

CHAPTER 12

Managerial Accounting and Cost-Volume-Profit Relationships



When asked by a marketing or production manager what a certain item or activity costs, the management accountant who asks “Why do you want to know?” is not being disrespectful. Costs used for valuing inventory are different from the costs that should be considered when analyzing a product modification or potential new product.

Managerial accounting, sometimes called *management accounting*, involves using economic and financial information to plan and control many of the activities of the entity and to support the management decision-making process. Managerial accounting has an internal orientation, as opposed to the primarily external orientation of financial accounting. The transactions generated by the accounting information system and used for financial reporting purposes also are used in managerial accounting, but the latter are more likely to have a future orientation, such as in the preparation of budgets. As with financial accounting, managerial accounting has special terminology or, as many would say, *jargon*. Most of these terms relate to different types of costs. An important early lesson about managerial accounting is that *there are different costs for different purposes*.

In this chapter we will briefly look at the management process, identify several of the contributions that the management accountant makes to that process, and then introduce a model for cost classifications. Subsequent chapters will describe these costs and illustrate how they are used in the planning, control, and decision-making processes.

Cost-volume-profit (CVP) analysis involves using cost behavior patterns to interpret and forecast the changes in operating income that result from changes in revenues, costs, or volume of activity. One especially important application of CVP analysis is the determination of the break-even point for a company (or one of its units or products). Because CVP analysis emphasizes the cost behavior pattern of various costs and the impact on costs and profits of changes in the volume of activity, it is useful for planning and for evaluating actual results achieved.

What Does It Mean?

1. What does it mean to state that there are different costs for different purposes?

LEARNING OBJECTIVES

After studying this chapter you should understand:

1. The management planning and control cycle.
2. The major differences between financial accounting and managerial accounting.
3. The difference between variable and fixed cost behavior patterns, and the simplifying assumptions made in this classification method.
4. Why expressing fixed costs on a per unit of activity basis is misleading and may result in faulty decisions.
5. What kinds of costs are likely to have a variable cost behavior pattern and what kinds of costs are likely to have a fixed cost behavior pattern.
6. How to use the high-low method to determine the cost formula for a cost that has a mixed behavior pattern.
7. The difference between the traditional income statement format and the contribution margin income statement format.
8. The importance of using the contribution margin format to analyze the impact of cost and sales volume changes on operating income.
9. How the contribution margin ratio is calculated and how it can be used in CVP analysis.
10. How changes in the sales mix can affect projections using CVP analysis.
11. The meaning and significance of the break-even point and how the break-even point is calculated.
12. The concept of operating leverage.

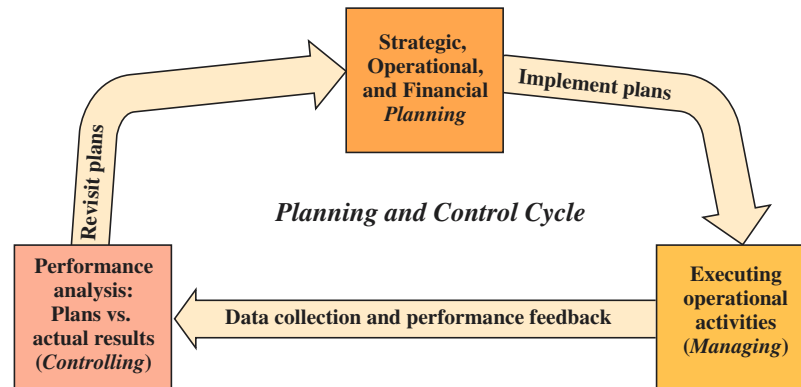
Managerial Accounting Contrasted to Financial Accounting

Managerial accounting supports the internal planning (future-oriented) decisions made by management. Financial accounting has more of a scorekeeping, historical orientation, although data produced by the financial accounting process form some of the foundation on which plans are based. Planning is a key part of the **management process**, and although there are many descriptions of that process, a generally acceptable definition would include reference to the process of planning, organizing, and controlling an entity's activities so that the organization can accomplish its purpose. A schematic model of the process looks like this:

OBJECTIVE 1

Understand the management planning and control cycle.

Decision Making



The diagram suggests that control is achieved through feedback. Actual results are compared to planned results, and if a variance exists between the two, then either the plan or the actions, or perhaps both, are changed. Managers, therefore, make decisions in each phase of the planning and control cycle using information provided by the management accounting information system.

Not all of a firm's objectives are stated in financial terms by any means. For example, market share, employee morale, absence of layoffs, and responsible corporate citizenship are all appropriate objectives that are expressed in nonfinancial terms. However, many of the firm's goals will be financial in nature (e.g., ROI, ROE, growth in sales, earnings, and dividends, to name just a few). The accountant plays a major role in identifying these goals, helping to achieve them, and measuring the degree to which they have been accomplished.

OBJECTIVE 2

Understand the major differences between financial accounting and managerial accounting.

Emphasis on the future is a principal characteristic that makes managerial accounting different from financial accounting. Anticipating what revenues will be and forecasting the expenses that will be incurred to achieve those revenues are critical activities of the budgeting process. Another difference between managerial accounting and financial accounting that is emphasized in planning is the breadth of focus. Financial accounting deals primarily with the financial statements for the organization as a whole; managerial accounting is more concerned with operating units within the organization. Thus, even though an overall company ROI objective is established, effective planning requires that the planned impact of the activities and results of each unit (division, product line, plant, sales territory, and so on) of the organization be considered.

Measuring results involves using the historical data of financial accounting, and because of the time required to perform financial accounting and auditing procedures, there is usually a time lag of weeks or months between the end of an accounting period and the issuance of financial statements. However, for performance feedback to be most effective, it should be provided as quickly as possible after action has been completed. Management accounting is not constrained by generally accepted accounting principles, so approximate results can be quickly generated for use in the control process. In other words, relevant data, even though not absolutely accurate in a financial accounting sense, are useful for evaluating performance soon after an activity has been completed.

Exhibit 12-1 summarizes the principal differences between managerial accounting and financial accounting.

If time and effort have been devoted to develop a plan, it is appropriate to attempt to control the activities of the organization so that the goals of the plan are accomplished.

Characteristic	Managerial Accounting	Financial Accounting
Service perspective	Internal to managers	External to investors and creditors
Time frame	Present and future for planning and control	Past—financial statements are historical
Breadth of concern	Micro—individual units of the organization plan and act	Macro—financial statements are for the organization as a whole
Reporting frequency and promptness	Control reports issued frequently (e.g., daily) and promptly (e.g., one day after period-end)	Most financial statements issued monthly, a week or more after month-end
Degree of precision of data used	Reasonable accuracy desired, but “close counts”—relevance is often more important than reliability	High accuracy desired, with time usually available to achieve it—reliability is of utmost importance
Reporting standards	None imposed because of internal and pragmatic orientation	Imposed by generally accepted accounting principles and the FASB

Exhibit 12-1

Managerial Accounting
Compared to Financial
Accounting

Many of the activities of the management accountant are related to cost control; this control emphasis will be seen in most of the managerial accounting ideas that are explained in these chapters.

Another management concept relevant to the control process is that if an individual is to be held accountable, or responsible, for the results of an activity, that individual also must have the authority to influence those results. If a manager is to be held responsible for costs incurred by a unit of the organization, the financial results reported for that unit should not include costs incurred by other units that have been arbitrarily assigned to the unit being evaluated. In other words, the results should not reflect costs that the manager being held responsible cannot control.

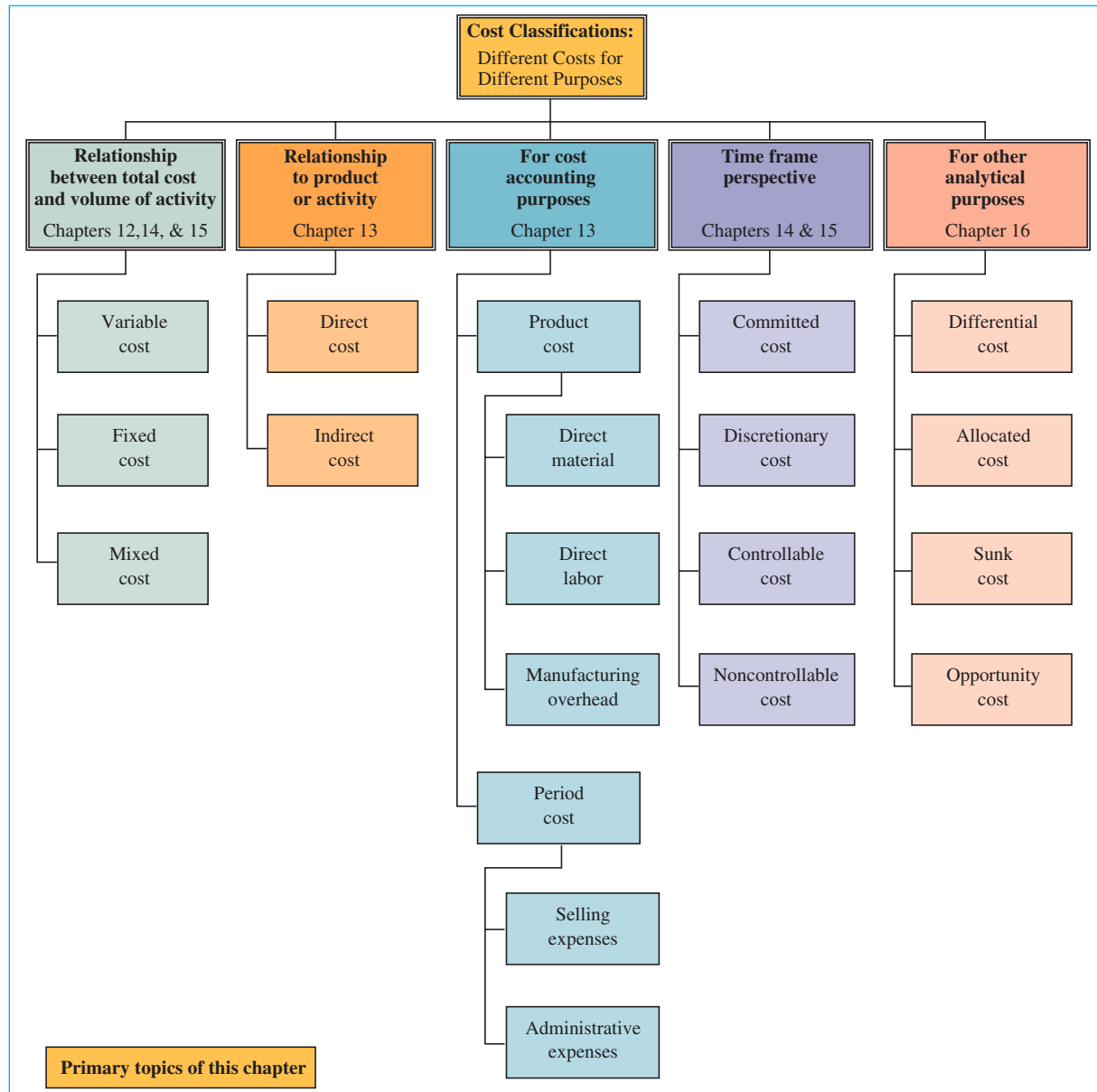
Management accountants work extensively with people in other functional areas of the organization. For example, industrial engineers and management accountants work together to develop **production standards**, which are the expected or allowed times and costs to make a product or perform an activity. Management accountants help production people interpret performance reports, which compare actual and planned production and costs. Sales personnel, the marketing staff, and management accountants are involved in estimating a future period’s sales. Human resource professionals and management accountants work together to determine the cost effect of compensation changes. And the management accountant will play a significant role in the firm’s systems development life cycle process by providing key insight into the planning, analysis, design, and implementation phases of an organization’s information systems projects. These few key examples illustrate the need for management accountants to have a breadth of knowledge and interest about the organization and its operating environment. The examples also suggest that it is appropriate for persons in other functional areas to have a general understanding of managerial accounting. Helping you to achieve that general understanding is the objective of the remaining chapters of this book.

2. What does it mean that managerial accounting has a different time frame from financial accounting?
3. What does it mean to have feedback for control purposes?



Exhibit 12-2

Cost Classifications—The Big Picture



Cost Classifications

The term *cost* means different things to different people, and in the management planning and decision-making process, it is important to use costs that are appropriate to the situation. Likewise, management accountants should make sure that everyone involved in any given situation understands the costs being used. Exhibit 12-2 presents cost classifications most frequently encountered and highlights the cost topics covered in this chapter.

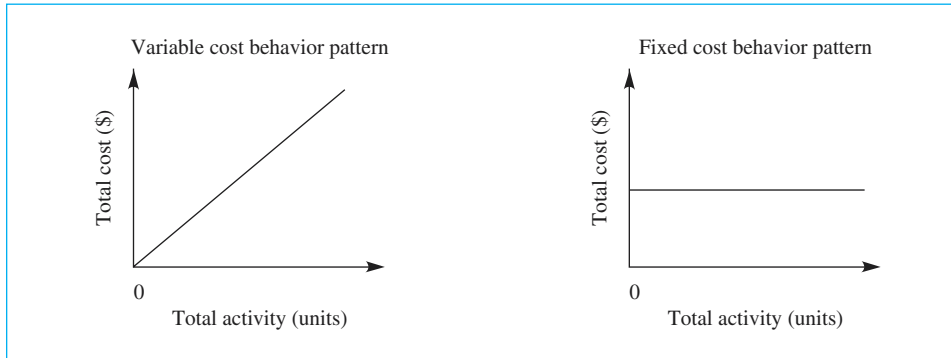


Exhibit 12-3

Cost Behavior Patterns

These classifications are not mutually exclusive; a cost might be identified as a “controllable, variable, direct, product cost,” for example. Overall, this basic concept of *different costs for different purposes* is so fundamental to an understanding of the planning, control, and decision-making process that the cost classification model will be presented again in each of the managerial accounting chapters that follow. From the perspective of this model you will be introduced to these cost concepts as they relate to the planning, control, or decision-making theme being developed. The cost classification concepts discussed in each chapter are:

- Relationship between total cost and volume of activity (Chapters 12, 14, and 15).
- Relationship to product or activity (Chapter 13).
- For cost accounting purposes (Chapter 13).
- Time frame perspective (Chapters 14 and 15).
- For other analytical purposes (Chapter 16).

Relationship of Total Cost to Volume of Activity

The relationship of total cost to volume of activity describes the **cost behavior pattern**, one of the most important cost classification methods to understand. A **variable cost** is one that changes *in total* as the volume of activity changes. A cost that does not change *in total* as the volume of activity changes is a **fixed cost**. For example, raw material cost incurred to manufacture a product has a variable cost behavior pattern because the greater the number of units produced, the higher the total raw material costs incurred. On the other hand, factory building depreciation expense is a fixed cost because total depreciation expense will not change regardless of the level of production (unless, of course, a units of production method is used to calculate depreciation, in which case this cost would be variable). The distinction between fixed and variable cost behavior patterns is illustrated graphically in Exhibit 12-3.

The fixed or variable label refers to the behavior of *total* cost relative to a change in activity. When referring to the behavior of unit costs, however, the labels may be confusing because variable costs are constant per unit but fixed costs per unit will change as the level of activity changes. Thus, it is necessary to understand the behavior pattern on both a total cost basis and a per unit basis as illustrated on the next page. Variable costs change in total as activity changes but are constant per unit. Fixed costs do not change in total as activity changes but will vary if expressed on a per unit of activity basis.

OBJECTIVE 3

Understand the difference between variable and fixed cost behavior patterns, and the simplifying assumptions made in this classification method.

	As Activity Changes	
	Total	Per Unit
Fixed Cost	Remains constant	Changes inversely
Variable Cost	Changes directly	Remains constant

Knowledge of the cost behavior pattern is important to the planning process, and several simplifying assumptions are usually made to facilitate the use of this analytical tool. The most significant assumption has to do with the range of activity over which the identified or assumed cost behavior pattern exists. This is the **relevant range** assumption, and it is most applicable to fixed costs. Returning to the depreciation expense example, it is clear that at some point an increase in the volume of production would require more plant capacity, and depreciation expense would increase. On the other hand, if substantially lower production volumes were anticipated in the future, some of the factory would be closed down or converted to other use, and depreciation expense would decrease. To say that depreciation expense is fixed is to say that over some relevant range of production the total cost will not change. Different fixed expenses will have different relevant ranges over which they have a fixed cost behavior pattern. When a cost is identified as fixed and cost projections are made based on that cost behavior pattern classification, the limits of the relevant range assumption must be considered. The other major simplifying assumption is that the cost behavior pattern is *linear*; not *curvilinear*. This assumption relates primarily to variable costs. Because of economies of scale, quantity discounts, and other factors, variable costs will change slightly when expressed on a per unit basis. These changes are usually not significant, but if they are, appropriate adjustment in unit costs should be made in analyses based on cost behavior patterns. These assumptions are illustrated and described in more detail later in this chapter.

It is clear that not all costs can be classified as either variable or fixed. Some costs are partly fixed and partly variable. Sometimes costs with this mixed behavior pattern are called **semivariable costs**. Utilities for the factory, for example, have a mixed behavior pattern because when the plant isn't operating, some lights must be kept on for safety and security, but as production increases more electricity is required. Analytical techniques can break this type of cost into its fixed and variable components, and a **cost formula** can be developed, expressed as:

$$\begin{aligned}\text{Total cost} &= \text{Fixed cost} + \text{Variable cost} \\ &= \text{Fixed cost} + (\text{Variable rate per unit} \times \text{Activity})\end{aligned}$$

This cost formula then can be used to forecast the total cost expected to be incurred at various levels of activity. For example, assume that it has been determined that the fixed cost for utilities is \$350 per month and that the variable rate for utilities is 30 cents per machine hour. Total estimated utilities cost for a month in which 6,000 machine hours were planned would be:

$$\begin{aligned}\text{Total cost} &= \$350 + (\$.30 \times 6,000 \text{ machine hours}) \\ &= \$2,150\end{aligned}$$

OBJECTIVE 4

Understand why expressing fixed costs on a per unit of activity basis is misleading and may result in faulty decisions.

Great care must be taken with the use of fixed cost per unit data because any change in the volume of activity will change the per unit cost. As a general rule, *do not unitize fixed expenses because they do not behave on a per unit basis!* For example, most of the costs of a university business office—salaries, depreciation, and utilities—are fixed; to calculate the “cost” of cashing student checks by dividing a portion of

Assume the following university business office costs per month associated with providing a student check-cashing privilege:

Salaries	\$ 900
Allocated space costs (depreciation, utilities, etc.)	300
Total per month	<u>\$1,200</u>
If 2,000 checks are cashed in a month, the "cost"	
per check is (\$1,200/2,000)	\$.60
If 6,000 checks are cashed in a month, the "cost"	
per check is (\$1,200/6,000)	\$.20

How much does it cost to cash a check?

What action would students take if they learned that a check-cashing fee was being considered based on the "cost" of cashing a check during the coming month?

Exhibit 12-4

The Error of Unitizing
Fixed Costs

business office costs by the number of checks cashed in a period of time will give a misleading result, as illustrated in Exhibit 12-4. Sometimes fixed costs must be unitized, as in the development of a predetermined overhead application rate (described in the next chapter). It is also important to recognize that the relevant range is often quite wide, and significant increases in activity can be achieved without increasing fixed costs (i.e., there are economies of scale to be achieved that result in efficiencies and a reduction of fixed cost per unit). However, whenever fixed costs are unitized, be very careful about the conclusions that may be drawn from the data.

4. What does it mean to say that determination of cost behavior pattern involves some implicit assumptions?
5. What does it mean to develop a cost formula?

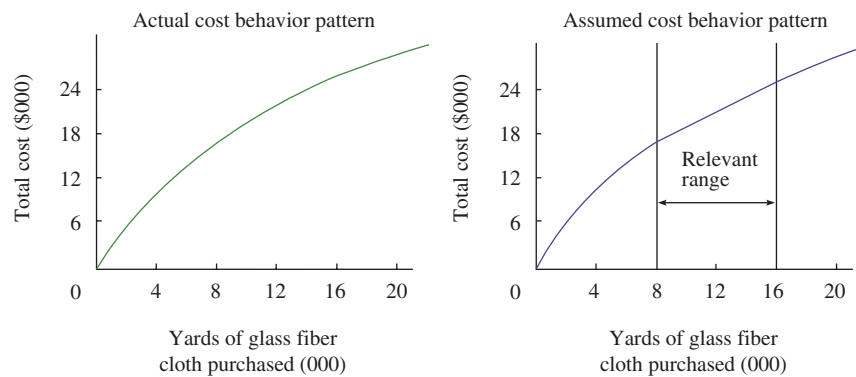
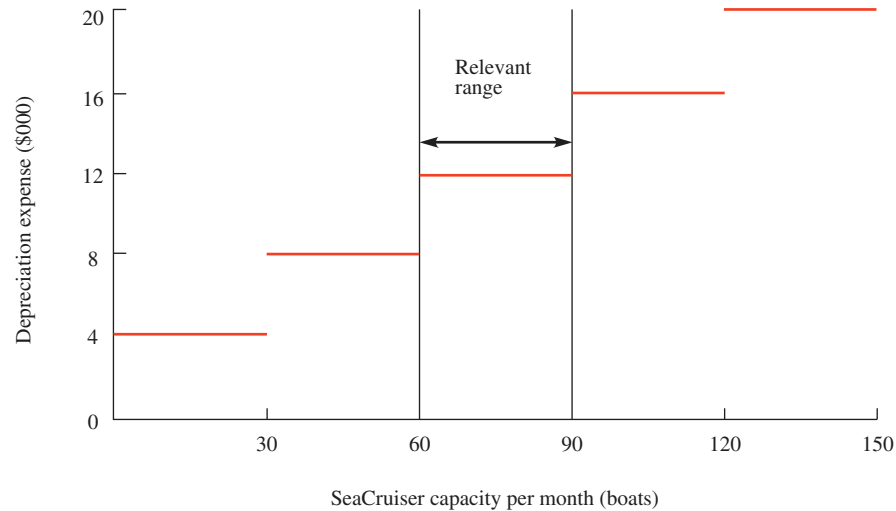


Applications of Cost-Volume-Profit Analysis

Cost Behavior Pattern: The Key

Recall the two simplifying assumptions that are made in connection with the determination of cost behavior patterns. First, the behavior pattern is true only within a relevant range of activity; if activity moves beyond the relevant range, the cost will change. Second, the cost behavior pattern identified is assumed to be linear within the relevant range, not curvilinear.

The relevant range idea relates to the level of activity over which a particular cost behavior pattern exists. For example, if the production capacity of the plant of Cruisers, Inc., is 90 SeaCruiser sailboats per month, additional equipment would be required if production of 120 boats per month were desired. The investment in additional equipment would result in an increase in depreciation expense. On the other hand, if long-term demand for the boat could be satisfied with a capacity of only 50 boats per month, it is likely that management would "mothball" (or dispose of), some of the present capacity, and depreciation expense would fall. The graph at the top of the next page illustrates a possible relationship between depreciation expense and capacity. The relevant range for depreciation expense of \$12,000 per month is production capacity of 60 to 90 boats. As long as capacity remains in this range, the total fixed expense for



depreciation will not change, but if capacity changes to another relevant range, then the amount of this fixed expense also will change.

The linearity assumption means that the cost behavior pattern will plot as a straight line within the relevant range. Although applicable to both fixed and variable costs, the significance of this assumption is best illustrated with a variable cost like raw materials such as glass fiber cloth. Because of quantity discounts and shipping efficiencies, the cost per unit of the raw material will decrease as the quantity purchased increases. This is illustrated in the left graph of the second set of graphs above. For analytical purposes, however, it may be assumed that the cost is linear within a relevant range, as shown in the right graph. Even though the cost per yard does vary slightly at different activity levels, for purposes of using cost-volume-profit analytical techniques it will be assumed constant per yard (variable in total) when purchases total between 8,000 and 16,000 yards per month.

It is clear that if these assumptions are overlooked, or if costs are incorrectly classified or described, the results of the analytical process illustrated later in this chapter will be inaccurate. Cost-volume-profit analysis is a valuable and appropriate tool to use in many situations, but the cost behavior assumptions made are crucial to the validity and applicability of its results, and they must be kept in mind when evaluating these results.

Generally speaking, raw materials and direct labor costs of manufacturing units of product are variable costs. In addition, some elements of manufacturing overhead (see the discussion of manufacturing overhead in Chapter 13 for more detail) will have a variable cost behavior pattern. For example, maintenance and housekeeping materials used, as well as the variable portion of factory utilities, will be a function of the quantity of product made. Other manufacturing overhead costs are fixed, including depreciation expense, supervisory salaries, and the fixed portion of utility costs.

Selling, general, administrative, and other operating expenses also fit both patterns. Sales commissions, for example, vary in proportion to sales revenue or the quantity of product sold. The wages associated with those employees who process orders from customers, or who handle payments from customers, may be variable if those functions are organized so that the number of workers can be expanded or contracted rapidly in response to changes in sales volume. On the other hand, advertising costs usually are fixed in the short run; once approved, the money is spent, and it is difficult to relate sales volume changes directly to advertising expenditures.

OBJECTIVE 5

Understand what kinds of costs are likely to have variable and fixed cost behavior patterns, respectively.

Estimating Cost Behavior Patterns

A particular cost's estimated behavior pattern is determined by analyzing cost and activity over a period of time. One of the analytical techniques involves using a scattergram to identify high and low cost-volume data and then simple arithmetic is used to compute the variable rate and cost formula. This "high-low" method is illustrated in Exhibit 12-5. More complex techniques, including simple and multiple regression analysis, also can be used, but at some point the perceived increase in accuracy is offset by the simplifying assumptions involved in using the cost formula for planning and control purposes.

OBJECTIVE 6

Understand how to use the high-low method to determine the cost formula for a cost that has a mixed behavior pattern.

A Modified Income Statement Format

The traditional income statement format classifies costs according to the reason they were incurred: cost of goods sold, selling expenses, administrative expenses, research and development expenses, and so on. The income statement format used in CVP analysis, frequently referred to as the **contribution margin format**, classifies costs according to their behavior pattern—variable or fixed. The alternative formats are:

OBJECTIVE 7

Understand the difference between the traditional income statement format and the contribution margin income statement format.

Traditional Format (expenses classified by function)		Contribution Margin Format (expenses classified by cost behavior pattern)	
Revenues	\$ _____	Revenues	\$ _____
Cost of goods sold	_____	Variable expenses	_____
Gross profit	\$ _____	Contribution margin	\$ _____
Operating expenses	_____	Fixed expenses	_____
Operating income	\$ _____	Operating income	\$ _____

Revenues and operating income (income before interest and taxes) are the same under either alternative. The difference is in the classification of expenses: functional in the traditional format and according to cost behavior pattern in the contribution margin format. Although the behavior pattern classification could be carried beyond operating income to other income and expense and income taxes, it usually isn't because the

Exhibit 12-5

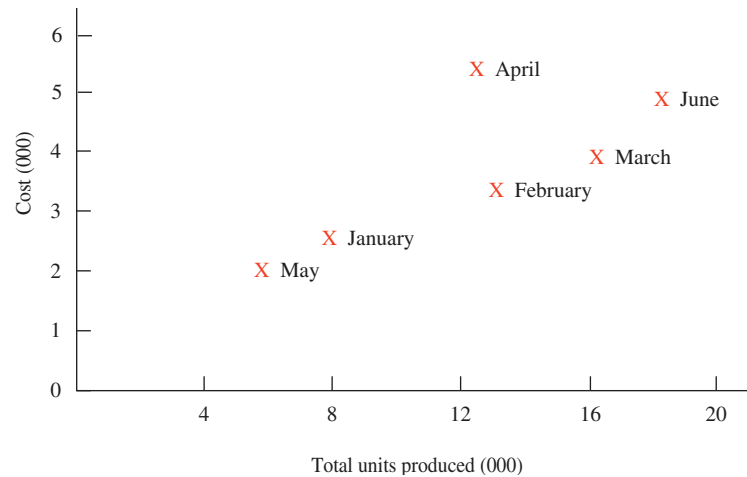
High-Low Method of
Estimating a Cost
Behavior Pattern

Assumption:

During the months of January through June, the following utility costs were incurred at various production volumes:

Month	Total Utility Cost	Total Production Volume
January	\$2,500	8,000 units
February	3,500	13,000 units
March	4,000	16,000 units
April	5,500	12,000 units
May	2,000	6,000 units
June	5,000	18,000 units

I. The Scattergram:



It can be observed in the scattergram that a cost-volume relationship does exist because of the approximate straight-line pattern of most of the observations. However, the April data do not fit the pattern. This may be due to an error or some unusual condition. This observation is an "outlier" and will be ignored in the calculation of the cost formula because of its variation from the cost-volume relationship that exists between the other data.

II. Calculation of the Variable Cost Behavior Pattern:

The high-low method of calculating the variable cost behavior pattern, or variable cost rate, relates the change in cost to the change in activity, using the highest and lowest relevant observations.

$$\begin{aligned}
 \text{Variable rate} &= \frac{\text{High cost} - \text{Low cost}}{\text{High activity} - \text{Low activity}} \\
 &= \frac{\$5,000 - \$2,000}{18,000 \text{ units} - 6,000 \text{ units}} \\
 &= \$3,000/12,000 \text{ units} \\
 &= \$0.25 \text{ per unit}
 \end{aligned}$$

III. The Cost Formula:

Knowing the variable rate, the fixed cost element can be calculated at either the high or low set of data, and the cost formula can then be developed because total cost is equal to variable cost plus fixed cost. (continued)

At 18,000 units of activity, the total variable cost is $18,000 \text{ units} \times \$0.25 \text{ per unit} = \$4,500$.

Fixed cost calculation:

$$\begin{array}{rcl} \text{Total cost at 18,000 units} & = & \$5,000 \\ \text{Variable cost at 18,000 units} & = & \underline{4,500} \\ \text{Fixed cost} & = & \underline{\underline{\$ 500}} \end{array}$$

At 6,000 units of activity, the total variable cost is $6,000 \text{ units} \times \$0.25 \text{ per unit} = \$1,500$.

Fixed cost calculation:

$$\begin{array}{rcl} \text{Total cost at 6,000 units} & = & \$2,000 \\ \text{Variable cost at 6,000 units} & = & \underline{1,500} \\ \text{Fixed cost} & = & \underline{\underline{\$ 500}} \end{array}$$

The cost formula for utilities is:

$$\begin{aligned} \text{Total cost} &= \text{Fixed cost} + \text{Variable cost} \\ &= \$500 + \$0.25 \text{ per unit produced} \end{aligned}$$

This cost formula now can be used to estimate total utility costs at any level of activity (within the relevant range). For example, if production volume for the month of July was expected to be 14,000 units, the estimated total utility cost would be:

$$\begin{aligned} \text{Total cost} &= \text{Fixed cost} + \text{Variable cost} \\ &= \$500 + (\$0.25 \times 14,000) = \$4,000 \end{aligned}$$

Note that it is considered a coincidence if the cost formula explains total cost accurately at points not used in the high-low calculation. This is because the calculation assumes a linear relationship between the observations used, and in practice exact linearity will not exist.

Exhibit 12-5*(concluded)*

greatest benefits of the contribution margin approach are realized in the planning and control/evaluation processes applied to a firm's operations.

The contribution margin format derives its name from the difference between revenues and variable expenses. **Contribution margin** means that this amount is the contribution to fixed expenses and operating income from the sale of product or provision of service. The key to this concept lies in understanding cost behavior patterns. As revenue increases as a result of selling more products or providing more services, variable expenses will increase proportionately, and so will contribution margin. However, *fixed expenses will not increase* because they are not a function of the level of revenue-generating activity.

Use of the traditional income statement model can result in misleading and erroneous conclusions when changes in activity levels are being considered because it is assumed that all expenses change in proportion to changes in activity. This error is made because cost behavior patterns are not disclosed. The error is avoided when the contribution margin model is used correctly. For example, assume that a firm currently has revenues of \$100,000 and operating income of \$10,000. If revenues were to drop by 20% to \$80,000, a quick conclusion would be that operating income also would decline by 20%, to \$8,000. However, analysis using the contribution margin format results in a much more accurate, and disturbing, result:

OBJECTIVE 8

Understand the importance of using the contribution margin format to analyze the impact of cost and sales volume changes on operating income.

	Current Results	Results Assuming a 20% Decline in Revenue
Revenues	\$100,000	\$80,000
Variable expenses (60%)	60,000	48,000
Contribution margin (40%)	\$ 40,000	\$32,000
Fixed expenses	30,000	30,000
Operating income	\$ 10,000	\$ 2,000

Because fixed expenses did not change (the firm did not move into a different relevant range), the \$8,000 reduction in contribution margin resulting from the 20% reduction in revenues carried right through to reduce operating income by the same dollar amount. This is an example of why it is misleading to think of fixed costs on a per unit basis. Although fixed costs (and especially the relevant range assumption) should not be overlooked by the manager, it must be recognized that they behave differently from variable costs.

OBJECTIVE 9

Understand how the contribution margin ratio is calculated and how it can be used in CVP analysis.

The **contribution margin ratio** is the ratio of contribution margin to revenues. Think of the ratio as the portion of each sales dollar that remains after covering the variable costs and is available to cover fixed costs or provide for profits. This ratio can be used to calculate directly the change in contribution margin for a change in revenues. Continuing with the same data used above, a \$12,000 increase in revenue would result in a \$4,800 ($40\% \times \$12,000$) increase in contribution margin and a \$4,800 increase in operating income.

What Does It Mean?

- What does it mean to rearrange the income statement model from the traditional format to the contribution margin format?
- What does it mean to state that the contribution margin model is more useful than the traditional model for determining the effect on operating income of changes in activity?

An Expanded Contribution Margin Model

The benefits of using the contribution margin model for planning can be best understood, and illustrated, by applying the model to a single product. For analytical purposes, an expanded version of the model, using the captions already illustrated, but adding some columns, is helpful. The expanded model is:

	Per Unit	×	Volume	=	Total	%
Revenue	\$					
Variable expenses						
Contribution margin	\$	×		=	\$	%
Fixed expenses						
Operating income					\$	

The preferred route through the model is to : (1) express revenue, variable expense, and contribution margin on a per unit basis, (2) multiply contribution margin per unit by volume to get total contribution margin, and (3) subtract fixed expenses from total contribution margin to get operating income. Note that *fixed expenses are not unitized!* The contribution margin ratio is calculated (contribution margin per unit divided by

Understanding the relationships in the expanded contribution margin model very well may be the single most important concept developed in managerial accounting. The model presented here provides a structure for explaining, in a consistent manner, the effect on operating income of changes in selling price, variable expenses, fixed expenses, or the volume of activity. As you study these examples, you will notice that four relationships are constantly interacting with one another:

1. Revenue – Variable expenses = Contribution margin.
2. Contribution margin / Revenue = Contribution margin ratio.
3. Total contribution margin depends on the volume of activity.
4. Contribution margin must cover fixed expenses before an operating income is earned.

Your goals are to identify these relationships in every cost-volume-profit question and appreciate their interaction as a way of thinking that becomes second nature for you. Once you can visualize this interaction of relationships you are well on your way to becoming a successful decision maker.



Study Suggestion

revenue per unit) because it can frequently be used to answer what-if questions that may be asked in the planning process.

Contribution Margin in Action—Example 1. To illustrate the use of the model, assume that management wants to know the operating income from a product that has the following revenue, cost, and volume characteristics:

Selling price per case	\$ 15
Variable expenses per case	9
Fixed expenses associated with the product	\$ 40,000
Sales volume in cases	8,000 cases

Using these data in the model results in the following analysis:

	Per Unit	×	Volume	=	Total	%
Revenue	\$ 15					
Variable expenses	9					
Contribution margin	<u>\$ 6</u>	×	<u>8,000</u>	=	\$48,000	<u>40%</u>
Fixed expenses					<u>40,000</u>	
Operating income					<u>\$ 8,000</u>	

Contribution Margin in Action—Example 2. Now suppose that management wants to know what would happen to operating income if a \$3 per unit price cut were to result in a volume increase of 5,000 units, to a total of 13,000 units. The solution:

	Per Unit	×	Volume	=	Total	%
Revenue	\$ 12					
Variable expenses	9					
Contribution margin	<u>\$ 3</u>	×	<u>13,000</u>	=	\$39,000	<u>25%</u>
Fixed expenses					<u>40,000</u>	
Operating income					<u>\$ (1,000)</u>	

Based on the quantitative analysis, the price reduction would not be made.

Contribution Margin in Action—Example 3. Next, suppose that management proposes the same \$3 per unit price cut in conjunction with a \$3,000 increase in advertising, with the expectation that volume will increase to 18,000 units. The analysis of the effect on operating income is:

	Per Unit	×	Volume	=	Total	%
Revenue	\$ 12					
Variable expenses	9					
Contribution margin	<u>\$ 3</u>	×	<u>18,000</u>	=	\$54,000	<u>25%</u>
Fixed expenses					<u>43,000</u>	
Operating income					<u>\$11,000</u>	

Note that the advertising expense increase is reflected in fixed expenses. The analysis suggests that if the volume increase can be achieved with the price cut and increased advertising combination, operating income will increase from its present level. But watch out for the relevant range assumption: The impact on fixed expenses of such a large increase in sales volume must be questioned.

Contribution Margin in Action—Example 4. The expanded contribution margin model can also be used to calculate the volume of activity required to achieve a target level of operating income. For example, using the original data for selling price and variable expenses, suppose management wanted to know the sales volume required to have operating income of \$23,000. The solution involves entering the known data in the model and working to the middle to obtain the required volume:

	Per Unit	×	Volume	=	Total	%
Revenue	\$ 15					
Variable expenses	9					
Contribution margin	<u>\$ 6</u>	×	<u>?</u>	=	\$63,000	<u>40%</u>
Fixed expenses					<u>40,000</u>	
Operating income					<u>\$23,000</u>	

The required sales volume is $\$63,000/\$6 = 10,500$ units.

Contribution Margin Ratio in Action—Example 5. The contribution margin *ratio* is used to directly calculate the effect on contribution margin and operating income when the change in operations is expressed in terms of total revenues. For example, if the contribution margin ratio is 40%, and total revenues are expected to increase by \$12,000, a \$4,800 ($\$12,000 \times 40\%$) increase in contribution margin and operating income would result, assuming that fixed expenses didn't change.

Contribution Margin Ratio in Action—Example 6. Another use of the contribution margin ratio is to determine the increase in revenues and sales volume that would be necessary to cover an increase in fixed expenses. For example, if fixed expenses were to increase by \$9,000, contribution margin would have to increase by the same amount if operating income was not going to change. If the contribution margin ratio is 40%, revenues would have to increase by \$22,500 ($\$9,000/40\%$) to generate a \$9,000 increase in contribution margin. The sales volume increase needed to generate the additional revenue is determined by dividing \$22,500 by the \$15 selling price per unit. (Of course, the volume increase of 1,500 units could also be calculated by

dividing the increased contribution margin required, \$9,000, by the contribution margin of \$6 per unit.)

Contribution Margin Ratio in Action—Example 7. The contribution margin ratio also is used to determine revenue and contribution margin changes when per unit data are not available or not applicable. For example, the contribution margin model is frequently used to analyze the impact on the operating income of an entire product line (e.g., a candy bar brand) that is sold in a variety of package or size configurations, assuming that each configuration has the same, or very nearly the same, contribution margin ratio. Thus, if a product line had a contribution margin ratio of 30%, would an advertising program costing \$21,000 be cost effective if it generated an additional \$80,000 of revenue? The increase in contribution margin would be \$24,000 (30% × \$80,000), which is \$3,000 more than the cost of the additional advertising; so yes, the program would be cost effective. Alternatively, the increased fixed expenses divided by the contribution margin ratio (\$21,000/30%) shows that an additional \$70,000 of revenue would be needed to cover the increased fixed expense. Because the revenue increase is estimated to be \$80,000, which is \$10,000 more than required, an operating income increase of \$3,000 (30% × \$10,000) can be expected.

Contribution Margin Ratio in Action—Example 8. Although all of the examples used so far have expressed volume as units of product, the contribution margin model is also useful for organizations that provide services rather than sell products. For example, a day care center could identify variable expenses by type of activity and then set charges to achieve a target contribution margin to cover fixed expenses and operating income. Using the expanded contribution margin model, expected variable expenses of \$18 per week per child, and a target contribution margin ratio of 40 percent, the revenue needed to be charged per week per child is calculated as follows:

	Per Child	×	Volume	=	Total	%
Revenue	\$?					100%
Variable expenses	18					?
Contribution margin	<u>\$?</u>	×	<u>?</u>	=	\$?	<u>40%</u>

If the contribution margin ratio is 40%, the variable expense ratio is 60% (revenues = 100%); 60% of revenue per child = \$18; revenue per child = \$18/0.60 = \$30. This process is virtually the same as that described in Chapter 9 to calculate a required selling price when the cost of the item and the desired gross profit ratio are known.

Multiple Products or Services and Sales Mix Considerations

When the contribution margin model is applied using data for more than one product or service the sales mix issue must be considered. Sales mix refers to the relative proportion of total sales accounted for by different products or services. Because different products or services are likely to have different contribution margin ratios, the average contribution margin ratio for a given mix of products or services will change if the sales mix of the products or services changes.

The effect of a sales mix change is illustrated in Exhibit 12-6. Sales mix is an important concept to understand because almost all firms have multiple products or services. When there is a range of quality to a firm’s products (e.g., good, better, best), the higher-quality products generally have higher contribution margin ratios, so marketing efforts are frequently focused on those products. On the other hand, a strategy that

OBJECTIVE 10

Understand how changes in the sales mix can affect projections made with CVP analysis.

Exhibit 12-6 Multiple Products and Sales Mix

I. Assume that a company has two products. Per unit revenue, variable expenses, and product volumes for present operations are shown below:

	Product A			Product B			Total Company					
	Per Unit	×	Volume	=	Total	%	Per Unit	×	Volume	=	Total	%
Revenue	\$ 40	×	2,000	=	\$80,000		\$ 30	×	2,000	=	\$60,000	100%
Variable expenses	<u>30</u>						<u>18</u>					
Contribution margin	<u>\$ 10</u>	×	<u>2,000</u>	=	\$20,000	25%	<u>\$ 12</u>	×	<u>2,000</u>	=	\$24,000	40%
Fixed expenses												
Operating income												
												</

Note that fixed expenses are shown only in the total company column because they apply to the company as a whole, not to individual products.

II. Now assume that the sales mix changes and that, instead of sales volume of 2,000 units of each product, sales volume becomes 2,500 units of Product A and 1,500 units of Product B. The company's contribution margin format income statement becomes:

	Product A			Product B			Total Company					
	Per Unit	×	Volume	=	Total	%	Per Unit	×	Volume	=	Total	%
Revenue	\$ 40	×	2,500	=	\$100,000		\$ 30	×	1,500	=	\$45,000	100%
Variable expenses	<u>30</u>						<u>18</u>					
Contribution margin	<u>\$ 10</u>	×	<u>2,500</u>	=	\$ 25,000	25%	<u>\$ 12</u>	×	<u>1,500</u>	=	\$18,000	40%
Fixed expenses												
Operating income											<u>\$ 30,000</u>	
											<u>\$ 13,000</u>	

Note that even though total sales volume remained the same, total revenues increased, but total contribution margin and operating income decreased. This is due to the fact that proportionately more units of Product A, with its relatively low contribution margin ratio, were sold than Product B, which has a relatively high contribution margin ratio. As a result, the company's average contribution margin ratio also decreased.

some firms try to follow is to price their products to achieve a contribution margin ratio that is about the same for all products. A company that is able to achieve this approximate parity in contribution margin ratios among its products doesn't have to be concerned, from a product profitability standpoint, about sales mix changes. Thus marketing efforts can be more broadly based than if sales mix were a consideration.

8. What does it mean to expand the contribution margin model?
9. What does it mean that fixed expenses should not be unitized because they don't behave that way?
10. What does it mean to state that contribution margin ratio is frequently a more useful measurement than contribution margin per unit?



Break-Even Point Analysis

The **break-even point** is usually expressed as the amount of revenue that must be realized for the firm (or product or activity or group of products or activities) to have neither profit nor loss (i.e., operating income equal to zero). The break-even point is useful to managers because it expresses a minimum revenue target, and managers frequently find it easier to think in terms of revenues rather than variable and fixed expenses. In addition, the amount of sales (or revenues) generated by the firm is easily determined on a daily basis from the accounting system.

The contribution margin model is used to determine the break-even point by setting operating income equal to zero and solving the model for the revenue or physical sales volume that will cause that result. The calculation of break-even point in terms of units and total revenues is illustrated below.

OBJECTIVE 11

Understand the meaning and significance of break-even point and how the break-even point is calculated.

Selling price per unit	\$	12
Variable expenses per unit		8
Total fixed expenses	\$45,000	

	Per Unit	×	Volume	=	Total	%
Revenue	\$ 12					
Variable expenses	8					
Contribution margin	<u>\$ 4</u>	×	<u>?</u>	=	<u>?</u>	<u>33.3%</u>
Fixed expenses					45,000	
Operating income					<u>\$ 0</u>	

According to the model, contribution margin clearly must be equal to fixed expenses of \$45,000.

$$\begin{aligned} \text{Volume in units at break even} &= \frac{\text{Fixed expenses}}{\text{Contribution margin per unit}} \\ &= \$45,000/\$4 \\ &= 11,250 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Total revenues at break even} &= \frac{\text{Fixed expenses}}{\text{Contribution margin ratio}} \\ &= \$45,000/33.3\% \\ &= \$135,000 \end{aligned}$$

or

$$\begin{aligned}\text{Volume in units at break even} &= \frac{\text{Total revenues required}}{\text{Revenue per unit}} \\ &= \$135,000/\$12 \\ &= 11,250 \text{ units}\end{aligned}$$

Most firms plan for certain desired levels of operating income and would not be satisfied to simply break even. As illustrated earlier, the contribution margin model can be used to determine total revenues, and sales volume in units, for any amount of desired operating income. The break-even formula also can be easily modified to determine these amounts by adding the desired operating income to the numerator. To illustrate, assume the same information as above and a desired operating income of \$10,000.

$$\begin{aligned}\text{Volume in units for desired} &= \frac{\text{Fixed expenses} + \text{Desired}}{\text{level of operating income}} \quad \text{operating income} \\ &= \frac{\text{Contribution margin per unit}}{\text{Contribution margin per unit}} \\ &= (\$45,000 + \$10,000)/\$4 \\ &= 13,750 \text{ units}\end{aligned}$$

$$\begin{aligned}\text{Total revenues for desired} &= \frac{\text{Fixed expenses} + \text{Desired}}{\text{level of operating income}} \quad \text{operating income} \\ &= \frac{\text{Contribution margin ratio}}{\text{Contribution margin ratio}} \\ &= (\$45,000 + \$10,000)/33.3\% \\ &= \$165,000\end{aligned}$$

Break-even analysis is frequently illustrated in graphical format, as illustrated in Exhibits 12-7 and 12-8 with data from the above example. Note that in these graphs, the horizontal axis is sales volume in units, and the vertical axis is total dollars. In Exhibit 12-7 the horizontal line represents fixed expenses of \$45,000, and variable expenses of \$8 per unit are added to fixed expenses to produce the total expense line. Revenues start at the origin and rise at the rate of \$12 per unit in proportion to the sales volume in units. The intersection of the total expense line and the total revenue line is the break-even point. The sales volume required to break even (11,250 units) is on the horizontal axis directly below this point, and total revenues required to break even (\$135,000) can be read on the vertical axis opposite the intersection. The amount of operating income or loss can be read as the dollar amount of the vertical distance between the total revenue line and total expense line for the sales volume actually achieved. Sometimes the area between the two lines is marked as “profit area” or “loss area.” Note that the loss area begins with an amount equal to total fixed expenses of \$45,000 (at a sales volume of 0 units). As unit sales increase, the loss decreases by the contribution margin per unit of \$4 until the break-even point is achieved—then the profit increases by the contribution margin per unit.

Exhibit 12-8 is another version of the break-even graph. The variable expense line begins at the origin, with fixed expenses added to total variable expenses. Although expenses are rearranged compared to Exhibit 12-7, the total expense line stays the same, and the break-even point and the profit and loss areas are the same. This version permits identification of contribution margin and shows how contribution margin grows as volume increases.

The key to the break-even point calculation (and graphic presentation) is that fixed expenses remain fixed in total regardless of the level of activity, subject to the relevant range assumption. In addition to that assumption, the linearity and constant sales mix assumptions also must be considered. In spite of these simplifications, the contribution margin model and cost behavior pattern concepts are among the most important

Chapter 12 Managerial Accounting and Cost-Volume-Profit Relationships

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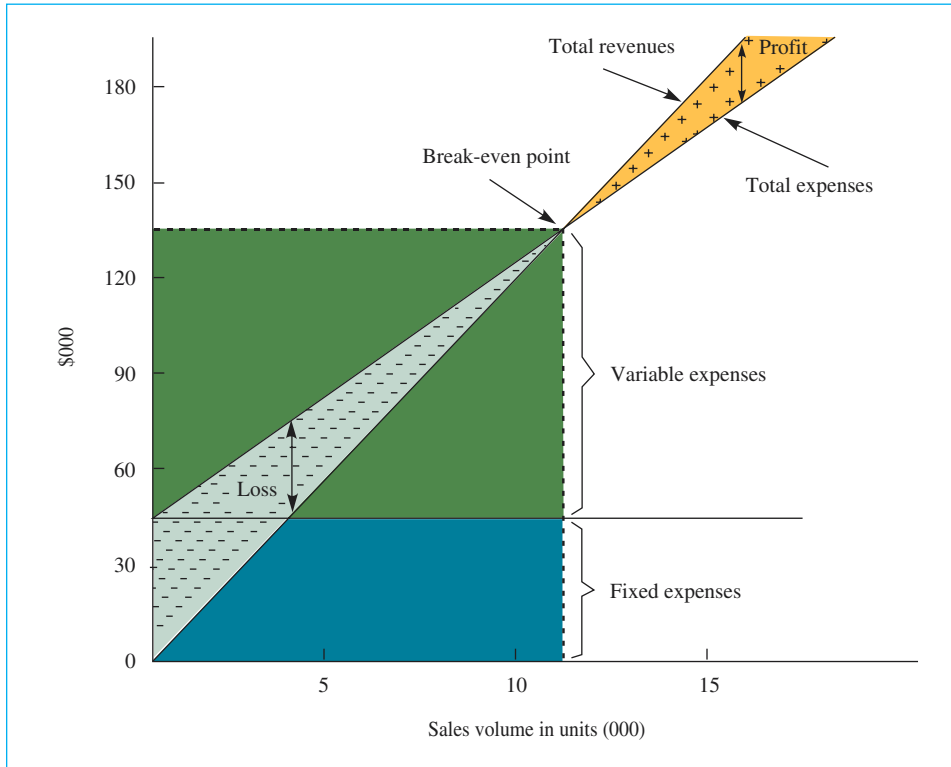


Exhibit 12-7

Break-Even Graph

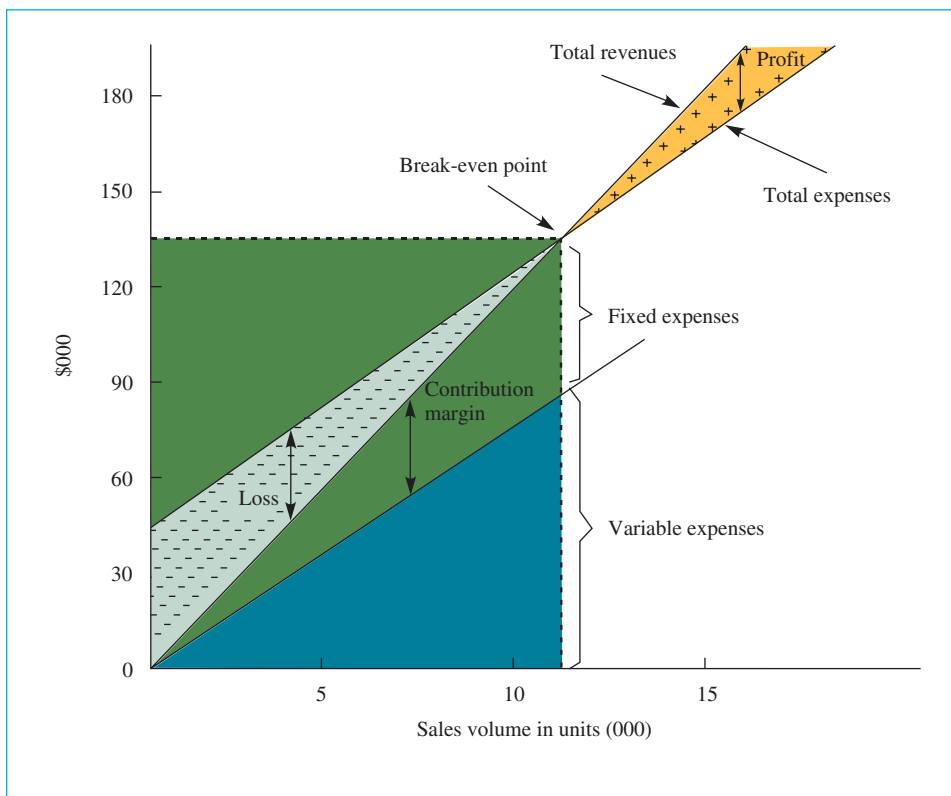


Exhibit 12-8

Break-Even Graph
Featuring Contribution
Margin



Business in Practice

The 1-Cent Sale

An understanding of cost-volume-profit relationships is shown by the manager of a fast-food and soft ice cream business operating in a midwestern city when a 1-cent sale is held in February. Ice cream sundaes are featured—two for the price of one, plus 1 cent. None of the other menu items are on sale.

Those sundaes usually sell for a price of \$1.25 to \$1.75, but even with generous estimates, it is hard to come up with variable costs (ice cream, topping, cup, and spoon) much greater than 30 percent of the usual selling price. So even when the price is effectively cut in half, there is still a positive contribution margin. And what happens to the store's fixed costs during the sale? They are probably not affected at all. The fixed costs (including workers' wages) will be incurred whether or not extra customers come in for the sundae special. And of course, many of those customers probably will buy other items at the regular price.

The net result of the special promotion is that the store builds traffic and business at a time of otherwise low activity (assuming that normal demand for sundaes is low in February). All of the additional sales volume generates a positive contribution margin, fixed expenses are the same as they would have been without the promotion, and operating income is increased over what it otherwise would have been.

management accounting ideas to understand and be able to apply. The manager encounters many situations in which cost-volume-profit analysis supports decisions that contribute to the achievement of the organization's objectives. One of these applications is described in Business in Practice—The 1-Cent Sale.

What Does It Mean?

11. What does it mean to break even?
12. What does it mean to be aware of the effect of sales mix changes on a firm's operating income?

Operating Leverage

OBJECTIVE 12

Understand the concept of operating leverage.

When an entity's revenues change because the volume of activity changes, variable expenses and contribution margin will change proportionately. But the presence of fixed expenses, which do not change as the volume of activity changes, means that operating income will change proportionately more than the change in revenues. This magnification of the effect on operating income of a change in revenues is called **operating leverage**. This was illustrated in the discussion of the contribution margin format income statement example earlier in this chapter (pages 425–426). It showed a 20% decline in volume with revenues, variable expenses, and contribution margin also declining by 20%, but operating income declined 80% (from \$10,000 to \$2,000). Note the similarity of operating leverage to financial leverage, explained in Chapter 11, in which fixed interest expense causes a proportionately greater change in ROE than the percentage change in ROI resulting from any given change in operating income.

Operating leverage also helps to explain the proportionately greater growth in **Intel Corporation's** Net Income relative to its growth in Net Revenues for 1997 to 2000 and the opposite effect in 2001, as shown in the example of horizontal income statement analysis on page 393 in Chapter 11.

Just as high financial leverage increases the risk that a firm may not be able to meet its required interest payments, high operating leverage increases the risk that a small percentage decline in revenues will cause a relatively larger percentage decline in operating income. *The higher a firm's contribution margin ratio, the greater its operating leverage.* Management can influence the operating leverage of a firm by its decisions

CCH Incorporated, in its current form, was founded in 1913 and is well respected among accountants and attorneys as a leading provider of tax and business law information. The company produces approximately 700 publications in print and electronic form for accounting, legal, human resources, banking, securities, insurance, government, and health care professionals. At www.cch.com, CCH provides access to an online Business Owners' Toolkit at www.toolkit.cch.com that includes ready-to-use tools such as model business documents, financial spreadsheet templates, and checklists. Go to www.toolkit.cch.com/text/P06_7500.asp for a discussion of Cost/Volume/Profit Analysis including examples of fixed and variable costs, break-even analysis, contribution margin analysis, and operating leverage.



**Business on the
Internet**

about incurring variable versus fixed costs. For example, if a firm substitutes automated production equipment for employees, it has changed a variable cost (assuming the employees could be laid off if demand for the firm's products declined) to a fixed cost (the machine will depreciate, be insured, and be included in the property tax base whether or not it is being used), and it has increased its contribution margin ratio and operating leverage. If the management of a firm anticipates a decline in demand for the firm's products or services, it may be reluctant to change its cost structure by shifting variable costs to fixed costs, even though productivity increases could be attained, because the equipment has to be operating to realize the benefits of productivity gains.

The effect of different cost structures on operating leverage is illustrated in Exhibit 12-9. Observe that with the alternative cost structures and a volume of 10,000 units, Company A and Company B achieved an identical amount of operating income of \$100,000. This exhibit illustrates an important element of the decision-making process involving the trade-off between fixed cost (capital intensive) and variable cost (labor intensive) alternatives and is referred to as the **indifference point**. The indifference

Operating Leverage

Exhibit 12-9

- I. Assume that two companies make similar products but that the companies have adopted different cost structures. Company A's product is made in a labor-intensive operation with relatively high variable costs but relatively low fixed costs, and Company B's product is made in a capital-intensive operation with relatively low variable costs but relatively high fixed costs. Each firm presently sells 10,000 units of product. A contribution margin model for each firm is represented below.

	Company A— Lower Operating Leverage					Company B— Higher Operating Leverage				
	Per Unit	×	Volume	=	Total	%	Per Unit	×	Volume	= Total %
Revenue	\$ 50						\$ 50			
Variable expenses . . .	35						20			
Contribution margin	<u>\$ 15</u>	×	<u>10,000</u>	=	\$150,000	30%	<u>\$ 30</u>	×	<u>10,000</u>	= \$300,000 60%
Fixed expenses . . .					50,000					200,000
Operating income					<u>\$100,000</u>					<u>\$100,000</u>

(continued)

Exhibit 12–9

(concluded)

II. Effect on operating income of an increase in volume from 10,000 to 11,000 units:

Contribution margin	<u>\$ 15</u>	×	<u>11,000</u>	=	\$165,000	30%	<u>\$ 30</u>	×	<u>11,000</u>	=	\$330,000	60%
Fixed expenses					<u>50,000</u>						<u>200,000</u>	
Operating income					<u>\$115,000</u>						<u>\$130,000</u>	
Percentage change in volume					+10%						+10%	
Percentage change in operating income					+15%						+30%	

Note that Company B's operating income increased at a much greater rate, and to a considerably higher amount, than Company A's operating income. Operating leverage resulted in the operating income of each firm increasing proportionately more than the change in volume of activity. With an increase in volume, the greater contribution margin per unit and contribution margin ratio of Company B's product resulted in a greater increase in its operating income than experienced by Company A.

III. Effect on operating income of a decrease in volume from 10,000 units to 9,000 units:

Contribution margin	<u>\$ 15</u>	×	<u>9,000</u>	=	\$135,000	30%	<u>\$ 30</u>	×	<u>9,000</u>	=	\$270,000	60%
Fixed expenses					<u>50,000</u>						<u>200,000</u>	
Operating income					<u>\$ 85,000</u>						<u>\$ 70,000</u>	
Percentage change in volume					–10%						–10%	
Percentage change in operating income					–15%						–30%	

Note that Company B's operating income decreased at a much greater rate, and to a considerably lower amount, than Company A's operating income. Operating leverage resulted in the operating income of each firm decreasing proportionately more than the change in volume of activity. With a decrease in volume, the greater contribution margin per unit and contribution margin ratio of Company B's product resulted in a greater reduction of its operating income than experienced by Company A.

point is found by setting the cost structure (total cost) of each alternative (Company A and Company B in this example) equal to one another and solving for the volume of activity that equates total cost. For example:

$$\begin{aligned}
 &\frac{\text{Company A}}{\text{Fixed costs} + (\text{Variable cost per unit} \times \text{Volume})} = \frac{\text{Company B}}{\text{Fixed costs} + (\text{Variable cost per unit} \times \text{Volume})} \\
 &\$50,000 + (\$35 \times \text{Volume}) = \$200,000 + (\$20 \times \text{Volume}) \\
 &\$15 \times \text{Volume} = \$150,000 \\
 &\text{Volume} = 10,000 \text{ units}
 \end{aligned}$$

Cost Structures of Emerging Technologies

The demise of many Internet based dot-com companies by late in the year 2000 was a technological phenomenon that history has seen repeated several times. Over a century ago, the railroads provided an early lesson as reported by Hal Varian:

In the 1880s there were more miles of railroad track laid than in any other decade in American history. By the 1890s there were more miles in bankruptcy than in any other decade.

Why do we always seem to overinvest in new technologies? In the case of railroads, the major economic force at work was economies of scale. The primary costs associated with a railroad are the fixed costs—the cost of servicing the debt incurred in laying the track and buying the rolling stock. In the late 1880s, about two-thirds of the total costs of operating a railroad were fixed.

When fixed costs are high, large companies have an inherent advantage, since (as volume increases) they have a lower total cost per shipment. The railroads recognized this and invested heavily in building capacity. But once the capacity was installed, there was inevitable cutthroat competition for freight. There was no way around the fact that there was just too much rail stock relative to demand. Companies went bankrupt, wiping out their obligation to make debt payments, leading to even more aggressive pricing. The industry sank into a slump from which it took decades to recover.

(What can be learned from this episode?) The railroad boom and bust arose because there were large fixed costs and a commodity product—freight transportation. Since there were many providers, price wars were all too likely. The cost structure of this industry bears a remarkable resemblance to long-haul fiber optics. The big fixed cost comes from laying the fiber, with (variable) operating expenses being relatively small. This is a recipe for price wars, and indeed, the cost of long-distance telephony—especially in negotiated contracts for large business—has been plummeting.

Many of the dot-com start-ups have invested heavily in building a technology infrastructure to support their business-to-consumer activities. The resulting cost structures provide a high degree of operating leverage and the opportunity for a very big payoff once the revenues from their venture produce enough contribution margin to exceed fixed costs. Of course generating enough revenue proved to be a major challenge for many dot-com start-ups. The large number of business failures illustrates the high risk of high operating leverage.

Source: www.nytimes.com, "Economic Scene: Technology Rise and Fall Is as American as the Model T," December 14, 2000, by Hal R. Varian. Copyright ©2000, by the New York Times Co. Reprinted by permission.



Business in Practice

Parts II and III of Exhibit 12-9 illustrate that as a change in volume moves each company away from the indifference point, the effect on operating income is more dramatic with Company B's higher proportion of fixed cost to variable cost relative to Company A. The relatively higher operating leverage provides for a faster accumulation of operating income for increases in volume but also indicates that operating income will decrease faster when volume decreases. Microsoft's performance during the 1990s is a good example of the effect that operating leverage can have on an organization's profit. During this period of time, Microsoft's profits grew by an average annual rate of 47%, which was much faster than the 38% average annual rate of growth in sales. Another example is described in Business in Practice—Cost Structures of Emerging Technologies. The effect of operating leverage on operating income is a key information component in the selection of a cost structure.

13. What does it mean to state that a firm has a relatively high degree of operating leverage?



Demonstration Problem

Visit the text website at www.mhhe.com/marshall6e to view a Demonstration Problem for this chapter.

Summary

Management is the process of planning, organizing, and controlling an organization's activities to accomplish its goals. Managerial accounting (sometimes called *management accounting*) supports the management process.

Managerial accounting differs from financial accounting in several ways. Managerial accounting has an internal orientation, a future perspective, and often focuses on individual units within the firm rather than on the organization as a whole. Reasonably accurate data are acceptable for internal analysis, and performance reports tend to be issued on a frequent basis for managerial control and decision making.

There are different costs for different purposes. Cost terminology is important to understand if cost data are to be used appropriately.

The behavior pattern of a cost relates to the change in total cost for a change in activity. Variable costs change, in total, as activity changes. Fixed costs remain constant in total as activity changes. Assumptions about linearity and relevant range are implicit when a cost is described as variable or fixed. Many costs have a mixed behavior pattern (i.e., they are partly variable and partly fixed). A cost formula expresses the total amount of a cost for a given level of activity by combining the fixed and variable elements of the total cost. It is inappropriate, and may be misleading, to express a fixed cost on a per unit basis because by definition a fixed cost is constant over a range of activity.

Cost-volume-profit (CVP) analysis uses knowledge about cost behavior patterns to interpret and forecast changes in operating income resulting from changes in revenue, cost, or the volume of activity.

When a particular cost is partly fixed and partly variable, the high-low method can be used to develop a cost formula that recognizes both the variable and fixed elements of the cost.

The contribution margin format income statement reclassifies the functional cost categories of the traditional income statement to cost behavior pattern categories. Contribution margin is the difference between revenues and variable expenses. Unless there are changes in the composition of variable expenses, contribution margin changes in proportion to the change in revenues.

The expanded contribution margin format model provides a framework for analyzing the effect of revenue, cost, and volume changes on operating income. A key to using this model is that fixed costs are recognized only in total; they are not unitized.

The contribution margin ratio sometimes can be used to determine the effect of a volume change on operating income more quickly and more easily than using unit revenue and variable expense and volume.

Sales mix describes the relative proportion of total sales accounted for by specific products. When different products or product lines have significantly different contribution margin ratios, changes in the sales mix will cause the percentage change in total contribution margin to be different from the percentage change in revenues.

The break-even point is the total sales volume (in units or dollars) at which operating income is zero. Using the contribution margin model, the break-even point is

achieved when total contribution margin is equal to fixed expenses. Break-even analysis also can be illustrated graphically to provide a visual representation of profit and loss areas and to demonstrate the impact of the contribution margin per unit on operating income (or loss).

Operating leverage describes the percentage change in operating income for a given percentage change in revenues. Since fixed expenses don't change when revenues change, operating income changes by a greater percentage amount than revenues. The higher a firm's fixed expenses relative to its variable expenses, the greater the operating leverage and the greater the risk that a change in the level of activity will cause a relatively larger change in operating income than with less leverage. Operating leverage can influence management's decisions about whether to incur variable costs or fixed costs.

Key Terms and Concepts

break-even point (p. 429) The amount of revenue required to have neither operating profit nor operating loss.

contribution margin (p. 423) The difference between revenues and variable costs.

contribution margin format (p. 421) An income statement format in which variable costs are subtracted from revenues to show contribution margin, from which fixed costs are subtracted to determine operating income.

contribution margin ratio (p. 424) The ratio of contribution margin to revenues.

cost behavior pattern (p. 417) Identification of whether a cost is fixed or variable.

cost formula (p. 418) An algebraic expression that reflects the fixed and variable elements of a cost.

cost-volume-profit (CVP) analysis (p. 412) Analysis of the impact on profit of volume and cost changes using knowledge about the behavior pattern of the costs involved.

fixed cost (p. 417) A cost that does not change in total as the level of activity changes within the relevant range.

indifference point (p. 433) The activity level that produces the same total cost for two different cost formulas or cost structures.

management process (p. 413) Planning, organizing, and controlling the activities of an organization so it can accomplish its purpose.

managerial accounting (p. 412) Accounting that uses economic and financial information to plan and control many of the activities of the entity and to support the management decision-making process. Sometimes called *management accounting*.

operating leverage (p. 432) The concept that operating income changes proportionately more than revenues for any given change in the level of activity. Firms with relatively higher fixed costs (and relatively lower variable costs per unit) have greater operating leverage than firms with relatively lower fixed costs (and relatively higher variable costs per unit) and will experience a relatively larger impact on operating income for a given change in activity.

production standard (p. 415) Expected or allowed times and costs to make a product or perform an activity.

relevant range (p. 418) The range of activity over which the fixed or variable cost behavior pattern exists.

sales mix (p. 427) The proportion of total sales represented by various products or categories of products.

semivariable cost (p. 418) A cost that has both fixed and variable elements.

variable cost (p. 417) A cost that changes in total as the volume of activity changes.

Solutions To What Does It Mean?

1. It means that cost is a very broad term that must be qualified so communication about cost is clear. It is important to understand cost terminology.
2. It means that managerial accounting is more future oriented, while financial accounting is concerned primarily with reporting events that have already occurred.
3. It means that planned results are compared to actual results, and either actions or plans are changed so future results come closer to planned results.
4. It means that classification of a cost as fixed or variable is based on the simplifying assumptions of linearity and relevant range.
5. It means that a formula for predicting the total cost at some level of activity has been developed and that it recognizes both the fixed and variable elements of the cost's behavior pattern.
6. It means that instead of using cost of goods sold and operating expense functional categories, expenses are classified according to cost behavior pattern as variable or fixed; then variable expenses are subtracted from sales to arrive at contribution margin, from which fixed expenses are subtracted to arrive at operating income.
7. It means that because cost behavior pattern classification is based on the effect on expenses of changes in activity, the impact of activity changes on operating income can be more easily and more accurately determined using the contribution margin model.
8. It means to express revenue and variable expenses on a per unit basis, multiply per unit contribution margin by volume to obtain total contribution margin, and subtract total fixed expenses to arrive at operating income.
9. It means that since fixed expenses don't change as the volume of activity changes, to express fixed expenses on a per unit basis doesn't make sense.
10. It means that because many firms have multiple products, overall planning and control are more easily accomplished by focusing on contribution margin ratio rather than the contribution margin of individual products.
11. It means that revenues equal expenses, so operating income is zero.
12. It means that because different products have different contribution margin ratios, changes in the proportion of sales of one product to total sales compared to the proportion of sales of another product to total sales—that is, a change in the sales mix—will affect operating income based on the products' relative contribution margin ratios.
13. It means that the firm has a relatively high proportion of fixed to variable costs, so the effect of changes in sales volume on contribution margin and operating income will be magnified relative to a firm with a lower operating leverage.

Self-Study Quiz

Visit the text website at www.mhhe.com/marshall6e to take a self-study quiz for this chapter.

Exercises

Cost classifications. For each of the following costs, check the column(s) that most likely apply. **E12.1.**
LO 3

Cost	Variable	Fixed
Wages of assembly-line workers	<input type="checkbox"/>	<input type="checkbox"/>
Depreciation—plant equipment	<input type="checkbox"/>	<input type="checkbox"/>
Glue and thread	<input type="checkbox"/>	<input type="checkbox"/>
Shipping costs	<input type="checkbox"/>	<input type="checkbox"/>
Raw materials handling costs	<input type="checkbox"/>	<input type="checkbox"/>
Salary of public relations manager	<input type="checkbox"/>	<input type="checkbox"/>
Production run setup costs	<input type="checkbox"/>	<input type="checkbox"/>
Plant utilities	<input type="checkbox"/>	<input type="checkbox"/>
Electricity cost of retail stores	<input type="checkbox"/>	<input type="checkbox"/>
Research and development expense	<input type="checkbox"/>	<input type="checkbox"/>

Cost classifications. For each of the following costs, check the column(s) that most likely apply. **E12.2.**
LO 3

Cost	Variable	Fixed
Raw materials	<input type="checkbox"/>	<input type="checkbox"/>
Staples used to secure packed boxes of product	<input type="checkbox"/>	<input type="checkbox"/>
Plant janitors' wages	<input type="checkbox"/>	<input type="checkbox"/>
Order processing clerks' wages	<input type="checkbox"/>	<input type="checkbox"/>
Advertising expenses	<input type="checkbox"/>	<input type="checkbox"/>
Production workers' wages	<input type="checkbox"/>	<input type="checkbox"/>
Production supervisors' salaries	<input type="checkbox"/>	<input type="checkbox"/>
Sales force commissions	<input type="checkbox"/>	<input type="checkbox"/>
Maintenance supplies used	<input type="checkbox"/>	<input type="checkbox"/>
President's salary	<input type="checkbox"/>	<input type="checkbox"/>
Electricity cost	<input type="checkbox"/>	<input type="checkbox"/>
Real estate taxes for:		
Factory	<input type="checkbox"/>	<input type="checkbox"/>
Office building	<input type="checkbox"/>	<input type="checkbox"/>

Estimating costs based on behavior patterns. Ryan estimates that the costs of insurance, license, and depreciation to operate his car total \$320 per month and that the gas, oil, and maintenance costs are 14 cents per mile. Ryan also estimates that, on average, he drives his car 1,400 miles per month. **E12.3.**
LO 3

Required:

- How much cost would Ryan expect to incur during April if he drove the car 1,529 miles?
- Would it be meaningful for Ryan to calculate an estimated average cost per mile for a typical 1,400-mile month? Explain your answer.



E12.4.
LO 3



Estimating costs based on behavior patterns. The following table shows the amount of cost incurred in March for the cost items indicated. During March 4,000 units of the firm's single product were manufactured.

Raw materials	\$20,800
Factory depreciation expense	40,500
Direct labor	49,600
Production supervisor's salary	5,000
Computer rental expense	3,100
Maintenance supplies used	600

Required:



- How much cost would you expect to be incurred for each of the above items during April when 5,600 units of the product are planned for production?
- Calculate the average total cost per unit for the 4,000 units manufactured in March. Explain why this figure would not be useful to a manager interested in predicting the cost of producing 5,600 units in April.

E12.5.
LO 7, 9

Understanding CVP relationships. Calculate the missing amounts for each of the following firms:

			Contribution		
	Sales	Variable Costs	Margin Ratio	Fixed Costs	Operating Income (Loss)
Firm A	\$320,000	?	32%	?	\$38,300
Firm B	?	\$465,050	?	\$118,000	71,950
Firm C	134,000	?	26%	36,700	?
Firm D	?	59,000	20%	?	(4,920)

E12.6.
LO 7

Understanding CVP relationships. Calculate the missing amounts for each of the following firms:



	Units Sold	Selling Price	Variable Costs per Unit	Contribution Margin	Fixed Costs	Operating Income (Loss)
Firm A	11,200	\$24.00	?	\$100,800	\$41,300	?
Firm B	8,400	?	\$18.20	?	64,500	\$32,940
Firm C	?	7.30	4.20	10,850	?	(6,750)
Firm D	4,720	?	51.25	41,064	48,210	?

E12.7.
LO 8, 9

Calculate selling price of new product with a target CM ratio. Sevprod, Inc., makes and sells a large number of consumer products. The firm's average contribution margin ratio is 35%. Management is considering adding a new product that will require an additional \$15,000 per month of fixed expenses and will have variable expenses of \$7.80 per unit.

Required:

- Calculate the selling price that will be required for the new product if it is to have a contribution margin ratio equal to 35%.

- b. Calculate the number of units of the new product that would have to be sold if the new product is to increase the firm's monthly operating income by \$6,000.

Calculate selling price of new product; what-if questions; break-even. Hancock Corp. has annual revenues of \$275,000, an average contribution margin ratio of 34%, and fixed expenses of \$100,000.

E12.8.
LO 8, 9,
10, 11

Required:

- Management is considering adding a new product to the company's product line. The new item will have \$8.25 of variable costs per unit. Calculate the selling price that will be required if this product is not to affect the average contribution margin ratio.
- If the new product adds an additional \$30,600 to Hancock's fixed expenses, how many units of the new product must be sold at the price calculated in part (a) to break even on the new product?
- If 20,000 units of the new product could be sold at a price of \$13.75 per unit, and the company's other business did not change, calculate Hancock's total operating income and average contribution margin ratio.
- Describe how the analysis of adding the new product would be complicated if it were to "steal" some volume from existing products.



Special promotion—effects of a two-for-one sale. Barb and Jan's ice cream shop charges \$1.25 for a cone. Variable expenses are \$.35 per cone, and fixed costs total \$1,800 per month. A "sweetheart" promotion is being planned for the second week of February. During this week, a person buying a cone at the regular price would receive a free cone for a friend. It is estimated that 400 additional cones would be sold and that 600 cones would be given away. Advertising costs for the promotion would be \$120.

E12.9.
LO 8, 9

Required:

- Calculate the effect of the promotion on operating income for the second week of February.
- Do you think the promotion should occur? Explain your answer.



Special promotion—effects of a 1-cent sale. The management of Primo's Prime Pizzeria is considering a special promotion for the last two weeks of May, which is normally a relatively low demand period. The special promotion would involve selling two medium pizzas for the price of one, plus 1 cent. The medium pizza normally sells for \$9.99 and has variable expenses of \$3.00. Expected sales volume without the special promotion is 400 medium pizzas per week.

E12.10.
LO 8, 9



Required:

- Calculate the total contribution margin generated by the normal volume of medium pizzas in a week.
- Calculate the total number of medium pizzas that would have to be sold during the 1-cent sale to generate the same amount of contribution margin that results from the normal volume.
- What other factors should management consider in evaluating the pros and cons of the special promotion?



Problems

P12.11.
LO 6



High-low method. A department of Gamma Co. incurred the following costs for the month of February. Variable costs, and the variable portion of mixed costs, are a function of the number of units of activity.

Activity level in units	5,000
Variable costs	\$10,000
Fixed costs	30,000
Mixed costs	20,000
Total costs	\$60,000

During April the activity level was 8,000 units, and the total costs incurred were \$70,500.

Required:

- Calculate the variable costs, fixed costs, and mixed costs incurred during April.
- Use the high-low method to calculate the cost formula for mixed cost.

P12.12.
LO 6



High-low method—missing amounts. The following data have been extracted from the records of Puzzle Co.:

	June	November
Production level, in units	12,000	18,000
Variable costs	\$21,000	\$?
Fixed costs	?	31,000
Mixed costs	18,000	?
Total costs	\$70,000	\$88,000

Required:

- Calculate the missing costs.
- Calculate the cost formula for mixed cost using the high-low method.
- Calculate the total cost that would be incurred for the production of 20,000 units.
- Identify the two key cost behavior assumptions made in the calculation of your answer to part c.

P12.13.
LO 7, 8, 9

Prepare a contribution margin format income statement—answer what-if questions. Shown below is an income statement in the traditional format for a firm with a sales volume of 8,000 units. Cost formulas also are shown.

Revenues	\$32,000
Cost of goods sold (\$6,000 + \$2.10/unit)	22,800
Gross profit	\$ 9,200

Operating expenses:	
Selling (\$1,200 + \$.10/unit)	2,000
Administration (\$4,000 + \$.20/unit)	5,600
	<u>7,600</u>
Operating income	<u>\$ 1,600</u>

Required:

- Prepare an income statement in the contribution margin format.
- Calculate the contribution margin per unit and the contribution margin ratio.
- Calculate the firm's operating income (or loss) if the volume changed from 8,000 units to:
 - 12,000 units.
 - 4,000 units.
- Refer to your answer to part *a* for total revenues of \$32,000. Calculate the firm's operating income (or loss) if unit selling price and variable expenses per unit do not change, and total revenues:
 - Increase \$12,000.
 - Decrease \$7,000.

Prepare a contribution margin format income statement—answer what-if questions. Shown below is an income statement in the traditional format for a firm with a sales volume of 15,000 units.

P12.14.
LO 7, 8, 9, 12



Revenues	\$105,000
Cost of goods sold (\$8,000 + \$3.60/unit)	<u>62,000</u>
Gross profit	\$ 43,000
Operating expenses:	
Selling (\$1,500 + \$0.80/unit)	13,500
Administration (\$4,000 + \$0.50/unit)	<u>11,500</u>
Operating income	<u>\$ 18,000</u>

Required:

- Prepare an income statement in the contribution margin format.
- Calculate the contribution margin per unit and the contribution margin ratio.
- Calculate the firm's operating income (or loss) if the volume changed from 15,000 units to:
 - 20,000 units.
 - 10,000 units.
- Refer to your answer to part *a* when total revenues were \$105,000. Calculate the firm's operating income (or loss) if unit selling price and variable expenses do not change, and total revenues:
 - Increase \$15,000.
 - Decrease \$10,000.

Prepare a contribution margin format income statement—calculate break-even point. Presented on the next page is the income statement for Big Wateb, Inc., for the month of August:

P12.15.
LO 7, 8, 9, 11

Sales	\$65,000
Cost of goods sold	56,000
Gross profit	\$ 9,000
Operating expenses	14,000
Operating loss	\$ (5,000)

Based on an analysis of cost behavior patterns, it has been determined that the company's contribution margin ratio is 20%.

Required:

- Rearrange the above income statement to the contribution margin format.
- If sales increase by 30%, what will be the firm's operating income?
- Calculate the amount of revenue required for Big Wateb, Inc., to break even.

P12.16.
LO 7, 8, 9, 11



Prepare a contribution margin format income statement—calculate break-even point. Presented below is the income statement for Docmag Co. for March:

Sales	\$80,000
Cost of goods sold	42,000
Gross profit	\$38,000
Operating expenses	32,000
Operating income	\$ 6,000

Based on an analysis of cost behavior patterns, it has been determined that the company's contribution margin ratio is 30%.

Required:

- Rearrange the above income statement to the contribution margin format.
- Calculate operating income if sales volume increases by 8%. (*Note: Do not construct an income statement to get your answer.*)
- Calculate the amount of revenue required for Docmag to break even.

P12.17.
LO 7, 8, 9, 10

CVP analysis—what-if questions; break even. Penta Co. makes and sells a single product. The current selling price is \$15 per unit. Variable expenses are \$9 per unit, and fixed expenses total \$27,000 per month.

Required:

(Unless otherwise stated, consider each requirement separately.)

- Calculate the break-even point expressed in terms of total sales dollars and sales volume.
- Calculate the monthly operating income (or loss) at a sales volume of 5,400 units per month.
- Calculate monthly operating income (or loss) if a \$2 per unit reduction in selling price results in a volume increase to 8,400 units per month.

- d. What questions would have to be answered about the cost-volume-profit analysis simplifying assumptions before adopting the price-cut strategy of part *c*?
- e. Calculate monthly operating income (or loss) that would result from a \$1 per unit price increase and a \$6,000 per month increase in advertising expenses, both relative to the original data. Assume a sales volume of 5,400 units per month.
- f. Management is considering a change in the salesforce compensation plan. Currently, each of the firm's two salespersons is paid a salary of \$2,500 per month. Calculate the monthly operating income (or loss) that would result from changing the compensation plan to a salary of \$400 per month, plus a commission of \$.80 per unit, assuming a sales volume of:
 1. 5,400 units per month.
 2. 6,000 units per month.
- g. Assuming that the sales volume of 6,000 units per month achieved in part *f* could also be achieved by increasing advertising by \$1,000 per month instead of changing the salesforce compensation plan, which strategy would you recommend? Explain your answer.



CVP analysis—what-if questions; sales mix issue. Kiwi Manufacturing Co. makes a single product that sells for \$32 per unit. Variable costs are \$20.80 per unit, and fixed costs total \$47,600 per month.

P12.18.
LO 7, 8, 9,
10, 11

Required:

- a. Calculate the number of units that must be sold each month for the firm to break even.
- b. Calculate operating income if 5,000 units are sold in a month.
- c. Calculate operating income if the selling price is raised to \$33 per unit, advertising expenditures are increased by \$7,000 per month, and monthly unit sales volume becomes 5,400 units.
- d. Assume that the firm adds another product to its product line and that the new product sells for \$20 per unit, has variable costs of \$14 per unit, and causes fixed expenses in total to increase to \$63,000 per month. Calculate the firm's operating income if 5,000 units of the original product and 4,000 units of the new product are sold each month. For the original product, use the selling price and variable cost data given in the problem statement.
- e. Calculate the firm's operating income if 4,000 units of the original product and 5,000 units of the new product are sold each month.
- f. Explain why operating income is different in parts *d* and *e*, even though sales totaled 9,000 units in each case.



CVP application—expand existing product line? Campus Canvas Co. currently makes and sells two models of a backpack/book sack. Data applicable to the current operation are summarized in the columns on the next page labeled Current Operation. Management is considering adding a Value model to its current Luxury and Economy models. Expected data if the new model is added are shown in the columns on the next page labeled Proposed Expansion.

P12.19.
LO 7, 8, 9,
10, 11

	Current Operation		Proposed Expansion		
	Luxury	Economy	Luxury	Economy	Value
Selling price per unit	\$20	\$12	\$20	\$12	\$15
Variable expenses per unit	8	7	8	7	8
Annual sales volume—units	10,000	20,000	6,000	17,000	8,000
Fixed expenses for year	Total of \$70,000		Total of \$84,000		

Required:

- Calculate the company's current total contribution margin and the current average contribution margin ratio.
- Calculate the company's current amount of operating income.
- Calculate the company's current break-even point in dollar sales.
- Explain why the company might incur a loss, even if the sales amount calculated in part *c* was achieved and selling prices and costs didn't change.
- Calculate the company's total operating income under the proposed expansion.
- Based on the proposed expansion data, would you recommend adding the Value model? Why or why not?
- Would your answer to part *f* change if the Value model sales volume were to increase to 10,000 units annually, and all other data remained the same? Why or why not?



P12.20.
LO 8, 9,
10, 11



CVP application—eliminate product from operations? Muscle Beach, Inc., makes three models of high-performance weight-training benches. Current operating data are summarized below:

	MegaMuscle	PowerGym	ProForce
Selling price per unit	\$170	\$220	\$310
Contribution margin per unit	51	77	62
Monthly sales volume—units	4,000	3,000	1,000
Fixed expenses per month	Total of \$468,000		

Required:

- Calculate the contribution margin ratio of each product.
- Calculate the firm's overall contribution margin ratio.
- Calculate the firm's monthly break-even point in sales dollars.
- Calculate the firm's monthly operating income.
- Management is considering the elimination of the ProForce model due to its low sales volume and low contribution margin ratio. As a result, total fixed expenses can be reduced to \$420,000 per month. Assuming that this change would not affect the other models, would you recommend the elimination of the ProForce model? Explain your answer.
- Assume the same facts as in part *e*. Assume also that the sales volume for the PowerGym model will increase by 500 units per month if the ProForce model is eliminated. Would you recommend the elimination of the ProForce model? Explain your answer.



CVP analysis—effects of changes in cost structure; break even. Greene Co. makes and sells a single product. The current selling price is \$32 per unit. Variable expenses are \$20 per unit, and fixed expenses total \$43,200 per month. Sales volume for January totaled 4,100 units.

P12.21.
LO 8, 9, 11

Required:

- Calculate operating income for January.
- Calculate the break-even point in terms of units sold and total revenues.
- Management is considering installing automated equipment to reduce direct labor cost. If this were done, variable expenses would drop to \$14 per unit, but fixed expenses would increase to \$67,800 per month.
 - Calculate operating income at a volume of 4,100 units per month with the new cost structure.
 - Calculate the break-even point in units with the new cost structure.
 - Why would you suggest that management seriously consider investing in the automated equipment and accept the new cost structure?
 - Why might management not accept your recommendation but decide instead to maintain the old cost structure?



CVP analysis—effects of change in cost structure; break even. Hucker, Inc., produces small-scale replicas of vintage automobiles for collectors and museums. Finished products are based on a 1/20th scale of originals. The firm's income statement showed the following:

P12.22.
LO 8, 9, 11



Revenues (1,500 units)	\$840,000
Variable expenses	<u>462,000</u>
Contribution margin	\$378,000
Fixed expenses	<u>290,000</u>
Operating income	<u>\$ 88,000</u>

An automated stamping machine has been developed that can efficiently produce body frames, hoods, and doors to the desired scale. If the machine is leased, fixed expenses will increase by \$30,000 per year. The firm's production capacity will increase, which is expected to result in a 20% increase in sales volume. It is also estimated that labor costs of \$28 per unit could be saved, because less polishing and finishing time will be required.

Required:

- Calculate the firm's current contribution margin ratio and break-even point in terms of revenues.
- Calculate the firm's contribution margin ratio and break-even point in terms of revenues if the new machine is leased.
- Calculate the firm's operating income assuming that the new machine is leased.
- Do you believe that management of Hucker, Inc., should lease the new machine? Explain your answer.



Cases

C12.23.
LO 8, 9, 11



CVP application—allow special discount? Assume that you are a sales representative for Saturn Candy Company. One of your customers is interested in buying some candy that will be given to the members of a high school Substance Abuse Awareness Club. The club members will be marching in a community parade and will give the candy to children who are watching the parade. Your customer has asked that you discount the normal selling price of the candy to be given to the club by 35%. You know that the contribution margin ratio of the candy, based on the regular selling price, is 50%.

Required:

Identify the pros and cons of complying with the customer's request, and state the recommendation you would make to your sales manager.

C12.24.
LO 5, 8, 9



CVP application—determine offering price. Bill Sparks is in charge of arranging the "attitude adjustment" period and dinner for the monthly meetings of the local chapter of the Young Executives Association. Bill is negotiating with a new restaurant that would like to have the group's business, and Bill wants to apply some of the cost-volume-profit analysis material he has learned. The restaurant is proposing its regular menu prices of \$1.50 for a before-dinner drink, and \$16.50 for dinner. Bill has determined that on average, the persons attending the meeting have 1.5 drinks before dinner. He also believes that the contribution margin ratios for the drinks and dinner are 60% and 45%, respectively.

Required:

Prepare a memo to Bill outlining the possible offers he might make to the restaurant owner, and recommend which offer he should make.

C12.25.
LO 12



Comparison of operating leverage and financial leverage. The concept of financial leverage was introduced in Chapter 7 and expanded upon in Chapter 11. In Exercise 7.15, you were asked to describe the risks associated with financial leverage. You should now review the solution provided for this problem in the student supplement, *Student Study Resource*.

Required:

- Describe the risks associated with operating leverage.
- Outline the similarities and differences between operating leverage and financial leverage. (*Hint: Compare Exhibit 12-9 to the discussion and analysis in Exhibits 7-2 and 11-3.*)

C12.26.
LO 12



Understanding the effects of operating leverage. Clarke, Inc., and Spence Co. compete within the same industry and had the following operating results in 2003:

	Clarke, Inc.	Spence Co.
Sales	\$420,000	\$420,000
Variable expenses	84,000	252,000
Contribution margin	\$336,000	\$168,000
Fixed expenses	294,000	126,000
Operating income	\$ 42,000	\$ 42,000

Required:

- a. Calculate the break-even point for each firm in terms of revenue.
- b. What observations can you draw by examining the break-even point of each firm given that they earned an equal amount of operating income on identical sales volumes in 2003?
- c. Calculate the amount of operating income (or loss) that you would expect each firm to report in 2004 if sales were to:
 1. Increase by 20%.
 2. Decrease by 20%.
- d. Using the amounts computed in requirement c above, calculate the increase or decrease in the amount of operating income expected in 2004 from the amount reported in 2003.
- e. Explain why an equal percentage increase (or decrease) in sales for each firm would have such differing effects on operating income.
- f. Calculate the ratio of contribution margin to operating income for each firm in 2003. (*Hint: Divide contribution margin by operating income.*)
- g. Multiply the expected increase in sales of 20% for 2004 by the ratio of contribution margin to operating income for 2003 computed in requirement f for each firm. (*Hint: Multiply your answer in requirement f by .2.*)
- h. Multiply your answer in requirement g by the operating income of \$42,000 reported in 2003 for each firm.
- i. Compare your answer in requirement h with your answer in requirement d. What conclusions can you draw about the effects of operating leverage from the steps you performed in requirements f, g, and h?



Break-even analysis, CVP application using Internet tools. You have recently been engaged by Dominic's Italian Cafe to evaluate the financial impact of adding gourmet pizza items to the menu. A survey of the clientele indicates that demand for the product exists at an average selling price of \$18 per pizza. Fixed costs related to new equipment would be \$12,000 per month. Variable costs for ingredients, labor, and electricity for the oven would average \$6 per pizza. You decide that a good starting point is to conduct an initial break-even analysis on the new project.

Knowing that many commercial Internet companies provide free downloads or online demos of their products for your evaluation and testing pleasure, you decide to conduct the break-even analysis using break-even calculators that have been located at several websites.

Required:

- a. Calculate the break-even point in pizzas per month and print your results using the online break-even analysis tools at each of the following websites:
 1. www.anz.com.au/australia/business/calculator/businessbenchmark/break_even.asp
 2. www.dinkytown.net/java/breakeven.html
 3. www.calculatorweb.com/calculators/profitcalc/
- b. Calculate the break-even point in pizzas per month and print your results using the break-even chart analysis spreadsheet available at the following website:
 1. Go to www.jaxworks.com, the Small Business Spreadsheet Factory.

**C12.27.
LO 11**





2. Click on the “Downloads” link to access the list of free spreadsheets and other files.
3. Scroll down the file list and download the file “Breakeven Chart Analysis” for Excel.
- c. Write a comparative analysis of each of the four tools that you used to calculate the break-even point. You might discuss strengths, weaknesses, usefulness, and user interaction of each tool.
- d. Dominic’s now is interested in the amount of operating income available from the gourmet pizza operation if sales are initially expected to be 2,000 pizzas each month. Calculate the operating income and print your results using the Excel file “Contribution Income Analysis” available at www.jaxworks.com.
- e. Dominic’s now would like to understand the effect on operating income if certain changes in costs or volume occur. Use the “Contribution Income Analysis” Excel spreadsheet to evaluate each of the following independent cases assuming sales are initially expected to be 2,000 pizzas each month.
 1. Selling price is lowered by 10% and pizza sales are expected to increase by 5%.
 2. Selling price is increased to \$20 and pizza sales are expected to decrease by 20%.
 3. Higher-quality ingredients are used at a cost of \$8 per pizza and pizza sales are expected to increase to 2,200 pizzas per month.
 4. A more efficient pizza oven is available that would reduce the electricity used in baking each pizza. Variable costs would be reduced to \$5 per pizza. The more efficient oven would increase the fixed costs to \$15,000 per month.
- f. Write a memo to Dominic’s explaining the results of your analysis.

