

# Absorption/Variable Costing and Cost-Volume-Profit Analysis



## LEARNING OBJECTIVES

*After completing this chapter, you should be able to answer the following questions:*

- 1  
What are the cost accumulation and cost presentation approaches to product costing?
- 2  
What are the differences between absorption and variable costing?
- 3  
How do changes in sales and/or production levels affect net income as computed under absorption and variable costing?
- 4  
How can cost-volume-profit (CVP) analysis be used by a company?
- 5  
How does CVP analysis differ between single-product and multiproduct firms?
- 6  
How are margin of safety and operating leverage concepts used in business?
- 7  
What are the underlying assumptions of CVP analysis?
- 8  
(Appendix) How are break-even charts and profit-volume graphs constructed?

**T**orrington Supply Company is the largest Connecticut-based wholesale-distributor of residential, commercial, and industrial plumbing, heating and air conditioning equipment, pumps, and industrial piping supplies. The firm serves contractors, industry, and institutions throughout Connecticut. Torrington employs almost 100 employees and operates from four locations in the state.

Torrington has dedicated its resources to provide the best combination of hassle free service at the lowest price, and does everything it promises. Its goal is to eliminate non-value-added costs and pass the savings along to customers in the form of lower prices and increased services.

David Stein, a Lithuanian émigré who came to this country as a 17-year-old in 1905, established Torrington Supply Company in 1917. Lacking money or formal education, he learned the plumbing trade in New York City. Soon after, he moved to New Britain, Connecticut, and eventually opened a plumbing contracting business of his

own in Waterbury. Almost immediately he developed a small but growing sideline, furnishing plumbing supplies to other local tradesmen. As that sideline grew, Stein realized that he preferred merchandising to contracting, and soon was in the wholesale business full-time: The Brass City Plumbing Supply Company.

Today, thanks to the inquisitive mind of chairman and CEO Joel Becker and CFO David Petitti, Torrington Supply Co. can run numbers that pinpoint to the dollar what percentage of gross margin on the average sale is profit—or loss—for any given customer. And they are able to use those numbers to improve profitability for both Torrington and the customer. These days, all Torrington salespeople can view customer information at a keystroke in a user-friendly format. With these numbers and the sales negotiating and pricing guidelines on the screen, the representative knows how large a commitment of services or how liberal a discount he can offer the customer on the phone.

SOURCES: Margie O'Conner, "A Full Measure of Customer Service," *Supply House Times* (December 1999) pp. 44ff; Torrington Supply Co. Web site, <http://www.torringtonsupply.com> (February 11, 2000).

This chapter discusses the cost accumulation and cost presentation approaches to product costing. The **cost accumulation** approach determines which manufacturing costs are recorded as part of product cost. Although one approach to cost accumulation may be appropriate for external reporting, that approach is not necessarily appropriate for internal decision making. The **cost presentation** approach focuses on how costs are shown on external financial statements or internal management reports. Accumulation and presentation procedures are accomplished using one of two methods: absorption costing or variable costing. Each method uses the same basic data, but structures and processes the data differently. Either method can be used in job order or process costing and with actual, normal, or standard costs.

Absorption costing is the traditional approach to product costing. Variable costing facilitates the use of models for analyzing break-even point, cost-volume-profit relationships, margin of safety, and the degree of operating leverage. Use of these models is explained in this chapter after presentation of absorption costing and variable costing.

**cost accumulation**

**cost presentation**

## AN OVERVIEW OF ABSORPTION AND VARIABLE COSTING

**Absorption costing** treats the costs of all manufacturing components (direct material, direct labor, variable overhead, and fixed overhead) as inventoriable or product costs in accordance with generally accepted accounting principles (GAAP). Absorption costing is also known as **full costing**. This method has been used consistently in the previous chapters that dealt with product costing systems and valuation. In fact, the product cost definition given in Chapter 3 specifically fits the

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What are the cost accumulation and cost presentation approaches to product costing?

**absorption costing**  
**full costing**

absorption costing method. Under absorption costing, costs incurred in the non-manufacturing areas of the organization are considered period costs and are expensed in a manner that properly matches them with revenues. Exhibit 11–1 depicts the absorption costing model.

### functional classification

Absorption costing presents expenses on an income statement according to their functional classifications. A **functional classification** is a group of costs that were all incurred for the same principal purpose. Functional classifications include categories such as cost of goods sold, selling expense, and administrative expense.<sup>1</sup>

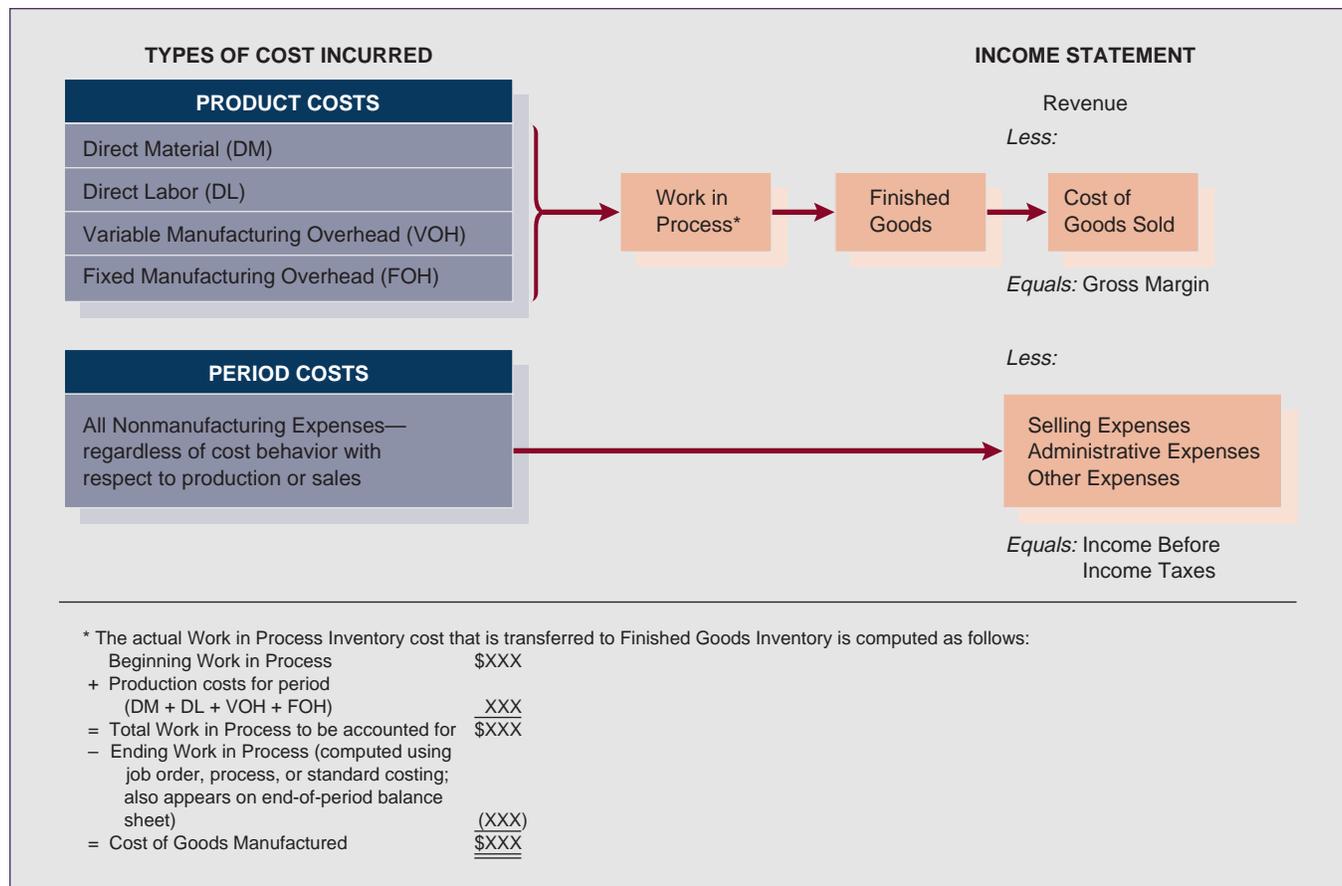
### variable costing

In contrast, **variable costing** is a cost accumulation method that includes only variable production costs (direct material, direct labor, and variable overhead) as product or inventoriable costs. Under this method, fixed manufacturing overhead is treated as a period cost. Like absorption costing, variable costing treats costs incurred in the organization's selling and administrative areas as period costs. Variable costing income statements typically present expenses according to cost behavior (variable and fixed), although they may also present expenses by functional classifications within the behavioral categories. Variable costing has also been known as **direct costing**. Exhibit 11–2 presents the variable costing model.

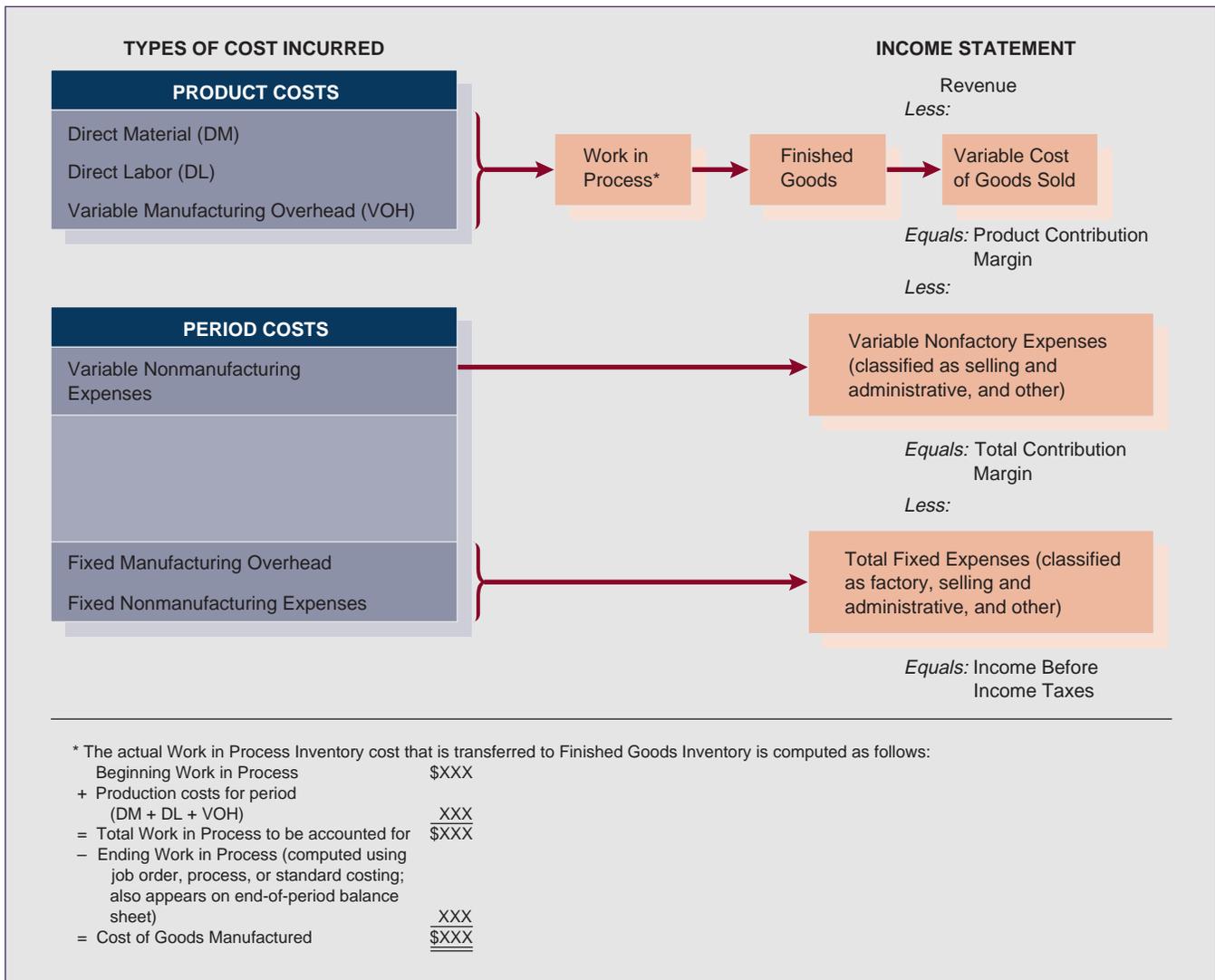
### direct costing

## EXHIBIT 11-1

### Absorption Costing Model



<sup>1</sup> Under FASB Statement 34, certain interest costs may be capitalized during a period of asset construction. If a company is capitalizing or has capitalized interest costs, these costs will not be shown on the income statement, but will become a part of fixed asset cost. The fixed asset cost is then depreciated as part of fixed overhead. Thus, although interest is typically considered a period cost, it may be included as fixed overhead and affect the overhead application rate.



**EXHIBIT 11-2**

Variable Costing Model

Two basic differences can be seen between absorption and variable costing. The first difference is the way fixed overhead (FOH) is treated for product costing purposes. Under absorption costing, FOH is considered a product cost; under variable costing, it is considered a period cost. Absorption costing advocates contend that products cannot be made without the capacity provided by fixed manufacturing costs and so these costs are product costs. Variable costing advocates contend that the fixed manufacturing costs would be incurred whether or not production occurs and, therefore, cannot be product costs because they are not caused by production. The second difference is in the presentation of costs on the income statement. Absorption costing classifies expenses by function, whereas variable costing categorizes expenses first by behavior and then may further classify them by function.

Variable costing allows costs to be separated by cost behavior on the income statement or internal management reports. Cost of goods sold, under variable costing, is more appropriately called variable cost of goods sold (VCGS), because it is composed only of variable production costs. Sales (S) minus variable cost of goods sold is called **product contribution margin** (PCM) and indicates how much revenue is available to cover all period expenses and potentially to provide net income.

**product contribution margin**

**total contribution margin**

Variable, nonmanufacturing period expenses (VNME), such as a sales commission set at 10 percent of product selling price, are deducted from product contribution margin to determine the amount of **total contribution margin** (TCM). Total contribution margin is the difference between total revenues and total variable expenses. This amount indicates the dollar figure available to “contribute” to the coverage of all fixed expenses, both manufacturing and nonmanufacturing. After fixed expenses are covered, any remaining contribution margin provides income to the company. A variable costing income statement is also referred to as a contribution income statement. A formula representation of a variable costing income statement follows:

$$\begin{array}{l}
 S - VCGS = PCM \\
 PCM - VNME = TCM \longrightarrow \text{Fixed Expenses} \\
 \phantom{PCM - VNME = TCM} \phantom{\longrightarrow} \phantom{\text{Fixed Expenses}} \phantom{\longrightarrow} \text{Income Before Taxes}
 \end{array}$$

Major authoritative bodies of the accounting profession, such as the Financial Accounting Standards Board and Securities and Exchange Commission, believe that absorption costing provides external parties with a more informative picture of earnings than does variable costing. By specifying that absorption costing must be used to prepare external financial statements, the accounting profession has, in effect, disallowed the use of variable costing as a generally accepted inventory method for external reporting purposes. Additionally, the IRS requires absorption costing for tax purposes.<sup>2</sup>

Cost behavior (relative to changes in activity) cannot be observed from an absorption costing income statement or management report. However, cost behavior is extremely important for a variety of managerial activities including cost-volume-profit analysis, relevant costing, and budgeting.<sup>3</sup> Although companies prepare external statements on an absorption costing basis, internal financial reports distinguishing costs by behavior are often prepared to facilitate short-term management decision making and analysis. For long-term management decision making, however, neither absorption costing nor variable costing may be appropriate. The accompanying News Note addresses the need for a different approach for sharing long-term royalties in a technology licensing arrangement.

The next section provides a detailed illustration using both absorption and variable costing.

<http://www.coke.com>  
<http://www.gillette.com>  
<http://abc.go.com>  
<http://www.americanexpress.com>  
<http://disney.go.com>

## ABSORPTION AND VARIABLE COSTING ILLUSTRATIONS

2

What are the differences between absorption and variable costing?

Comfort Valve Company makes a single product, the climate control valve. Comfort Valve Company is a 3-year-old firm operating out of the owner’s home. Data for this product are used to compare absorption and variable costing procedures and presentations. The company employs standard costs for material, labor, and overhead. Exhibit 11–3 gives the standard production costs per unit, the annual budgeted nonmanufacturing costs, and other basic operating data for Comfort Valve Company. All standard and budgeted costs are assumed to remain constant over the three years 2000 through 2002 and, for simplicity, the company is assumed to

<sup>2</sup> The Tax Reform Act of 1986 requires all manufacturers and many wholesalers and retailers to include many previously expensed indirect costs in inventory. This method is referred to as “super-full absorption” or uniform capitalization. The uniform capitalization rules require manufacturers to assign to inventory all costs that directly benefit or are incurred because of production, including some administrative and other costs. Wholesalers and retailers, who previously did not need to include any indirect costs in inventory, now must inventory costs for items such as off-site warehousing, purchasing agents’ salaries, and repackaging. However, the material in this chapter is not intended to reflect “super-full absorption.”

<sup>3</sup> Cost-volume-profit analysis is discussed subsequently in this chapter. Relevant costing is covered in Chapter 12 and budgeting is discussed in Chapter 13.

## GENERAL BUSINESS



## NEWS NOTE

### Using Goodwill as the Vital Income Determinant

Incremental profit is not the proper basis for sharing between a licensor and licensee involved in negotiations for a long-term royalty. Incremental profits are generally short-term in nature. Rarely can a successful company acquire, license or develop technology and have incremental profits that fairly represent long-term profitability. For the purposes of computing damages, however, incremental profits may be an appropriate basis, depending on the facts and the law.

Generally accepted accounting principles are not an adequate basis for determining full or partial absorption, or variable costing. Among other failures, conventional accounting statements do not recognize the true cost and benefit of goodwill, intellectual capital, distribution networks, brands and other intangibles. No less an investor than Warren Buffett finds GAAP a starting point, at best, for financial analysis. As he observes, goodwill according to GAAP often turns out to be “no-will.” When Buffett analyzed the purchase of major interests in Coca-Cola Beverages Ltd., Gillette Co., ABC TV, American Express and Walt Disney Co., he found tangible assets to be al-

most irrelevant; rather, goodwill was the vital income and value determinant.

Goodwill increasingly represents intellectual capital in a global economy. That’s why a number of large public companies are now making efforts to account for internally generated intellectual capital and other complementary assets—either directly in their financial statements or in the notes thereto. According to a recent Ernst & Young study, 75% of the assets held by Standard & Poor 500 companies are intangible. Ten years ago, the percentage stood at 40%.

In the context of determining a reasonable royalty rate (or damages in a related matter), the time frame, the product’s nature and the complementary assets will dictate how best to consider intellectual capital and other intangibles.

SOURCE: Stephen R. Cole, A. Scott Davidson, and Alexander J. Stack, “Reasonable Royalty Rates,” *CA Magazine* (May 1999), pp. 30ff. Reproduced with permission from *CA Magazine*, published by the Canadian Institute of Chartered Accountants, Toronto, Canada.

have no Work in Process Inventory at the end of a period.<sup>4</sup> Also, all actual costs are assumed to equal the budgeted and standard costs for the years presented. The bottom section of Exhibit 11–3 compares actual unit production with actual unit sales to determine the change in inventory for each of the three years.

The company determines its standard fixed manufacturing overhead application rate by dividing estimated annual FOH by expected annual capacity. Total estimated annual fixed manufacturing overhead for Comfort Valve is \$16,020 and expected annual production is 30,000 units. These figures provide a standard FOH rate of \$0.534 per unit. Fixed manufacturing overhead is typically under- or overapplied at year-end when a standard, predetermined fixed overhead rate is used rather than actual FOH cost.

Under- or overapplication is caused by two factors that can work independently or simultaneously. These two factors are cost differences and utilization differences. If actual FOH cost differs from expected FOH cost, a fixed manufacturing overhead spending variance is created. If actual capacity utilization differs from expected utilization, a volume variance arises.<sup>5</sup> The independent effects of these differences are as follows:

Actual FOH Cost > Expected FOH Cost = Underapplied FOH  
 Actual FOH Cost < Expected FOH Cost = Overapplied FOH  
 Actual Utilization > Expected Utilization = Overapplied FOH  
 Actual Utilization < Expected Utilization = Underapplied FOH

<sup>4</sup> Actual costs can also be used under either absorption or variable costing. Standard costing was chosen for these illustrations because it makes the differences between the two methods more obvious. If actual costs had been used, production costs would vary each year and such variations would obscure the distinct differences caused by the use of one method, rather than the other, over a period of time. Standard costs are also treated as constant over time to more clearly demonstrate the differences between absorption and variable costing and to reduce the complexity of the chapter explanations.

<sup>5</sup> These variances are covered in depth in Chapter 10.

**EXHIBIT 11-3**

Basic Data for 2000, 2001, and 2002

Sales price per unit				<u>\$ 6.00</u>
Standard variable cost per unit:				
Direct material				\$2.040
Direct labor				1.500
Variable manufacturing overhead				<u>0.180</u>
Total variable manufacturing cost per unit				<u>\$3.720</u>
Standard Fixed Factory Overhead Rate =	$\frac{\text{Budgeted Annual Fixed Factory Overhead}}{\text{Budgeted Annual Capacity in Units}}$			
FOH rate =	$\$16,020 \div 30,000 = \$0.534$			
Total absorption cost per unit:				
Standard variable manufacturing cost				\$3.720
Standard fixed manufacturing overhead (SFOH)				<u>0.534</u>
Total absorption cost per unit				<u>\$4.254</u>
Budgeted nonproduction expenses:				
Variable selling expenses per unit				<u>\$0.24</u>
Fixed selling and administrative expenses				<u>\$2,340</u>
Total budgeted nonproductive expenses =	(\$0.24 per unit sold + \$2,340)			
	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>Total</b>
Actual units made	30,000	29,000	31,000	90,000
Actual unit sales	<u>30,000</u>	<u>27,000</u>	<u>33,000</u>	<u>90,000</u>
Change in FG inventory	<u>0</u>	<u>+2,000</u>	<u>-2,000</u>	<u>0</u>

In most cases, however, both costs and utilization differ from estimates. When this occurs, no generalizations can be made as to whether FOH will be under- or over-applied. Assume that Comfort Valve Company began operations in 2000. Production and sales information for the years 2000 through 2002 are shown in Exhibit 11-3.

Because the company began operations in 2000, that year has a zero balance for beginning Finished Goods Inventory. The next year, 2001, also has a zero beginning inventory because all units produced in 2000 were also sold in 2000. In 2001 and 2002, production and sales quantities differ, which is a common situation because production frequently “leads” sales so that inventory can be stockpiled for a later period. The illustration purposefully has no beginning inventory and equal cumulative units of production and sales for the 3 years to demonstrate that, regardless of whether absorption or variable costing is used, the cumulative income before taxes will be the same (\$128,520 in Exhibit 11-4) under these conditions. Also, for any particular year in which there is no change in inventory levels from the beginning of the year to the end of the year, both methods will result in the same net income. An example of this occurs in 2000 as is demonstrated in Exhibit 11-4.

Because all actual production and operating costs are assumed to be equal to the standard and budgeted costs for the years 2000 through 2002, the only variances presented are the volume variances for 2001 and 2002. These volume variances are immaterial and are reflected as adjustments to the gross margins for 2001 and 2002 in Exhibit 11-4.

Volume variances under absorption costing are calculated as standard fixed overhead (SFOH) of \$0.534 multiplied by the difference between expected capacity (30,000 valves) and actual production. For 2000, there is no volume variance because expected and actual production are equal. For 2001, the volume variance is \$534 unfavorable, calculated as [ $\$0.534 \times (29,000 - 30,000)$ ]. For 2002, it is \$534

**EXHIBIT 11-4**

*Absorption and Variable Costing  
Income Statements for 2000,  
2001, and 2002*

<b>ABSORPTION COSTING PRESENTATION</b>				
	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>Total</b>
Sales (\$6 per unit)	\$180,000	\$162,000	\$198,000	\$540,000
CGS (\$4.254 per unit)	(127,620)	(114,858)	(140,382)	(382,860)
Standard Gross Margin	\$ 52,380	\$ 47,142	\$ 57,618	\$157,140
Volume Variance (U)	0	(534)	534	0
Adjusted Gross Margin	\$ 52,380	\$ 46,608	\$ 58,152	\$157,140
Operating Expenses				
Selling and administrative	(9,540)	(8,820)	(10,260)	(28,620)
Income before Tax	\$ 42,840	\$ 37,788	\$ 47,892	\$128,520
<b>VARIABLE COSTING PRESENTATION</b>				
	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>Total</b>
Sales (\$6 per unit)	\$180,000	\$162,000	\$198,000	\$540,000
Variable CGS (\$3.72 per unit)	(111,600)	(100,440)	(122,760)	(334,800)
Product Contribution Margin	\$ 68,400	\$ 61,560	\$ 75,240	\$205,200
Variable Selling Expenses (\$0.24 × units sold)	(7,200)	(6,480)	(7,920)	(21,600)
Total Contribution Margin	\$ 61,200	\$ 55,080	\$ 67,320	\$183,600
Fixed Expenses				
Manufacturing	\$ 16,020	\$ 16,020	\$ 16,020	\$ 48,060
Selling and administrative	2,340	2,340	2,340	7,020
Total fixed expenses	\$ (18,360)	\$ (18,360)	\$ (18,360)	\$ (55,080)
Income before Tax	\$ 42,840	\$ 36,720	\$ 48,960	\$128,520
Differences in Income before Tax	\$ 0	\$ 1,068	\$ (1,068)	\$ 0

favorable, calculated as [ $\$0.534 \times (31,000 - 30,000)$ ]. Variable costing does not have a volume variance because fixed manufacturing overhead is not applied to units produced but is written off in its entirety as a period expense.

In Exhibit 11-4, income before tax for 2001 for absorption costing exceeds that of variable costing by \$1,068. This difference is caused by the positive change in inventory (2,000 shown in Exhibit 11-3) to which the absorption SFOH of \$0.534 per unit has been assigned ( $2,000 \times \$0.534 = \$1,068$ ). This \$1,068 is the fixed manufacturing overhead added to absorption costing inventory and therefore not expensed in 2001. Critics of absorption costing refer to this phenomenon as one that creates illusionary or phantom profits. **Phantom profits** are temporary absorption-costing profits caused by producing more inventory than is sold. When sales increase to eliminate the previously produced inventory, the phantom profits disappear. In contrast, all fixed manufacturing overhead, including the \$1,068, is expensed in its entirety in variable costing.

Exhibit 11-3 shows that in 2002 inventory decreased by 2,000 valves. This decrease, multiplied by the SFOH (\$0.534), explains the \$1,068 by which 2002 absorption costing income falls short of variable costing income on Exhibit 11-4. This is because the fixed manufacturing overhead written off in absorption costing through the cost of goods sold at \$0.534 per valve for all units sold in excess of production ( $33,000 - 31,000 = 2,000$ ) results in the \$1,068 by which absorption costing income is lower than variable costing income in 2002.

Variable costing income statements are more useful internally for short-term planning, controlling, and decision making than absorption costing statements. To carry out their functions, managers need to understand and be able to project how different costs will change in reaction to changes in activity levels. Variable costing, through its emphasis on cost behavior, provides that necessary information.

**phantom profit**

The income statements in Exhibit 11–4 show that absorption and variable costing tend to provide different income figures in some years. Comparing the two sets of statements illustrates that the difference in income arises solely from which production component costs are included in or excluded from product cost for each method.

If no beginning or ending inventories exist, cumulative total income under both methods will be identical. For the Comfort Valve Company over the three-year period, 90,000 valves are produced and 90,000 valves are sold. Thus, all the costs incurred (whether variable or fixed) are expensed in one year or another under either method. The income difference in each year is caused solely by the timing of the expensing of fixed manufacturing overhead.

## COMPARISON OF THE TWO APPROACHES

3

How do changes in sales and/or production levels affect net income as computed under absorption and variable costing?

Whether absorption costing income is greater or less than variable costing income depends on the relationship of production to sales. In all cases, to determine the effects on income, it must be assumed that variances from standard are immaterial and that unit product costs are constant over time. Exhibit 11–5 shows the possible relationships between production and sales levels and the effects of these relationships on income. These relationships are as follows:

- If production is equal to sales, absorption costing income will equal variable costing income.
- If production is greater than sales, absorption costing income is greater than variable costing income. This result occurs because some fixed manufacturing overhead cost is deferred as part of inventory cost on the balance sheet under

### EXHIBIT 11-5

*Production/Sales Relationships and Effects on Income Measurement and Inventory Assignments\**

where P = Production and S = Sales

AC = Absorption Costing and VC = Variable Costing

	Absorption vs. Variable Income Statement Income before Taxes	Absorption vs. Variable Balance Sheet Ending Inventory
P = S	AC = VC No difference from beginning inventory $FOH_{EI} - FOH_{BI} = 0$	No additional difference $FOH_{EI} = FOH_{BI}$
P > S (Stockpiling inventory)	AC > VC By amount of fixed OH in ending inventory minus fixed OH in beginning inventory $FOH_{EI} - FOH_{BI} = + \text{amount}$	Ending inventory increased (by fixed OH in additional units because P > S) $FOH_{EI} > FOH_{BI}$
P < S (Selling off beginning inventory)	AC < VC By amount of fixed OH released from balance sheet beginning inventory $FOH_{EI} - FOH_{BI} = - \text{amount}$	Ending inventory difference reduced (by fixed OH from BI charged to cost of goods sold) $FOH_{EI} < FOH_{BI}$

\*The effects of the relationships presented here are based on two qualifying assumptions:

- (1) that unit costs are constant over time; and
- (2) that any fixed cost variances from standard are written off when incurred rather than being prorated to inventory balances.

absorption costing, whereas the total amount of fixed manufacturing overhead cost is expensed as a period cost under variable costing.

- If production is less than sales, income under absorption costing is less than income under variable costing. In this case, absorption costing expenses all of the current period fixed manufacturing overhead cost and releases some fixed manufacturing overhead cost from the beginning inventory where it had been deferred from a prior period.

This process of deferring and releasing fixed overhead costs in and from inventory makes income manipulation possible under absorption costing, by adjusting production of inventory relative to sales. For this reason, some people believe that variable costing might be more useful for external purposes than absorption costing. For internal reporting, variable costing information provides managers with information about the behavior of the various product and period costs. This information can be used when computing the break-even point and analyzing a variety of cost-volume-profit relationships.

## DEFINITION AND USES OF CVP ANALYSIS

Examining shifts in costs and volume and their resulting effects on profit is called **cost-volume-profit (CVP) analysis**. This analysis is applicable in all economic sectors, including manufacturing, wholesaling, retailing, and service industries. CVP can be used by managers to plan and control more effectively because it allows them to concentrate on the relationships among revenues, costs, volume changes, taxes, and profits. The CVP model can be expressed through a formula or graphically, as illustrated in the chapter Appendix. All costs, regardless of whether they are product, period, variable, or fixed, are considered in the CVP model. The analysis is usually performed on a companywide basis. The same basic CVP model and calculations can be applied to a single- or multiproduct business. CVP is a component of business intelligence (BI), which is gathered within the context of knowledge management (KM). The News Note (page 452) discusses this context.

CVP analysis has wide-range applicability. It can be used to determine a company's **break-even point (BEP)**, which is that level of activity, in units or dollars, at which total revenues equal total costs. At breakeven, the company's revenues simply cover its costs; thus, the company incurs neither a profit nor a loss on operating activities. Companies, however, do not wish merely to "break even" on operations. The break-even point is calculated to establish a point of reference. Knowing BEP, managers are better able to set sales goals that should generate income from operations rather than produce losses. CVP analysis can also be used to calculate the sales volume necessary to achieve a desired target profit. Target profit objectives can be stated as either a fixed or variable amount on a before- or after-tax basis. Because profit cannot be achieved until the break-even point is reached, the starting point of CVP analysis is BEP. Over time, the break-even point for a firm or even an industry changes, as demonstrated in the News Note on page 453.

**cost-volume-profit analysis**

**break-even point**

<http://www.pricewaterhousecoopers.com>

## THE BREAK-EVEN POINT

Finding the break-even point first requires an understanding of company revenues and costs. A short summary of revenue and cost assumptions is presented at this point to provide a foundation for CVP analysis. These assumptions, and some challenges to them, are discussed in more detail at the end of the chapter.

- *Relevant range:* A primary assumption is that the company is operating within the relevant range of activity specified in determining the revenue and cost information used in each of the following assumptions.<sup>6</sup>

<sup>6</sup> Relevant range is the range of activity over which a variable cost will remain constant per unit and a fixed cost will remain constant in total.

## NEWS NOTE



## GENERAL BUSINESS

**Managing CVP Information**

Information, like gold, is worthless if you can't find it. A few years ago the information wasn't there. Today's manufacturing managers are swamped.

The change, needless to say, is one outcome of the information technology revolution. Equally needless to say, the IT vendors who created the glut are now selling sieves—IBM said last year there were already 1,800 software products in the knowledge management (KM) arena alone.

The most pressing manufacturing need is to share information across the organization as well as up and down it. Manufacturers used to have no accurate idea of the true cost of making a product or whether it was profitable—a particular weak spot was the effect different product volumes had on profit margins. Today's tools remove any excuse for such ignorance.

Whichever [software] system provides the tools, BI lets senior management drill down into the business, identify the data that will provide good performance measures and manipulate it into a series of measures by which to steer the company.

By some definitions, true BI is a component of a data warehousing system; by others BI is a step towards data warehousing. Creating an effective data warehouse, one which is allied to the tools which will deliver information from the mere data it contains, is not straightforward. The choice of systems and tools has to be carefully made, and it should be based not just on current information needs but those that develop as the business develops.

Many BI systems are sold on the basis that they are powerful enough to overwhelm that last redoubt of technofear, the boardroom. But any company investigating BI would do well to avoid restricting access to BI tools to a small group of powerful individuals at the top. Some tools treat data exactly this way, as information there solely to be sucked from the bottom to the top of an organization. At the opposite extreme, other tools act as a single input and retrieval system for information, one that everyone has access to, and which can have thousands of users rather than these elect few. Still others treat BI as an information delivery system made up of a clutch of linked but distinct data management, access, analysis and presentation tools. The tools can be added or subtracted at will, as the user company chooses.

Ultimately, the data warehouse can reveal information not initially sought. With large amounts of data, stored in complex ways, it is becoming ever more difficult to make sense of the information either by eye or with analytical methods. Data mining can tell you what is important to a particular problem, and what to ignore.

Pattern detection is vital in gathering information from data. It can tie warranty problems to particular factories, machines, or even operators or purchasing staff. Whether you know what you're looking for or not, data mining can help you do the work better and quicker.

SOURCE: John Dwyer, "The Info-Filter," *Works Management* (July 1999), pp. 26ff.

- **Revenue:** Revenue per unit is assumed to remain constant; fluctuations in per-unit revenue for factors such as quantity discounts are ignored. Thus, total revenue fluctuates in direct proportion to level of activity or volume.
- **Variable costs:** On a per-unit basis, variable costs are assumed to remain constant. Therefore, total variable costs fluctuate in direct proportion to level of activity or volume. Note that assumed variable cost behavior is the same as assumed revenue behavior. Variable production costs include direct material, direct labor, and variable overhead; variable selling costs include charges for items such as commissions and shipping. Variable administrative costs may exist in areas such as purchasing.
- **Fixed costs:** Total fixed costs are assumed to remain constant and, as such, per-unit fixed cost decreases as volume increases. (Fixed cost per unit would increase as volume decreases.) Fixed costs include both fixed manufacturing overhead and fixed selling and administrative expenses.
- **Mixed costs:** Mixed costs must be separated into their variable and fixed elements before they can be used in CVP analysis. Any method (such as regression analysis) that validly separates these costs in relation to one or more predictors can be used. After being separated, the variable and fixed cost components of the mixed cost take on the assumed characteristics mentioned above.

## GENERAL BUSINESS



## NEWS NOTE

**It Moves**

The U.S. lodging industry's overall occupancy level is probably as high as it's going to be for the foreseeable future, and in many geographic markets and segments occupancy rates are declining. So, how can it be that the industry will still be turning a profit in future years?

The answer comes from a study by Bear Stearns and PricewaterhouseCoopers. As explained by Bjorn Hanson, chairman of the PricewaterhouseCoopers lodging and gaming group, the overall breakeven occupancy has declined from as high as 80 percent back in the 1980s, to 55.5 percent today.

"Three factors underlie the dramatic reduction in breakeven occupancy to 55.5 percent," noted Hanson. "They are: average daily room rates that have been increasing at greater than the rate of inflation; a redefined hotel revenue mix that emphasizes rooms revenue over

revenue from low-margin food and beverage [F&B] operations; and lower debt and equity costs for the industry as a whole." Thus, even as occupancy declines, the industry's bid to control fixed costs has paid off.

By segment, upscale hotels (with their higher cost structure) are closest to breakeven, but the analysts say that upscale occupancy would have to drop 9.2 percent to hit breakeven. On the other hand, such segments as midscale without F&B, economy, and extended-stay (upper tier) are in a strong occupancy position and are operating far above breakeven.

SOURCE: Reprinted by permission of Elsevier Science from "U.S. Lodging Industry Breakeven Occupancy = 55.5%," by Glenn Withiam, *The Cornell Hotel and Restaurant Administration Quarterly* (August 1998), p. 10. Copyright 1998 by Cornell University.

An important amount in break-even and CVP analysis is **contribution margin** (CM), which can be defined on either a per-unit or total basis. Contribution margin per unit is the difference between the selling price per unit and the sum of variable production, selling, and administrative costs per unit. Unit contribution margin is constant because revenue and variable cost have been defined as remaining constant per unit. Total contribution margin is the difference between total revenues and total variable costs for all units sold. This amount fluctuates in direct proportion to sales volume. On either a per-unit or total basis, contribution margin indicates the amount of revenue remaining after all variable costs have been covered.<sup>7</sup> This amount contributes to the coverage of fixed costs and the generation of profits.

Data needed to compute the break-even point and perform CVP analysis are given in the income statement shown in Exhibit 11-6 for Comfort Valve Company.

**contribution margin**

	Total	Per Unit	Percentage
Sales	\$180,000	\$ 6.00	100
Variable Costs:			
Production	\$111,600	\$ 3.72	62
Selling	7,200	0.24	4
Total Variable Cost	(118,800)	\$(3.96)	(66)
Contribution Margin	\$ 61,200	\$ 2.04	34
Fixed Costs:			
Production	\$ 16,020		
Selling and administrative	2,340		
Total Fixed Cost	(18,360)		
Income before Income Taxes	\$ 42,840		

**EXHIBIT 11-6**

*Comfort Valve Company Income Statement for 2000*

<sup>7</sup> Contribution margin refers to the total contribution margin discussed in the preceding section of the chapter rather than product contribution margin. Product contribution margin is the difference between revenues and total variable *production* costs for the cost of goods sold.

## FORMULA APPROACH TO BREAKEVEN

The formula approach to break-even analysis uses an algebraic equation to calculate the exact break-even point. In this analysis, sales, rather than production activity, are the focus for the relevant range. The equation represents the variable costing income statement presented in the first section of the chapter and shows the relationships among revenue, fixed cost, variable cost, volume, and profit as follows:

$$R(X) - VC(X) - FC = P$$

where  $R$  = revenue (selling price) per unit

$X$  = volume (number of units)

$R(X)$  = total revenue

$VC$  = variable cost per unit

$VC(X)$  = total variable cost

$FC$  = total fixed cost

$P$  = profit

Because the above equation is simply a formula representation of an income statement,  $P$  can be set equal to zero so that the formula indicates a break-even situation. At the point where  $P = \$0$ , total revenues are equal to total costs and break-even point (BEP) in units can be found by solving the equation for  $X$ .

$$R(X) - VC(X) - FC = \$0$$

$$R(X) - VC(X) = FC$$

$$(R - VC)(X) = FC$$

$$X = FC \div (R - VC)$$

Break-even point volume is equal to total fixed cost divided by (revenue per unit minus the variable cost per unit). Using the operating statistics shown in Exhibit 11-6 for Comfort Valve Company (\$6.00 selling price per valve, \$3.96 variable cost per valve, and \$18,360 of total fixed costs), break-even point for the company is calculated as

$$\$6.00(X) - \$3.96(X) - \$18,360 = \$0$$

$$\$6.00(X) - \$3.96(X) = \$18,360$$

$$(\$6.00 - \$3.96)(X) = \$18,360$$

$$X = \$18,360 \div (\$6.00 - \$3.96)$$

$$X = 9,000 \text{ valves}$$

Revenue minus variable cost is contribution margin. Thus, the formula can be shortened by using the contribution margin to find BEP.

$$(R - VC)(X) = FC$$

$$(CM)(X) = FC$$

$$X = FC \div CM$$

where  $CM$  = contribution margin per unit

Comfort Valve's contribution margin is \$2.04 per valve (\$6.00 – \$3.96). The calculation for BEP using the abbreviated formula is  $\$18,360 \div \$2.04$  or 9,000 valves.

Break-even point can be expressed either in units or dollars of revenue. One way to convert a unit break-even point to dollars is to multiply units by the selling price per unit. For Comfort Valve, break-even point in sales dollars is \$54,000 (9,000 valves  $\times$  \$6.00 per valve).

Another method of computing break-even point in sales dollars requires the computation of a **contribution margin (CM) ratio**. The CM ratio is calculated as contribution margin divided by revenue and indicates what proportion of revenue remains after variable costs have been covered. The contribution margin ratio represents that portion of the revenue dollar remaining to go toward covering fixed costs and increasing profits. The CM ratio can be calculated using either per-unit or total revenue minus variable cost information. Subtracting the CM ratio from 100 percent gives the **variable cost (VC) ratio**, which represents the variable cost proportion of each revenue dollar.

The contribution margin ratio allows the break-even point to be determined even if unit selling price and unit variable cost are not known. Dividing total fixed cost by CM ratio gives the break-even point in sales dollars. The derivation of this formula is as follows:

$$\begin{aligned} \text{Sales} - [(\text{VC}\%)(\text{Sales})] &= \text{FC} \\ (1 - \text{VC}\%)\text{Sales} &= \text{FC} \\ \text{Sales} &= \text{FC} \div (1 - \text{VC}\%) \\ \text{because } (1 - \text{VC}\%) &= \text{CM}\% \\ \text{Sales} &= \text{FC} \div \text{CM}\% \end{aligned}$$

where VC% = the % relationship of variable cost to sales

CM% = the % relationship of contribution margin to sales

Thus, the variable cost ratio plus the contribution margin ratio is equal to 100 percent.

The contribution margin ratio for Comfort Valve Company is given in Exhibit 11-6 as 34 percent ( $\$2.04 \div \$6.00$ ). The company's computation of dollars of break-even sales is  $\$18,360 \div 0.34$  or \$54,000. The BEP in units can be determined by dividing the BEP in sales dollars by the unit selling price or  $\$54,000 \div \$6.00 = 9,000$  valves.

The break-even point provides a starting point for planning future operations. Managers want to earn operating profits rather than simply cover costs. Substituting an amount other than zero for the profit (P) term in the break-even formula converts break-even analysis to cost-volume-profit analysis.

**contribution margin ratio**

**variable cost ratio**

## USING COST-VOLUME-PROFIT ANALYSIS

CVP analysis requires the substitution of known amounts in the formula to determine an unknown amount. The formula mirrors the income statement when known amounts are used for selling price per unit, variable cost per unit, volume of units, and fixed costs to find the amount of profit generated under given conditions. Because CVP analysis is concerned with relationships among the elements comprising continuing operations, in contrast with nonrecurring activities and events, profits, as used in this chapter, refer to operating profits before extraordinary and other nonoperating, nonrecurring items. The pervasive usefulness of the CVP model is expressed as follows:

4

How can cost-volume-profit (CVP) analysis be used by a company?

*Cost Volume Profit analysis (CVP) is one of the most ballowed, and yet one of the simplest, analytical tools in management accounting. [CVP provides a financial overview that] allows managers to examine the possible impacts of a wide range of strategic decisions. Those decisions can include such crucial areas as pricing policies, product mixes, market expansions or contractions, outsourcing contracts, idle plant usage, discretionary expense planning, and a variety of other important considerations in the planning process. Given the broad range of contexts in which CVP can be used, the basic simplicity of CVP is quite remarkable. Armed with just three inputs of data—sales price, variable cost per unit, and fixed costs—a managerial analyst can evaluate the effects of decisions that potentially alter the basic nature of a firm.<sup>8</sup>*

An important application of CVP analysis is to set a desired target profit and focus on the relationships between it and other known income statement element amounts to find an unknown. A common unknown in such applications is volume because managers want to know what quantity of sales needs to be generated to produce a particular amount of profit.

Selling price is not assumed to be as common an unknown as volume because selling price is often market related and not a management decision variable. Additionally, because selling price and volume are often directly related, and certain costs are considered fixed, managers may use CVP to determine how high variable cost may be and still allow the company to produce a desired amount of profit. Variable cost may be affected by modifying product specifications or material quality or by being more efficient or effective in the production, service, and/or distribution processes. Profits may be stated as either a fixed or variable amount and on either a before- or after-tax basis. The following examples continue to use the Comfort Valve Company data using different amounts of target profit.

### Fixed Amount of Profit

Because contribution margin represents the amount of sales dollars remaining after variable costs are covered, each dollar of CM generated by product sales goes first to cover fixed costs and then to produce profits. *After the break-even point is reached, each dollar of contribution margin is a dollar of profit.*

*Theme parks have substantial fixed costs that must be covered before a profit can be earned. For parks that are closed part of the year, the contribution margin generated during the open season must be large enough to cover the fixed costs that continue even when revenues are not being generated.*



<sup>8</sup> Flora Guidry, James O. Horrigan, and Cathy Craycraft, "CVP Analysis: A New Look," *Journal of Managerial Issues* (Spring 1998), pp. 74ff.

**BEFORE TAX**

Profits are treated in the break-even formula as additional costs to be covered. The inclusion of a target profit changes the formula from a break-even to a CVP equation.

$$R(X) - VC(X) - FC = PBT$$

$$R(X) - VC(X) = FC + PBT$$

$$X = (FC + PBT) \div (R - VC)$$

or

$$X = (FC + PBT) \div CM$$

where PBT = fixed amount of profit before taxes

Comfort Valve's management wants to produce a before-tax profit of \$25,500. To do so, the company must sell 21,500 valves that will generate \$129,000 of revenue. These calculations are shown in Exhibit 11-7.

**AFTER TAX**

Income tax represents a significant influence on business decision making. Managers need to be aware of the effects of income tax in choosing a target profit amount. A company desiring to have a particular amount of net income must first determine the amount of income that must be earned on a before-tax basis, given the applicable tax rate. The CVP formulas that designate a fixed after-tax net income amount are

$$PBT = PAT + [(TR)(PBT)] \text{ and}$$

$$R(X) - VC(X) - FC = PAT + [(TR)(PBT)]$$

where PBT = fixed amount of profit before tax

PAT = fixed amount of profit after tax

TR = tax rate

PAT is further defined so that it can be integrated into the original CVP formula:

$$PAT = PBT - [(TR)(PBT)]$$

or

$$PBT = PAT \div (1 - TR)$$

In units:

PBT desired = \$25,500

$$R(X) - VC(X) = FC + PBT$$

$$CM(X) = FC + PBT$$

$$(\$6.00 - \$3.96)X = \$18,360 + \$25,500$$

$$\$2.04X = \$43,860$$

$$X = \$43,860 \div \$2.04 = 21,500 \text{ valves}$$

In sales dollars:

$$\text{Sales} = (FC + PBT) \div \text{CM ratio}$$

$$= \$43,860 \div 0.34 = \$129,000$$

**EXHIBIT 11-7**

*CVP Analysis—Fixed Amount of Profit before Tax*

Substituting into the formula,

$$R(X) - VC(X) = FC + PBT$$

$$(R - VC)(X) = FC + [PAT \div (1 - TR)]$$

$$CM(X) = FC + [PAT \div (1 - TR)]$$

Assume the managers at Comfort Valve Company want to earn \$24,480 of profit after tax and the company's marginal tax rate is 20 percent. The number of valves and dollars of sales needed are calculated in Exhibit 11-8.

### Variable Amount of Profit

Managers may wish to state profits as a variable amount so that, as units are sold or sales dollars increase, profits will increase at a constant rate. Variable amounts of profit may be stated on either a before- or after-tax basis. Profit on a variable basis can be stated either as a percentage of revenues or a per-unit profit. The CVP formula must be adjusted to recognize that profit (P) is related to volume of activity.

#### BEFORE TAX

This example assumes that the variable amount of profit is related to the number of units sold. The adjusted CVP formula for computing the necessary unit volume of sales to earn a specified variable amount of profit before tax per unit is

$$R(X) - VC(X) - FC = P_u BT(X)$$

where  $P_u BT$  = variable amount of profit per unit before tax

Moving all the Xs to the same side of the equation and solving for X (volume) gives the following:

$$R(X) - VC(X) - P_u BT(X) = FC$$

$$CM(X) - P_u BT(X) = FC$$

$$X = FC \div (CM - P_u BT)$$

### EXHIBIT 11-8

*CVP Analysis—Fixed Amount of Profit after Tax*

In units:

PAT desired = \$24,480; tax rate = 20%

$$\begin{aligned} PBT &= PAT \div (1 - TR) \\ &= \$24,480 \div (1 - 0.20) \\ &= \$24,480 \div 0.80 \\ &= \$30,600 \text{ necessary profit before tax} \end{aligned}$$

and

$$\begin{aligned} CM(X) &= FC + PBT \\ \$2.04X &= \$18,360 + \$30,600 \\ \$2.04X &= \$48,960 \\ X &= \$48,960 \div \$2.04 = 24,000 \text{ valves} \end{aligned}$$

In sales dollars:

$$\begin{aligned} \text{Sales} &= (FC + PBT) \div CM \text{ ratio} \\ &= (\$18,360 + \$30,600) \div 0.34 \\ &= \$48,960 \div 0.34 = \$144,000 \end{aligned}$$

The variable profit is treated in the CVP formula as if it were an additional variable cost to be covered. This treatment effectively “adjusts” the original contribution margin and contribution margin ratio. When setting the desired profit as a percentage of selling price, the profit percentage cannot exceed the contribution margin ratio. If it does, an infeasible problem is created because the “adjusted” contribution margin is negative. In such a case, the variable cost percentage plus the desired profit percentage would exceed 100 percent of the selling price, and such a condition cannot occur.

Assume that the president of Comfort Valve Company wants to know what level of sales (in valves and dollars) would be required to earn a 16 percent before-tax profit on sales. The calculations shown in Exhibit 11–9 provide the answers to these questions.

### AFTER TAX

Adjustment to the CVP formula to determine variable profits on an after-tax basis involves stating profits in relation to both the volume and the tax rate. The algebraic manipulations are:

$$R(X) - VC(X) - FC = P_{uAT}(X) + \{(TR)[P_{uBT}(X)]\}$$

where  $P_{uAT}$  = variable amount of profit per unit after tax

$P_{uAT}$  is further defined so that it can be integrated into the original CVP formula:

$$P_{uAT}(X) = P_{uBT}(X) - \{(TR)[P_{uBT}(X)]\}$$

$$= P_{uBT}(X)[1 - TR]$$

$$P_{uBT}(X) = [P_{uAT} \div (1 - TR)](X)$$

In units:

$$P_{uBT} \text{ desired} = 16\% \text{ of sales revenues}$$

$$P_{uBT} = 0.16(\$6.00) = \$0.96$$

$$CM(X) - P_{uBT}(X) = FC$$

$$\$2.04X - \$0.96X = \$18,360$$

$$X = \$18,360 \div \$1.08$$

$$X = 17,000 \text{ valves}$$

In sales dollars, the following relationships exist:

	Per Valve	Percentage
Selling price	\$ 6.00	100
Variable costs	(3.96)	(66)
Variable profit before tax	(0.96)	(16)
“Adjusted” contribution margin	<u>\$ 1.08</u>	<u>18</u>

$$\text{Sales} = FC \div \text{“Adjusted” CM ratio}^*$$

$$= \$18,360 \div 0.18 = \$102,000$$

\*Note that it is not necessary to have per-unit data; all computations can be made with percentage information only.

### EXHIBIT 11-9

*CVP Analysis—Variable Amount of Profit before Tax*

Thus, the following relationship exists:

$$\begin{aligned} R(X) - VC(X) &= FC + [P_uAT \div (1 - TR)](X) \\ &= FC + P_uBT(X) \\ CM(X) &= FC + P_uBT(X) \\ CM(X) - P_uBT(X) &= FC \\ X &= FC \div (CM - P_uBT) \end{aligned}$$

Comfort Valve wishes to earn a profit after tax of 16 percent of revenue and has a 20 percent tax rate. The necessary sales in units and dollars are computed in Exhibit 11-10.

All of the preceding illustrations of CVP analysis were made using a variation of the formula approach. Solutions were not accompanied by mathematical proofs. The income statement model is an effective means of developing and presenting solutions and/or proofs for solutions to CVP applications.

## THE INCOME STATEMENT APPROACH

The income statement approach to CVP analysis allows accountants to prepare pro forma (budgeted) statements using available information. Income statements can be used to prove the accuracy of computations made using the formula approach to CVP analysis, or the statements can be prepared merely to determine the impact of various sales levels on profit after tax (net income). Because the formula and income statement approaches are based on the same relationships, each should be able to prove the other.<sup>9</sup> Exhibit 11-11 proves each of the computations made in Exhibits 11-7 through 11-10 for Comfort Valve Company. The answers provided by break-even or cost-volume-profit analysis are valid only in relation to specific

### EXHIBIT 11-10

*CVP Analysis—Variable Amount of Profit after Tax*

In units:

$$P_uAT \text{ desired} = 16\% \text{ of revenue} = 0.16(\$6.00) = \$0.96; \text{ tax rate} = 20\%$$

$$P_uBT(X) = [\$0.96 \div (1 - 0.20)]X$$

$$P_uBT(X) = (\$0.96 \div 0.80)X = \$1.20X$$

$$CM(X) - P_uBT(X) = FC$$

$$\$2.04X - \$1.20X = \$18,360$$

$$\$0.84X = \$18,360$$

$$X = \$18,360 \div \$0.84 = 21,858 \text{ valves (rounded)}$$

	Per Valve	Percentage
Selling price	\$6.00	100
Variable costs	(3.96)	(66)
Variable profit before tax	(1.20)	(20)
"Adjusted" contribution margin	<u>\$0.84</u>	<u>14</u>

$$\text{Sales} = FC \div \text{"Adjusted" CM ratio}$$

$$= \$18,360 \div 0.14 = \$131,143 \text{ (rounded)}$$

<sup>9</sup> The income statement approach can be readily adapted to computerized spreadsheets, which can be used to quickly obtain the results of many different combinations of the CVP factors.

Previous computations:

Break-even point: 9,000 valves

Fixed profit (\$25,500) before tax: 21,500 valves

Fixed profit (\$24,480) after tax: 24,000 valves

Variable profit (16% on revenues) before tax: 17,000 valves

Variable profit (16% on revenues) after tax: 21,858 valves

R = \$6.00 per valve; VC = \$3.96 per valve; FC = \$18,360;

tax rate = 20% for Exhibits 11–8 and 11–10

	Basic Data	Ex. 11–7	Ex. 11–8	Ex. 11–9	Ex. 11–10
<b>Valves sold</b>	<b>9,000</b>	<b>21,500</b>	<b>24,000</b>	<b>17,000</b>	<b>21,858</b>
Sales	\$ 54,000	\$129,000	\$144,000	\$102,000	\$131,143
Total variable costs	(35,640)	(85,140)	(95,040)	(67,320)	(86,554)
Contribution margin	\$ 18,360	\$ 43,860	\$ 48,960	\$ 34,680	\$ 44,589
Total fixed costs	(18,360)	(18,360)	(18,360)	(18,360)	(18,360)
Profit before tax	\$ 0	\$ 25,500	\$ 30,600	\$ 16,320*	\$ 26,229
Taxes (20%)			(6,120)		(5,246)
Profit after tax (NI)			\$ 24,480		\$ 20,983**

\*Desired profit before tax = 16% on revenue;  $0.16 \times \$102,000 = \$16,320$

\*\*Desired profit after tax = 16% on revenue;  $0.16 \times \$131,143 = \$20,983$

### EXHIBIT 11-11

Income Statement Approach to  
CVP—Proof of Computations

selling prices and cost relationships. Changes that occur in the company's selling price or cost structure will cause a change in the break-even point or in the sales needed to obtain a desired profit figure. However, the effects of revenue and cost changes on a company's break-even point or sales volume can be determined through incremental analysis.

## INCREMENTAL ANALYSIS FOR SHORT-RUN CHANGES

The break-even point may increase or decrease, depending on the particular changes that occur in the revenue and cost factors. Other things being equal, the break-even point will increase if there is an increase in the total fixed cost or a decrease in the unit (or percentage) contribution margin. A decrease in contribution margin could arise because of a reduction in selling price, an increase in variable cost per unit, or a combination of the two. The break-even point will decrease if there is a decrease in total fixed cost or an increase in unit (or percentage) contribution margin. A change in the break-even point will also cause a shift in total profits or losses at any level of activity.

**Incremental analysis** is a process focusing only on factors that change from one course of action or decision to another. As related to CVP situations, incremental analysis is based on changes occurring in revenues, costs, and/or volume. Following are some examples of changes that may occur in a company and the incremental computations that can be used to determine the effects of those changes on the break-even point or profits. In most situations, incremental analysis is sufficient to determine the feasibility of contemplated changes, and a complete income statement need not be prepared.

We continue to use the basic facts presented for Comfort Valve Company in Exhibit 11–6. All of the following examples use before-tax information to simplify the computations. After-tax analysis would require the application of a  $(1 - \text{tax rate})$  factor to all profit figures.

### incremental analysis

**CASE 1**

The company wishes to earn a before-tax profit of \$10,200. How many valves does it need to sell? The incremental analysis relative to this question addresses the number of valves above the break-even point that must be sold. Because each dollar of contribution margin after BEP is a dollar of profit, the incremental analysis focuses only on the profit desired:

$$\$10,200 \div \$2.04 = 5,000 \text{ valves above BEP}$$

Because the BEP has already been computed as 9,000 valves, the company must sell a total of 14,000 valves.

**CASE 2**

Comfort Valve Company estimates that it can sell an additional 3,600 valves if it spends \$1,530 more on advertising. Should the company incur this extra fixed cost? The contribution margin from the additional valves must first cover the additional fixed cost before profits can be generated.

Increase in contribution margin	
(3,600 valves × \$2.04 CM per valve)	\$7,344
– Increase in fixed cost	<u>(1,530)</u>
= Net incremental benefit	<u>\$5,814</u>

Because the net incremental benefit is \$5,814, the advertising campaign would result in an additional \$5,814 in profits and, thus, should be undertaken.

An alternative computation is to divide \$1,530 by the \$2.04 contribution margin. The result indicates that 750 valves would be required to cover the additional cost. Because the company expects to sell 3,600 valves, the remaining 2,850 valves would produce a \$2.04 profit per valve or \$5,814.

**CASE 3**

The company estimates that, if the selling price of each valve is reduced to \$5.40, an additional 2,000 valves per year can be sold. Should the company take advantage of this opportunity? Current sales volume, given in Exhibit 11–6, is 30,000 valves.

If the selling price is reduced, the contribution margin per unit will decrease to \$1.44 per valve (\$5.40 SP – \$3.96 VC). Sales volume will increase to 32,000 valves (30,000 + 2,000).

Total new contribution margin	
(32,000 valves × \$1.44 CM per valve)	\$ 46,080
– Total fixed costs (unchanged)	<u>(18,360)</u>
= New profit before taxes	\$ 27,720
– Current profit before taxes	
(from Exhibit 11–6)	<u>(42,840)</u>
= Net incremental loss	<u>\$(15,120)</u>

Because the company will have a lower before-tax profit than is currently being generated, the company should not reduce its selling price based on this computation. Comfort Valve should investigate the possibility that the reduction in price might, in the long run, increase demand to more than the additional 2,000 valves per year and, thus, make the price reduction more profitable.

**CASE 4**

Comfort Valve Company has an opportunity to sell 10,000 valves to a contractor for \$5.00 per valve. The valves will be packaged and sold using the contractor's own logo. Packaging costs will increase by \$0.28 per valve, but no other variable

selling costs will be incurred by the company. If the opportunity is accepted, a \$1,000 commission will be paid to the salesperson calling on this contractor. This sale will not interfere with current sales and is within the company's relevant range of activity. Should Comfort Valve make this sale?

The new total variable cost per valve is \$4.00 (\$3.96 total current variable costs + \$0.28 additional variable packaging cost – \$0.24 current variable selling costs). The \$5.00 selling price minus the \$4.00 new total variable cost provides a contribution margin of \$1.00 per valve sold to the contractor.

Total contribution margin provided by	
this sale (10,000 valves × \$1.00 CM per valve)	\$10,000
– Additional fixed cost (commission) related to this sale	(1,000)
= Net incremental benefit	<u>\$ 9,000</u>

The total contribution margin generated by the sale is more than enough to cover the additional fixed cost. Thus, the sale produces a net incremental benefit to the firm in the form of increased profits and, therefore, should be made.

Similar to all proposals, this one should be evaluated on the basis of its long-range potential. Is the commission a one-time payment? Will sales to the contractor continue for several years? Will such sales not affect regular business in the future? Is such a sale within the boundaries of the law?<sup>10</sup> If all of these questions can be answered “yes,” Comfort Valve should seriously consider this opportunity. In addition to the direct contractor sales potential, referral business might also arise to increase sales.

The contribution margin or incremental approach will often be sufficient to decide on the monetary merits of proposed or necessary changes. Joel Becker, CEO of Torrington Supply Company, provides an excellent example of combining cost behavior and activity-based costing techniques to understand and manage decisions about customer profitability in the accompanying News Note on page 464.

## CVP ANALYSIS IN A MULTIPRODUCT ENVIRONMENT

Companies typically produce and sell a variety of products, some of which may be related (such as dolls and doll clothes or sheets, towels, and bedspreads). To perform CVP analysis in a multiproduct company, one must assume either a constant product sales mix or an average contribution margin ratio. The constant mix assumption can be referred to as the “bag” (or “basket”) assumption. The analogy is that the sales mix represents a bag of products that are sold together. For example, whenever some of Product A is sold, a set amount of Products B and C is also sold. Use of an assumed constant mix allows the computation of a weighted average contribution margin ratio for the bag of products being sold. Without the assumption of a constant sales mix, break-even point cannot be calculated nor can CVP analysis be used effectively.<sup>11</sup>

In a multiproduct company, the CM ratio is weighted on the quantities of each product included in the “bag” of products. This weighting process means that the contribution margin ratio of the product making up the largest proportion of the bag has the greatest impact on the average contribution margin of the product mix.

The Comfort Valve Company example continues. Because of the success of the valves, company management has decided to produce regulators also. The vice president of marketing estimates that, for every three valves sold, the company will sell

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How does CVP analysis differ between single-product and multiproduct firms?

<sup>10</sup> The Robinson-Patman Act addresses the legal ways in which companies can price their goods for sale to different purchasers.

<sup>11</sup> Once the constant percentage contribution margin in a multiproduct firm is determined, all situations regarding profit points can be treated in the same manner as they were earlier in the chapter. One must remember, however, that the answers reflect the “bag” assumption.

## NEWS NOTE



## GENERAL BUSINESS

**Rationale for Activity-Based Costing Analysis**

Most distributors' cost structure is such that they have high fixed costs and a very tight linkage between activities and variable costs. The key to any distributor's success is to minimize the variable cost component of his incremental margin once his fixed costs have been met. Sounds straightforward, but it is very hard to do. The first thing one has to do is decide which customers consume variable costs at a loss and eliminate those specialized services your fixed cost structure does not cover (i.e., special deliveries, special orders, special pricing, terms, etc.).

In order to do that we needed to know exactly which customers were asking us to perform activities that were not profitable. Thus, the activity-based costing analysis project was begun. It has obviously come a long way from there. Below I've outlined briefly how we come up with the costs and apply them.

We measure our operating costs to perform the following sales-related activities.

1. Cost to answer incoming sales calls and enter sales order header information (name, ship date, address, etc.)
2. Cost to enter each line item
3. Cost to pick a line item
4. Cost to pack an order
5. Cost to deliver an order
6. Cost to process an order (invoice, mail, collect, etc.)
7. Cost to make a field sales call
8. Cost to carry average receivable balance

We know the number of times we perform each activity company-wide each year. From this we calculate the average cost to do each activity. We test the data by calculating the median cost for each activity and have found each to be within pennies of the average. Once this is done we measure the number of times each of these activities is performed for each of our customers over the previous 52 weeks (we always use 52 weeks to eliminate large fluctuations week to week). The individual customer activity costs are subtracted from the customer's 52-week gross margin and a net ABC profit is calculated. We update our calculations every week and provide real-time displays at a single keystroke from most customer-related screens (i.e., sales entry and Accounts Receivable inquiries). We found that more important were the individualized service recommendations on how to respond to customer special pricing and service requests based on the customer's profitability profile.

The system works extremely well. Our goal is to service our unprofitable customers with fixed cost services only. This system has gone a long way to eliminate spending variable cost money on unprofitable customers.

SOURCE: Joel S. Becker, CEO, Torrington Supply Company, Inc., Waterbury, CT 06723-2838.

one regulator. Therefore, the "bag" of products has a 3:1 ratio. The company will incur an additional \$4,680 in fixed costs related to plant assets (depreciation, insurance, and so forth) needed to support a higher relevant range of production. Exhibit 11-12 provides relevant company information and shows the break-even computations.

Any shift in the proportion of sales mix of products will change the weighted average contribution margin and the break-even point. If the sales mix shifts toward products with lower dollar contribution margins, the BEP will increase and profits decrease unless there is a corresponding increase in total revenues. A shift toward higher dollar margin products without a corresponding decrease in revenues will cause a lower break-even point and increased profits. As illustrated by the financial results shown in Exhibit 11-13 on page 466, a shift toward the product with the lower dollar contribution margin (regulators) causes a higher break-even point and lower profits (in this case, a loss). This exhibit assumes that Comfort Valve sells 3,200 "bags" of product, but the mix was not in the exact proportions assumed in Exhibit 11-12. Instead of a 3:1 ratio, the sales mix was 2.5:1.5 valves to regulators. A loss of \$1,536 resulted because the company sold a higher proportion of the regulators, which have a lower contribution margin than the valves.

**EXHIBIT 11-12**

CVP Analysis—Multiple Products

	Valves		Regulators		
<b>Product Cost Information</b>					
Selling price	\$6.00	100%	\$2.00		100%
Total variable cost	(3.96)	(66)%	(0.92)		(46)%
Contribution margin	<u>\$2.04</u>	<u>34%</u>	<u>\$1.08</u>		<u>54%</u>
Total fixed costs = \$18,360 previous + \$4,680 new = \$23,040					
	Valves	Regulators	Total	Percentage	
Number of products per bag	3	1			
Revenue per product	\$6.00	\$2.00			
Total revenue per "bag"	\$18.00	\$2.00	\$20.00	100	
Variable cost per product	(3.96)	(0.92)			
Total variable per "bag"	(11.88)	(0.92)	(12.80)	(64)	
Contribution margin—product	<u>\$2.04</u>	<u>\$1.08</u>			
Contribution margin—"bag"	<u>\$ 6.12</u>	<u>\$1.08</u>	<u>\$ 7.20</u>	<u>36</u>	
BEP in units (where B = "bags" of products)					
$CM(B) = FC$					
$\$7.20B = \$23,040$					
$B = 3,200 \text{ bags}$					
Note: Each "bag" consists of 3 valves and 1 regulator; therefore, it will take 9,600 valves and 3,200 regulators to break even, assuming the constant 3:1 mix.					
BEP in sales dollars (where CM ratio = weighted average CM per "bag"):					
$B = FC \div CM \text{ ratio}$					
$B = \$23,040 \div 0.36$					
$B = \$64,000$					
Note: The break-even sales dollars also represent the assumed constant sales mix of \$18.00 of sales of valves to \$2.00 of sales of regulators to represent a 90% to 10% ratio. Thus, the company must have \$57,600 ( $\$64,000 \times 90\%$ ) in sales of valves and \$6,400 in sales of regulators to break even.					
Proof of the above computations using the income statement approach:					
	Valves	Regulators	Total		
Sales	\$57,600	\$6,400	\$64,000		
Variable costs	(38,016)	(2,944)	(40,960)		
Contribution margin	<u>\$19,584</u>	<u>\$3,456</u>	\$23,040		
Fixed costs			(23,040)		
Income before taxes			<u>\$ 0</u>		

**MARGIN OF SAFETY**

When making decisions about various business opportunities and changes in sales mix, managers often consider the size of the company's **margin of safety** (MS). The margin of safety is the excess of a company's budgeted or actual sales over its break-even point. It is the amount that sales can drop before reaching the break-even point and, thus, it provides a measure of the amount of "cushion" from losses.

6

How are margin of safety and operating leverage concepts used in business?

**margin of safety**

**EXHIBIT 11-13***Effects of Product Mix Shift*

	Valves	Regulators	Total	Percentage
Number of products per bag	2.5	1.5		
Revenue per product	\$6.00	\$2.00		
Total revenue per "bag"	\$15.00	\$3.00	\$18.00	100.0
Variable cost per product	(3.96)	(0.92)		
Total variable per "bag"	(9.90)	(1.38)	(11.28)	(62.7)
Contribution margin—product	<u>\$2.04</u>	<u>\$1.08</u>		
Contribution margin—"bag"	<u>\$ 5.10</u>	<u>\$1.62</u>	<u>\$ 6.72</u>	<u>37.3</u>
BEP in units (where B = "bags" of products)				
$CM(B) = FC$				
$\$6.72B = \$23,040$				
$B = 3,429 \text{ bags}$				
Actual results: 3,200 "bags" with a sales mix ratio of 2.5 valves to 1.5 regulators; thus, the company sold 8,000 valves and 4,800 regulators.				
	8,000 Valves	4,800 Regulators	Total	
Sales	\$48,000	\$9,600	\$57,600	
Variable costs	(31,680)	(4,416)	(36,096)	
Contribution margin	<u>\$16,320</u>	<u>\$5,184</u>	<u>\$21,504</u>	
Fixed costs			(23,040)	
Net loss			<u>\$ (1,536)</u>	

The margin of safety can be expressed as units, dollars, or a percentage. The following formulas are applicable:

Margin of safety in units = Actual units – Break-even units

Margin of safety in \$ = Actual sales in \$ – Break-even sales in \$

Margin of safety % = Margin of safety in units ÷ Actual unit sales

or

Margin of safety % = Margin of safety in \$ ÷ Actual sales \$

The break-even point for Comfort Valve (using the original, single-product data) is 9,000 units or \$54,000 of sales. The income statement for the company presented in Exhibit 11-6 shows actual sales for 2000 or 30,000 kits or \$180,000. The margin of safety for Comfort Valve is quite high, because it is operating far above its break-even point (see Exhibit 11-14).

**EXHIBIT 11-14***Margin of Safety*

In units: 30,000 actual – 9,000 BEP = 21,000 valves

In sales \$: \$180,000 actual – \$54,000 BEP = \$126,000

Percentage: 21,000 ÷ 30,000 = 70%

or

\$126,000 ÷ \$180,000 = 70%

The margin of safety calculation allows management to determine how close to a danger level the company is operating and, as such, provides an indication of risk. The lower the margin of safety, the more carefully management must watch sales figures and control costs so that a net loss will not be generated. At low margins of safety, managers are less likely to take advantage of opportunities that, if incorrectly analyzed or forecasted, could send the company into a loss position.

## OPERATING LEVERAGE

Another measure that is closely related to the margin of safety and also provides useful management information is the company's degree of **operating leverage**. The relationship of a company's variable and fixed costs is reflected in its operating leverage. Typically, highly labor-intensive organizations, such as Pizza Hut and H & R Block, have high variable costs and low fixed costs and, thus, have low operating leverage. (An exception to this rule is a sports team, which is highly labor intensive, but the labor costs are fixed rather than variable.)

Conversely, organizations that are highly capital intensive (such as Lone Star Technologies, a Dallas producer of steel pipe used in oil wells) or automated (such as Allen-Bradley) have a cost structure that includes low variable and high fixed costs, providing high operating leverage. Because variable costs are low relative to selling prices, the contribution margin is high. However, the high level of fixed costs means that the break-even point also tends to be high. If the market predominantly sets selling prices, volume has the primary impact on profitability. As they become more automated, companies will face this type of cost structure and become more dependent on volume to add profits. Thus, a company's **cost structure**, or the relative composition of its fixed and variable costs, strongly influences the degree to which its profits respond to changes in volume.

Companies with high operating leverage have high contribution margin ratios. Although such companies have to establish fairly high sales volumes to initially cover fixed costs, once those costs are covered, each unit sold after breakeven produces large profits. Thus, a small increase in sales can have a major impact on a company's profits. The accompanying News Note on page 468 illustrates some of the dynamics of operating leverage in the hotel industry.

The **degree of operating leverage** (DOL) measures how a percentage change in sales from the current level will affect company profits. In other words, it indicates how sensitive the company is to sales volume increases and decreases. The computation providing the degree of operating leverage factor is

$$\text{Degree of Operating Leverage} = \text{Contribution Margin} \div \text{Profit before Tax}$$

This calculation assumes that fixed costs do not increase when sales increase.

Assume that Comfort Valve Company is currently selling 20,000 valves. Exhibit 11-15 on page 468 provides the income statement that reflects this sales level. At this level of activity, the company has an operating leverage factor of 1.818. If the company increases sales by 20 percent, the change in profits is equal to the degree of operating leverage multiplied by the percentage change in sales or 36.36 percent. If sales decrease by the same 20 percent, there is a negative 36.36 percent impact on profits. Exhibit 11-15 confirms these computations.

The degree of operating leverage decreases the farther a company moves from its break-even point. Thus, when the margin of safety is small, the degree of operating leverage is large. In fact, at breakeven, the degree of operating leverage is infinite because any increase from zero is an infinite percentage change. If a company is operating close to the break-even point, each percentage increase in sales can make a dramatic impact on net income. As the company moves away from break-even sales, the margin of safety increases, but the degree of operating leverage declines.

**operating leverage**

<http://www.pizzahut.com>

<http://www.hrblock.com>

<http://www.ab.com>

**cost structure**

**degree of operating leverage**

## NEWS NOTE



## GENERAL BUSINESS

**Bucking the Hospitality Trend**

In the highly cyclical lodging industry, profits and values vary according to changes in occupancy and room rate. For the most part, these changes depend on availability of financing and growth in new rooms supply.

A major risk in owning a hotel entails supply. In the last 40 years, investors who lost money in this industry suffered from overbuilding, not shrinking demand or poor management. During the building spree of the 1980s, some markets experienced supply gains of more than 100 percent. This rapid growth in new hotel rooms diluted areawide occupancies, eroded profits and forced many hotels into bankruptcy.

New hotel construction usually begins when a developer can build a hotel worth more when finished than its replacement cost.

As more hotels are built, occupancies and values fall. When it costs more to build new than to buy an existing hotel with the same utility, feasibility is negative, financing evaporates and new construction ceases. Construction loans on hotels lag feasibility, so when values

rise, many lenders are slow to respond to new lending opportunities.

During 1997, hotel values in some parts of the U.S. rose by up to 70 percent. To someone not familiar with hotel operating leverage, this enormous rise was astonishing.

In 1991, the nadir of the hotel industry, 35 out of the 47 markets our firm tracks lost value. In 1997, the best year, only three markets sustained losses.

On the revenue side, hotels can continually adjust rates to take advantage of occupancy cycles. When a hotel is likely to reach capacity, management can aggressively raise rates, unlike conventional real estate.

As occupancies rise above breakeven, profitability and values rise significantly. But operating leverage works in reverse, causing profitability and values to crash as occupancies drop below the point where revenue can cover fixed expenses.

SOURCE: Stephen Rushmore, "Bucking the Hospitality Trend," *Lodging Hospitality* (July 1998), pp. 30ff.

**EXHIBIT 11-15***Degree of Operating Leverage*

	(20,000 valves) Current	(24,000 valves) 20% Increase	(16,000 valves) 20% Decrease
Sales	\$120,000	\$144,000	\$96,000
Variable costs (\$3.96 per valve)	(79,200)	(95,040)	(63,360)
Contribution margin	\$ 40,800	\$ 48,960	\$32,640
Fixed costs	(18,360)	(18,360)	(18,360)
Profit before tax	<u>\$ 22,440</u>	<u>\$ 30,600*</u>	<u>\$14,280**</u>
Degree of operating leverage:			
Contribution margin ÷ Profit before tax			
(\$40,800 ÷ \$22,440)	1.818		
(\$48,960 ÷ \$30,600)		1.600	
(\$32,640 ÷ \$14,280)			2.286
*Profit increase = \$30,600 - \$22,440 = \$8,160 (or 36.36% of the original profit)			
**Profit decrease = \$14,280 - \$22,440 = \$(8,160) (or -36.36% of the original profit)			
The relationship between the margin of safety and degree of operating leverage is shown below:			
$\text{Margin of Safety \%} = 1 \div \text{Degree of Operating Leverage}$ $\text{Degree of Operating Leverage} = 1 \div \text{Margin of Safety \%}$			

This relationship is proved in Exhibit 11-16 using the 20,000-valve sales level information for Comfort Valve. Therefore, if one of the two measures is known, the other can be easily calculated.

$$\begin{aligned}\text{Margin of Safety \%} &= \text{Margin of Safety in Units} \div \text{Actual Sales in Units} \\ &= [(20,000 - 9,000) \div 20,000] = 0.55 \text{ or } 55\%\end{aligned}$$

$$\begin{aligned}\text{Degree of Operating Leverage} &= \text{Contribution Margin} \div \text{Profit before Tax} \\ &= \$40,800 \div \$22,440 = 1.818\end{aligned}$$

$$\text{Margin of Safety} = (1 \div \text{DOL}) = (1 \div 1.818) = 0.55 \text{ or } 55\%$$

$$\text{Degree of Operating Leverage} = (1 \div \text{MS \%}) = (1 \div 0.55) = 1.818$$

**EXHIBIT 11-16**

*Margin of Safety and Degree of Operating Leverage Relationship*

**UNDERLYING ASSUMPTIONS OF CVP ANALYSIS**

CVP analysis is a short-run model that focuses on relationships among several items: selling price, variable costs, fixed costs, volume, and profits. This model is a useful planning tool that can provide information on the impact on profits when changes are made in the cost structure or in sales levels. However, the CVP model, like other human-made models, is an abstraction of reality and, as such, does not reveal all the forces at work. It reflects reality but does not duplicate it. Although limiting the accuracy of the results, several important but necessary assumptions are made in the CVP model. These assumptions follow.

7

What are the underlying assumptions of CVP analysis?

1. All revenue and variable cost behavior patterns are constant per unit and linear within the relevant range.
2. Total contribution margin (total revenue – total variable costs) is linear within the relevant range and increases proportionally with output. This assumption follows directly from assumption 1.
3. Total fixed cost is a constant amount within the relevant range.
4. Mixed costs can be accurately separated into their fixed and variable elements. Although accuracy of separation may be questioned, reliable estimates can be developed from the use of regression analysis or the high-low method (discussed in Chapter 3).
5. Sales and production are equal; thus, there is no material fluctuation in inventory levels. This assumption is necessary because of the allocation of fixed costs to inventory at potentially different rates each year. This assumption requires that variable costing information be available. Because both CVP and variable costing focus on cost behavior, they are distinctly compatible with one another.
6. There will be no capacity additions during the period under consideration. If such additions were made, fixed (and, possibly, variable) costs would change. Any changes in fixed or variable costs would violate assumptions 1 through 3.
7. In a multiproduct firm, the sales mix will remain constant. If this assumption were not made, no weighted average contribution margin could be computed for the company.
8. There is either no inflation or, if it can be forecasted, it is incorporated into the CVP model. This eliminates the possibility of cost changes.
9. Labor productivity, production technology, and market conditions will not change. If any of these changes occur, costs would change correspondingly and selling prices might change. Such changes would invalidate assumptions 1 through 3.

These assumptions limit not only the volume of activity for which the calculations can be made, but also the time frame for the usefulness of the calculations to that period for which the specified revenue and cost amounts remain constant. Changes in either selling prices or costs will require that new computations be made for break-even and product opportunity analyses.

The nine assumptions listed above are the traditional ones associated with cost-volume-profit analysis. An additional assumption must be noted with regard to the distinction of variable and fixed costs. Accountants have generally assumed that cost behavior, once classified, remained constant over periods of time as long as operations remained within the relevant range. Thus, for example, once a cost was determined to be “fixed,” it would be fixed next year, the year after, and 10 years from now.

It is more appropriate to regard fixed costs instead as long-term variable costs. Over the long run, through managerial decisions, companies can lay off supervisors and sell plant and equipment items. Fixed costs are not fixed forever. Generating cost information in a manner that yields a longer run perspective is presented in Chapter 4 on activity-based costing/management. Part of the traditional “misclassification” of fixed costs has been caused by improperly specifying the drivers of the costs. As companies become less focused on production and sales volumes as cost drivers, they will begin to recognize that “fixed costs” only exist under a short-term reporting period perspective.

Such a reclassification simply means that the cost drivers of the long-term variable costs will have to be specified in the break-even and CVP analyses. The formula will need to be expanded to include these additional drivers, and more information and a longer time frame will be needed to make the calculations. No longer will sales volume necessarily be the overriding nonmonetary force in the computations.

These adjustments to the CVP formula will force managers to take a long-run, rather than a short-run, view of product opportunities. Such a perspective could produce better organizational decisions. As the time frame is extended, both the time value of money and life-cycle costing become necessary considerations. Additionally, the traditional income statement becomes less useful for developing projects that will take several years to mature. A long-run perspective is important in a variety of circumstances, such as when variable or fixed costs arise only in the first year that a product or service is provided to customers.

## QUALITY AND COSTS

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One important long-run change that may create significant short-run costs is the implementation of a total quality management (TQM) program. A TQM program, as discussed in Chapter 8, generally causes prevention costs to increase. These costs probably will not be recouped in the short run by the decreases in appraisal and failure costs. However, in the long run, appraisal and failure costs should decline and the higher quality goods produced might command higher selling prices and sell better than the lower quality goods produced before the TQM program. Thus, the three primary factors in determining a company’s profits (costs, price, and volume) are intimately related to a fourth factor: quality. Quality considerations are primarily concerned with improving or maintaining customer satisfaction. Keeping current customers satisfied costs far less than having to court new customers to replace former dissatisfied customers. Further, servicing long-term customers is less costly than servicing new customers.

It would seem that the costs of ensuring quality should, in the long run, outweigh the costs of having poor quality. Implementation of a TQM program could cause higher variable costs (in the form of higher quality materials) or fixed costs (for plant assets and training). Other costs (such as those attributable to rework, redesign, and product failure) should fall after a period of time. Higher variable costs will not necessarily result in a lower contribution margin because of the possibility of higher selling prices. Higher fixed costs may only be incurred for the short run, returning to lower levels after the implementation program is completed.

Recall that CVP behavior patterns were required to be stable for the model to produce valid results. If the CVP component elements are sensitive to continuous

quality improvement efforts, they must be reevaluated frequently enough to compensate for changes that have occurred. Updating the CVP factors and their relationships for the impact of quality initiatives will help ensure the valid measurement of longer run results.

Although efforts to improve quality may take some time to produce noticeable results, it is widely believed that continuous quality improvement will increase sales volume and productivity, lower costs, and support management's ability to adjust product and service prices. As mentioned in the previous sections, when managers analyze break-even computations or product opportunities, managers should consider both quantitative and qualitative information. In addition, managers should consider the potential benefits generated by focusing their attention more on the long run and less on the short run.

## REVISITING

Torrington  
Supply Co.

<http://www.torringtonsupply.com>

**T**orrington has utilized the latest technology in every aspect of its business from the office operations of accounting, purchasing, sales management, and customer service, to all warehousing and shipping functions. The firm now is working with selected customers and vendors to eliminate duplicate processing costs. Torrington is using technology to implement programs to eliminate overlapping business functions such as order placement and stock replenishment and processing payables and receivables. The objective is to provide customers and suppliers hassle free, faster, and lower cost transactions.

Joel Becker [CEO] realized that kind of real-time information about a customer's net profitability would be very helpful to Torrington's inside-sales staff as they took orders. He and David Petitti [CFO] worked with Eclipse to develop a way to deliver the data with a single keystroke. But once they had it, they were shocked to discover that some of the company's "best" customers were also among its biggest profit drains.

Becker points to a sample report on one customer. This contractor was buying more than \$200,000 in materials from Torrington every year and paying in less than 29 days. And Torrington was earning a gross profit of almost 20% on these orders. "Yet we were losing a fortune on him!" Becker says.

The problem was that Torrington was making less than \$3 a line—\$21 an order—on this customer. "There is a fixed cost associated with every single order," Becker says. "What matters is the gross profit per order, not the

individual gross profit per line item. We actually make the lowest gross profit percent on our most profitable customers. The secret is the size of the order."

Becker decided that the best approach to take with such a delicate situation was the direct route. Armed with the profitability report, he called on the owner and the operations manager of the customer company. "I told them, 'You're a great customer,'" he recalls. "You've been doing business with us for a long time, and we love you. But we need you to do something if we're going to continue to do business. We need you to help us reduce our transaction costs." And I specifically listed what I thought they could do."

The customers themselves were surprised. They realized that placing so many orders was undoubtedly costing them money, as well. They were happy to work with Torrington to reduce their shared business costs.

"They now place all their orders electronically," Becker says. "Most customers are surprised at the activity levels their business requires of us. It's a real win-win."

So far Becker has these conversations only with customers with significant opportunity for improvement. "I review the details of their activity with us over the last 52 weeks: how much business they've done; the gross profit we earned; the number of lines, invoices, returns, deliveries, counter pickups, direct shipments, everything. They forget about our costs for what they require of us. But when they see all this, they respond very well."

## CHAPTER SUMMARY

Cost accumulation and cost presentation are two dimensions of product costing. Cost accumulation determines which costs are treated as product costs, whereas cost presentation focuses on how costs are shown on the financial statements or internal management reports.

Absorption and variable costing are two production-costing methods that differ in regard to product cost composition and income statement presentation. Under absorption costing, all manufacturing costs, both variable and fixed, are treated as product costs. The absorption costing method presents nonmanufacturing costs according to functional areas on the income statement, whereas the variable costing method presents both nonmanufacturing and manufacturing costs according to cost behavior on the income statement.

Variable costing computes product costs by including only the variable costs of production (direct material, direct labor, and variable manufacturing overhead). Fixed manufacturing overhead is viewed as a period expense in the period of occurrence by variable costing. Variable costing is not considered to be an acceptable method of inventory valuation for preparing external reports or filing tax returns.

Absorption costing income differs from variable costing income for any period in which production and sales volumes differ. This difference reflects the amount of fixed manufacturing overhead that is either attached to, or released from, inventory in absorption costing as opposed to being immediately expensed in variable costing.

Management planning includes planning for prices, volumes, fixed and variable costs, contribution margins, and break-even point. The interrelationships of these factors are studied when applying cost-volume-profit (CVP) analysis. Management should understand these interrelationships and combine them effectively and efficiently for company success.

The CVP model reflects linear relationships that can be used to calculate the level of sales volume necessary to achieve target profit objectives. CVP can also be used to compute break-even point (BEP), at which total contribution margin is equal to total fixed costs. Contribution margin equals sales minus all variable costs. BEP can be calculated using a cost-volume-profit formula that reflects basic income statement relationships. The BEP will change if the company's selling price(s) or costs change. Because most companies do not wish to operate at breakeven, CVP analysis extends the break-even point computation through the introduction of profit. The sales necessary to generate a desired amount of profit are computed by adding the desired profit to fixed costs and dividing that total by contribution margin. Profit can be stated as a fixed or a variable amount on a before- or after-tax basis. After fixed costs are covered, each dollar of contribution margin generated by company sales will produce a dollar of before-tax profit.

In a multiproduct firm, all break-even and cost-volume-profit analyses are performed using an assumed constant sales mix of products. This sales mix is referred to as the "bag" assumption. Use of the bag assumption requires the computation of a weighted average contribution margin (and, thus, contribution margin ratio) for the "bag" of products being sold by the company. Answers to break-even or CVP computations are in units or dollars of "bags" of products; these bag amounts can be converted to individual products by using the sales mix relationship.

The margin of safety (MS) of a firm indicates how far (in units, sales dollars, or a percentage) a company is operating from its break-even point. A company's degree of operating leverage (DOL) shows what percentage change in profit would occur given a specified percentage change in sales from the current level. The MS percentage is equal to  $(1 \div \text{DOL})$  and the DOL is equal to  $(1 \div \text{MS}\%)$ .

CVP analysis enhances a manager's ability to beneficially influence current operations and to predict future operations, thereby reducing the risk of uncertainty. The

model is, however, based on several assumptions that limit its ability to reflect reality. Managers may also wish to begin viewing the CVP relationships more on a long-range basis than the currently held short-range viewpoint.

**APPENDIX**

**Graphic Approaches to Breakeven**

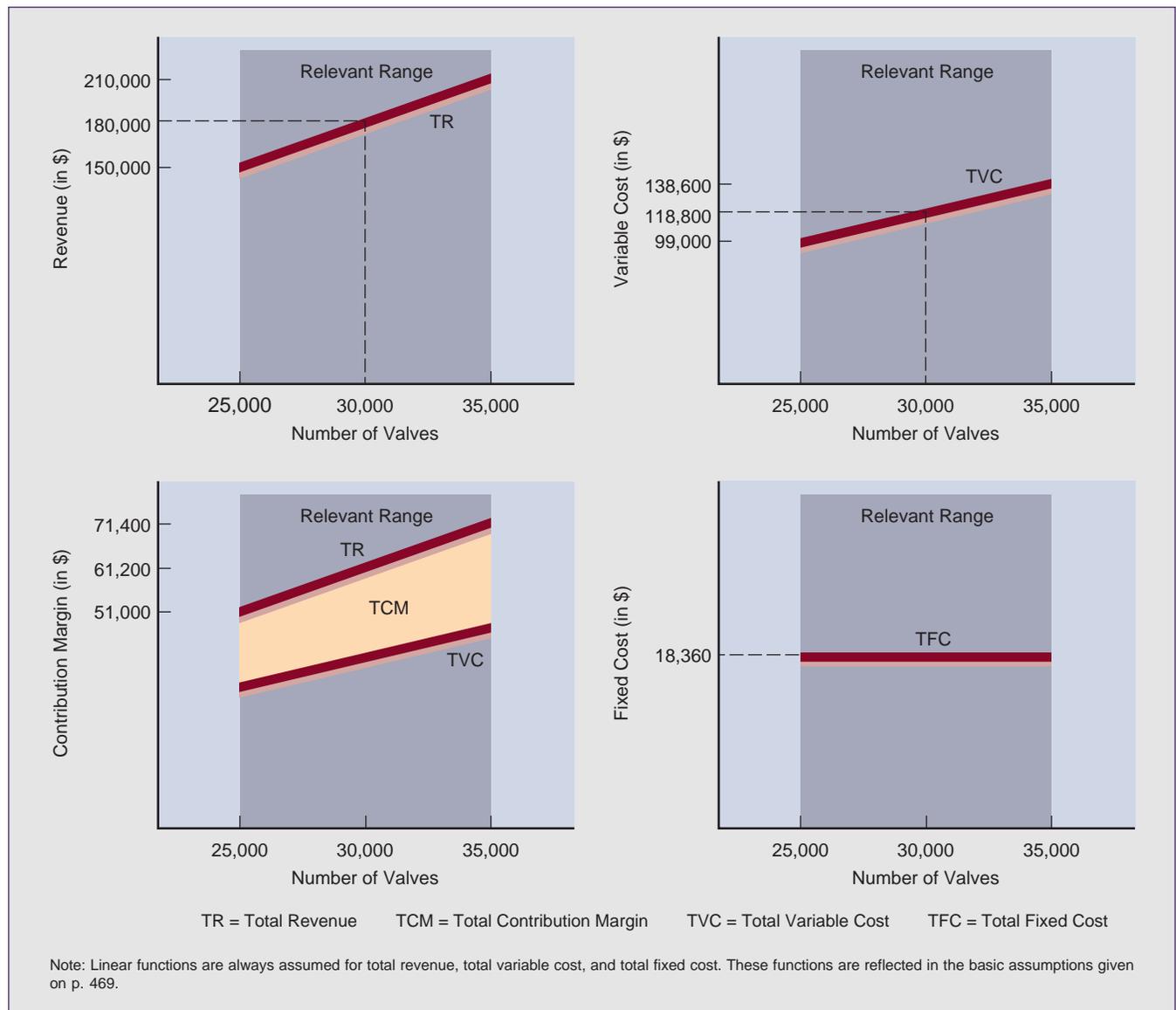
8

Solutions to break-even problems are determined in this chapter using an algebraic formula. Sometimes, however, the cost accountant may wish to present information to managers in a more visual format, such as graphs. Exhibit 11-17 graphically presents each income statement item for Comfort Valve Company's original data (see Exhibit 11-6), to provide visual representations of the behavior of revenue, costs, and contribution margin.

(Appendix) How are break-even charts and profit-volume graphs constructed?

**EXHIBIT 11-17**

*Graphical Presentation of Income Statement Items*



## break-even chart

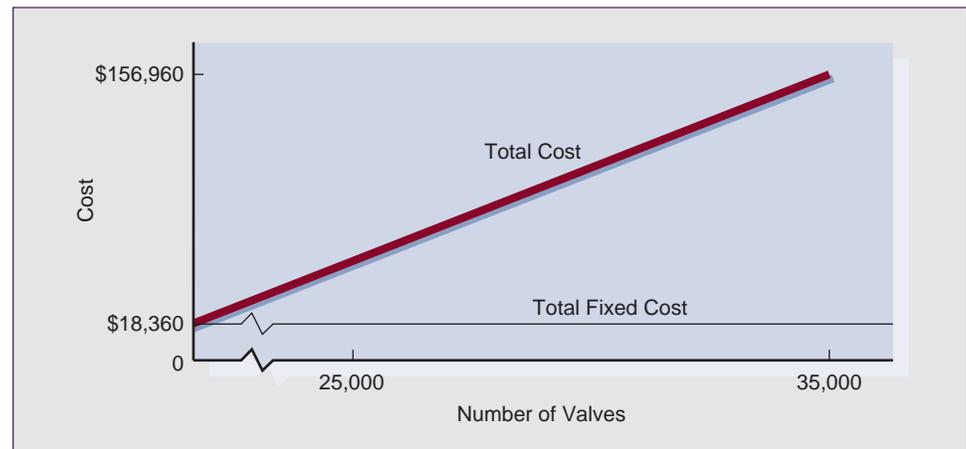
While illustrating individual behaviors, the graphs presented in Exhibit 11–17 are not very useful for determining the relationships among the various income statement categories. A **break-even chart** can be prepared to graph the relationships among revenue, volume, and the various costs. The break-even point on a break-even chart is located at the point where the total cost and total revenue lines cross.

Two approaches can be used to prepare break-even charts: the traditional approach and the contemporary approach. A third graphical presentation, the profit-volume graph, is closely related to the break-even chart.

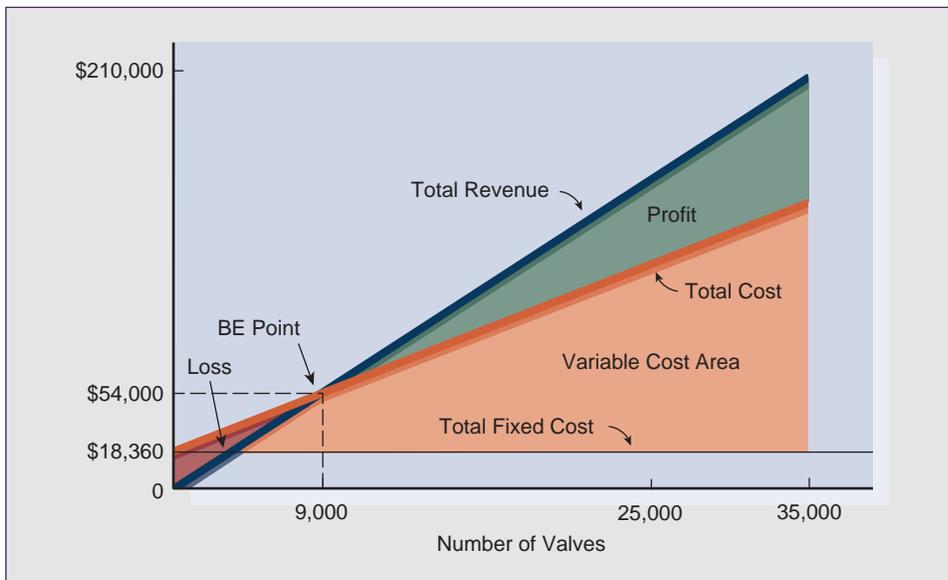
### Traditional Approach

The traditional approach to graphical break-even analysis focuses on the relationships among revenues, costs, and profits (losses). This approach does not show contribution margin. A traditional break-even chart for Comfort Valve Company is prepared as follows.

**Step 1:** Label each axis and graph the cost lines. The total fixed cost is drawn horizontal to the  $x$ -axis (volume). The variable cost line begins at the point where the total fixed cost line intersects the  $y$ -axis. The slope of the variable cost line is the per-unit variable cost. The resulting line represents total cost. The distance between the fixed cost and the total cost lines indicates total variable cost at each activity volume level.



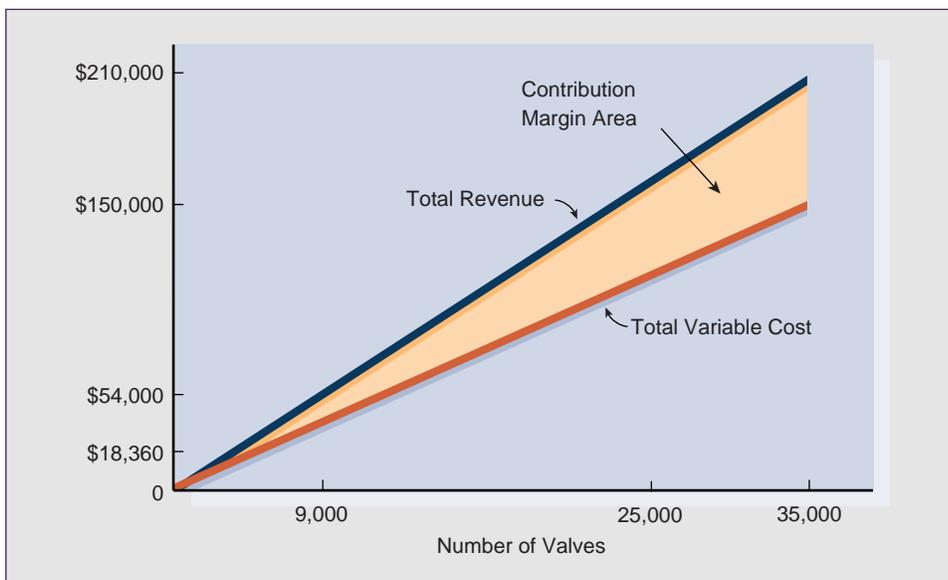
**Step 2:** Chart the revenue line, beginning at zero dollars. The break-even point is located at the intersection of the revenue line and the total cost line. The vertical distance to the right of the BEP and between the revenue and total cost lines represents profits; the distance between the revenue and total cost lines to the left of the break-even point represents losses. If exact readings could be taken on the graph, the break-even point for Comfort Valve Company would be \$54,000 of sales or 9,000 valves.



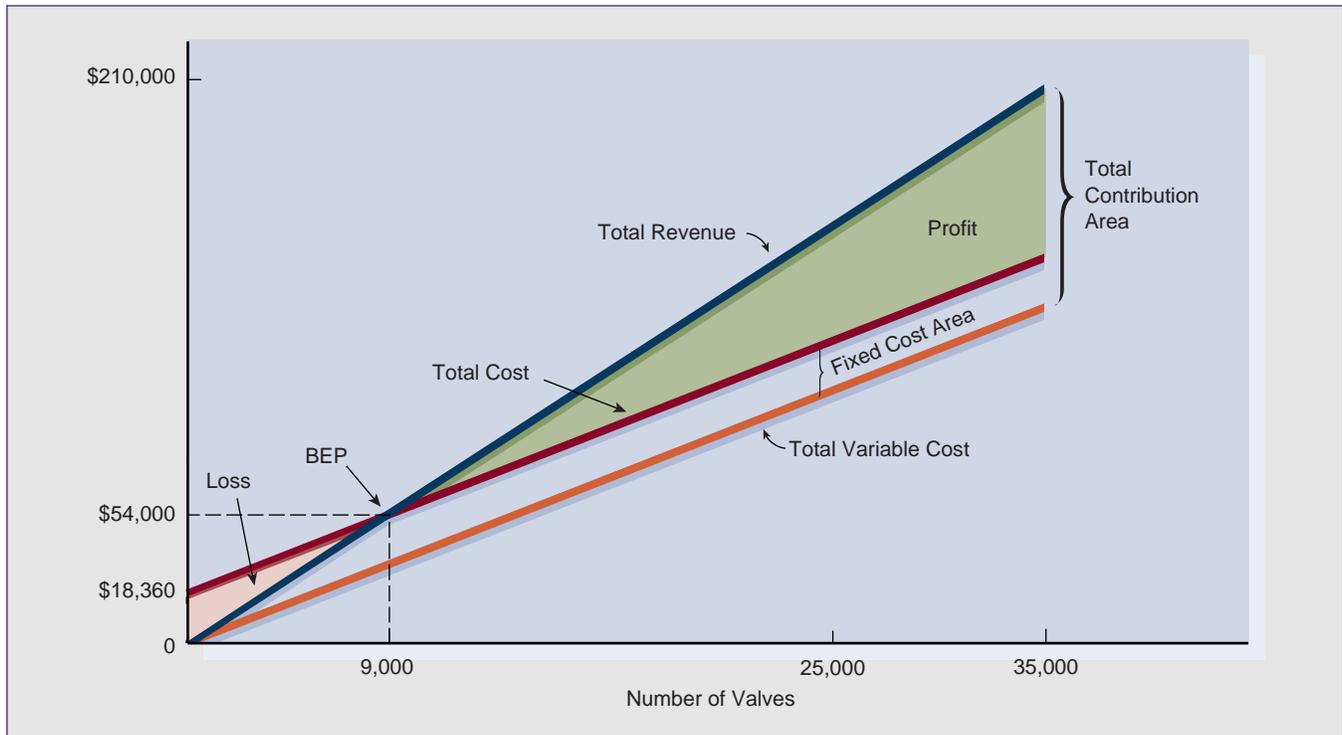
### Contemporary Approach

The contribution margin provided by each level of sales volume is not apparent on the traditional break-even chart. Because contribution margin is so important in CVP analysis, another graphical approach can be used. The contemporary approach specifically presents CM in the break-even chart. The preparation of a contemporary break-even chart is detailed in the following steps.

**Step 1:** The contemporary break-even chart plots the variable cost first. The revenue line is plotted next and the contribution margin area is indicated.



**Step 2:** Total cost is graphed by adding a line parallel to the total variable cost line. The distance between the total cost line and the variable cost line is the amount of fixed cost. The break-even point is located where the revenue and total cost lines intersect. Breakeven for Comfort Valve Company is again shown at \$54,000 of sales and 9,000 valves.



The contemporary graphic approach allows the following important observations to be made:

1. The excess of revenues over variable costs creates contribution margin. If variable costs are greater than revenues, no volume will ever allow a profit to be made.
2. Total contribution margin is always equal to total fixed cost plus profit or minus loss.
3. Before profits can be generated, contribution margin must exceed fixed costs.

### Profit-Volume Graph

#### profit-volume graph

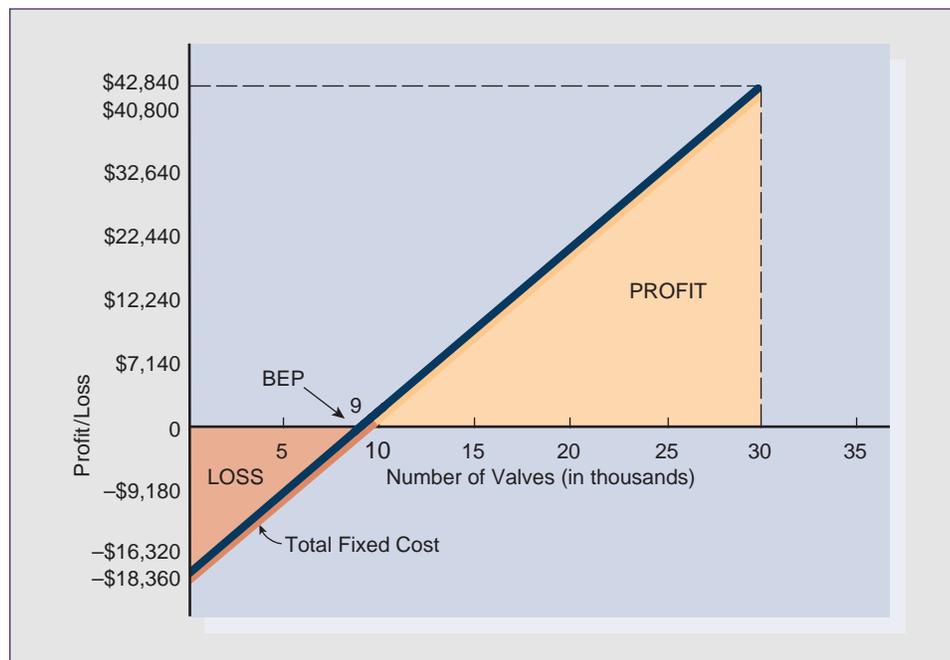
The **profit-volume (PV) graph** reflects the amount of profit or loss associated with each level of sales. The horizontal axis on the PV graph represents sales volume and the vertical axis represents dollars. Amounts shown above the horizontal axis are positive and represent profits; amounts shown below the horizontal axis are negative and represent losses.

Two points are located on the graph: total fixed costs and break-even point. Total fixed costs are shown on the vertical axis below the sales volume line as a negative amount. If no products were sold, fixed costs would still be incurred and a loss of the entire amount would result. The location of the break-even point may be determined algebraically or by using a break-even chart. Break-even point in units is shown on the horizontal axis because there is zero profit/loss at that point.

The last step in preparing the PV graph is to draw a profit line that passes between and extends through the two located points. Using this line, the amount of profit or loss for any sales volume can be read from the vertical axis. The profit line is really a contribution margin line and the slope of the line is determined by the unit contribution margin. The line shows that no profit is earned until the contribution margin covers the fixed costs.

The PV graph for Comfort Valve Company is shown in Exhibit 11–18. Total fixed costs are \$18,360 and break-even point is 9,000 valves. The profit line reflects the original Exhibit 11–6 income statement data indicating a profit of \$42,840 at a sales level of 30,000 valves.

The graphic approaches to breakeven provide detailed visual displays of break-even point. They do not, however, provide a precise solution because exact points cannot be determined on a graph. A definitive computation of break-even point can be found algebraically using the formula approach or a computer software application.

**EXHIBIT 11-18**

Profit-Volume Graph

**KEY TERMS**

- absorption costing (p. 443)
- break-even chart (p. 474)
- break-even point (p. 451)
- contribution margin (p. 453)
- contribution margin ratio (p. 455)
- cost accumulation (p. 443)
- cost presentation (p. 443)
- cost structure (p. 467)
- cost-volume-profit analysis (p. 451)
- degree of operating leverage (p. 467)
- direct costing (p. 444)
- full costing (p. 443)
- functional classification (p. 444)
- incremental analysis (p. 461)
- margin of safety (p. 465)
- operating leverage (p. 467)
- phantom profit (p. 449)
- product contribution margin (p. 445)
- profit-volume graph (p. 476)
- total contribution margin (p. 446)
- variable cost ratio (p. 455)
- variable costing (p. 444)

## SOLUTION STRATEGIES

### Absorption and Variable Costing

1. Which method is being used (absorption or variable)?
  - a. If absorption:
    - What is the fixed manufacturing overhead application rate?
    - What denominator capacity is used in determining the fixed manufacturing overhead application rate?
    - Is production equal to the denominator capacity used in determining the fixed manufacturing overhead application rate? If not, there is a fixed overhead volume variance that must be properly assigned to cost of goods sold and, possibly, inventories.
    - What is the cost per unit of product? (DM + DL + VOH + FOH)
  - b. If variable:
    - What is the cost per unit of product? (DM + DL + VOH)
    - What is total fixed manufacturing overhead? Assign to income statement in total as a period expense.
2. What is the relationship of production to sales?
  - a. Production = Sales  
Absorption Costing Income = Variable Costing Income
  - b. Production > Sales  
Absorption Costing Income > Variable Costing Income
  - c. Production < Sales  
Absorption Costing Income < Variable Costing Income
3. Dollar Difference between Absorption Costing Income and Variable Costing Income = FOH Application Rate × Change in Inventory Units

### Cost-Volume-Profit

The basic equation for break-even and CVP problems is

$$\text{Total Revenue} - \text{Total Cost} = \text{Profit}$$

CVP problems can also be solved by using a numerator/denominator approach. All numerators and denominators and the types of problems each relate to are listed below. The formulas relate to both single- and multiproduct firms, but results for multiproduct firms are per bag and can be converted to units of individual products.

Problem Situation	Numerator	Denominator
Simple BEP in units	FC	CM
Simple BEP in dollars	FC	CM%
CVP with fixed profit in units	FC + P	CM
CVP with fixed profit in dollars	FC + P	CM%
CVP with variable profit in units	FC	CM - P <sub>U</sub>
CVP with variable profit in dollars	FC	CM% - P <sub>U</sub> %

where FC = fixed cost

CM = contribution margin per unit

CM% = contribution margin percentage

P = total profit (on a before-tax basis)

P<sub>U</sub> = profit per unit (on a before-tax basis)

P<sub>U</sub>% = profit percentage per unit (on a before-tax basis)

To convert after-tax profit to before-tax profit, divide after-tax profit by (1 - tax rate).

## Margin of Safety

Margin of Safety in Units = Actual units – Break-even units

Margin of Safety in Dollars = Actual sales \$ – Break-even sales \$

Margin of Safety % = (Margin of safety in units or \$) ÷ (Actual sales in units or \$)

## Degree of Operating Leverage

Degree of Operating Leverage = Contribution margin ÷ Profit before tax

Predicted Profit = [1 + (DOL × Percent change in sales)] × Current profit

## DEMONSTRATION PROBLEM

Andersen Company's management is interested in seeing the company's absorption costing income statements for 2000 and 2001 (the first two years of operation) recast using variable costing. The company incurred total fixed manufacturing overhead of \$100,000 each year and produced 25,000 and 20,000 units, respectively, each year. The following absorption costing statements are based on standard costing using \$3 variable production cost per unit and 25,000 units as the activity level on which to determine the standard fixed costs each year. Other than the volume variance occurring in 2001, there are no other variances.

	2000	2001
Net sales (a)	\$300,000	\$330,000
Cost of goods sold (b)	(140,000)	(154,000)
Volume variance (5,000 units @ \$4)	0	(20,000)
Gross margin	<u>\$160,000</u>	<u>\$156,000</u>
Operating expenses (c)	(82,500)	(88,500)
Income before tax	<u>\$ 77,500</u>	<u>\$ 67,500</u>
 (a) Net sales:		
20,000 units @ \$15	<u>\$300,000</u>	
22,000 units @ \$15		<u>\$330,000</u>
 (b) Cost of goods sold:		
Beginning inventory	\$ 0	\$ 35,000
Cost of goods manufactured*	175,000	140,000
Goods available for sale	<u>\$175,000</u>	<u>\$175,000</u>
Ending inventory**	(35,000)	(21,000)
Cost of goods sold	<u>\$140,000</u>	<u>\$154,000</u>
 (c) Analysis of operating expenses:		
Variable	\$ 50,000	\$ 55,000
Fixed	32,500	33,500
Total	<u>\$ 82,500</u>	<u>\$ 88,500</u>
 *CGM		
25,000 units @ \$7.00 (of which \$3 are variable)	\$175,000	
20,000 units @ \$7.00 (of which \$3 are variable)		\$140,000
 **EI		
5,000 units @ \$7.00	\$ 35,000	
3,000 units @ \$7.00		\$ 21,000

### Required:

- Recast the 2000 and 2001 income statements on a variable costing basis.
- Reconcile income for each year between absorption and variable costing.

### Solution to Demonstration Problem

a.	2000	2001
Net sales	\$ 300,000	\$ 330,000
Variable cost of goods sold	(60,000)	(66,000)
Product contribution margin	<u>\$ 240,000</u>	<u>\$ 264,000</u>
Variable operating expenses	(50,000)	(55,000)
Total contribution margin	<u>\$ 190,000</u>	<u>\$ 209,000</u>
Fixed costs		
Manufacturing	\$ 100,000	\$ 100,000
Operating	32,500	33,500
Total fixed costs	<u>\$(132,500)</u>	<u>\$(133,500)</u>
Income before tax	<u>\$ 57,500</u>	<u>\$ 75,500</u>
b. Reconciliation 2000:		
Absorption costing income before tax		\$77,500
– Fixed manufacturing overhead in ending inventory (\$4.00 × 5,000)		<u>(20,000)</u>
Variable costing income before tax		<u>\$57,500</u>
Reconciliation 2001:		
Absorption costing income before tax		\$67,500
+ Fixed manufacturing overhead released from beginning inventory (\$4.00 × 2,000)		<u>8,000</u>
Variable costing income before tax		<u>\$75,500</u>

### QUESTIONS

1. In what ways does absorption costing differ from variable costing?
2. What is the difference between absorption and variable costing in the treatment of fixed overhead?
3. What is meant by functionally classifying costs? What is meant by behaviorally classifying costs?
4. Which product costing alternative, variable or absorption, is generally required for external reporting? Why?
5. What do external users of financial reports emphasize that is different from internal users?
6. How do the income statement formats for variable and absorption costing differ?
7. Why do you think variable costing has also been called direct costing?
8. Why does the variable costing approach provide more useful information for making internal decisions?
9. On the Internet, find a discussion of a company that uses variable costing. State how the company uses variable costing and any advantages or disadvantages cited.
10. Why is income under absorption costing higher (lower) than under variable costing in years when production exceeds (is below) sales?
11. What is the break-even point? Why is calculating break-even point the starting point for cost-volume-profit analysis?
12. What is contribution margin and why does it fluctuate in direct proportion with sales volume?
13. Why is CVP analysis a short-run tool? Why is it inappropriate as a long-run model?
14. Why is the formula for a variable costing income statement the basis for break-even or cost-volume-profit analysis?

15. If a product's fixed costs increase and its selling price and variable costs remain constant, what will happen to (a) contribution margin and (b) break-even point?
16. How can contribution margin be used to calculate break-even point in both units and dollars?
17. What is the contribution margin ratio? How is it used to calculate the break-even point?
18. A company is in the 40 percent tax bracket. Why is desired profit after tax divided by 60 percent to determine the needed before-tax profit amount?
19. What is meant by the "bag" assumption and why is it necessary in a multi-product firm? What additional assumption must be made in multiproduct CVP analysis that doesn't pertain to a single-product CVP situation?
20. How are BEP and margin of safety integrally related?
21. What is operating leverage? How does it pertain to CVP analysis? What is the margin of safety? How does it apply to CVP analysis?
22. (*Appendix*) What are the purposes of a break-even chart? What is the difference between the traditional approach and the contemporary approach to preparing a break-even chart? Between a break-even chart and a profit-volume graph?

## EXERCISES

23. (*Ending inventory valuation; absorption vs. variable costing*) Harvard Hats Company produces baseball caps. In May 2000, the company manufactured 20,000 caps. May sales were 18,400 caps. The cost per unit for the 20,000 caps produced was

Direct material	\$3.00
Direct labor	2.00
Variable overhead	1.00
Fixed overhead	<u>1.50</u>
Total	<u>\$7.50</u>

There was no beginning inventory for May.

- a. What is the value of ending inventory using absorption costing?
  - b. What is the value of ending inventory using variable costing?
  - c. Which accounting method, variable or absorption, would have produced the higher net income for May?
24. (*Absorption vs. variable costing*) The following data were taken from records of the Kitchen Juicer Company. The company uses variable costing. The data relate to the company's first year of operation.

Units produced:	40,000
Units sold:	37,500
Variable cost per unit:	
Direct material	\$48
Direct labor	27
Variable overhead	14
Variable selling costs	12
Fixed costs:	
Selling and administrative	\$750,000
Manufacturing	500,000

How much higher (or lower) would the company's first-year net income have been if the company had used absorption costing rather than variable costing? Show computations.

25. (*Production cost; absorption vs. variable costing*) Bright Smile Mouthwash began business in 1999. Production for the year was 100,000 bottles of mouthwash, and sales were 98,000 bottles. Costs incurred during the year were as follows:

Ingredients used	\$28,000
Direct labor	13,000
Variable overhead	24,000
Fixed overhead	12,000
Variable selling expenses	5,000
Fixed selling and administrative expenses	<u>14,000</u>
Total actual costs	<u>\$96,000</u>

- a. What was the actual production cost per bottle under variable costing? Under absorption costing?
  - b. What was variable Cost of Goods Sold for 1999 under variable costing?
  - c. What was Cost of Goods Sold for 1999 under absorption costing?
  - d. What was the value of ending inventory under variable costing? Under absorption costing?
  - e. How much fixed overhead was charged to expense in 1999 under variable costing? Under absorption costing?
26. (*Net income; absorption vs. variable costing*) Skillful Scanners produces commercial scanners. Throughout 2000, unit variable cost remained constant and fixed overhead was applied at the rate of \$5 per unit. Income before tax using the variable costing method was \$90,000 for July 2000. Beginning and ending inventories for July were 17,000 and 15,000 units, respectively.
- a. Calculate income before tax under absorption costing assuming no variances.
  - b. Assume instead that the company's July beginning and ending inventories were 15,000 and 18,000 units, respectively. Calculate income before tax under absorption costing.
27. (*Convert variable to absorption*) James Walton, vice president of marketing for Charming Curios, has just received the April 2000 income statement, shown below, which was prepared on a variable costing basis. The firm uses a variable costing system for internal reporting purposes.

CHARMING CURIOS  
Income Statement  
For the Month Ended April 30, 2000  
(\$000 omitted)

Sales		\$4,800
Variable standard cost of goods sold		(2,400)
Product contribution margin		<u>\$2,400</u>
Fixed expenses		
Manufacturing (at budget)	\$1,000	
Manufacturing spending variance	0	
Selling and administrative	<u>800</u>	<u>(1,800)</u>
Income before taxes		<u>\$ 600</u>

The controller attached the following notes to the statements:  
The unit sales price for April averaged \$48.  
The standard unit manufacturing costs for the month were:

Variable cost	\$24
Fixed cost	<u>10</u>
Total cost	<u>\$34</u>

The unit rate for fixed manufacturing costs is a predetermined rate based on a normal monthly production of 100,000 units. Production for April was 5,000 units in excess of sales, and the April ending inventory consisted of 8,000 units.

- a. The vice president of marketing is not comfortable with the variable cost basis and wonders what income before tax would have been under absorption costing.
  1. Present the April income statement on an absorption costing basis.
  2. Reconcile and explain the difference between the variable costing and the absorption costing income figures.
- b. Explain the features associated with variable cost income measurement that should be attractive to the vice president of marketing. *(CMA adapted)*

28. *(Standard costing; variable and absorption costing)* Gramps' Remedy manufactures athletes' foot powder. The company uses a standard costing system. Following are data pertaining to the company's operations for 1999:



Production for the year	180,000 units
Sales for the year (sales price per unit, \$1.25)	195,000 units
Beginning 1999 inventory	35,000 units

#### STANDARD COSTS TO PRODUCE 1 UNIT

Direct material	\$0.15
Direct labor	0.10
Variable overhead	0.05
Fixed overhead	0.15

#### SELLING AND ADMINISTRATIVE COSTS

Variable (per unit sold)	\$0.14
Fixed (per year)	\$120,000

Fixed manufacturing overhead is assigned to units of production based on a predetermined rate using a normal production capacity of 200,000 units per year.

- a. What is the estimated annual fixed manufacturing overhead?
  - b. If estimated fixed overhead is equal to actual fixed overhead, what is the amount of under- or overapplied overhead in 1999 under absorption costing? Under variable costing?
  - c. What is the product cost per unit under absorption costing? Under variable costing?
  - d. How much expense will be charged against revenues in 1999 under absorption costing? Under variable costing?
  - e. Will pretax income be higher under absorption or variable costing? By what amount?
29. *(Cost and revenue behavior)* The following financial data have been determined from analyzing the records of Jordan Appliances (a one-product firm):

Contribution margin per unit	\$	25
Variable costs per unit		21
Annual fixed costs		180,000

How do each of the following measures change when product volume goes up by one unit at Jordan Appliances?

- a. Total revenue
- b. Total costs
- c. Income before taxes

30. (*Break-even point*) Thompson Company has the following revenue and cost functions:

$$\begin{aligned}\text{Revenue} &= \$60 \text{ per unit} \\ \text{Costs} &= \$241,750 + \$35 \text{ per unit}\end{aligned}$$

What is the break-even point in units? In dollars?

31. (*Incremental sales*) Brunswick Industries has annual sales of \$2,500,000 with variable expenses of 60 percent of sales and fixed expenses per month of \$40,000. By how much will annual sales have to increase for Brunswick Industries to have pretax income equal to 30 percent of sales?
32. (*CVP, taxes*) Joan Michaels has a small plant that makes playhouses. She sells them to local customers at \$3,000 each. Her costs are as follows:

Costs	Per Unit	Total
Direct material	\$1,200	
Direct labor	400	
Variable overhead	150	
Variable selling	50	
Fixed production overhead		\$200,000
Fixed selling and administrative		80,420

Joan is in a 35 percent tax bracket.

- How many playhouses must she sell to earn \$247,507 after taxes?
  - What level of revenue is needed to yield an after-tax income equal to 20 percent of sales?
33. (*Operating leverage, margin of safety*) One of the products produced by Orlando Citrus is Citrus Delight. The selling price per half-gallon is \$4.50, and variable cost of production is \$2.70. Total fixed costs per year are \$316,600. The company is currently selling 200,000 half-gallons per year.
- What is the margin of safety in units?
  - What is the degree of operating leverage?
  - If the company can increase sales in units by 30 percent, what percentage increase will it experience in income? Prove your answer using the income statement approach.
  - If the company increases advertising by \$41,200, sales in units will increase by 15 percent. What will be the new break-even point? The new degree of operating leverage?
34. (*Miscellaneous*) Compute the answers to each of the following independent situations.
- SmallCo sells two products, M and N. The sales mix of these products is 2:4, respectively. M has a contribution margin of \$10 per unit, and N has a contribution margin of \$5 per unit. Fixed costs for the company are \$90,000. What would be the total units of N sold at the break-even point?
  - Brooke Company has a break-even point of 2,000 units. At breakeven, variable costs are \$3,200 and fixed costs are \$800. If the company sells one unit over breakeven, what will be the pretax income of the company?
  - Cool Cologne sells its product for \$5 per bottle. The fixed costs of the company are \$108,000. Variable costs amount to 40 percent of selling price. What amount of sales (in units) would be necessary for Cool Cologne to earn a 25 percent pretax profit on sales?
  - Johnston Company has a break-even point of 1,400 units. The company is currently selling 1,600 units for \$65 each. What is the margin of safety for the company in units, sales dollars, and percentage?

35. (CVP, multiproduct) Winnie Wholesalers sells baseball products. The Little League Division handles both bats and gloves. Historically, the firm has averaged three bats sold for each glove sold. Each bat has a \$4 contribution margin and each glove has a \$5 contribution margin. The fixed costs of operating the Little League Division are \$200,000 per year. Each bat sells for \$10 on average and each glove sells for \$15 on average. The corporatewide tax rate for the company is 40 percent.
- How much revenue is needed to break even? How many bats and gloves would this represent?
  - How much revenue is needed to earn a pretax profit of \$90,000?
  - How much revenue is needed to earn an after-tax profit of \$90,000?
  - If the Little League Division earns the revenue determined in part (b), but in doing so sells two bats for each glove, what would the pretax profit (or loss) be? Why is this amount not \$90,000?
36. (Appendix) Tom & Jerry Inc. had the following income statement for 2000.

Sales (15,000 gallons @ \$8)		\$120,000
Variable Costs		
Production (20,000 gallons @ \$3)	\$60,000	
Selling (20,000 gallons @ \$0.50)	<u>10,000</u>	<u>(70,000)</u>
Contribution Margin		\$ 50,000
Fixed Costs		
Production	\$22,000	
Selling and administrative	<u>4,000</u>	<u>(26,000)</u>
Income before Taxes		\$ 24,000
Income Taxes (40%)		<u>(9,600)</u>
Net Income		<u>\$ 14,400</u>

- Prepare a CVP graph, in the traditional manner, to reflect the relations among costs, revenues, profit, and volume.
- Prepare a CVP graph, in the contemporary manner, to reflect the relations among costs, revenues, profit, and volume.
- Prepare a profit-volume graph.
- Prepare a short explanation for company management about each of the graphs.

## PROBLEMS

37. (Convert variable to absorption) George Massat started a new business in 1999 to produce portable, climate-controlled shelters. The shelters have many applications in special events and sporting activities. George's accountant prepared the variable costing income statement shown after part (d3) after the first year to help him in making decisions. During the year, the following variable production costs per unit were recorded: direct material, \$800; direct labor, \$300; and overhead, \$200.
- Mr. Massat was upset about the net loss because he had wanted to borrow funds to expand capacity. His friend who teaches accounting at a local university suggested that the use of absorption costing could change the picture.
- Prepare an absorption costing pretax income statement.
  - Explain the source of the difference between the net income and the net loss figures under the two costing systems.
  - Would it be appropriate to present an absorption costing income statement to the local banker in light of Mr. Massat's knowledge of the net loss determined under variable costing? Explain. *(continued)*

- d. Assume that during the second year of operations, Mr. Massat's company produced 1,750 shelters, sold 1,850, and experienced the same total fixed costs. For the second year:
1. Prepare a variable costing pretax income statement.
  2. Prepare an absorption costing pretax income statement.
  3. Explain the difference between the incomes for the second year under the two systems.

GEORGE MASSAT ENTERPRISES  
Income Statement  
For the Year Ended December 31, 1999

Sales (1,500 shelters @ \$2,500)	\$3,750,000
Variable cost of goods sold:	
Beginning inventory	\$ 0
Cost of goods manufactured (1,750 @ \$1,300)	2,275,000
Cost of goods available for sale	\$2,275,000
Less ending inventory (250 @ \$1,300)	<u>(325,000)</u>
Product contribution margin	\$1,800,000
Less variable selling and administrative expenses (1,500 @ \$180)	<u>(270,000)</u>
Total contribution margin	\$1,530,000
Less fixed expenses:	
Fixed factory overhead	\$1,500,000
Fixed selling and administrative expenses	<u>190,000</u>
Net loss	<u>\$ (160,000)</u>

38. (*Income statements, variance*) Johnson Tools makes a unique workman's tool. The company produces and sells approximately 500,000 units per year. The projected unit cost data for 2001 follows; the company uses standard full absorption costing and writes off all variances to Cost of Goods Sold.

	Variable	Fixed
Direct material	\$1.50	0
Direct labor	1.20	0
Variable overhead	0.40	0
Fixed overhead		\$ 82,000
Selling and administrative	4.00	145,000

The fixed overhead application rate is \$0.16 per unit.

- Calculate the per-unit inventory cost for variable costing.
  - Calculate the per-unit inventory cost for absorption costing.
  - The projected income before tax from variable costing is \$223,000 at production and sales of 500,000 units and 490,000 units, respectively. Projected beginning and ending finished goods inventories are 30,000 and 40,000 units, respectively. Calculate the projected income before tax using absorption costing.
39. (*Comprehensive*) Brookfield Fashions produces and sells cotton blouses. The firm uses variable costing for internal management purposes and absorption costing for external purposes. At the end of each year, financial information must be converted from variable costing to absorption costing to satisfy external requirements.

At the end of 1999, it was anticipated that sales would rise 20 percent from 1999 levels for 2000. Therefore, production was increased from 20,000 to 24,000 units to meet this expected demand. However, economic conditions kept the sales level at 20,000 for both years. The following data pertain to 1999 and 2000:



	1999	2000
Selling price per unit	\$40	\$40
Sales (units)	20,000	20,000
Beginning inventory (units)	2,000	2,000
Production (units)	20,000	24,000
Ending inventory (units)	2,000	?
Unfavorable labor, material, and variable overhead variances (total)	\$5,000	\$4,000

Standard variable costs per unit for 1999 and 2000 were

Material	\$ 4.50
Labor	7.50
Overhead	3.00
Total	<u>\$15.00</u>

Annual fixed costs for 1999 and 2000 (budgeted and actual) were

Production	\$117,000
Selling and administrative	125,000
Total	<u>\$242,000</u>

The overhead rate under absorption costing is based on practical capacity of 30,000 units per year. All variances and under- or overapplied overhead are taken to Cost of Goods Sold. All taxes are to be ignored.

- Present the income statement based on variable costing for 2000.
- Present the income statement based on absorption costing for 2000.
- Explain the difference, if any, in the income figures. Assuming no Work in Process Inventory, give the entry necessary to adjust the book income amount to the financial statement income amount, if one is necessary.
- The company finds it worthwhile to develop its internal financial data on a variable costing basis. What advantages and disadvantages are attributed to variable costing for internal purposes?
- Many accountants believe that variable costing is appropriate for external reporting and many oppose its use for external reporting. What arguments for and against the use of variable costing can you think of in external reporting? *(CMA adapted)*

40. (*Income statements for 2 years, both methods*) Edison Digital manufactures palm-top computers. The following data from the company are available for 2000 and 2001:

	2000	2001
Selling price per unit	\$170	\$170
Number of units sold	20,000	24,000
Number of units produced	25,000	22,000
Beginning inventory (units)	15,000	20,000
Ending inventory (units)	20,000	?

Standard costs per unit for 2000 and 2001 were

Direct material	\$20.00
Direct labor	60.00
Variable overhead	20.00
Fixed overhead	30.00 (based on budget of \$750,000 and normal capacity of 25,000 units)
Variable sales commission	20.00

In addition, selling and administrative fixed costs were \$190,000 for both years. All variances are charged or credited to Cost of Goods Sold.

Prepare income statements under absorption and variable costing for the years ended 2000 and 2001. Reconcile the differences in income between the methods. (Ignore taxes.)

- 41.** (*CVP decision alternatives*) Norman Horn owns a small travel agency. His revenues are based on commissions earned as follows:

Airline bookings	8% commission
Rental car bookings	10% commission
Hotel bookings	20% commission

Monthly fixed costs include advertising (\$1,100), rent (\$900), utilities (\$250), and other costs (\$2,200). There are no variable costs.

During a normal month, Norman records the following items, which are subject to the above commission structure:

Airlines	\$30,000
Cars	4,500
Hotels	7,000
Total	<u>\$41,500</u>

Norman is concerned because he is experiencing a monthly loss.

- What is Norman's normal monthly income?
- Norman can increase his airline bookings by 40 percent with an increase in advertising of \$600. Should he increase advertising?
- Norman's friend Jeff has asked him for a job in the travel agency. Jeff has proposed that he be paid 50 percent of whatever additional commissions he can bring to the agency plus a salary of \$300 per month. Norman has estimated Jeff can generate the following additional bookings per month:

Airlines	\$10,000
Cars	1,500
Hotels	4,000
Total	<u>\$15,500</u>

Hiring Jeff would also increase other fixed costs by \$400 per month. Should Norman accept Jeff's offer?

- Norman hired Jeff and in the first month Jeff generated an additional \$8,000 of bookings for the agency. The bookings, however, were all airline tickets. Was the decision to hire Jeff a good one? Why or why not?



- 42.** (*Retail merchant CVP*) Franklin Optical Shop has been in operation for several years. Analysis of the firm's recent financial statements and records reveals the following:

Average selling price per pair of glasses	\$70
Variable expenses per pair:	
Lenses and frames	\$28
Sales commission	12
Variable overhead	8
Annual fixed costs:	
Selling expenses	\$18,000
Administrative expenses	48,000

The company's effective tax rate is 40 percent. Samantha Franklin, company president, has asked you to help her answer the following questions about the business.

- What is the break-even point in pairs of glasses? In dollars?
- How much revenue must be generated to produce \$80,000 of pretax earnings? How many pairs of glasses would this level of revenue represent?

- c. How much revenue must be generated to produce \$80,000 of after-tax earnings? How many pairs of glasses would this represent?
- d. What amount of revenue would be necessary to yield an after-tax profit equal to 20 percent of revenue?
- e. Franklin is considering adding a lens-grinding lab, which will save \$6 per pair of glasses in lens cost, but will raise annual fixed costs by \$8,000. She expects to sell 5,000 pairs of glasses. Should she make this investment?
- f. A marketing consultant told Franklin that she could increase the number of glasses sold by 30 percent if she would lower the selling price by 10 percent and spend \$20,000 on advertising. She has been selling 3,000 pairs of glasses. Should she make these two related changes?
43. (CVP single product—comprehensive) Speedy Mouse Inc. makes a special mouse for computers. Each mouse sells for \$25 and annual production and sales are 120,000 units. Costs for each mouse are as follows:

Direct material	\$ 6.00
Direct labor	3.00
Variable overhead	0.80
Variable selling expenses	2.20
Total variable cost	<u>\$12.00</u>
Total fixed overhead	<u>\$589,550</u>

- a. Calculate the unit contribution margin in dollars and the contribution margin ratio for the product.
- b. Determine the break-even point in number of mice.
- c. Calculate the dollar break-even point using the contribution margin ratio.
- d. Determine Speedy Mouse Inc.'s margin of safety in units, in sales dollars, and as a percentage.
- e. Compute Speedy Mouse Inc.'s degree of operating leverage. If sales increase by 25 percent, by what percentage would before-tax income increase?
- f. How many mice must the company sell if it desires to earn \$996,450 in before-tax profits?
- g. If Speedy Mouse Inc. wants to earn \$657,800 after tax and is subject to a 20 percent tax rate, how many units must be sold?
- h. How many units would the company need to sell to break even if its fixed costs increased by \$7,865? (Use original data.)
- i. Speedy Mouse Inc. has received an offer to provide a one-time sale of 4,000 mice to a network of computer superstores. This sale would not affect other sales or their costs, but the variable cost of the additional units will increase by \$0.60 for shipping and fixed costs will increase by \$18,000. The selling price for each unit in this order would be \$20. Based on quantitative measurement, should the company accept this offer? Show your calculations.
44. (CVP, DOL, MS—two quarters, comprehensive) Presented below is information pertaining to the first and second quarters of 2001 operations of the Oak Company:

	QUARTER	
	First	Second
Units:		
Production	35,000	30,000
Sales	30,000	35,000
Expected activity level	32,500	32,500
Unit selling price	\$75.00	\$75.00

(continued)

	QUARTER	
	First	Second
Unit variable costs:		
Direct material	\$34.50	\$34.50
Direct labor	16.50	16.50
Factory overhead	7.80	7.80
Operating expenses	5.70	5.70
Quarterly fixed costs:		
Factory overhead	\$97,500.00	\$97,500.00
Operating expenses	21,400.00	21,400.00

Additional information:

- There were no finished goods at January 1, 2001.
  - Oak writes off any quarterly underapplied or overapplied overhead as an adjustment of Cost of Goods Sold.
  - Oak's income tax rate is 35 percent.
- a. Prepare an absorption costing income statement for each quarter.
  - b. Prepare a variable costing income statement for each quarter.
  - c. Calculate each of the following for 2001, if 130,000 units were produced and sold:
    1. Unit contribution margin
    2. Contribution margin ratio
    3. Total contribution margin
    4. Net income
    5. Degree of operating leverage
    6. Annual break-even unit sales volume
    7. Annual break-even dollar sales volume
    8. Annual margin of safety as a percentage
45. (*Multiproduct firm*) Elegant Books produces and sells two book products: an encyclopedia set and a dictionary set. The company sells these book sets in a ratio of three encyclopedia sets to five dictionary sets. Selling prices for the encyclopedia and dictionary sets are, respectively, \$1,200 and \$240; respective variable costs are \$480 and \$160. The company's fixed costs are \$1,800,000 per year. Compute the volume of sales of each type of book set needed to
- a. break even.
  - b. earn \$800,000 of income before tax.
  - c. earn \$800,000 of income after tax, assuming a 30 percent tax rate.
  - d. earn 12 percent on sales revenue in before-tax income.
  - e. earn 12 percent on sales revenue in after-tax income, assuming a 30 percent tax rate.
46. (*Comprehensive; multiproduct*) European Flooring makes three types of flooring products: tile, carpet, and parquet. Cost analysis reveals the following costs (expressed on a per-square-yard basis) are expected for 2000:



	Tile	Carpet	Parquet
Direct material	\$5.20	\$3.25	\$8.80
Direct labor	1.80	0.40	6.40
Variable overhead	1.00	0.15	1.75
Variable selling expenses	0.50	0.25	2.00
Variable administrative expenses	0.20	0.10	0.30
Fixed overhead	\$760,000		
Fixed selling expenses	240,000		
Fixed administrative expenses	200,000		

Per-yard expected selling prices are as follows: tile, \$16.40; carpet, \$8.00; and parquet, \$25.00. In 1999, sales were as follows and the mix is expected to continue in 2000:

	Tile	Carpet	Parquet
Square yards	18,000	144,000	12,000

Review of recent tax returns reveals an expected tax rate of 40 percent.

- Calculate the break-even point for 2000.
  - How many square yards of each product are expected to be sold at the break-even point?
  - Assume that the company desires a pretax profit of \$800,000. How many square yards of each type of product would need to be sold to generate this profit level? How much revenue would be required?
  - Assume that the company desires an after-tax profit of \$680,000. Use the contribution margin percentage approach to determine the revenue needed.
  - If the company actually achieves the revenue determined in part (d), what is European Flooring's margin of safety in (1) dollars and (2) percentage?
47. (*Appendix*) The Hattiesburg Chamber of Commerce (HCC) has provided you with the following monthly cost and fee information: monthly membership fee per member, \$25; variable cost per member per month, \$12; fixed cost per month, \$1,800. Costs are extremely low because almost all services and supplies are provided by volunteers.
- Prepare a traditional break-even chart for HCC.
  - Prepare a contemporary break-even chart for the HCC.
  - Prepare a profit-volume graph for the HCC.
  - Indicate which of the above you would use in giving a speech to the membership to solicit volunteers to help with a fund-raising project. Assume at this time there are only 120 members belonging to the HCC.

## CASES

48. (*Absorption costing versus variable costing*) Anderson Manufacturing builds engines for light airplane manufacturers. Company sales have increased yearly as the company gains a reputation for reliable and quality products. The company manufactures engines to customer specifications and it uses a job order cost system. Factory overhead is applied to the jobs based on direct labor hours, using the absorption costing method. Under- or overapplied overhead is treated as an adjustment to Cost of Goods Sold. The company's inventory balances and income statements for the last two years are presented below.

Inventory Balances	12/31/99	12/31/00	12/31/01
Raw material (direct)	\$22,000	\$30,000	\$10,000
Work in process			
Costs	\$40,000	\$48,000	\$64,000
Direct labor hours	1,335	1,600	2,100
Finished goods			
Costs	\$25,000	\$18,000	\$14,000
Direct labor hours	1,450	1,050	820

## 2000–2001 COMPARATIVE INCOME STATEMENTS

	2000	2001
Sales	\$840,000	\$1,015,000
Cost of goods sold		
Finished goods, 1/1	\$ 25,000	\$ 18,000
Cost of goods manufactured	<u>548,000</u>	<u>657,600</u>
Total available	\$573,000	\$675,600
Finished goods, 12/31	<u>(18,000)</u>	<u>(14,000)</u>
CGS before overhead adjustment	\$555,000	\$661,600
Underapplied factory overhead	<u>36,000</u>	<u>14,400</u>
CGS	(591,000)	(676,000)
Gross margin	\$249,000	\$ 339,000
Selling expenses	\$ 82,000	\$ 95,000
Administrative expenses	<u>70,000</u>	<u>75,000</u>
Total operating expenses	(152,000)	(170,000)
Operating income	<u>\$ 97,000</u>	<u>\$ 169,000</u>

The same predetermined overhead rate was used in applying overhead to production orders in both 2000 and 2001. The rate was based on the following estimates:

Fixed factory overhead	\$25,000
Variable factory overhead	\$155,000
Direct labor hours	25,000
Direct labor cost	\$150,000

In 2000 and 2001, actual direct labor hours expended were 20,000 and 23,000, respectively. The cost of raw material put into production was \$292,000 in 2000 and \$370,000 in 2001. Actual fixed overhead was \$37,400 for 2000 and \$42,300 for 2001, and the planned direct labor rate was equal to the actual direct labor rate.

For both years, all of the reported administrative costs were fixed. The variable portion of the reported selling expenses results from a commission of 5 percent of sales revenue.

- a. For the year ended December 31, 2001, prepare a revised income statement using the variable costing method.
- b. Prepare a numerical reconciliation of the difference in operating income between the 2001 absorption and variable costing statements.
- c. Describe both the advantages and disadvantages of using variable costing. *(CMA adapted)*

49. *(Absorption costing versus variable costing)* Virginia Company, a wholly owned subsidiary of Bluebeard, Inc., produces and sells three main product lines. The company employs a standard cost accounting system for recordkeeping purposes. At the beginning of 1999, the president of Virginia Company presented the budget to the parent company and accepted a commitment to contribute \$15,800 to Bluebeard's consolidated profit in 1999. The president has been confident that the year's profit would exceed the budget target, because the monthly sales reports that he has been receiving have shown that sales for the year will exceed budget by 10 percent. The president is both disturbed and confused when the controller presents an adjusted forecast as of November 30, 1999, indicating that profits will be 11 percent under budget. The two forecasts follow:

	1/1/99	11/30/99
Sales	\$268,000	\$294,800
Cost of sales at standard*	(212,000)	(233,200)
Gross margin at standard	\$ 56,000	\$ 61,600
(Under-) overapplied fixed overhead	0	(6,000)
Actual gross margin	<u>\$ 56,000</u>	<u>\$ 55,600</u>
Selling expenses	\$ 13,400	\$ 14,740
Administrative expenses	26,800	26,800
Total operating expenses	<u>\$(40,200)</u>	<u>\$(41,540)</u>
Earnings before tax	<u>\$ 15,800</u>	<u>\$ 14,060</u>

\*Includes fixed manufacturing overhead of \$30,000.

There have been no sales price changes or product mix shifts since the 1/1/99 forecast. The only cost variance on the income statement is the underapplied manufacturing overhead. This amount arose because the company produced only 16,000 standard machine hours (budgeted machine hours were 20,000) during 1999 as a result of a shortage of raw material while the company's principal supplier was closed because of a strike. Fortunately, Virginia Company's finished goods inventory was large enough to fill all sales orders received.

- a. Analyze and explain why the profit has declined in spite of increased sales and effective control over costs.
- b. What plan, if any, could Virginia Company adopt during December to improve its reported profit at year-end? Explain your answer.
- c. Illustrate and explain how Virginia Company could adopt an alternative internal cost reporting procedure that would avoid the confusing effect of the present procedure.
- d. Would the alternative procedure described in part (c) be acceptable to Bluebeard, Inc., for financial reporting purposes? Explain.

50. (CVP analysis) Susan Katz owns the Holiday Litter Box, a luxury hotel for dogs and cats. The capacity is 40 pets: 20 dogs and 20 cats. Each pet has an air-conditioned room with a window overlooking a garden. Soft music is played continuously. Pets are awakened at 7 a.m., served breakfast at 8 a.m., fed snacks at 3:30 p.m., and receive dinner at 5 p.m. Hotel services also include airport pickup, daily bathing and grooming, night lighting in each suite, carpeted floors, and daily play visits by pet "babysitters."

Pet owners are interviewed about their pets' health-care requirements, likes and dislikes, diet, and other needs. Reservations are essential and each pet's veterinarian must document health. The costs of operating the pet hotel are substantial. The hotel's original cost was \$96,000. Depreciation is \$8,000 per year. Other costs of operating the hotel include:

Labor costs	\$16,000 per year plus \$0.25 per animal per day
Utilities	\$ 7,900 per year plus \$0.05 per animal per day
Miscellaneous costs	\$ 5,000 per year plus \$0.30 per animal per day

In addition to these costs, costs are incurred for food and water for each pet. These costs are strictly variable and (on average) run \$2.00 per day for dogs and \$0.75 per day for cats.

- a. Assuming that the hotel is able to maintain an average annual occupancy of 75 percent in both the cat and the dog units (based on a 360-day year), determine the minimum daily charge that must be assessed per animal day to generate \$12,000 of income before taxes. (continued)

- b.** Assume that the price Susan charges cat owners is \$10 per day and the price charged to dog owners is \$12 per day. If the sales mix is 1 to 1 (one cat day of occupancy for each dog day of occupancy) compute the following:
- 1.** The break-even point in total occupancy days.
  - 2.** Total occupancy days required to generate \$20,000 of income before tax.
  - 3.** Total occupancy days to generate \$20,000 of after-tax income; Susan's personal tax rate is 35 percent.
- c.** Susan is considering adding an animal training service for guests to complement her other hotel services. Susan has estimated the costs of providing such a service would largely be fixed. Because all of the facilities already exist, Susan would merely need to hire a dog trainer. She estimates a dog trainer could be hired at a cost of \$25,000 per year. If Susan decides to add this service, how much would her daily charges have to increase (assume equal dollar increases to cat and dog fees) to maintain the break-even level you computed in part (b)?
- 51. (CVP analysis)** Reliable Airlines is a small local carrier in the Midwest. All seats are coach and the following data are available.

Number of seats per plane	120
Average load factor (percentage of seats filled)	75%
Average full passenger fare	\$70
Average variable cost per passenger	\$30
Fixed operating costs per month	\$1,200,000

- a.** What is break-even point in passengers and revenues?
- b.** What is break-even point in number of flights?
- c.** If Reliable raises its average full passenger fare to \$85, it is estimated that the load factor will decrease to 60 percent. What will be the break-even point in number of flights?
- d.** The cost of fuel is a significant variable cost to any airline. If fuel charges increase by \$8 per barrel, it is estimated that variable cost per passenger will rise to \$40. In this case, what would be the new break-even point in passengers and in number of flights? (Refer back to original data.)
- e.** Reliable has experienced an increase in variable cost per passenger to \$35 and an increase in total fixed costs to \$1,500,000. The company has decided to raise the average fare to \$80. What number of passengers is needed to generate an after-tax profit of \$400,000 if the tax rate is 40 percent?
- f.** (Use original data.) Reliable is considering offering a discounted fare of \$50, which the company feels would increase the load factor to 80 percent. Only the additional seats would be sold at the discounted fare. Additional monthly advertising costs would be \$80,000. How much pretax income would the discounted fare provide Reliable if the company has 40 flights per day, 30 days per month?
- g.** Reliable has an opportunity to obtain a new route. The company feels it can sell seats at \$75 on the route, but the load factor would be only 60 percent. The company would fly the route 15 times per month. The increase in fixed costs for additional crew, additional planes, landing fees, maintenance, etc., would total \$100,000 per month. Variable cost per passenger would remain at \$30.
  - 1.** Should the company obtain the route?
  - 2.** How many flights would Reliable need to earn pretax income of \$50,500 per month on this route?
  - 3.** If the load factor could be increased to 75 percent, how many flights would be needed to earn pretax income of \$50,500 per month on this route?
  - 4.** What qualitative factors should be considered by Reliable in making its decision about acquiring this route?

**REALITY CHECK**

52. A group of prospective investors has asked your help in understanding the comparative advantages and disadvantages of building a company that is either labor intensive or, in contrast, one that uses significant cutting-edge technology and is therefore capital intensive. Prepare a report addressing the issues. Include discussions regarding cost structure, BEP, CVP, MS, DOL, risk, customer satisfaction, and the relationships among these constructs.
53. A colleague of yours alleged to your company's board of directors that CVP is a short-run-oriented model and is therefore of limited usefulness. Because you have used it many times in making presentations to the board, the CEO has asked you to evaluate the perspective voiced by your colleague and prepare a report addressing the contention for the board. In a second request, the CEO has asked you to prepare a separate report for internal management's use addressing how the CVP model could be adapted to become more useful for making long-run decisions. Prepare these two reports for the board and for management's use.
54. A significant difference between absorption costing and variable costing centers around the debate of whether fixed manufacturing overhead is justified as a product cost. Because your professor is scheduled to address a national professional meeting at the same time your class would ordinarily meet, the class has been divided into teams to confront selected issues. Your team's assignment is to prepare a report arguing both sides of the issue stated above. You are also expected as a team to draw your own conclusion and so state it in your report along with the basis for your conclusion.
55. Missouri Chemical Company's new president has learned that, for the past four years, the company has been dumping its industrial waste into the local river and falsifying reports to authorities about the levels of suspected cancer-causing materials in that waste. The plant manager says that there is no proof that the waste causes cancer and there are only a few fishing villages within a hundred miles downriver. If the company has to treat the substance to neutralize its potentially injurious effects and then transport it to a legal dump site, the company's variable and fixed costs would rise to a level that might make the firm uncompetitive. If the company loses its competitive advantage, 10,000 local employees could become unemployed and the town's economy could collapse.
- What kinds of variable and fixed costs can you think of that would increase (or decrease) if the waste were treated rather than dumped? How would these costs affect product contribution margin?
  - What are the ethical conflicts the president faces?
  - What rationalizations can you detect that have been devised by plant employees?
  - What options and suggestions can you offer the president?
56. A significant trend in business today is increasing use of outsourcing. Go to the Internet and search Web sites with the objective of gaining an understanding for the vast array of outsourcing services that are available. Prepare a presentation in which you discuss the extensive use of outsourcing today and how outsourcing could be used as a tool to manage a firm's cost structure, and as a tool in CVP planning.
57. An article about the financial troubles of Air-India indicates that the airline plans to break even in 2000–2001:



<http://www.airindia.com>

<http://indian-airlines.nic.in>

*Air-India has arrived at a difficult point in its history. Held back from modernization by government policy, it has no global alliance partners, an aging fleet and an enormous workforce. With no fuel for privatization, and an unwillingness to look at the carrier's synergies with Indian Airlines, will the management be able to steer it out of trouble? Air-India's financial position is precarious. Its net loss of \$43 million in 1997 to 1998 is ample evidence of the fact. The airline is taking remedial action to reduce losses and aims to reach breakeven by 2000 to 2001. Losses in 1997 to 1998 were less than those for the previous year, when the carrier reported a loss of Rs2.97 billion, but the goal of breakeven in 2 years' time will be an uphill struggle. At the root of Air-India's difficulties are persistently low yields, on the one hand, and steadily rising costs on the other.*

SOURCE: Dominic Jones, "Good Airline, Shame about Its Problems," *Airfinance Journal* (March 1999), p. 31.

In light of the discussion in the chapter that breakeven is a reference point rather than a goal of business, reconcile the comment in the article that Air-India has a goal of breaking even in two years.