Cost-Volume-Profit Relationships

LEARNING OBJECTIVES

After studying Chapter 5, you should be able to:

LO5-1 Explain how changes in activity affect contribution margin and net operating income.

LO5-2 Prepare and interpret a cost-volume-profit (CVP) graph and a profit graph.

LO5-3 Use the contribution margin ratio (CM ratio) to compute changes in contribution margin and net operating income resulting from changes in sales volume.

LO5-4 Show the effects on net operating income of changes in variable costs, fixed costs, selling price, and volume.

LO5-5 Determine the break-even point.

LO5-6 Determine the level of sales needed to achieve a desired target profit.

LO5-7 Compute the margin of safety and explain its significance.

LO5-8 Compute the degree of operating leverage at a particular level of sales and explain how it can be used to predict changes in net operating income.

LO5-9 Compute the break-even point for a multiproduct company and explain the effects of shifts in the sales mix on contribution margin and the break-even point.

Moreno Turns Around the Los Angeles Angels

BUSINESS FOCUS

When Arturo Moreno bought Major League Baseball's **Los Angeles Angels** in 2003, the team was drawing 2.3 million fans and losing $5.5 million per year. Moreno immediately cut prices to attract more fans and increase profits. In his first spring training game, he reduced the price of selected tickets from $12 to $6. By increasing attendance, Moreno understood that he would sell more food and souvenirs. He dropped the price of draft beer by $2 and cut the price of baseball caps from $20 to $7.

The Angels now consistently draw about 3.4 million fans per year. This growth in attendance helped double stadium sponsorship revenue to $26 million, and it motivated the Fox Sports Network to pay the Angels $500 million to broadcast all of its games for the next ten years. Since Moreno bought the Angels, annual revenues have jumped from $127 million to $212 million, and the team's operating loss of $5.5 million has been transformed to a profit of $10.3 million. ■

Source: Matthew Craft, "Moreno's Math," Forbes, *May 11, 2009, pp. 84–87.*

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Cost-volume-profit (CVP) analysis helps managers make many important decisions such as what products and services to offer, what prices to charge, what marketing strategy to use, and what cost structure to maintain. Its primary purpose is to estimate how profits are affected by the following five factors:

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

To simplify CVP calculations, managers typically adopt the following assumptions with respect to these factors[1]:

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. The fixed element is constant in total over the entire relevant range.
3. In multiproduct companies, the mix of products sold remains constant.

While these assumptions may be violated in practice, the results of CVP analysis are often "good enough" to be quite useful. Perhaps the greatest danger lies in relying on simple CVP analysis when a manager is contemplating a large change in sales volume that lies outside the relevant range. However, even in these situations the CVP model can be adjusted to take into account anticipated changes in selling prices, variable costs per unit, total fixed costs, and the sales mix that arise when the estimated sales volume falls outside the relevant range.

To help explain the role of CVP analysis in business decisions, we'll now turn our attention to the case of Acoustic Concepts, Inc., a company founded by Prem Narayan.

MANAGERIAL ACCOUNTING IN ACTION
THE ISSUE

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

The Sonic Blaster was an 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 sales volume, but I'm not sure the increased volume will offset the loss in revenue from the lower price.

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

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

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

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

Bob Luchinni's preparation for his forthcoming meeting with Prem begins with the contribution income statement. The contribution income statement emphasizes the behavior of costs and therefore is extremely helpful to managers in judging the impact on profits of changes in selling price, cost, or volume. Bob will base his analysis on the following contribution income statement he prepared last month:

Acoustic Concepts, Inc.
Contribution Income Statement
For the Month of June

	Total	Per Unit
Sales (400 speakers)	$100,000	$250
Variable expenses	60,000	150
Contribution margin	40,000	$100
Fixed expenses	35,000	
Net operating income	$ 5,000	

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

Contribution Margin

LO5-1

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

Contribution margin is the amount remaining from sales revenue after variable expenses have been deducted. Thus, it is the amount available to cover fixed expenses and then to provide profits for the period. Notice the sequence here—contribution margin is used *first* to cover the fixed expenses, and then whatever remains goes toward profits. If the contribution margin is not sufficient to cover the

fixed expenses, then a loss occurs for the period. To illustrate with an extreme example, assume that Acoustic Concepts sells only one speaker during a particular month. The company's income statement would appear as follows:

Contribution Income Statement
Sales of 1 Speaker

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

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

Contribution Income Statement
Sales of 2 Speakers

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

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

Contribution Income Statement
Sales of 350 Speakers

	Total	Per Unit
Sales (350 speakers)	$87,500	$250
Variable expenses	52,500	150
Contribution margin	35,000	$100
Fixed expenses	35,000	
Net operating income	$ 0	

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

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

Contribution Income Statement
Sales of 351 Speakers

	Total	Per Unit
Sales (351 speakers)	$87,750	$250
Variable expenses	52,650	150
Contribution margin	35,100	$100
Fixed expenses	35,000	
Net operating income	$ 100	

If 352 speakers are sold (2 speakers above the break-even point), the net operating income for the month will be $200. If 353 speakers are sold (3 speakers above the break-even point), the net operating income for the month will be $300, and so forth. To estimate the profit at any sales volume above the break-even point, multiply the number of units sold in excess of the break-even point by the unit contribution margin. The result

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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	$ 2,500

These calculations can be verified as follows:

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

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

CVP Relationships in Equation Form

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

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

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

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

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

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

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

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

$$\begin{aligned}
\text{Profit} &= (P \times Q - V \times Q) - \text{Fixed expenses} \\
\text{Profit} &= (\$250 \times 351 - \$150 \times 351) - \$35{,}000 \\
&= (\$250 - \$150) \times 351 - \$35{,}000 \\
&= (\$100) \times 351 - \$35{,}000 \\
&= \$35{,}100 - \$35{,}000 = \$100
\end{aligned}$$

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

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

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

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

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

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

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

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

CVP Relationships in Graphic Form

LO5-2

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

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

Preparing the CVP Graph In a CVP graph (sometimes called a *break-even chart*), unit volume is represented on the horizontal (*X*) axis and dollars on the vertical (*Y*) axis. Preparing a CVP graph involves the three steps depicted in Exhibit 5-1:

1. Draw a line parallel to the volume axis to represent total fixed expense. For Acoustic Concepts, total fixed expenses are $35,000.
2. Choose some volume of unit sales and plot the point representing total expense (fixed and variable) at the sales volume you have selected. In Exhibit 5-1, Bob Luchinni chose a volume of 600 speakers. Total expense at that sales volume is:

Fixed expense	$ 35,000
Variable expense (600 speakers × $150 per speaker)	90,000
Total expense	$125,000

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

3. Again choose some sales volume and plot the point representing total sales dollars at the activity level you have selected. In Exhibit 5-1, Bob Luchinni again chose a volume of 600 speakers. Sales at that volume total $150,000 (600 speakers × $250 per speaker). Draw a line through this point back to the origin.

The interpretation of the completed CVP graph is given in Exhibit 5-2. The anticipated profit or loss at any given level of sales is measured by the vertical distance between the total revenue line (sales) and the total expense line (variable expense plus fixed expense).

EXHIBIT 5-1
Preparing the CVP Graph

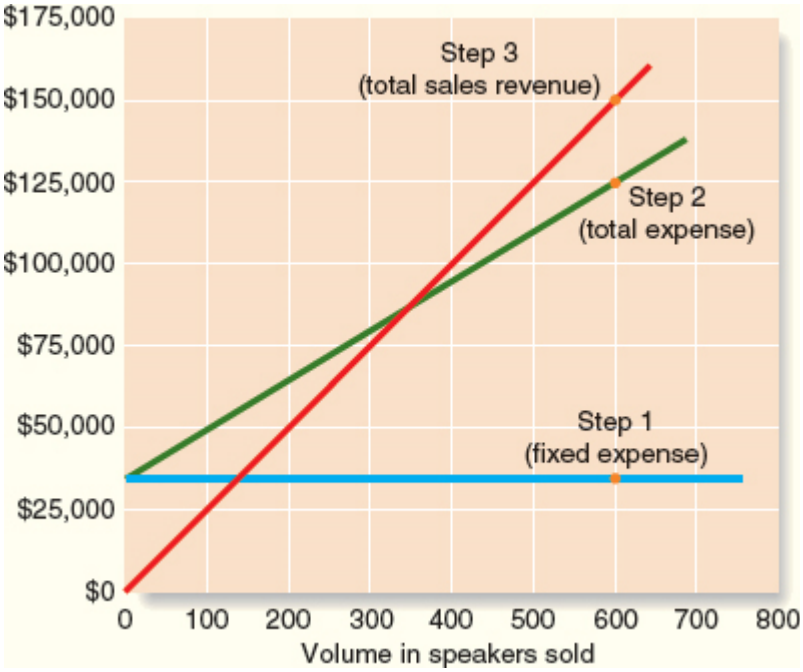
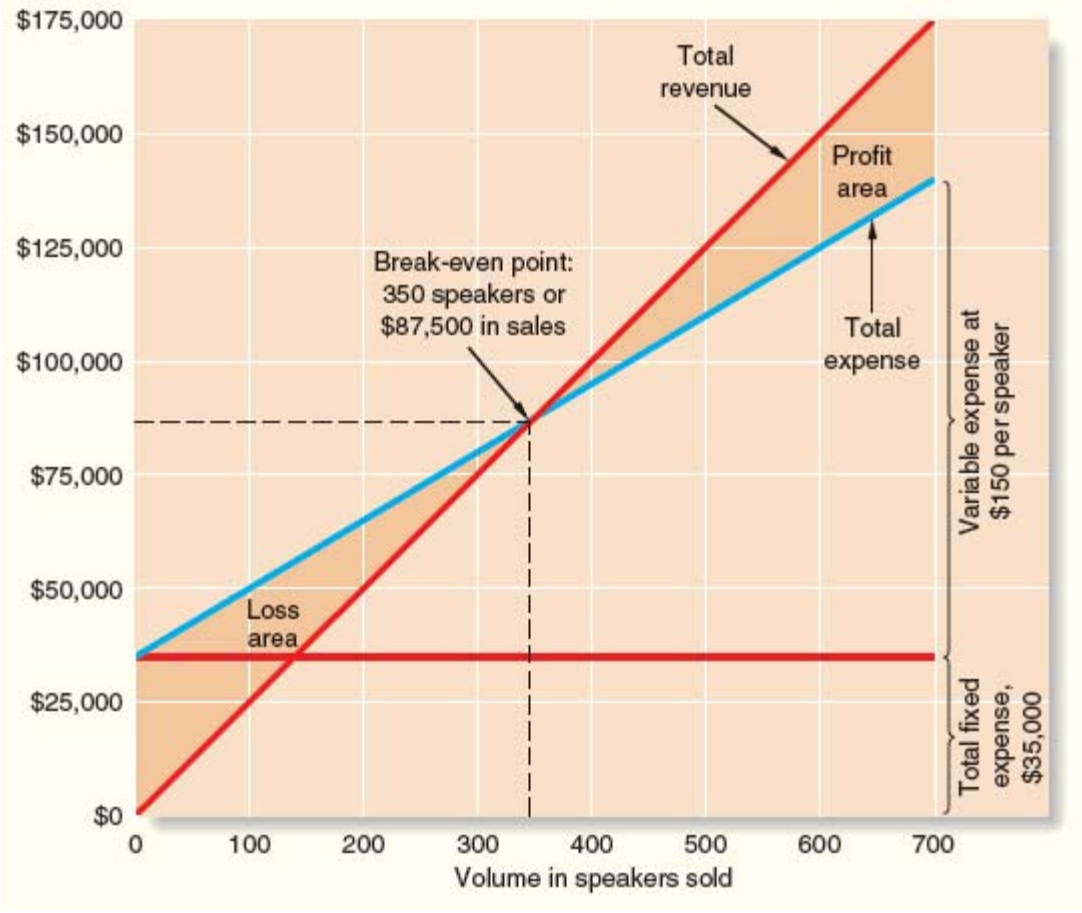


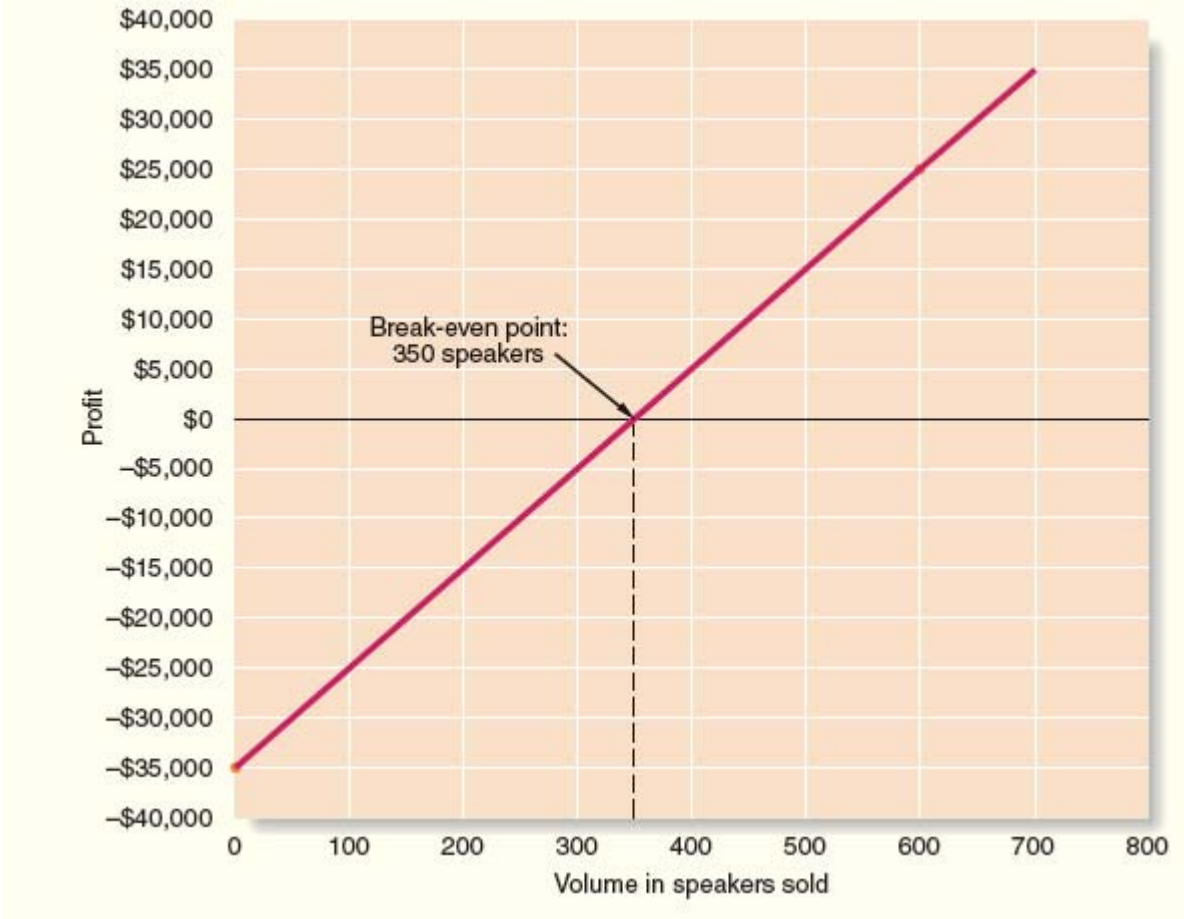
EXHIBIT 5-2
The Completed CVP Graph



The break-even point is where the total revenue and total expense lines cross. The break-even point of 350 speakers in Exhibit 5-2 agrees with the break-even point computed earlier.

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

EXHIBIT 5-3
The Profit Graph



An even simpler form of the CVP graph, which we call a profit graph, is presented in Exhibit 5-3. That graph is based on the following equation:

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

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

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

Because this is a linear equation, it plots as a single straight line. To plot the line, compute the profit at two different sales volumes, plot the points, and then connect them with a straight line. For example, when the sales volume is zero (i.e., $Q = 0$), the profit is − $35,000 (= $100 × 0 − $35,000). When Q is 600, the profit is $25,000 (= $100 × 600 − $35,000). These two points are plotted in Exhibit 5-3 and a straight line has been drawn through them.

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

Contribution Margin Ratio (CM Ratio)

LO5-3

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

In the previous section, we explored how cost-volume-profit relationships can be visualized. In this section, we show how the *contribution margin ratio* can be used in cost-volume-profit calculations. As the first step, we have added a column to Acoustic Concepts'

contribution format income statement in which sales revenues, variable expenses, and contribution margin are expressed as a percentage of sales:

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

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

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

For Acoustic Concepts, the computations are:

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

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

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

The CM ratio shows how the contribution margin will be affected by a change in total sales. Acoustic Concepts' CM ratio of 40% means that for each dollar increase in sales, total contribution margin will increase by 40 cents ($1 sales × CM ratio of 40%). Net operating income will also increase by 40 cents, assuming that fixed costs are not affected by the increase in sales. Generally, the effect of a change in sales on the contribution margin is expressed in equation form as:

$$\text{Change in contribution margin} = \text{CM ratio} \times \text{Change in sales}$$

As this illustration suggests, *the impact on net operating income of any given dollar change in total sales can be computed by 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 × CM ratio of 40%). As we noted above, net operating income will also increase by $12,000 if fixed costs do not change. This is verified by the following table:

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

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

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

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$$\text{Profit} = \text{CM ratio} \times \text{Sales} - \text{Fixed expenses}^2$$

or, in terms of changes,

$$\text{Change in profit} = \text{CM ratio} \times \text{Change in sales} - \text{Change in fixed expenses}$$

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

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

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

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

Some Applications of CVP Concepts

LO5-4

Show the effects on net operating income 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%
Variable expenses	150	60%
Contribution margin	$100	40%

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

Before proceeding further, however, we need to introduce another concept—the *variable expense ratio.* The **variable expense ratio** is the ratio of variable expenses to sales. It can be computed by

dividing the total variable expenses by the total sales, or in a single product analysis, it can be computed by dividing the variable expenses per unit by the unit selling price. In the case of Acoustic Concepts, the variable expense ratio is 0.60; that is, variable expense is 60% of sales. Expressed as an equation, the definition of the variable expense ratio is:

$$\text{Variable expense ratio} = \frac{\text{Variable expenses}}{\text{Sales}}$$

This leads to a useful equation that relates the CM ratio to the variable expense ratio as follows:

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

$$\text{CM ratio} = \frac{\text{Sales} - \text{Variable expenses}}{\text{Sales}}$$

$$\text{CM ratio} = 1 - \text{Variable expense ratio}$$

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

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

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

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

Alternative Solution 1

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

Because in this case only the fixed costs and the sales volume change, the solution can also be quickly derived as follows:

Alternative Solution 2

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

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

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

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

Solution

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

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

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

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

Solution

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

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

	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
Variable expenses	60,000	150	90,000	150	30,000
Contribution margin	40,000	$100	48,000	$ 80	8,000
Fixed expenses	35,000		50,000*		15,000
Net operating income (loss)	$ 5,000		$ (2,000)		$ (7,000)

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

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

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

Expected total contribution margin with sales staff on commissions:	
460 speakers × $85 per speaker	$39,100
Present total contribution margin:	
400 speakers × $100 per speaker	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
Variable expenses	60,000	150	75,900	165	15,900
Contribution margin	40,000	$100	39,100	$ 85	900
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 Selling Price Refer to the original data where Acoustic Concepts is currently selling 400 speakers per month. The company has an opportunity to make a bulk sale of 150 speakers to a wholesaler if an acceptable price can be negotiated. This sale would not disturb the company's regular sales and would not affect the company's total fixed expenses. What price per speaker should be quoted to the wholesaler if Acoustic Concepts is seeking a profit of $3,000 on the bulk sale?

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Solution

Variable cost per speaker	$150
Desired profit per speaker:	
$3,000 ÷ 150 speakers	20
Quoted price per speaker	$170

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

IN BUSINESS

MANAGING RISK IN THE BOOK PUBLISHING INDUSTRY

Greenleaf Book Group is a book publishing company in Austin, Texas, that attracts authors who are willing to pay publishing costs and forgo up-front advances in exchange for a larger royalty rate on each book sold. For example, assume a typical publisher prints 10,000 copies of a new book that it sells for $12.50 per unit. The publisher pays the author an advance of $20,000 to write the book and then incurs $60,000 of expenses to market, print, and edit the book. The publisher also pays the author a 20% royalty (or $2.50 per unit) on each book sold above 8,000 units. In this scenario, the publisher must sell 6,400 books to break even (= $80,000 in fixed costs ÷ $12.50 per unit). If all 10,000 copies are sold, the author earns $25,000 (= $20,000 advance + 2,000 copies × $2.50) and the publisher earns $40,000 (= $125,000 − $60,000 − $20,000 − $5,000).

Greenleaf alters the financial arrangement described above by requiring the author to assume the risk of poor sales. It pays the author a 70% royalty on all units sold (or $8.75 per unit), but the author forgoes the $20,000 advance and pays Greenleaf $60,000 to market, print, and edit the book. If the book flops, the author fails to recover her production costs. If all 10,000 units are sold, the author earns $27,500 (= $10,000 units × $8.75 − $60,000) and Greenleaf earns $37,500 (= 10,000 units × ($12.50 − $8.75)).

Source: Christopher Steiner, "Book It," *Forbes,* September 7, 2009, p. 58.

Break-Even and Target Profit Analysis

Managers use break-even and target profit analysis to answer questions such as how much would we have to sell to avoid incurring a loss or how much would we have to sell to make a profit of $10,000 per month? We'll discuss break-even analysis first followed by target profit analysis.

Break-Even Analysis

LO5-5

Determine the break-even point.

Earlier in the chapter we defined the break-even point as *the level of sales at which the company's profit is zero.* To calculate the break-even point (in unit sales and dollar sales), managers can use either of two approaches, the equation method or the formula method. We'll demonstrate both approaches using the data from Acoustic Concepts.

The Equation Method The equation method relies on the basic profit equation introduced earlier in the chapter. Since Acoustic Concepts has only one product, we'll use the contribution margin form of this equation to perform the break-even calculations. Remembering that Acoustic Concepts' unit contribution margin is $100, and its fixed expenses are $35,000, the company's break-even point is computed as follows:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expense} \\ \$0 &= \$100 \times Q - \$35{,}000 \\ \$100 \times Q &= \$0 + \$35{,}000 \\ Q &= \$35{,}000 \div \$100 \\ Q &= 350 \end{aligned}$$

Thus, as we determined earlier in the chapter, Acoustic Concepts will break even (or earn zero profit) at a sales volume of 350 speakers per month.

The Formula Method The formula method is a shortcut version of the equation method. It centers on the idea discussed earlier in the chapter that each unit sold provides a certain amount of contribution margin that goes toward covering fixed expenses. In a single product situation, the formula for computing the unit sales to break even is:

$$\text{Units sales to break even} = \frac{\text{Fixed expenses}^{3}}{\text{Unit CM}}$$

In the case of Acoustic Concepts, the unit sales needed to break even is computed as follows:

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

Notice that 350 units is the same answer that we got when using the equation method. This will always be the case because the formula method and equation method are mathematically equivalent. The formula method simply skips a few steps in the equation method.

Break-Even in Dollar Sales In addition to finding the break-even point in unit sales, we can also find the break-even point in dollar sales using three methods. First, we could solve for the break-even point in *unit* sales using the equation method or formula method and then simply multiply the result by the selling price. In the case of Acoustic Concepts, the break-even point in dollar sales using this approach would be computed as 350 speakers × $250 per speaker, or $87,500 in total sales.

Second, we can use the equation method to compute the break-even point in dollar sales. Remembering that Acoustic Concepts' contribution margin ratio is 40% and its fixed expenses are $35,000, the equation method calculates the break-even point in dollar sales as follows:

$$\begin{aligned}
\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\
\$0 &= 0.40 \times \text{Sales} - \$35{,}000 \\
0.40 \times \text{Sales} &= \$0 + \$35{,}000 \\
\text{Sales} &= \$35{,}000 \div 0.40 \\
\text{Sales} &= \$87{,}500
\end{aligned}$$

Third, we can use the formula method to compute the dollar sales needed to break even as shown below:

Page 202

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}^4}{\text{CM ratio}}$$

In the case of Acoustic Concepts, the computations are performed as follows:

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

$$= \frac{\$35{,}000}{0.40}$$

$$= \$87{,}500$$

Again, you'll notice that the break-even point in dollar sales ($87,500) is the same under all three methods. This will always be the case because these methods are mathematically equivalent.

Target Profit Analysis

LO5-6

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

Target profit analysis is one of the key uses of CVP analysis. In **target profit analysis**, we estimate what sales volume is needed to achieve a specific target profit. For example, suppose Prem Narayan of Acoustic Concepts would like to estimate the sales needed to attain a target profit of $40,000 per month. To determine the unit sales and dollar sales needed to achieve a target profit, we can rely on the same two approaches that we have been discussing thus far, the equation method or the formula method.

The Equation Method To compute the unit sales required to achieve a target profit of $40,000 per month, Acoustic Concepts can use the same profit equation that was used for its break-even analysis. Remembering that the company's contribution margin per unit is $100 and its total fixed expenses are $35,000, the equation method could be applied as follows:

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expense} \\
\$40{,}000 &= \$100 \times Q - \$35{,}000 \\
\$100 \times Q &= \$40{,}000 + \$35{,}000 \\
Q &= \$75{,}000 \div \$100 \\
Q &= 750
\end{aligned}$$

Thus, the target profit can be achieved by selling 750 speakers per month. Notice that the only difference between this equation and the equation used for Acoustic Concepts' break-even calculation is the profit figure. In the break-even scenario, the profit is $0, whereas in the target profit scenario the profit is $40,000.

The Formula Method In general, in a single product situation, we can compute the sales volume required to attain a specific target profit using the following formula:

Page 203

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

In the case of Acoustic Concepts, the unit sales needed to attain a target profit of 40,000 is computed as follows:

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

Target Profit Analysis in Terms of Dollar Sales When quantifying the dollar sales needed to attain a target profit we can apply the same three methods that we used for calculating the dollar sales needed to break even. First, we can solve for the *unit* sales needed to attain the target profit using the equation method or formula method and then simply multiply the result by the selling price. In the case of Acoustic Concepts, the dollar sales to attain its target profit would be computed as 750 speakers × $250 per speaker, or $187,500 in total sales.

Second, we can use the equation method to compute the dollar sales needed to attain the target profit. Remembering that Acoustic Concepts' target profit is $40,000, its contribution margin ratio is 40%, and its fixed expenses are $35,000, the equation method calculates the answer as follows:

$$\begin{aligned}\text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \$40{,}000 &= 0.40 \times \text{Sales} - \$35{,}000 \\ 0.40 \times \text{Sales} &= \$40{,}000 + \$35{,}000 \\ \text{Sales} &= \$75{,}000 \div 0.40 \\ \text{Sales} &= \$187{,}500\end{aligned}$$

Third, we can use the formula method to compute the dollar sales needed to attain the target profit as shown below:

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

In the case of Acoustic Concepts, the computations would be:

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

$$= \frac{\$40{,}000 + \$35{,}000}{\$0.40}$$

$$= \$187{,}500$$

Again, you'll notice that the answers are the same regardless of which method we use. This is because all of the methods discussed are simply different roads to the same destination.

IN BUSINESS

SNAP FITNESS GROWS IN A WEAK ECONOMY

When Bally's Total Fitness was filing for bankruptcy, Snap Fitness was expanding to more than 900 clubs in the United States with 400,000 members. The secret to Snap Fitness' success is its "no frills" approach to exercise. Each club typically has five treadmills, two stationary bikes, five elliptical machines, and weight equipment while bypassing amenities such as on-site child care, juice bars, and showers. Each club is usually staffed only 25–40 hours per week and it charges a membership fee of $35 per month.

To open a new Snap Fitness location, each franchise owner has an initial capital outlay of $120,000 for various types of equipment and a one-time licensing fee of $15,000. The franchisee also pays Snap (the parent company) a royalty fee of $400 per month plus $0.50 for each membership. Snap also collects one-time fees of $5 for each new member's "billing setup" and $5 for each security card issued. If a new club attracts 275 members, it can break even in as little as three months. Can you estimate the underlying calculations related to this break-even point?

Source: Nicole Perlroth, "Survival of the Fittest," *Forbes,* January 12, 2009, pp. 54–55.

The Margin of Safety

LO5-7

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 is 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 and incurring a loss. The formula for the margin of safety is:

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

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

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

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

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

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

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

IN BUSINESS

COMPUTING MARGIN OF SAFETY FOR A SMALL BUSINESS

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

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

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

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

Prem: Bob, everything you have shown me is pretty clear. I can see what impact the sales manager's suggestions would have on our profits. Some of those suggestions are quite good and others are not so good. I am concerned that our margin of safety is only 50 speakers. What can we do to increase this number?

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

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

Bob: Exactly.

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

Bob: Correct.

Prem: So what do you suggest?

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

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

CVP Considerations in Choosing a Cost Structure

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

Cost Structure and Profit Stability

Which cost structure is better—high variable costs and low fixed costs, or the opposite? No single answer to this question is possible; each approach has its advantages. To show what we mean, refer to the following contribution format income statements 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:

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

Which farm has the better cost structure? The answer depends on many factors, including the long-run trend in sales, year-to-year fluctuations in the level of sales, and the attitude of the owners toward risk. If sales are expected to exceed $100,000 in the future, then Sterling Farm probably has the better cost structure. The reason is that its CM ratio is higher, and its profits will therefore increase more rapidly as sales increase. To illustrate, assume that each farm experiences a 10% increase in sales without any increase in fixed costs. The new income statements would be as follows:

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

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

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

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

Bogside Farm's margin of safety is greater and its contribution margin ratio is lower than Sterling Farm. Therefore, Bogside Farm is less vulnerable to downturns than Sterling Farm. Due to its lower contribution margin ratio, Bogside Farm will not lose contribution margin as rapidly as Sterling Farm when sales decline. Thus, Bogside Farm's profit will be less volatile. We saw earlier that this is a drawback when sales increase, but it provides

more protection when sales drop. And because its break-even point is lower, Bogside Farm can suffer a larger sales decline before losses emerge.

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

Operating Leverage

LO5-8

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

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

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

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

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

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

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

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

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

$$\text{Percentage change in net operating income} = \text{Degree of operating leverage} \times \text{Percentage change in sales}$$

Bogside Farm: Percentage change in net operating income $= 4 \times 10\% = 40\%$

Sterling Farm: Percentage change in net operating income $= 7 \times 10\% = 70\%$

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 206, 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.

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

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

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

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

IN BUSINESS

THE DANGERS OF A HIGH DEGREE OF OPERATING LEVERAGE

In recent years, computer chip manufacturers have poured more than $75 billion into constructing new manufacturing facilities to meet the growing demand for digital devices such as iPhones and Blackberrys. Because 70% of the costs of running these facilities are fixed, a sharp drop in customer demand forces these companies to choose between two undesirable options. They can slash production levels and absorb large amounts of unused capacity costs, or they can continue producing large volumes of output in spite of shrinking demand, thereby flooding the market with excess supply and lowering prices. Either choice distresses investors who tend to shy away from computer chip makers in economic downturns.

Source: Bruce Einhorn, "Chipmakers on the Edge," *BusinessWeek,* January 5, 2009, pp. 30–31.

Structuring Sales Commissions

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

	Model	
	XR7	Turbo
Selling price	$695	$749
Variable expenses	344	410
Contribution margin	$351	$339

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

To eliminate such conflicts, commissions can be based on contribution margin rather than on selling price. If this is done, the salespersons will want to sell the mix of products that maximizes contribution margin. Providing that fixed costs are not affected by the sales mix, maximizing the contribution margin will also maximize the company's profit.[5] In effect, by maximizing their own compensation, salespersons will also maximize the company's profit.

Sales Mix

LO5-9

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

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

The Definition of Sales Mix

The term **sales mix** refers to the relative proportions in which a company's products are sold. The idea is to achieve the combination, or mix, that will yield the greatest 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

NETBOOK SALES CANNIBALIZE PC SALES

When computer manufacturers introduced the "netbook," they expected it to serve as a consumer's third computer—complementing home and office personal computers (PCs) rather than replacing them. However, when the economy soured many customers decided to buy lower-priced netbooks instead of PCs, which in turn adversely affected the financial performance of many companies. For example, when Microsoft failed to achieve its sales goals, the company partially blamed growing netbook sales and declining PC sales for its troubles. Microsoft's Windows operating system for netbooks sells for $15–$25 per device, which is less than half the cost of the company's least expensive Windows operating system for PCs.

Source: Olga Kharif, "Small, Cheap—and Frighteningly Popular," *BusinessWeek,* December 8, 2008, p. 64.

Sales Mix and Break-Even Analysis

If a company sells more than one product, break-even analysis is more complex than discussed to this point. The reason is that different products will have different selling prices, different costs, and different contribution margins. Consequently, the break-even point depends on the mix in which the various products are sold. To illustrate, consider Virtual Journeys Unlimited, a small company that sells two DVDs: the Monuments DVD, a tour of the United States' most popular National Monuments; and the Parks DVD, which tours the United States' National Parks. The company's September sales, expenses, and break-even point are shown in Exhibit 5-4.

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

Although sales have remained unchanged at $100,000, the sales mix is exactly the reverse of what it was in Exhibit 5-4, with the bulk of the sales now coming from the less profitable Monuments DVD. Notice that this shift in the sales mix has caused both the overall CM ratio and total profits to drop sharply from the prior month even though total sales are the same. The overall CM ratio has dropped from 45% in September to only 30% in October, and net operating income has dropped from $18,000 to only $3,000. In addition, with the drop in the overall CM ratio, the company's break-even point is no longer $60,000 in sales. Because the company is now realizing less average contribution

margin per dollar of sales, it takes more sales to cover the same amount of fixed costs. Thus, the break-even point has increased from $60,000 to $90,000 in sales per year.

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

EXHIBIT 5-4
Multiproduct Break-Even Analysis

Virtual Journeys Unlimited
Contribution Income Statement
For the Month of September

	Monuments DVD		Parks DVD		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales	$20,000	100%	$80,000	100%	$100,000	100%
Variable expenses	15,000	75%	40,000	50%	55,000	55%
Contribution margin	$ 5,000	25%	$40,000	50%	45,000	45%
Fixed expenses					27,000	
Net operating income					$ 18,000	

Computation of the break-even point:

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

Verification of the break-even point:

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

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

EXHIBIT 5-5
Multiproduct Break-Even Analysis: A Shift in Sales Mix (see Exhibit 5-4)

Virtual Journeys Unlimited
Contribution Income Statement
For the Month of October

	Monuments DVD		Parks DVD		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales	$80,000	100%	$20,000	100%	$100,000	100%
Variable expenses	60,000	75%	10,000	50%	70,000	70%
Contribution margin	$20,000	25%	$10,000	50%	30,000	30%
Fixed expenses					27,000	
Net operating income					$ 3,000	

Computation of the break-even point:

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

Summary

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

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

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

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

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

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

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

Review Problem: CVP Relationships

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

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

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

Required:

1. Compute the company's CM ratio and variable expense ratio.
2. Compute the company's break-even point in both unit sales and dollar sales. Use the equation method.
3. Assume that sales increase by $400,000 next year. If cost behavior patterns remain unchanged, by how much will the company's net operating income increase? Use the CM ratio to compute your answer.
4. Refer to the original data. Assume that next year management wants the company to earn a profit of at least $90,000. How many units will have to be sold to meet this target profit?
5. Refer to the original data. Compute the company's margin of safety in both dollar and percentage form.
6.

a. Compute the company's degree of operating leverage at the present level of sales.

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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 unit sales and dollar sales. Use the formula method.
   c. Would you recommend that the changes be made?

Solution to Review Problem

1.

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

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

2.

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$
$$\$0 = (\$60 - \$45) \times Q - \$240{,}000$$
$$\$15Q = \$240{,}000$$
$$Q = \$240{,}000 \div \$15$$
$$Q = 16{,}000 \text{ units; or at } \$60 \text{ per unit, } \$960{,}000$$

3.

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

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

4. Equation method:

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

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

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

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

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

Formula method:

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

5.

$$\text{Margin of safety in dollars} = \text{Total sales} - \text{Break-even sales}$$

$$= \$1{,}200{,}000 - \$960{,}000 = \$240{,}000$$

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

6.

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

b.

Expected increase in sales	8%
Degree of operating leverage	× 5
Expected increase in net operating income	40%

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

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

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

7.

a. A 20% increase in sales would result in 24,000 units being sold next year: 20,000 units × 1.20 = 24,000 units.

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

*$45 + $3 = $48; $48 ÷ $60 = 80%.
†$240,000 − $30,000 = $210,000.

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

b.

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}$$
$$= \frac{\$210{,}000}{\$12 \text{ per unit}} = 17{,}500 \text{ units}$$
$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$
$$= \frac{\$210{,}000}{0.20} = \$1{,}050{,}000$$

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

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

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

Glossary

Break-even point The level of sales at which profit is zero. (p. 190)

Contribution margin ratio (CM ratio) A ratio computed by dividing contribution margin by dollar sales. (p. 195)

Cost-volume-profit (CVP) graph A graphical representation of the relationships between an organization's revenues, costs, and profits on the one hand and its sales volume on the other hand. (p. 192)

Degree of operating leverage A measure, at a given level of sales, of how a percentage change in sales will affect profits. The degree of operating leverage is computed by dividing contribution margin by net operating income. (p. 207)

Incremental analysis An analytical approach that focuses only on those costs and revenues that change as a result of a decision. (p. 198)

Margin of safety The excess of budgeted or actual dollar sales over the break-even dollar sales. (p. 204)

Operating leverage A measure of how sensitive net operating income is to a given percentage change in dollar sales. (p. 207)

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. 209)

Target profit analysis Estimating what sales volume is needed to achieve a specific target profit. (p. 202)

Variable expense ratio A ratio computed by dividing variable expenses by dollar sales. (p. 196)

Questions

5-1 What is meant by a product's contribution margin ratio? How is this ratio useful in planning business operations?

5-2 Often the most direct route to a business decision is an incremental analysis. What is meant by an *incremental analysis?*

5-3 In all respects, Company A and Company B are identical except that Company A's costs are mostly variable, whereas Company B's costs are mostly fixed. When sales increase, which company will tend to realize the greatest increase in profits? Explain.

5-4 What is meant by the term *operating leverage?*

5-5 What is meant by the term *break-even point?*

5-6 In response to a request from your immediate supervisor, you have prepared a CVP graph portraying the cost and revenue characteristics of your company's product and operations. Explain how the lines on the graph and the break-even point would change if (*a*) the selling price per unit decreased, (*b*) fixed cost increased throughout the entire range of activity portrayed on the graph, and (*c*) variable cost per unit increased.

5-7 What is meant by the margin of safety?

5-8 What is meant by the term *sales mix?* What assumption is usually made concerning sales mix in CVP analysis?

5-9 Explain how a shift in the sales mix could result in both a higher break-even point and a lower net income.

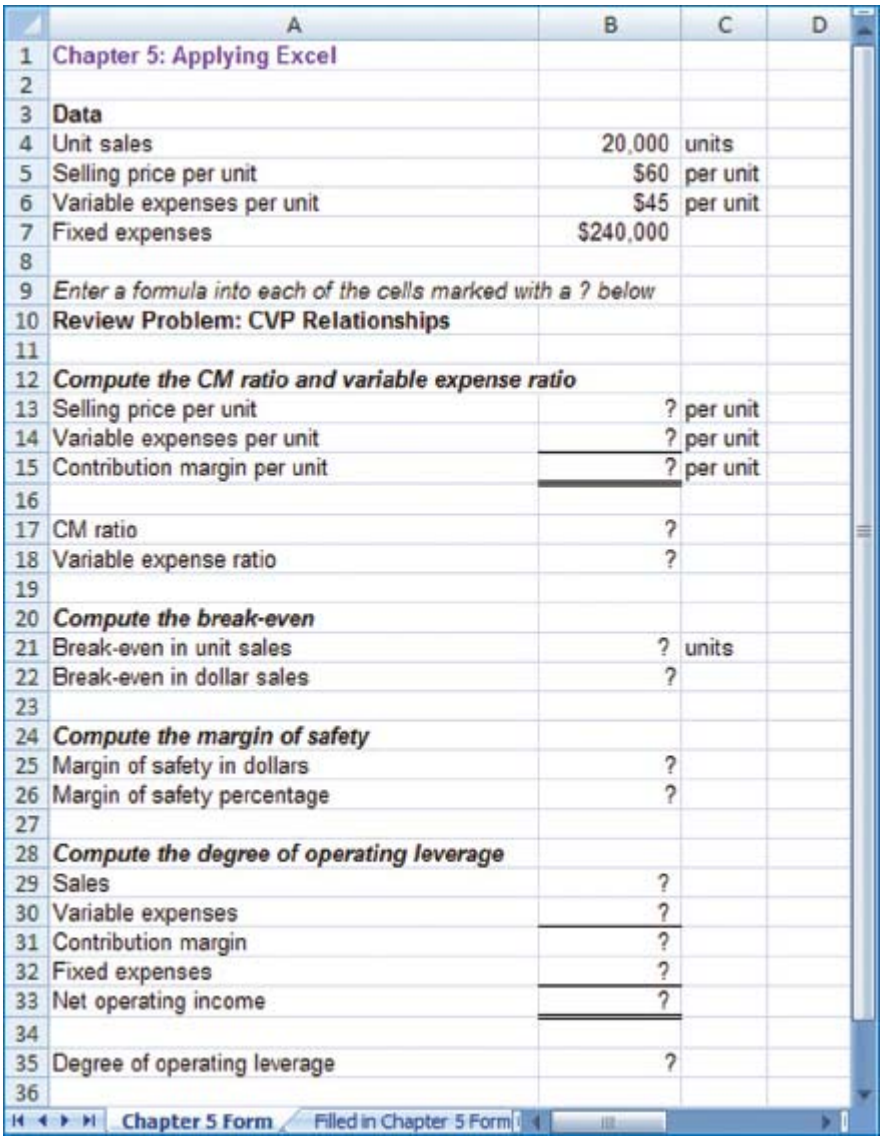
Multiple-choice questions are provided on the text website at **www.mhhe.com/garrison15e**.

Applying Excel

Available with McGraw-Hill's *Connect*® *Accounting*.

LO5-6, LO5-7, LO5-8

The Excel worksheet form that appears on the next page is to be used to recreate portions of the Review Problem on pages 212–214. Download the workbook containing this form from the Online Learning Center at **www.mhhe.com/garrison15e**. *On the website you will also receive instructions about how to use this worksheet form.*



	A	B	C	D
1	Chapter 5: Applying Excel			
2				
3	Data			
4	Unit sales	20,000	units	
5	Selling price per unit	$60	per unit	
6	Variable expenses per unit	$45	per unit	
7	Fixed expenses	$240,000		
8				
9	*Enter a formula into each of the cells marked with a ? below*			
10	**Review Problem: CVP Relationships**			
11				
12	***Compute the CM ratio and variable expense ratio***			
13	Selling price per unit	?	per unit	
14	Variable expenses per unit	?	per unit	
15	Contribution margin per unit	?	per unit	
16				
17	CM ratio	?		
18	Variable expense ratio	?		
19				
20	***Compute the break-even***			
21	Break-even in unit sales	?	units	
22	Break-even in dollar sales	?		
23				
24	***Compute the margin of safety***			
25	Margin of safety in dollars	?		
26	Margin of safety percentage	?		
27				
28	***Compute the degree of operating leverage***			
29	Sales	?		
30	Variable expenses	?		
31	Contribution margin	?		
32	Fixed expenses	?		
33	Net operating income	?		
34				
35	Degree of operating leverage	?		
36				

Chapter 5 Form | Filled in Chapter 5 Form

You should proceed to the requirements below only after completing your worksheet.

Required:

1. Check your worksheet by changing the fixed expenses to $270,000. If your worksheet is operating properly, the degree of operating leverage should be 10. If you do not get this answer, find the errors in your worksheet and correct them. How much is the margin of safety percentage? Did it change? Why or why not?
2. Enter the following data from a different company into your worksheet:

Unit sales	10,000 units
Selling price per unit	$120 per unit
Variable expenses per unit	$72 per unit
Fixed expenses	$420,000

What is the margin of safety percentage? What is the degree of operating leverage?

3. Using the degree of operating leverage and without changing anything in your worksheet, calculate the percentage change in net operating income if unit sales increase by 15%.
4. Confirm the calculations you made in part (3) above by increasing the unit sales in your worksheet by 15%. What is the new net operating income and by what percentage did it increase?

5.

Thad Morgan, a motorcycle enthusiast, has been exploring the possibility of relaunching the Western Hombre brand of cycle that was popular in the 1930s. The retro-look cycle would be sold for $10,000 and at that price, Thad estimates 600 units would be sold each year. The variable cost to produce and sell the cycles would be $7,500 per unit. The annual fixed cost would be $1,200,000.

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a. Using your worksheet, what would be the break-even unit sales, the margin of safety in dollars, and the degree of operating leverage?
b. Thad is worried about the selling price. Rumors are circulating that other retro brands of cycles may be revived. If so, the selling price for the Western Hombre would have to be reduced to $9,000 to compete effectively. In that event, Thad would also reduce fixed expenses by $300,000 by reducing advertising expenses, but he still hopes to sell 600 units per year. Do you think this is a good plan? Explain. Also, explain the degree of operating leverage that appears on your worksheet.

The Foundational 15

Available with McGraw-Hill's *Connect*® *Accounting.*

LO5-1, LO5-3, LO5-4, LO5-5, LO5-6, LO5-7, LO5-8

Oslo Company prepared the following contribution format income statement based on a sales volume of 1,000 units (the relevant range of production is 500 units to 1,500 units):

Sales	$20,000
Variable expenses	12,000
Contribution margin	8,000
Fixed expenses	6,000
Net operating income	$ 2,000

Required:

(Answer each question independently and always refer to the original data unless instructed otherwise.)

1. What is the contribution margin per unit?
2. What is the contribution margin ratio?
3. What is the variable expense ratio?
4. If sales increase to 1,001 units, what would be the increase in net operating income?
5. If sales decline to 900 units, what would be the net operating income?
6. If the selling price increases by $2 per unit and the sales volume decreases by 100 units, what would be the net operating income?
7. If the variable cost per unit increases by $1, spending on advertising increases by $1,500, and unit sales increase by 250 units, what would be the net operating income?
8. What is the break-even point in unit sales?
9. What is the break-even point in dollar sales?
10. How many units must be sold to achieve a target profit of $5,000?
11. What is the margin of safety in dollars? What is the margin of safety percentage?
12. What is the degree of operating leverage?
13. Using the degree of operating leverage, what is the estimated percent increase in net operating income of a 5% increase in sales?

14. Assume that the amounts of the company's total variable expenses and total fixed expenses were reversed. In other words, assume that the total variable expenses are $6,000 and the total fixed expenses are $12,000. Under this scenario and assuming that total sales remain the same, what is the degree of operating leverage?
15. Using the degree of operating leverage that you computed in the previous question, what is the estimated percent increase in net operating income of a 5% increase in sales?

Exercises

All applicable exercises are available with McGraw-Hill's *Connect*® *Accounting*.

EXERCISE 5–1 Preparing a Contribution Format Income Statement [LO5-1]
Whirly Corporation's most recent income statement is shown below:

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

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 5–2 Prepare a Cost-Volume-Profit (CVP) Graph [LO5-2]

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

Required:

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

EXERCISE 5–3 Prepare a Profit Graph [LO5-2]

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

Required:

1. Prepare a profit graph for the company up to a sales level of 4,000 units.

2. Estimate the company's break-even point in unit sales using your profit graph.

EXERCISE 5–4 Computing and Using the CM Ratio [LO5-3]

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

Required:

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

EXERCISE 5–5 Changes in Variable Costs, Fixed Costs, Selling Price, and Volume [LO5-4]

Data for Hermann Corporation are shown below:

	Per Unit	Percent of Sales
Selling price	$90	100%
Variable expenses	63	70
Contribution margin	$27	30%

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 expense by $2 per unit. The marketing manager believes that the higher-quality product would increase sales by 10% per month. Should the higher-quality components be used?

EXERCISE 5–6 Compute the Break-Even Point [LO5-5]

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

Required:

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

EXERCISE 5–7 Compute the Level of Sales Required to Attain a Target Profit [LO5-6]

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

Required:

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

EXERCISE 5–8 Compute the Margin of Safety [LO5-7]

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

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

Required:

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

EXERCISE 5–9 Compute and Use the Degree of Operating Leverage [LO5-8]

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

	Amount	Percent of Sales
Sales	$80,000	100%
Variable expenses	32,000	40%
Contribution margin	48,000	60%
Fixed expenses	38,000	
Net operating income	$10,000	

Required:

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

EXERCISE 5–10 Compute the Break-Even Point for a Multiproduct Company [LO5-9]

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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
Variable expenses	20,000	50,000	70,000
Contribution margin	$10,000	$20,000	30,000
Fixed expenses			24,000
Net operating income			$ 6,000

Required:

1. Compute the overall contribution margin (CM) ratio for the company.
2. Compute the overall break-even point for the company in dollar sales.
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 5–11 Missing Data; Basic CVP Concepts [LO5-1, LO5-9]

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

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

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

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

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

EXERCISE 5–12 Multiproduct Break-Even Analysis [LO5-9]


Olongapo Sports Corporation distributes 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	$150,000	$250,000	$400,000
CM ratio	80%	36%	?

Fixed expenses total $183,750 per month.

Required:

1. Prepare a contribution format income statement for the company as a whole. Carry computations to one decimal place.
2. Compute the break-even point for the company based on the current sales mix.
3. If sales increase by $100,000 a month, by how much would you expect net operating income to increase? What are your assumptions?

EXERCISE 5–13 Using a Contribution Format Income Statement [LO5-1, LO5-4]

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

	Total	Per Unit
Sales (20,000 units)	$300,000	$15.00
Variable expenses	180,000	9.00
Contribution margin	120,000	$ 6.00
Fixed expenses	70,000	
Net operating income	$ 50,000	

Required:

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

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

EXERCISE 5–14 Break-Even and Target Profit Analysis [LO5-3, LO5-4, LO5-5, LO5-6]

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

Required:

1. What are the variable expenses per unit?
2. Using the equation method:
   a. What is the break-even point in unit sales and in dollar sales?
   b. What amount of unit sales and dollar sales 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 unit sales and in dollar sales?
3. Repeat (2) above using the formula method.

EXERCISE 5–15 Operating Leverage [LO5-4, LO5-8]

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 expenses associated with the game total $182,000 per year, and variable expenses are $6 per game. Production of the game is entrusted to a printing contractor. Variable expenses consist mostly of payments to this contractor.

Required:

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

EXERCISE 5–16 Break-Even Analysis and CVP Graphing [LO5-2, LO5-4, LO5-5]

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

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

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

Required:

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

EXERCISE 5–17 Break-Even and Target Profit Analysis [LO5-4, LO5-5, LO5-6]


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

EXERCISE 5–18 Break-Even and Target Profit Analysis; Margin of Safety; CM Ratio [LO5-1, LO5-3, LO5-5, LO5-6, LO5-7]

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

	Total	Per Unit
Sales	$450,000	$30
Variable expenses	180,000	12
Contribution margin	270,000	$18
Fixed expenses	216,000	
Net operating income	$ 54,000	

Required:

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

Problems

All applicable problems are available with McGraw-Hill's *Connect*® *Accounting*.

PROBLEM 5–19 Break-Even Analysis; Pricing [LO5-1, LO5-4, LO5-5]

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 unit sales and in dollar sales?
3. Assuming that the marketing studies are correct, what is the maximum annual profit that the company can earn? 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 unit sales and in dollar sales 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 5–20 Various CVP Questions: Break-Even Point; Cost Structure; Target Sales [LO5-1, LO5-3, LO5-4, LO5-5, LO5-6, LO5-8]

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 expenses are high, totaling $15 per ball, of which 60% is direct labor cost.

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

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

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 expenses 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 expenses 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 expenses per ball by 40%, but it would cause fixed expenses per year to double. If the new plant is built, what would be the company's new CM ratio and new break-even point in balls?
6. Refer to the data in (5) above.
    a. If the new plant is built, how many balls will have to be sold next year to earn the same net operating income, $90,000, as last year?
    b. Assume the new plant is built and that next year the company manufactures and sells 30,000 balls (the same number as sold last year). Prepare a contribution format income statement and compute the degree of operating leverage.
    c. If you were a member of top management, would you have been in favor of constructing the new plant? Explain.

PROBLEM 5–21 Sales Mix; Multiproduct Break-Even Analysis [LO5-9]

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Gold Star Rice, Ltd., of Thailand exports Thai rice throughout Asia. The company grows three varieties of rice—Fragrant, White, and Loonzain. 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	$150,000	100%	$390,000	100%	$210,000	100%	$750,000	100%
Variable expenses	108,000	72%	78,000	20%	84,000	40%	270,000	36%
Contribution margin	$ 42,000	28%	$312,000	80%	$126,000	60%	480,000	64%
Fixed expenses							449,280	
Net operating income							$30,720	

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$449{,}280}{0.64} = \$702{,}000$$

As shown by these data, net operating income is budgeted at $30,720 for the month and break-even sales at $702,000.

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

Required:

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

PROBLEM 5–22 Basics of CVP Analysis; Cost Structure [LO5-1, LO5-3, LO5-4, LO5-5, LO5-6]

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

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

Required:

1. Compute the company's CM ratio and its break-even point in both unit sales and dollar sales.
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 double unit sales. 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?

Refer to the original data. By automating, the company could reduce variable expenses by $3 per unit. However, fixed expenses would increase by $72,000 each month. Page 225

a. Compute the new CM ratio and the new break-even point in both unit sales and dollar sales.
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 5–23 Basics of CVP Analysis [LO5-1, LO5-3, LO5-4, LO5-5, LO5-8]

Feather Friends, Inc., distributes a high-quality wooden birdhouse that sells for $20 per unit. Variable expenses are $8 per unit, and fixed expenses 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 dollar sales.
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 expenses do not change?
4. Assume that the operating results for last year were:

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

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

PROBLEM 5–24 Break-Even and Target Profit Analysis [LO5-5, LO5-6]


The Shirt Works sells a large variety of tee shirts and sweatshirts. Steve Hooper, the owner, is thinking of expanding his sales by hiring 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 Hooper $8 each with a minimum order of 75 sweatshirts. Any additional sweatshirts would have to be ordered in increments of 75.

Since 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. Hooper would pay the students a commission of $1.50 for each shirt sold.

Required:

1. To make the project worthwhile, Hooper would require a $1,200 profit for the first three months of the venture. What level of unit sales and dollar sales 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 Hooper's break-even point in unit sales and in dollar sales? Show computations and explain the reasoning behind your answer.

PROBLEM 5–25 Changes in Fixed and Variable Expenses; Break-Even and Target Profit Analysis [LO5-4, LO5-5, LO5-6]

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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 expenses to manufacture and sell one unit would be $1.25, and fixed expenses 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 expense of $1,000 per month. Variable expenses 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 unit sales and in dollar sales.
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 expenses?

PROBLEM 5–26 Basic CVP Analysis; Graphing [LO5-1, LO5-2, LO5-4, LO5-5]


The Fashion Shoe Company operates a chain of women's shoe shops that 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 base 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:

	Per Pair of Shoes
Selling price	$30.00
Variable expenses:	
Invoice cost	$13.50
Sales commission	4.50
Total variable expenses	$18.00
	Annual
Fixed expenses:	
Advertising	$ 30,000
Rent	20,000
Salaries	100,000
Total fixed expenses	$150,000

Required:

1. Calculate the annual break-even point in unit sales and in dollar sales for Shop 48.
2. Prepare a CVP graph showing cost and revenue data for Shop 48 from zero shoes up to 17,000 pairs of shoes sold each year. Clearly indicate the break-even point on the graph.
3. If 12,000 pairs of shoes are sold in a year, what would be Shop 48's net operating income or loss?
4. The company is considering paying the store manager of Shop 48 an incentive commission of 75 cents per pair of shoes (in addition to the salesperson's commission). If this change is made, what will be the new break-even point in unit sales and in dollar 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 unit sales and in dollar sales for Shop 48? Would you recommend that the change be made? Explain.

PROBLEM 5–27 Sales Mix; Break-Even Analysis; Margin of Safety [LO5-7, LO5-9]

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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.

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 dollar sales 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 dollar sales and the new margin of safety in both dollars and percent.
3. The president of the company examines your figures and says, “There's something strange here. Our fixed expenses haven't changed and you show greater total contribution margin if we add the new product, but you also show our break-even point going up. With greater contribution margin, the break-even point should go down, not up. You've made a mistake somewhere.” Explain to the president what has happened.

PROBLEM 5–28 Sales Mix; Commission Structure; Multiproduct Break-Even Analysis [LO5-9]

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

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

The company's fixed expenses each month are:

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

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

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

Required:

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

	Standard		Deluxe		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
Sales . . .						
Etc						

   Place the fixed expenses only in the Total column. Do not show percentages for the fixed expenses.
2. Explain the difference in net operating incomes between the two months, even though the same total number of sets was sold in each month.
3. What can be done to the sales commissions to improve the sales mix?
   a. Using April's sales mix, what is the break-even point in dollar sales?
   b. Without doing any calculations, explain whether the break-even points would be higher or lower with May's sales mix than April's sales mix.

PROBLEM 5–29 Changes in Cost Structure; Break-Even Analysis; Operating Leverage; Margin of Safety [LO5-4, LO5-5, LO5-7, LO5-8]

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

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

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 expenses would be reduced by $9 per unit. However, fixed expenses 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 expenses.
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 dollar sales, and (c) the margin of safety in both dollar and percentage terms.

3. Refer again to the data in (1) above. As a manager, what factor would be paramount in your mind in deciding whether to purchase the new equipment? (Assume that enough funds are available to make the purchase.)
4. Refer to the original data. Rather than purchase new equipment, the marketing manager argues that the company's marketing strategy should be changed. Rather than pay sales commissions, which are currently included in variable expenses, the company would pay salespersons fixed salaries and would invest heavily in advertising. The marketing manager claims this new approach would increase unit sales by 30% without any change in selling price; the company's new monthly fixed expenses would be $180,000; and its net operating income would increase by 20%. Compute the break-even point in dollar sales for the company under the new marketing strategy. Do you agree with the marketing manager's proposal?

PROBLEM 5–30 Graphing; Incremental Analysis; Operating Leverage [LO5-2, LO5-4, LO5-5, LO5-6, LO5-8]

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	$24
Fixed expenses per year:	
Building rental	$15,000
Equipment depreciation	7,000
Selling	20,000
Administrative	18,000
Total fixed expenses	$60,000

Required:

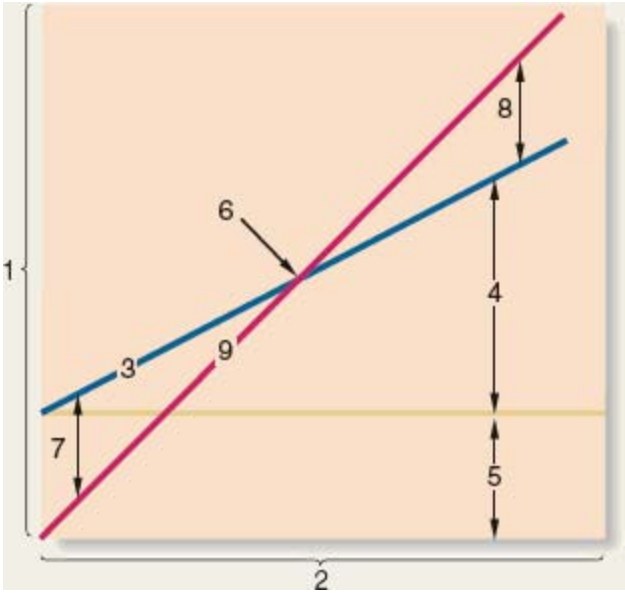
1. How many pairs of sandals must be sold each year to break even? What does this represent in total sales dollars?
2. Prepare a CVP graph or a profit graph for the store from zero pairs up to 4,000 pairs of sandals sold each year. Indicate the break-even point on your graph.
3. Angie has decided that 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
Variable expenses	48,000
Contribution margin	72,000
Fixed expenses	60,000
Net operating income	$ 12,000

   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 5–31 Interpretive Questions on the CVP Graph [LO5-2, LO5-5]

A CVP graph such as the one shown below is a useful technique for showing relationships among an organization's costs, volume, and profits.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9

Required:

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

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

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

   Remain unchanged.
   Increase.
   Decrease.
   Probably change, but the direction is uncertain.

   Treat each case independently.

   x. Example. Fixed expenses are reduced by $5,000 per period.
   Answer (see choices above): Line 3: Shift downward.
   Line 9: Remain unchanged.
   Break-even point: Decrease.

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

Cases

All applicable cases are available with McGraw-Hill's *Connect*® *Accounting.*

CASE 5–32 Break-Evens for Individual Products in a Multiproduct Company [LO5-5, LO5-9]

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 expense 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 lean production system, so there are no beginning or ending work in process or finished goods inventories.

Required:

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

CASE 5–33 Cost Structure; Break-Even and Target Profit Analysis [LO5-4, LO5-5, LO5-6]

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 sales commission of 15% 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 expenses:		
Variable	$7,200,000	
Fixed overhead	2,340,000	9,540,000
Gross margin		6,460,000
Selling and administrative expenses:		
Commissions to agents	2,400,000	
Fixed marketing expenses	120,000*	
Fixed administrative expenses	1,800,000	4,320,000
Net operating income		2,140,000
Fixed interest expenses		540,000
Income before income taxes		1,600,000
Income taxes (30%)		480,000
Net income		$ 1,120,000

*Primarily depreciation on storage facilities.

As Barbara handed the statement to Karl Vecci, 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 expenses 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:

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Salaries:	
Sales manager	$ 100,000
Salespersons	600,000
Travel and entertainment	400,000
Advertising	1,300,000
Total	$2,400,000

"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 expenses 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 dollar sales for next year assuming:
   a. The agents' commission rate remains unchanged at 15%.
   b. The agents' commission rate is increased to 20%.
   c. 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. The agents' commission rate remains unchanged at 15%.
   b. The agents' commission rate is increased to 20%.
   c. 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)

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[1] One additional assumption often used in manufacturing companies is that inventories do not change. The number of units produced equals the number of units sold.

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

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

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

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

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

[3] This formula can be derived as follows:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$0 &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \text{Unit CM} \times Q &= \$0 + \text{Fixed expenses} \\ Q &= \text{Fixed expenses} \div \text{Unit CM} \end{aligned}$$

[4] This formula can be derived as follows:

$$\begin{aligned} \text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \$0 &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \text{CM ratio} \times \text{Sales} &= \$0 + \text{Fixed expenses} \\ \text{Sales} &= \text{Fixed expenses} \div \text{CM ratio} \end{aligned}$$

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