers sold} \\ \$250 &= \text{Unit selling price} \\ \$150 &= \text{Unit variable expenses} \\ \$35,000 &= \text{Total fixed expenses} \\ \$40,000 &= \text{Target profit}\end{aligned}$$

Thus, the target profit can be achieved by selling 750 speakers per month, which represents \$187,500 in total sales (\$250 per speaker \times 750 speakers).

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 since 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 net 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 net 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 KBKids.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.

The Contribution Margin Approach A second approach involves expanding the contribution margin formula to include the target profit:

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

This approach gives the same answer as the equation method since it is simply a shortcut version of the equation method. Similarly, the dollar sales needed to attain the target profit can be computed as follows:

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

The Margin of Safety

LEARNING OBJECTIVE 7
Compute the margin of safety
and explain its significance.

The **margin of safety** is the excess of budgeted (or actual) sales dollars over the break-even volume of sales dollars. It states the amount by which sales can drop before losses are incurred. The higher the margin of safety, the lower the risk of not breaking even. The formula for its calculation is:

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

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

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

The calculation for 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)	<u>\$ 12,500</u>
Margin of safety as a percentage of sales, (b) ÷ (a) . . .	<u>12.5%</u>

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 ÷ \$250 per speaker = 50 speakers).

SOUP NUTSY

Pak Melwani and Kumar Hathiramani, former silk merchants from Bombay, opened a soup store in Manhattan after watching a *Seinfeld* episode featuring the "soup Nazi." The episode parodied a real-life soup vendor, Ali Yeganeh, whose loyal customers put up with hour-long lines and "snarling customer service." Melwani and Hathiramani approached Yeganeh about turning his soup kitchen into a chain, but they were gruffly rebuffed. Instead of giving up, the two hired a French chef with a repertoire of 500 soups and opened a store called **Soup Nutsy**. For \$6 per serving, Soup Nutsy offers 12 homemade soups each day, such as sherry crab bisque and Thai coconut shrimp. Melwani and Hathiramani report that in their first year of operation, they netted a profit of \$210,000 on sales of \$700,000. They report that it costs about \$2 per serving to make the soup. So their variable expense ratio is one-third (\$2 cost ÷ \$6 selling price). If so, what are their fixed expenses? We can answer that question using the equation approach as follows:

$$\begin{aligned}
 \text{Sales} &= \text{Variable expenses} + \text{Fixed expenses} + \text{Profits} \\
 \$700,000 &= \left(\frac{1}{3} \times \$700,000 \right) + \text{Fixed expenses} + \$210,000 \\
 \text{Fixed expenses} &= \$700,000 - \left(\frac{1}{3} \times \$700,000 \right) - \$210,000 \\
 &= \$256,667
 \end{aligned}$$

With this information, you can determine that Soup Nutsy's break-even point is about \$385,000 of sales. This gives the store a comfortable margin of safety of 45% of sales.

Source: Silva Sansoni, "The Starbucks of Soup?" *Forbes*, July 7, 1997, pp. 90–91.

IN BUSINESS



It is Thursday morning, and Prem Narayan and Bob Luchinni are discussing 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 some are not so good. I also understand that our break-even point is 350 speakers, so we have to make sure we don't slip below that level of sales. What really bothers me is that we are only selling 400 speakers a month now. What did you call the 50-speaker cushion?

Bob: That's the margin of safety.

Prem: Such a small cushion makes me very nervous. What can we do to increase the margin of safety?

**MANAGERIAL
ACCOUNTING
IN ACTION**
The Wrap Up



- Bob:** 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.
- Bob:** I agree. This is something everyone will want to work on.

CVP Considerations in Choosing a Cost Structure

Cost structure refers to the relative proportion of fixed and variable costs in an organization. An organization often has 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 focus on the impact of cost structure on profit stability, in which *operating leverage* plays a key role.

Cost Structure and Profit Stability

When a manager has some latitude in trading off between fixed and variable costs, 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 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%
Less variable expenses	60,000	60%	30,000	30%
Contribution margin	40,000	40%	70,000	70%
Less fixed expenses	30,000		60,000	
Net operating income	<u>\$ 10,000</u>		<u>\$ 10,000</u>	

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 be above \$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%
Less variable expenses	66,000	60%	33,000	30%
Contribution margin	44,000	40%	77,000	70%
Less fixed expenses	30,000		60,000	
Net operating income	<u>\$ 14,000</u>		<u>\$ 17,000</u>	

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 from time to time? What are the break-even points of the two farms? What are their margins of safety? The computations needed to answer these questions are carried out below using the contribution margin method:

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

This analysis makes it clear that Bogside Farm is less vulnerable to downturns than Sterling Farm. We can identify two reasons why it is less vulnerable. First, due to its lower fixed expenses, Bogside Farm has a lower break-even point and a higher margin of safety, as shown by the computations above. Therefore, it will not incur losses as quickly as Sterling Farm in periods of sharply declining sales. Second, due to its lower CM ratio, Bogside Farm will not lose contribution margin as rapidly as Sterling Farm when sales decline. Thus, Bogside Farm's income will be less volatile. We saw earlier that this is a drawback when sales increase, but it provides more protection when sales drop.

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 stability in net operating income and will be more protected from losses during bad years, but at the cost of lower net operating income in good years.

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.

IN BUSINESS



LEARNING OBJECTIVE 8

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

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 percentage changes in 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 given previously 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 a \$100,000 sales level would be computed as follows:

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

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

Since the degree of operating leverage for Bogside Farm is 4, the farm's net operating income grows four times as fast as its sales. Similarly, 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%.

	(1)	(2)	(3)
	Percent Increase in Sales	Degree of Operating Leverage	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 244, 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. This can be seen from the following tabulation, which 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
Less 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
Less 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 the company were operating at a \$225,000 sales level, 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 contribution margin ÷ \$0 net operating income = ∞).

FAN APPRECIATION

Operating leverage can be a good thing when business is booming but can turn the situation ugly when sales slacken. Jerry Colangelo, the managing partner of the **Arizona Diamondbacks** professional baseball team, spent over \$100 million to sign six free agents—doubling the team's payroll cost—on top of the costs of operating and servicing the debt on the team's new stadium. With annual expenses of about \$100 million, the team needs to average 40,000 fans per game to break even.

Faced with a financially risky situation, Colangelo decided to raise ticket prices by 12%. And he did it during Fan Appreciation Weekend! Attendance for the season dropped by 15%, turning what should have been a \$20 million profit into a loss of over \$10 million for the year. Note that a drop in attendance of 15% did not cut profit by just 15%—that's the magic of operating leverage at work.

Source: Mary Summers, "Bottom of the Ninth, Two Out," *Forbes*, November 1, 1999, pp. 69–70.

IN BUSINESS



A manager can use the degree of operating leverage 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 generally compensate salespeople by paying them either a commission based on sales or a salary plus a sales commission. Commissions based on sales dollars can lead to lower profits. To illustrate, consider Pipeline Unlimited, a producer of surfing equipment. Salespeople for the company sell the company's product 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
Less 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, since 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 since it has the higher contribution margin.

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

The Concept of Sales Mix

LEARNING OBJECTIVE 9

Compute the break-even point for a multiple product 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

KODAK: GOING DIGITAL

Kodak dominates the film industry in the U.S., selling two out of every three rolls of film. It also processes 40% of all film dropped off for developing. Unfortunately for Kodak, this revenue stream is threatened by digital cameras, which do not use film at all. To counter this threat, Kodak has moved into the digital market with its own line of digital cameras and various services, but sales of digital products undeniably cut into the company's film business. "Chief Financial Officer Robert Brust has 'stress-tested' profit models based on how quickly digital cameras may spread. If half of homes go digital, . . . Kodak's sales would rise 10% a year—but profits would go up only 8% a year. Cost cuts couldn't come fast enough to offset a slide in film sales and the margin pressure from selling cheap digital cameras." The sales mix is moving in the wrong direction, given the company's current cost structure and competitive prices.

Source: Bruce Upbin, "Kodak's Digital Moment," *Forbes*, August 21, 2000, pp. 106–112.

Sales Mix and Break-Even Analysis

If a company sells more than one product, break-even analysis is somewhat more complex than discussed earlier in this chapter. The reason is that different products will have different selling prices, different costs, and different contribution margins. Consequently, the break-even point will depend on the mix in which the various products are sold. To illustrate, consider Sound Unlimited, a small company that imports CDs from France for use in

personal computers. At present, the company distributes the following CDs to retail computer stores: the Le Louvre CD, a multimedia free-form tour of the famous art museum in Paris; and the Le Vin CD, which features the wines and wine-growing regions of France. Both multimedia products have sound, photos, video clips, and sophisticated software. The company's September sales, expenses, and break-even point are shown in Exhibit 6–3.

As shown in the exhibit, the break-even point is \$60,000 in sales. This is computed by dividing the fixed costs by the company's *overall* CM ratio of 45%. The sales mix is currently 20% for the Le Louvre CD and 80% for the Le Vin CD. If this sales mix does not change, then at the break-even total sales of \$60,000, the sales of the Le Louvre CD would be \$12,000 (20% of \$60,000) and the sales of the Le Vin CD would be \$48,000 (80% of \$60,000). As shown in Exhibit 6–3, 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 change.* This is illustrated by the results for October in which the sales mix shifted away from the more profitable Le Vin CD (which has a 50% CM ratio) toward the less profitable Le Louvre CD (which has a 25% CM ratio). These results appear in Exhibit 6–4.

Although sales have remained unchanged at \$100,000, the sales mix is exactly the reverse of what it was in Exhibit 6–3, with the bulk of the sales now coming from the less profitable Le Louvre CD. 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—the overall CM ratio

EXHIBIT 6–3

Multiple-Product Break-Even Analysis

SOUND UNLIMITED

Contribution Income Statement

For the Month of September

	Le Louvre CD		Le Vin CD		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales	\$20,000	100%	\$80,000	100%	\$100,000	100%
Less variable expenses	15,000	75%	40,000	50%	55,000	55%
Contribution margin	<u>\$ 5,000</u>	<u>25%</u>	<u>\$40,000</u>	<u>50%</u>	45,000	45%
Less fixed expenses					27,000	
Net operating income					<u>\$ 18,000</u>	

Computation of the break-even point:

Fixed expenses

\$27,000

=

Overall CM ratio

0.45

= \$60,000

Verification of the break-even:

	Le Louvre CD	Le Vin CD	Total
Current dollar sales	\$20,000	\$80,000	\$100,000
Percentage of total dollar sales ..	20%	80%	100%

↙

↘

↘

	Le Louvre CD	Le Vin CD	Total
Sales at break-even	\$12,000	\$48,000	\$60,000

	Le Louvre CD		Le Vin CD		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales	\$12,000	100%	\$48,000	100%	\$ 60,000	100%
Less variable expenses	9,000	75%	24,000	50%	33,000	55%
Contribution margin	<u>\$ 3,000</u>	<u>25%</u>	<u>\$24,000</u>	<u>50%</u>	27,000	45%
Less fixed expenses					27,000	
Net operating income					<u>\$ 0</u>	

EXHIBIT 6–4

Multiple-Product Break-Even Analysis: A Shift in Sales Mix (see Exhibit 6–3)

SOUND UNLIMITED Contribution Income Statement For the Month of October						
	Le Louvre CD		Le Vin CD		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales	\$80,000	100%	\$20,000	100%	\$100,000	100%
Less variable expenses	60,000	75%	10,000	50%	70,000	70%
Contribution margin	<u>\$20,000</u>	<u>25%</u>	<u>\$10,000</u>	<u>50%</u>	30,000	30%
Less fixed expenses					<u>27,000</u>	
Net operating income					<u>\$ 3,000</u>	
Computation of the break-even point:						
	$\frac{\text{Fixed expenses}}{\text{Overall CM ratio}} = \frac{\$27,000}{0.30} = \$90,000$					

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. Since 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, some 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 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 some of these assumptions may be violated in practice, the violations are usually not serious enough to call into question the validity of CVP analysis. For example, in most multiproduct companies, the sales mix is constant enough so that the results of CVP analysis are reasonably valid.

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 a manager can adjust the model 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. 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 235–238.

Summary

CVP analysis as presented in this chapter 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 specified changes are made in prices, costs, and volume.

A CVP graph depicts the relationships between sales volume in units on the one hand and fixed expenses, variable expenses, total expenses, total sales, and profits on the other hand. The CVP graph is useful for developing intuition about how costs and profits respond to changes in sales volume.

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.

The break-even point is the level of sales (in units or in dollars) at which the company just breaks even. The break-even point can be computed using several different techniques that are all based on the simple CVP model. With slight modifications, the same techniques can be used to compute the level of sales required to attain a target profit.

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

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%
Less variable expenses	900,000	45	? %
Contribution margin	300,000	\$15	? %
Less fixed expenses	240,000		
Net operating income	\$ 60,000		

Management is anxious to improve the company's profit performance 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 determine your answer.
4. Refer to the original data. Assume that next year management wants the company to earn a minimum profit of \$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 contribution margin method.
 - c. Would you recommend that the changes be made?

Solution to Review Problem

$$1. \quad \text{CM ratio} = \frac{\text{Contribution margin}}{\text{Selling price}} = \frac{\$15}{\$60} = 25\%$$

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

$$2. \quad \text{Sales} = \text{Variable expenses} + \text{Fixed expenses} + \text{Profits}$$

$$\$60Q = \$45Q + \$240,000 + \$0$$

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

$$Q = \$240,000 \div \$15 \text{ per unit}$$

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

Alternative solution:

$$X = 0.75X + \$240,000 + \$0$$

$$0.25X = \$240,000$$

$$X = \$240,000 \div 0.25$$

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

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

Since 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:

$$\text{Sales} = \text{Variable expenses} + \text{Fixed expenses} + \text{Profits}$$

$$\$60Q = \$45Q + \$240,000 + \$90,000$$

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

$$Q = \$330,000 \div \$15 \text{ per unit}$$

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

Contribution margin method:

$$\frac{\text{Fixed expenses} + \text{Target profit}}{\text{Contribution margin per unit}} = \frac{\$240,000 + \$90,000}{\$15 \text{ per unit}} = 22,000 \text{ units}$$

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>40%</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 will be as follows:

	Total	Per Unit	Percent of Sales
Sales (21,600 units)	\$1,296,000	\$60	100%
Less variable expenses	<u>972,000</u>	<u>45</u>	<u>75%</u>
Contribution margin	324,000	<u>\$15</u>	<u>25%</u>
Less 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 resulted in increases in *both* total sales and total variable expenses. It is a common error to overlook the increase in variable expenses when preparing a projected contribution format income statement.

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%
Less variable expenses	<u>1,152,000</u>	<u>48*</u>	<u>80%</u>
Contribution margin	288,000	<u>\$12</u>	<u>20%</u>
Less 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.

$$\begin{aligned} b. \quad \text{Break-even point in unit sales} &= \frac{\text{Fixed expenses}}{\text{Contribution margin per unit}} \\ &= \frac{\$210,000}{\$12 \text{ per unit}} = 17,500 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Break-even point in dollar sales} &= \frac{\text{Fixed expenses}}{\text{CM ratio}} \\ &= \frac{\$210,000}{0.20} = \$1,050,000 \end{aligned}$$

- c. Yes, based on these data the changes should be made. The changes will increase the company's net operating income from the present \$60,000 to \$78,000 per year. Although the changes will 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 will actually be wider 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) above, 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. The break-even point can also be defined as the point where total sales equals total expenses or as the point where total contribution margin equals total fixed expenses. (p. 232)

Contribution margin method A method of computing the break-even point in which the fixed expenses are divided by the contribution margin per unit. (p. 240)

Contribution margin ratio (CM ratio) The contribution margin as a percentage of total sales. (p. 235)

Cost-volume-profit (CVP) graph The relationships between an organization's revenues, costs, and level of activity presented in graphic form. (p. 233)

Degree of operating leverage A measure, at a given level of sales, of how a percentage change in sales volume will affect profits. The degree of operating leverage is computed by dividing contribution margin by net operating income. (p. 246)

Equation method A method of computing the break-even point that relies on the equation $\text{Sales} = \text{Variable expenses} + \text{Fixed expenses} + \text{Profits}$. (p. 239)

Incremental analysis An analytical approach that focuses only on those items of revenue, cost, and volume that will change as a result of a decision. (p. 237)

Margin of safety The excess of budgeted (or actual) sales over the break-even volume of sales. (p. 242)

Operating leverage A measure of how sensitive net operating income is to a given percentage change in sales. It is computed by dividing the contribution margin by net operating income. (p. 246)

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. 248)

Questions

- 6–1 What is meant by a product's CM 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** Company A's cost structure includes costs that are mostly variable, whereas Company B's cost structure includes costs that are mostly fixed. In a time of increasing sales, which company will tend to realize the most rapid increase in profits? Explain.
- 6–4** What is meant by the term *operating leverage*?
- 6–5** A 10% decrease in the selling price of a product will have the same impact on net income as a 10% increase in the variable expenses. Do you agree? Why or why not?
- 6–6** What is meant by the term *break-even point*?
- 6–7** Name three approaches to break-even analysis. Briefly explain how each approach works.
- 6–8** 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 costs increased throughout the entire range of activity portrayed on the graph, and (c) variable costs per unit increased.
- 6–9** Al's Auto Wash charges \$4 to wash a car. The variable costs of washing a car are \$0.60 per car. Fixed expenses total \$1,700 monthly. How many cars must be washed each month for Al to break even?
- 6–10** What is meant by the margin of safety?
- 6–11** Companies X and Y are in the same industry. Company X is highly automated, whereas Company Y relies primarily on labor to make its products. If sales and total expenses in the two companies are about the same, which would you expect to have the lower margin of safety? Why?
- 6–12** What is meant by the term *sales mix*? What assumption is usually made concerning sales mix in CVP analysis?
- 6–13** Explain how a shift in the sales mix could result in both a higher break-even point and a lower net income.



Exercises

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
Less variable expenses	<u>200,000</u>	<u>20.00</u>
Contribution margin	150,000	<u>\$15.00</u>
Less fixed expenses	<u>135,000</u>	
Net operating income	<u>\$ 15,000</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 has a single product whose selling price is \$24 and whose variable cost 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 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 total 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 income if it were to increase its total sales by \$1,000.

EXERCISE 6–4 Changes in Variable Costs, Fixed Costs, Selling Price, and Volume [L04]

Data for Hermann Corporation are shown below:

	Per Unit	Percent of Sales
Selling price	\$90	100%
Less variable expenses	63	70
Contribution margin	<u>\$27</u>	<u>30%</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 6–5 Compute the Break-Even Point [L05]

Mauro Products has a single product, a woven basket whose selling price is \$15 and whose variable cost is \$12 per unit. The company's monthly fixed expenses are \$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 contribution margin method.
4. Solve for the company's break-even point in sales dollars using the contribution margin method and the CM ratio.

EXERCISE 6–6 Compute the Level of Sales Required to Attain a Target Profit [L06]

Lin Corporation has a single product whose selling price is \$120 and whose variable cost 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 contribution margin approach, solve for the dollar sales that are required to earn a target profit of \$15,000.

**EXERCISE 6–7 Compute the Margin of Safety [L07]**

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 expense . . .	\$20 per unit
Fixed expense	\$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 6–8 Compute and Use the Degree of Operating Leverage [L08]

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%
Less variable expenses	32,000	40%
Contribution margin	48,000	60%
Less fixed expenses	38,000	
Net operating income	<u>\$10,000</u>	



Required:

1. Compute the company's degree of operating leverage.
2. Using the degree of operating leverage, estimate the impact on net 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 6–9 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 below:



	Claimjumper	Makeover	Total
Sales	\$30,000	\$70,000	\$100,000
Less variable expenses	20,000	50,000	70,000
Contribution margin	<u>\$10,000</u>	<u>\$20,000</u>	30,000
Less fixed expenses			<u>24,000</u>
Net operating income			<u>\$ 6,000</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 6–10 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
Less variable expenses	180,000	9.00
Contribution margin	120,000	<u>\$6.00</u>
Less fixed expenses	70,000	
Net operating income	<u>\$ 50,000</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 15%.
2. The selling price decreases by \$1.50 per unit, and the sales volume increases by 25%.
3. The selling price increases by \$1.50 per unit, fixed expenses increase by \$20,000, and the sales volume decreases by 5%.
4. The selling price increases by 12%, variable expenses increase by 60 cents per unit, and the sales volume decreases by 10%.

EXERCISE 6–11 Break-Even Analysis and CVP Graphing [LO2, LO4, LO5]

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 a zero level of activity up to 600 tickets sold. Number of persons should be placed on the horizontal (*X*) axis, and dollars should be placed on the vertical (*Y*) axis.



EXERCISE 6-12 Break-Even and Target Profit 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.

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 contribution margin method.



EXERCISE 6-13 Break-Even and Target Profit 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 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 6-14 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 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 (Percent)	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 Break-Even Analysis; Target Profit; Margin of Safety; CM Ratio [LO1, LO3, LO5, LO6, LO7]

Menlo Company manufactures and sells a single product. The company's sales and expenses for last quarter follow:

	Total	Per Unit
Sales	\$450,000	\$30
Less variable expenses	180,000	12
Contribution margin	270,000	\$18
Less fixed expenses	216,000	
Net operating income	\$ 54,000	

Required:

- What is the quarterly break-even point in units sold and in sales dollars?
- Without resorting to computations, what is the total contribution margin at the break-even point?
- How many units would have to be sold each quarter to earn a target profit of \$90,000? Use the contribution margin method. Verify your answer by preparing a contribution format income statement at the target sales level.
- Refer to the original data. Compute the company's margin of safety in both dollar and percentage terms.
- What is the company's CM ratio? If sales increase by \$50,000 per quarter and there is no change in fixed expenses, by how much would you expect quarterly net operating income to increase?

EXERCISE 6–16 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:

- Prepare a contribution format income statement for the game last year and compute the degree of operating leverage.
- 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:
 - The expected percentage increase in net operating income for next year.
 - 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 6–17 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 and the contribution margin ratios for the two products follow:

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



Fixed expenses total P183,750 per month. (The currency in the Philippines is the peso, which is denoted by P.)

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



PROBLEM 6–18 Basic CVP Analysis; Graphing [LO1, LO2, LO4, LO5]

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 - Problem 6-18 screen capture.xls		
File Edit View Insert Format Tools Data Window Help		
12 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15		
	A	B
1		Per Pair of Shoes
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		Annual
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 a zero level of activity 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.

PROBLEM 6–19 Basics of CVP Analysis; Cost Structure [L01, L03, L04, L05, L06]

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
Less variable expenses	409,500
Contribution margin	175,500
Less fixed expenses	180,000
Net operating loss	\$ (4,500)

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 6–20 Basics of CVP Analysis [L01, L03, L04, L05, L08]

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
Less variable expenses	160,000
Contribution margin	240,000
Less 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 income statements, one showing the results of last year's operations and one showing

**excel****excel**

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 6–21 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							
	White		Fragrant		Loonzain		Total	
Percentage of total sales	20%		52%		28%		100%	
Sales	B150,000	100%	B390,000	100%	B210,000	100%	B750,000	100%
Less variable expenses	108,000	72%	78,000	20%	84,000	40%	270,000	36%
Contribution margin	<u>B 42,000</u>	<u>28%</u>	<u>B312,000</u>	<u>80%</u>	<u>B126,000</u>	<u>60%</u>	<u>480,000</u>	<u>64%</u>
Less fixed expenses							449,280	
Net operating income							<u>B30,720</u>	

$$\text{Break-even point in sales dollars} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\text{B}449,280}{0.64} = \text{B}702,000$$

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 B750,000 as planned. Actual sales by product are: White, B300,000; Fragrant, B180,000; and Loonzain, B270,000.

Required:

1. Prepare a contribution format income statement for the month based on actual sales data. Present the income statement in the format shown above.
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 B750,000 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 6–22 Break-Even Analysis; Pricing [LO1, LO4, LO5]

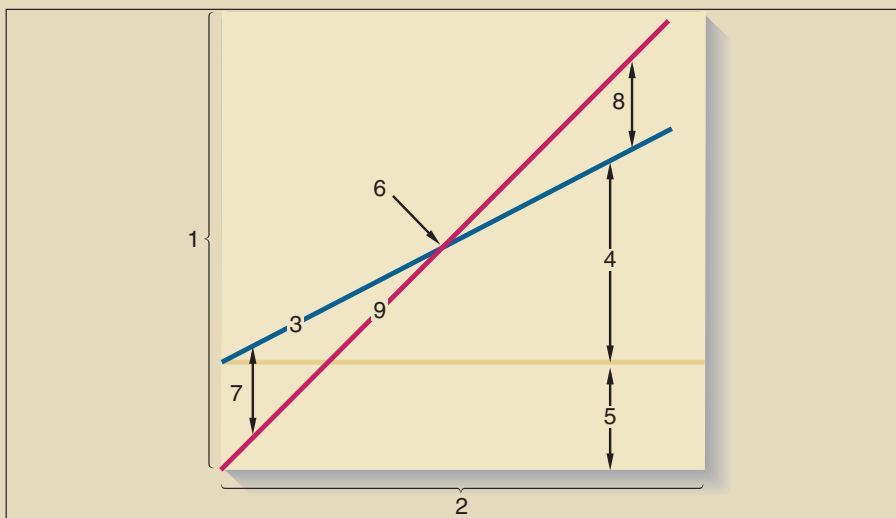
Minden Company introduced a new product last year for which it is trying to find an optimal selling price. Marketing studies suggest that the company can increase sales by 5,000 units for each \$2 reduction in the selling price. The company's present selling price is \$70 per unit, and variable expenses 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 6–23 Interpretive Questions on the CVP Graph [LO2, LO5]

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



Required:

- Identify the numbered components in the CVP graph.
- 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 point: Decrease.

- The unit selling price is increased from \$18 to \$20.
- Unit variable costs are decreased from \$12 to \$10.
- Fixed costs are increased by \$3,000 per period.
- Two thousand more units are sold during the period than were budgeted.
- 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.
- Due to an increase in the cost of materials, both unit variable costs and the selling price are increased by \$2.
- Advertising costs are increased by \$10,000 per period, resulting in a 10% increase in the number of units sold.
- 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 6–24 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.

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

Sales (30,000 balls)	\$750,000
Less variable expenses	450,000
Contribution margin	300,000
Less fixed expenses	210,000
Net operating income	<u>\$ 90,000</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 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 6–25 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	16
Contribution margin per pair of sandals	<u>\$24</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>\$60,000</u>

Required:

1. How many pairs of sandals must be sold each year to break even? What does this represent in total sales dollars?

2. Prepare a CVP graph for the store from a zero level of activity up to 4,000 pairs of sandals sold each year. Indicate the break-even point on your graph.
3. 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?
4. 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.)
5. 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
Less variable expenses	48,000
Contribution margin	72,000
Less fixed expenses	60,000
Net operating income	<u>\$ 12,000</u>

- a. What is the store's degree of operating leverage?
- b. 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 6–26 Changes in Fixed and Variable Costs; Break-Even and Target Profit 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.

Required:

1. Compute the monthly break-even point for the new toy in units and in total sales dollars. Show all computations in good form.
2. How many units must be sold each month to make a monthly profit of \$12,000?
3. If the sales manager receives a bonus of 10 cents for each unit sold in excess of the break-even point, how many units must be sold each month to earn a return of 25% on the monthly investment in fixed costs?

PROBLEM 6–27 Break-Even and Target Profit 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 6–28 Changes in Cost Structure; Break-Even Analysis; Operating Leverage; Margin of Safety [LO4, LO5, LO7, LO8]

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

Sales (15,000 units × \$30 per unit)	\$450,000
Less variable expenses	315,000
Contribution margin	135,000
Less fixed expenses	90,000
Net operating income	<u>\$ 45,000</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 ample funds are available to make the purchase.)
4. Refer to the original data. Rather than purchase new equipment, the marketing manager is thinking about changing the company's marketing strategy. 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 sales dollars for the company under the new marketing strategy. Do you agree with the marketing manager's proposal?



PROBLEM 6–29 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 costs 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 6–30 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 (in cost per set):



	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 why there is a difference in net operating income 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 optimize the sales mix?
4.
 - a. Using April's figures, what was the break-even point for the month in sales dollars?
 - b. Has May's break-even point gone up or down from that of April? Explain your answer without calculating the break-even point for May.

Cases

CASE 6–31 Detailed Income Statement; CVP Analysis [LO1, LO4, LO6]

The most recent income statement for Whitney Company appears below:



WHITNEY COMPANY			
Income Statement			
For the Year Ended December 31			
Sales (45,000 units at \$10 per unit)			\$450,000
Less cost of goods sold:			
Direct materials	\$90,000		
Direct labor	78,300		
Manufacturing overhead	98,500		266,800
Gross margin			183,200
Less operating expenses:			
Selling expenses:			
Variable:			
Sales commissions	\$27,000		
Shipping	5,400	32,400	
Fixed (advertising, salaries)		120,000	
Administrative:			
Variable (billing and other)		1,800	
Fixed (salaries and other)	48,000		202,200
Net operating loss			<u>\$ (19,000)</u>

All variable expenses in the company vary in terms of unit sold, except for sales commissions, which are based on sales dollars. Variable manufacturing overhead is 30 cents per unit. There were no beginning or ending inventories. Whitney Company's plant has a capacity of 75,000 units per year.

The company has been operating at a loss for several years. Management is studying several possible courses of action to determine what should be done to make next year profitable.

Required:

- Redo Whitney Company's income statement in the contribution format. Show both a Total column and a Per Unit column on your statement. Leave enough space to the right of your numbers to enter the solution to both parts of (2) below.
- The president is considering two proposals prepared by members of his staff:
 - For next year, the vice president would like to reduce the unit selling price by 20%. She is certain that this would fill the plant to capacity.
 - For next year, the sales manager would like to increase the unit selling price by 20%, increase the sales commission to 9% of sales, and increase advertising by \$100,000. Based on marketing studies, he is confident this would increase unit sales by one-third.

Prepare two contribution income statements, one showing what profits would be under the vice president's proposal and one showing what profits would be under the sales manager's proposal. On each statement, include both Total and Per Unit columns (do not show per unit data for the fixed costs).
- Refer to the original data. The president believes it would be a mistake to change the unit selling price. Instead, he wants to use less costly raw materials, thereby reducing unit costs by 70 cents. How many units would have to be sold next year to earn a target profit of \$30,200?
- Refer to the original data. Whitney Company's board of directors believes that the company's problem lies in inadequate promotion. By how much can advertising be increased and still allow the company to earn a target profit of 4.5% on sales of 60,000 units?
- Refer to the original data. The company has been approached by an overseas distributor who wants to purchase 9,500 units on a special price basis. There would be no sales commission on these units. However, shipping costs would be increased by 50% and variable administrative costs would be reduced by 25%. In addition, a \$5,700 special insurance fee would have to be paid by Whitney Company to protect the goods in transit. What unit price would have to be quoted on the 9,500 units by Whitney Company to allow the company to earn a profit of \$14,250 on total operations? Regular business would not be affected by this special order.

CASE 6–32 Missing Data; Break-Even Analysis; Target Profit; Margin of Safety; Operating Leverage
[LO1, LO4, LO5, LO7, LO8]

You were employed just this morning by Pyrrhic Company, a prominent and rapidly growing organization. As your initial assignment, you were asked to complete an analysis of one of the company's products for the board of directors meeting later in the day. After completing the analysis, you left your office for a few moments only to discover on returning that a broken sprinkler in the ceiling has destroyed most of your work. Only the following bits remained:



PYRRHIC COMPANY			
Actual Income Statement			
For the Month Ended June 30			
	Total	Per Unit	Percent
Sales (? units)	\$?	\$?	100%
Less variable expenses	<u>?</u>	<u>?</u>	<u>?%</u>
Contribution margin	<u>?</u>	<u>\$?</u>	<u>?%</u>
Less fixed expenses	<u>?</u>		
Net operating income	<u>\$?</u>		
Break-even point:			
In units		? units	
In dollars		\$180,000	
Margin of safety:			
In dollars		\$?	
In percentage		20%	
Degree of operating leverage		?	

The computations above are all based on actual results for June. The company's *projected* contribution format income statement for this product for July follows:

PYRRHIC COMPANY			
Projected Income Statement			
For the Month Ended July 31			
	Total	Per Unit	Percent
Sales (33,000 units)	\$?	\$?	?%
Less variable expenses	<u>?</u>	<u>?</u>	<u>?%</u>
Contribution margin	<u>?</u>	<u>\$?</u>	<u>?%</u>
Less fixed expenses	<u>?</u>		
Net operating income	<u>\$40,500</u>		

To add to your woes, the company's mainframe computer is down so no data are available from that source. You do remember that sales for July are projected to increase by 10% over sales for June. You also remember that June's net operating income was \$27,000—the same amount as your annual salary from the company. Finally, you remember that the degree of operating leverage is highly useful to the manager as a predictive tool.

Total fixed expenses, the unit selling price, and the unit variable expenses are planned to be the same in June and July.

The board of directors meets in just one hour.

Required:

- For the June data, do the following:
 - Complete the June contribution format income statement (all three columns).
 - Compute the break-even point in units and verify the break-even point in sales dollars that is provided above. Use the contribution margin method.
 - Compute the margin of safety in dollars and verify the margin of safety percentage that is provided above.
 - Compute the degree of operating leverage as of June 30.
- For the July data, do the following:
 - Complete the July projected contribution format income statement (all three columns).

- b. Compute the margin of safety in dollars and percent and compute the degree of operating leverage. Why has the margin of safety gone up and the degree of operating leverage gone down?
3. Brimming with confidence after having completed (1) and (2) above in less than one hour, you decide to give the board of directors some added data. You know that direct labor accounts for \$1.80 of the company's per unit variable expenses. You have learned that direct labor costs may increase by one-third next year. Assuming that this cost increase takes place and that selling price and other cost factors remain unchanged, how many units will the company have to sell in a month to earn a net operating income equal to 20% of sales?

**CASE 6-33 Cost Structure; Break-Even; Target Profits [LO4, LO5, LO6]**

Pittman Company is a small but growing manufacturer of telecommunications equipment. The company has no sales force of its own; rather, it relies completely on independent sales agents to market its products. These agents are paid a commission of 15% of selling price for all items sold.

Barbara Cheney, Pittman's controller, has just prepared the company's budgeted income statement for next year. The statement follows:

PITTMAN COMPANY			
Budgeted Income Statement			
For the Year Ended December 31			
Sales			\$16,000,000
Manufacturing costs:			
Variable	\$7,200,000		
Fixed overhead	2,340,000	9,540,000	
Gross margin			6,460,000
Selling and administrative costs:			
Commissions to agents	2,400,000		
Fixed marketing costs	120,000*		
Fixed administrative costs	1,800,000	4,320,000	
Net operating income			2,140,000
Less fixed interest cost			540,000
Income before income taxes			1,600,000
Less income taxes (30%)			480,000
Net income			<u>\$ 1,120,000</u>
*Primarily depreciation on storage facilities.			

As Barbara handed the statement to Karl Vecchi, Pittman's president, she commented, "I went ahead and used the agents' 15% commission rate in completing these statements, but we've just learned that they refuse to handle our products next year unless we increase the commission rate to 20%."

"That's the last straw," Karl replied angrily. "Those agents have been demanding more and more, and this time they've gone too far. How can they possibly defend a 20% commission rate?"

"They claim that after paying for advertising, travel, and the other costs of promotion, there's nothing left over for profit," replied Barbara.

"I say it's just plain robbery," retorted Karl. "And I also say it's time we dumped those guys and got our own sales force. Can you get your people to work up some cost figures for us to look at?"

"We've already worked them up," said Barbara. "Several companies we know about pay a 7.5% commission to their own salespeople, along with a small salary. Of course, we would have to handle all promotion costs, too. We figure our fixed costs would increase by \$2,400,000 per year, but that would be more than offset by the \$3,200,000 (20% × \$16,000,000) that we would avoid on agents' commissions."

The breakdown of the \$2,400,000 cost follows:

Salaries:	
Sales manager	\$ 100,000
Salespersons	600,000
Travel and entertainment ...	400,000
Advertising	1,300,000
Total	<u>\$2,400,000</u>

“Super,” replied Karl. “And I noticed that the \$2,400,000 is just what we’re paying the agents under the old 15% commission rate.”

“It’s even better than that,” explained Barbara. “We can actually save \$75,000 a year because that’s what we’re having to pay the auditing firm now to check out the agents’ reports. So our overall administrative costs would be less.”

“Pull all of these numbers together and we’ll show them to the executive committee tomorrow,” said Karl. “With the approval of the committee, we can move on the matter immediately.”

Required:

1. Compute Pittman Company’s break-even point in sales dollars for next year assuming:
 - a. That the agents’ commission rate remains unchanged at 15%.
 - b. That the agents’ commission rate is increased to 20%.
 - c. That the company employs its own sales force.
2. Assume that Pittman Company decides to continue selling through agents and pays the 20% commission rate. Determine the volume of sales that would be required to generate the same net income as contained in the budgeted income statement for next year.
3. Determine the volume of sales at which net income would be equal regardless of whether Pittman Company sells through agents (at a 20% commission rate) or employs its own sales force.
4. Compute the degree of operating leverage that the company would expect to have on December 31 at the end of next year assuming:
 - a. That the agents’ commission rate remains unchanged at 15%.
 - b. That the agents’ commission rate is increased to 20%.
 - c. That the company employs its own sales force.Use income *before* income taxes in your operating leverage computation.
5. Based on the data in (1) through (4) above, make a recommendation as to whether the company should continue to use sales agents (at a 20% commission rate) or employ its own sales force. Give reasons for your answer.

(CMA, adapted)

CASE 6–34 Break-Even Analysis with Step Fixed Costs [LO5, LO6]

The Pediatric Department at Wymont General Hospital has a capacity of 90 beds and operates 24 hours a day every day. The measure of activity in the department is patient-days, where one patient-day represents one patient occupying a bed for one day. The average revenue per patient-day is \$130 and the average variable cost per patient-day is \$50. The fixed cost of the department (not including personnel costs) is \$454,000.

The only personnel directly employed by the Pediatric Department are aides, nurses, and supervising nurses. The hospital has minimum staffing requirements for the department based on total annual patient-days in Pediatrics. Hospital requirements, beginning at the minimum expected level of activity, follow:

Annual Patient-Days	Aides	Nurses	Supervising Nurses
10,000–14,000	21	11	4
14,001–17,000	22	12	4
17,001–23,725	22	13	4
23,726–25,550	25	14	5
25,551–27,375	26	14	5
27,376–29,200	29	16	6

These staffing levels represent full-time equivalents, and it should be assumed that the Pediatric Department always employs only the minimum number of required full-time equivalent personnel.

Average annual salaries for each class of employee are: aides, \$18,000; nurses, \$26,000; and supervising nurses, \$36,000.

Required:

1. Compute the total fixed costs (including the salaries of aides, nurses, and supervising nurses) in the Pediatric Department for each level of activity shown above (i.e., total fixed costs at the 10,000–14,000 patient-day level of activity, total fixed costs at the 14,001–17,000 patient-day level of activity, etc.).
2. Compute the minimum number of patient-days required for the Pediatric Department to break even.



- Determine the minimum number of patient-days required for the Pediatric Department to earn an annual “profit” of \$200,000.

(CPA, adapted)

**CASE 6–35 Break-Events for Individual Products in a Multiproduct Company [LO5, LO9]**

Cheryl Montoya picked up the phone and called her boss, Wes Chan, the vice president of marketing at Piedmont Fasteners Corporation: “Wes, I’m not sure how to go about answering the questions that came up at the meeting with the president yesterday.”

“What’s the problem?”

“The president wanted to know the break-even point for each of the company’s products, but I am having trouble figuring them out.”

“I’m sure you can handle it, Cheryl. And, by the way, I need your analysis on my desk tomorrow morning at 8:00 sharp in time for the follow-up meeting at 9:00.”

Piedmont Fasteners Corporation makes three different clothing fasteners in its manufacturing facility in North Carolina. Data concerning these products appear below:

	Velcro	Metal	Nylon
Normal annual sales volume	100,000	200,000	400,000
Unit selling price	\$1.65	\$1.50	\$0.85
Variable cost per unit	\$1.25	\$0.70	\$0.25

Total fixed expenses are \$400,000 per year.

All three products are sold in highly competitive markets, so the company is unable to raise its prices without losing unacceptable numbers of customers.

The company has an extremely effective just-in-time manufacturing system, so there are no beginning or ending work in process or finished goods inventories.

Required:

- What is the company’s over-all break-even in total sales dollars?
- Of the total fixed costs of \$400,000, \$20,000 could be avoided if the Velcro product were dropped, \$80,000 if the Metal product were dropped, and \$60,000 if the Nylon product were dropped. The remaining fixed costs of \$240,000 consist of common fixed costs such as administrative salaries and rent on the factory building that could be avoided only by going out of business entirely.
 - What is the break-even point in units for each product?
 - If the company sells exactly the break-even quantity of each product, what will be the overall profit of the company? Explain this result.

Group and Internet Exercises

**GROUP EXERCISE 6–36 CVP and Collegiate Sports**

Revenue from major intercollegiate sports is an important source of funds for many colleges. Most of the costs of putting on a football or basketball game are fixed and increase very little as the size of the crowd increases. Thus, the revenue from every extra ticket sold is almost pure profit.

Choose a sport played at your college or university, such as football or basketball, that generates significant revenue. Talk with the business manager of your college’s sports programs before answering the following questions:

Required:

- What is the maximum seating capacity of the stadium or arena in which the sport is played? During the past year, what was the average attendance at the games? On average, what percentage of the stadium or arena capacity was filled?
- The number of seats sold often depends on the opponent. The attendance for a game with a traditional rival (e.g., Nebraska vs. Colorado, University of Washington vs. Washington State, or Texas vs. Texas A&M) is usually substantially above the average. Also, games against conference foes may draw larger crowds than other games. As a consequence, the number of tickets sold for a game is somewhat predictable. What implications does this have for the nature of the costs of putting on a game? Are most of the costs really fixed with respect to the number of tickets sold?
- Estimate the variable cost per ticket sold.

4. Estimate the total additional revenue that would be generated in an average game if all of the tickets were sold at their normal prices. Estimate how much profit is lost because these tickets are not sold.
5. Estimate the ancillary revenue (parking and concessions) per ticket sold. Estimate how much profit is lost in an average game from these sources of revenue as a consequence of not having a sold-out game.
6. Estimate how much additional profit would be generated for your college if every game were sold out for the entire season.

GROUP EXERCISE 6–37 The Economics of Higher Education

The “baby bust” of the 1960s and early 1970s resulted in the number of college-age 18- and 19-year-olds contrasting sharply from 1980 to 1993. The number of graduating high school seniors peaked in 1979 and declined to a low of 6.9 million in 1992, a drop of nearly 40%. Throughout the eighties, tuition at private and public universities rose at an average of 9% per year, a figure far above the rise in household family incomes. Then, the demographics began to reverse themselves: the number of 18- and 19-year-olds began to increase in 1996 and will continue until they peak in 2010 at about 9.3 million for nearly a 33% increase in the college-eligible population. The four-year cost of attending a private college now often exceeds \$100,000—including room and board.

Required:

1. If tuition and room and board costs increase at the rate of 9% per year, what will four years’ tuition at a private college cost in 10 years? How affordable will a college education be at this level?
2. What is the cost of adding an extra student to a typical class? Explain this in terms of the cost structure of a university.
3. After two decades of almost uninterrupted expansion, the “baby bust” enrollment drop left many colleges with considerable underutilized capacity. What impact will increasing enrollment and economies of scale have on costs and tuition?
4. Which colleges do you expect will be helped the most by increasing enrollments—public or private?

**GROUP EXERCISE 6–38 Airline Cost Structure**

Airlines provide an excellent illustration of the concept of operating leverage, the sensitivity of a firm’s operating profits to changes in demand, and the opportunities and risks presented by such a cost structure. The Uniform System of Accounts required by the Department of Transportation for airlines operating in the United States contains the following cost categories:

- Fuel and oil.
- Flying operations labor (flight crews—pilots, copilots, navigators, and flight engineers).
- Passenger service labor (flight attendants).
- Aircraft traffic and servicing labor (personnel servicing aircraft and handling passengers at gates, baggage, and cargo).
- Promotions and sales labor (reservations and sales agents, advertising and publicity).
- Maintenance labor (maintenance of flight equipment and ground property and equipment).
- Maintenance materials and overhead.
- Ground property and equipment (landing fees, rental expenses, and depreciation for ground property and equipment).
- Flight equipment (rental expenses and depreciation on aircraft frames and engines).
- General overhead (administrative personnel, utilities, insurance, communications, etc.).

Required:

1. Which of the above costs are likely to be affected if an airline adds an airport to its network?
2. Which of the above costs are likely to be affected if an airline schedules one more flight out of an airport that the airline already serves?
3. Which of the above costs are likely to be variable with respect to the number of passengers who actually fly on a particular scheduled flight?
4. Are airline profits likely to be affected very much by their load factors? Why? (The load factor refers to the percentage of scheduled seats filled by paying passengers.)

**INTERNET EXERCISE 6–39**

As you know, the World Wide Web is a medium that is constantly evolving. Sites come and go, and change without notice. To enable the periodic updating of site addresses, this problem has been posted to the textbook website (www.mhhe.com/garrison11e). After accessing the site, enter the Student Center and select this chapter. Select and complete the Internet exercise.