Chapter 22

Cost-Volume-Profit

STUDY OBJECTIVES

After studying this chapter, you should be able to:

1. Distinguish between variable and fixed costs.
2. Explain the significance of the relevant range.
3. Explain the concept of mixed costs.
4. List the five components of cost-volume-profit analysis.
5. Indicate what contribution margin is and how it can be expressed.
6. Identify the three ways to determine the break-even point.
7. Give the formulas for determining sales required to earn target net income.
8. Define margin of safety, and give the formulas for computing it.
9. Describe the essential features of a cost-volume-profit income statement.

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- Scan **Study Objectives**
- Read **Feature Story**
- Read **Preview**
- Read text and answer **DO IT!** p. 981 p. 983 p. 989 p. 994
- Work **Comprehensive** **DO IT!** p. 996
- Review **Summary of Study Objectives**
- Answer **Self-Study Questions**
- Complete **Assignments**

Feature Story

GROWING BY LEAPS AND LEOTARDS

When the last of her three children went off to school, Amy began looking for a job. At this same time, her daughter asked to take dance classes. The nearest dance studio was over 20 miles away, and Amy didn't know how she would balance a new job and drive her daughter to dance class. Suddenly it hit her—why not start her own dance studio?

Amy sketched out a business plan: A local church would rent its basement to her for $6 per hour. The size of the basement limited the number of students she could teach, but the rent was low. Insurance for a small studio was $50 per month. Initially she would teach only classes for young kids since that was all she felt qualified to do. She thought she could

charge $2.50 for a one-hour class. There was room for eight students per class. She wouldn't get rich—but at least it would be fun, and she didn't have much at risk.

Amy soon realized that the demand for dance classes far exceeded her capacity. She considered renting a bigger space that could serve 15 students per class. But her rent would also increase significantly. Also, rather than paying rent by the hour, she would have to pay $600 per month, even during the summer months when demand for dance classes was low. She also would have to pay utilities—roughly $70 per month.

However, with a bigger space Amy could offer classes for teens and adults. Teens and adults would pay a higher fee—$5 per hour—though the number of students per class would have to be smaller, probably only eight per class. She could hire a part-time instructor at about $18 per hour to teach advanced classes. Insurance costs could increase to $100 per month. In addition, she would need a part-time administrator at $100 per month to keep records. Amy also realized she could increase her income by selling dance supplies such as shoes, towels, and leotards.

Amy laid out a new business plan based on these estimates. If she failed, she stood to lose real money. Convinced she could make a go of it, she made the big plunge.

Her planning paid off: Within 10 years of starting her business in a church basement Amy had over 800 students, seven instructors, two administrators, and a facility with three separate studios.

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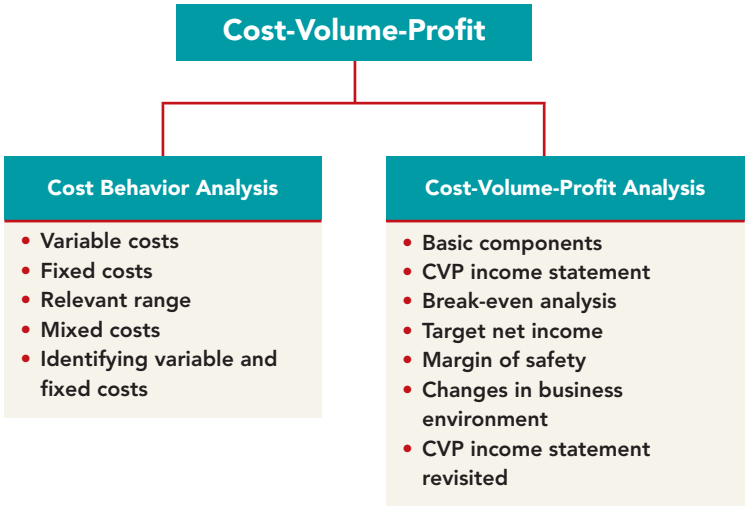
Inside Chapter 22...

Preview of Chapter 22

As the Feature Story indicates, to manage any size business you must understand how costs respond to changes in sales volume and the effect of costs and revenues on profits. A prerequisite to understanding cost-volume-profit (CVP) relationships is knowledge of how costs behave. In this chapter, we first explain the considerations involved in cost behavior analysis. Then we discuss and illustrate CVP analysis.

The content and organization of Chapter 22 are as follows.



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COST BEHAVIOR ANALYSIS

Cost behavior analysis is the study of how specific costs respond to changes in the level of business activity. As you might expect, some costs change, and others remain the same. For example, for an airline company such as Southwest or United, the longer the flight the higher the fuel costs. On the other hand, Massachusetts General Hospital's costs to staff the emergency room on any given night are relatively constant regardless of the number of patients treated. A knowledge of cost behavior helps management plan operations and decide between alternative courses of action. Cost behavior analysis applies to all types of entities, as the Feature Story about Amy's dance studio indicates.

The starting point in cost behavior analysis is measuring the key business activities. Activity levels may be expressed in terms of sales dollars (in a retail company), miles driven (in a trucking company), room occupancy (in a hotel), or dance classes taught (by a dance studio). Many companies use more than one measurement base. A manufacturer, for example, may use direct labor hours or units of output for manufacturing costs and sales revenue or units sold for selling expenses.

For an activity level to be useful in cost behavior analysis, changes in the level or volume of activity should be correlated with changes in costs. The activity level selected is referred to as the activity (or volume) index. The **activity index** identifies the activity that causes changes in the behavior of costs. With an appropriate activity index, companies can classify the behavior of costs in response to changes in activity levels into three categories: variable, fixed, or mixed.

Variable Costs

STUDY OBJECTIVE 1
Distinguish between variable and fixed costs.

Variable costs are costs that vary **in total** directly and proportionately with changes in the activity level. If the level increases 10%, total variable costs will increase 10%. If the level of activity decreases by 25%, variable costs will decrease 25%. Examples of variable costs include direct materials and direct labor for a manufacturer; cost of goods sold, sales commissions, and freight-out for a merchandiser; and gasoline in airline and trucking companies. A variable cost may also be defined as a cost that **remains the same *per unit* at every level of activity**.

To illustrate the behavior of a variable cost, assume that Damon Company manufactures radios that contain a $10 digital clock. The activity index is the number of radios produced. As Damon manufactures each radio, the total cost of the clocks increases by $10. As part (a) of Illustration 22-1 shows, total cost of the clocks will be $20,000 if Damon produces 2,000 radios, and $100,000 when it produces 10,000 radios. We also can see that a variable cost remains the same per unit as the level of activity changes. As part (b) of Illustration 22-1 shows, the unit cost of $10 for the clocks is the same whether Damon produces 2,000 or 10,000 radios.

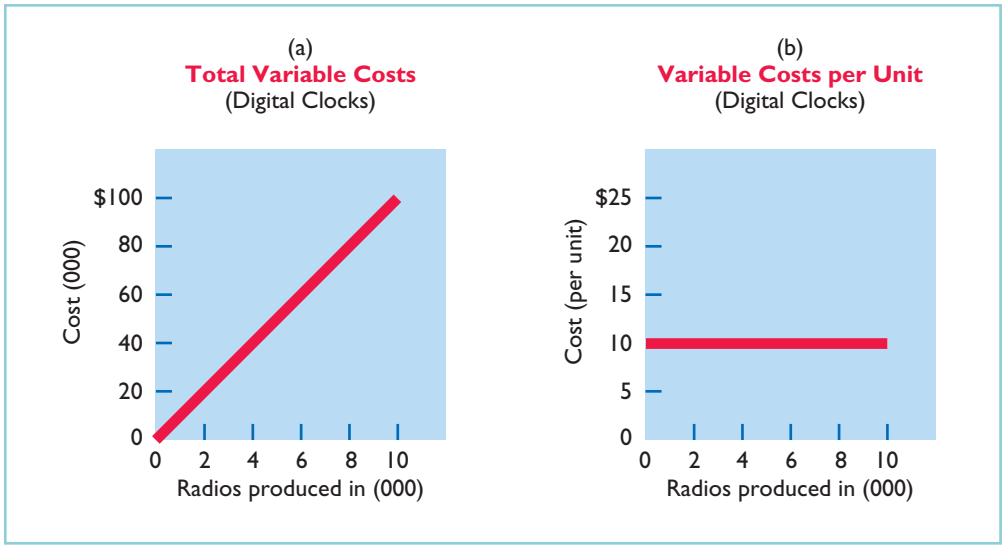


Illustration 22-1
Behavior of total and unit variable costs

HELPFUL HINT
True or false: Variable cost per unit changes directly and proportionately with changes in activity.
Answer: False. Per unit cost remains constant at all levels of activity.

Companies that rely heavily on labor to manufacture a product, such as Nike or Reebok, or to provide a service, such as Hilton or Marriott, are likely to have many variable costs. In contrast, companies that use a high proportion of machinery and equipment in producing revenue, such as AT&T or Duke Energy Co., may have few variable costs.

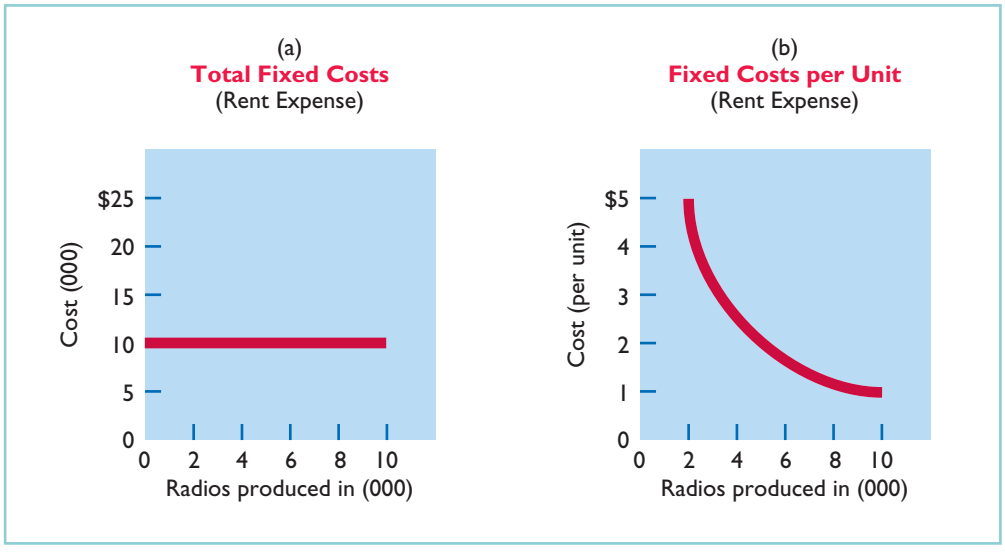
Fixed Costs

Fixed costs are costs that **remain the same in total** regardless of changes in the activity level. Examples include property taxes, insurance, rent, supervisory salaries, and depreciation on buildings and equipment. Because total fixed costs remain constant as activity changes, it follows that **fixed costs *per unit* vary inversely with activity: As volume increases, unit cost declines, and vice versa**.

To illustrate the behavior of fixed costs, assume that Damon Company leases its productive facilities at a cost of $10,000 per month. Total fixed costs of the facilities will remain constant at every level of activity, as part (a) of Illustration 22-2 (page 978) shows. But, on a per unit basis, the cost of rent will

decline as activity increases, as part (b) of Illustration 22-2 shows. At 2,000 units, the unit cost is $5 ($10,000 ÷ 2,000). When Damon produces 10,000 radios, the unit cost is only $1 ($10,000 ÷ 10,000).

Illustration 22-2
Behavior of total and unit fixed costs



The trend for many manufacturers is to have more fixed costs and fewer variable costs. This trend is the result of increased use of automation and less use of employee labor. As a result, depreciation and lease charges (fixed costs) increase, whereas direct labor costs (variable costs) decrease.

Relevant Range

STUDY OBJECTIVE 2
Explain the significance of the relevant range.

In Illustration 22-1, part (a), (page 977), a straight line is drawn throughout the entire range of the activity index for total variable costs. In essence, the assumption is that the costs are **linear**. If a relationship is linear (that is, straight-line), then changes in the activity index will result in a direct, proportional change in the variable cost. For example, if the activity level doubles, the cost doubles.

It is now necessary to ask: Is the straight-line relationship realistic? Does the linear assumption produce useful data for CVP analysis?

In most business situations, a straight-line relationship **does not exist** for variable costs throughout the entire range of possible activity. At abnormally low levels of activity, it may be impossible to be cost-efficient. Small-scale operations may not allow the company to obtain quantity discounts for raw materials or to use specialized labor. In contrast, at abnormally high levels of activity, labor costs may increase sharply because of overtime pay. Also at high activity levels, materials costs may jump significantly because of excess spoilage caused by worker fatigue.

As a result, in the real world, the relationship between the behavior of a variable cost and changes in the activity level is often **curvilinear**, as shown in part (a) of Illustration 22-3 (next page). In the curved sections of the line, a change in the activity index will not result in a direct, proportional change in the variable cost. That is, a doubling of the activity index will not result in an exact doubling of the variable cost. The variable cost may more than double, or it may be less than double.

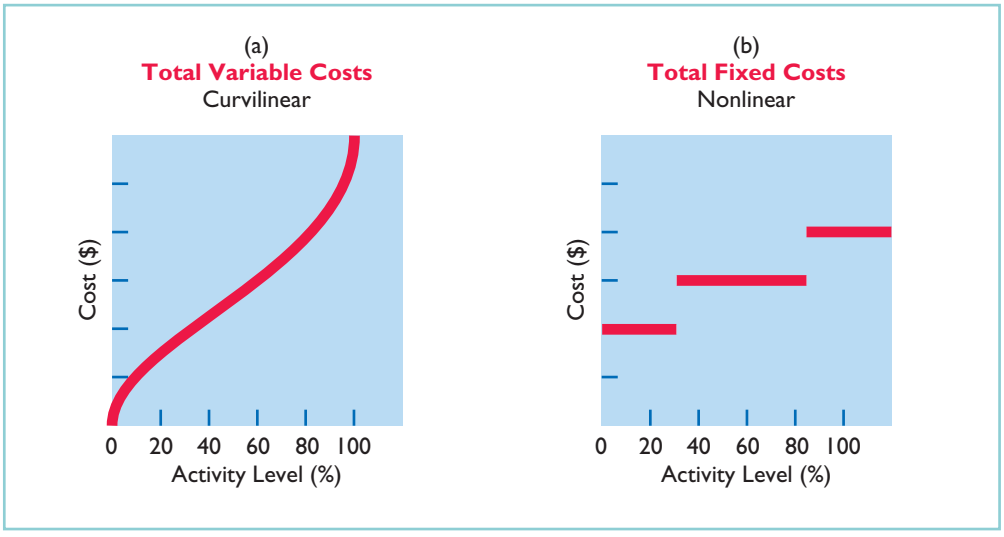


Illustration 22-3
Nonlinear behavior of variable and fixed costs

Total fixed costs also do not have a straight-line relationship over the entire range of activity. Some fixed costs will not change. But it is possible for management to change other fixed costs. For example, in the Feature Story the dance studio's rent was originally variable and then became fixed at a certain amount. It then increased to a new fixed amount when the size of the studio increased beyond a certain point. Illustration 23-3, part (b), shows an example of the behavior of total fixed costs through all potential levels of activity.

For most companies, operating at almost zero or at 100% capacity is the exception rather than the rule. Instead, companies often operate over a somewhat narrower range, such as 40–80% of capacity. The range over which a company expects to operate during a year is called the **relevant range** of the activity index. Within the relevant range, as both diagrams in Illustration 22-4 show, a straight-line relationship generally exists for both variable and fixed costs.

HELPFUL HINT
Fixed costs that may be changeable include research, such as new product development, and management training programs.

ALTERNATIVE TERMINOLOGY
The relevant range is also called the *normal* or *practical range*.

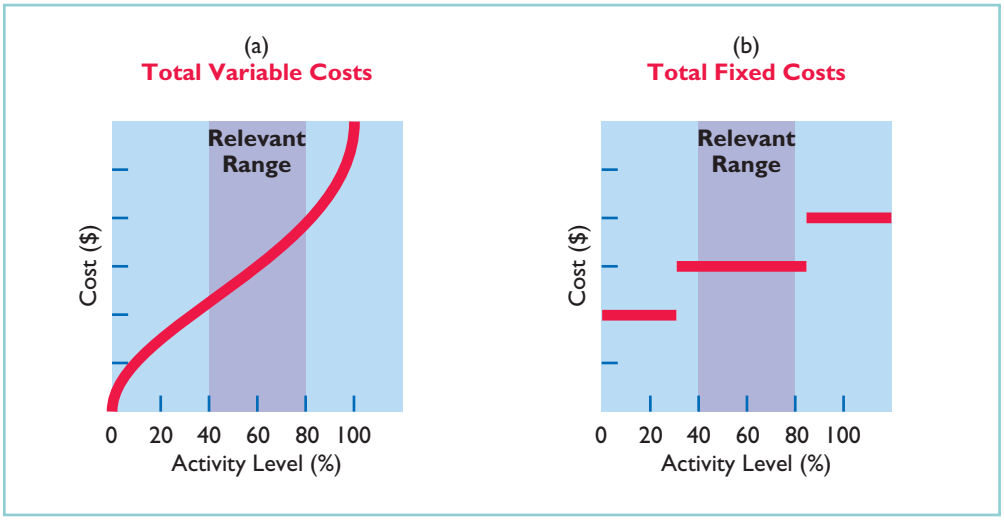


Illustration 22-4
Linear behavior within relevant range

As you can see, although the linear (straight-line) relationship may not be completely realistic, **the linear assumption produces useful data for CVP analysis as long as the level of activity remains within the relevant range**.

Mixed Costs

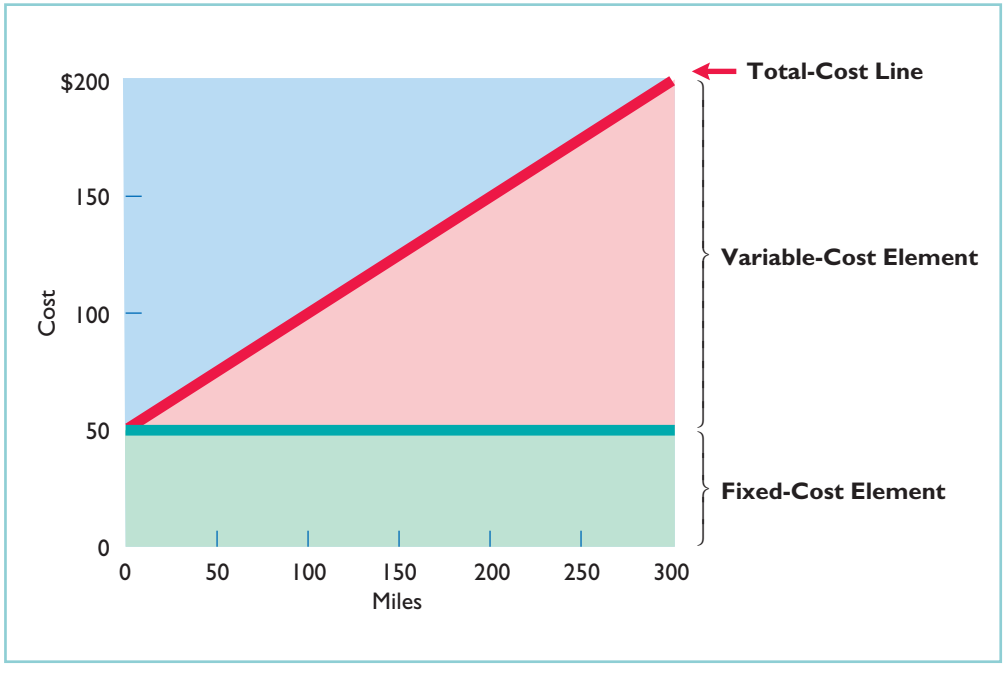
STUDY OBJECTIVE 3

Explain the concept of mixed costs.

Mixed costs are costs that contain both a variable element and a fixed element. **Mixed costs, therefore, change in total but not proportionately with changes in the activity level**.

The rental of a U-Haul truck is a good example of a mixed cost. Assume that local rental terms for a 17-foot truck, including insurance, are $50 per day plus 50 cents per mile. When determining the cost of a one-day rental, the per day charge is a fixed cost (with respect to miles driven), whereas the mileage charge is a variable cost. The graphic presentation of the rental cost for a one-day rental is as follows.

Illustration 22-5
Behavior of a mixed cost



In this case, the fixed-cost element is the cost of having the service available. The variable-cost element is the cost of actually using the service. Another example of a mixed cost is utility costs (electric, telephone, and so on), where there is a flat service fee plus a usage charge.

For purposes of CVP analysis, **mixed costs must be classified into their fixed and variable elements**. How does management make the classification? One possibility is to determine the variable and fixed components each time a mixed cost is incurred. But because of time and cost constraints, this approach is rarely followed. Instead, the usual approach is to collect data on the behavior of the mixed costs at various levels of activity. Analysts then identify the fixed and variable cost components. Companies use various types of analysis. One type of analysis, called the **high-low method**, is discussed on page 981. Other methods, such as the scatter diagram method and least squares regression analysis, are more appropriately explained in cost accounting courses.

DO IT!

TYPES OF COSTS

Helena Company reports the following total costs at two levels of production.

	10,000 Units	20,000 Units
Direct materials	$20,000	$40,000
Maintenance	8,000	10,000
Direct labor	17,000	34,000
Indirect materials	1,000	2,000
Depreciation	4,000	4,000
Utilities	3,000	5,000
Rent	6,000	6,000

Classify each cost as variable, fixed, or mixed.

action plan

- ✔ Recall that a variable cost varies in total directly and proportionately with each change in activity.
- ✔ Recall that a fixed cost remains the same in total with each change in activity.
- ✔ Recall that a mixed cost changes in total but not proportionately with each change in activity.

Solution

Variable costs: Direct materials, direct labor, and indirect materials are variable costs.

Fixed costs: Depreciation and rent are fixed costs.

Mixed costs: Maintenance and utilities are mixed costs.

Related exercise material: **BE22-1, BE22-2, E22-1, E22-2, E22-3,** and **DO IT! 22-1.**

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HIGH-LOW METHOD

The **high-low method** uses the total costs incurred at the high and low levels of activity to classify mixed costs into fixed and variable components. The difference in costs between the high and low levels represents variable costs, since only the variable cost element can change as activity levels change.

The steps in computing fixed and variable costs under this method are as follows.

1. Determine variable cost per unit from the following formula.

Change in Total Costs	÷	High minus Low Activity Level	=	Variable Cost per Unit

Illustration 22-6
Formula for variable cost per unit using high-low method

To illustrate, assume that Metro Transit Company has the following maintenance costs and mileage data for its fleet of buses over a 4-month period.

Month	Miles Driven	Total Cost	Month	Miles Driven	Total Cost
January	**20,000**	**$30,000**	March	35,000	$49,000
February	40,000	48,000	April	**50,000**	**63,000**

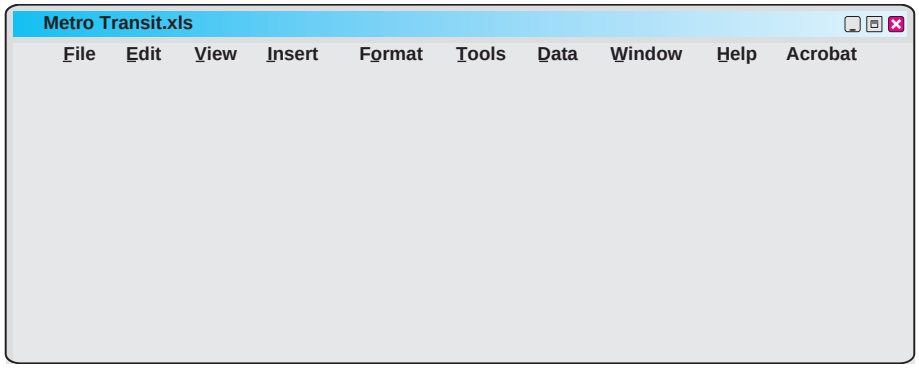
Illustration 22-7
Assumed maintenance costs and mileage data

The high and low levels of activity are 50,000 miles in April and 20,000 miles in January. The maintenance costs at these two levels are $63,000 and $30,000, respectively. The difference in maintenance costs is $33,000 ($63,000 − $30,000), and the difference in miles is 30,000 (50,000 − 20,000). Therefore, for Metro Transit, variable cost per unit is $1.10, computed as follows.

$$\$33{,}000 \div 30{,}000 = \$1.10$$

2. **Determine the fixed cost by subtracting the total variable cost at either the high or the low activity level from the total cost at that activity level.**

   For Metro Transit, the computations are shown in Illustration 22-8.



Maintenance costs are therefore $8,000 per month plus $1.10 per mile. This is represented by the following formula:

$$\text{Maintenance costs} = \text{Fixed costs} + (\$1.10 \times \text{miles driven})$$

For example, at 45,000 miles, estimated maintenance costs would be $8,000 fixed and $49,500 variable ($1.10 × 45,000) for a total of $57,500.

The high-low method generally produces a reasonable estimate for analysis. However, it does not produce a precise measurement of the fixed and variable elements in a mixed cost because it ignores other activity levels in the computation.

Importance of Identifying Variable and Fixed Costs

Why is it important to segregate costs into variable and fixed elements? The answer may become apparent if we look at the following four business decisions.

1. If American Airlines is to make a profit when it reduces all domestic fares by 30%, what reduction in costs or increase in passengers will be required?
   Answer: To make a profit when it cuts domestic fares by 30%, American Airlines will have to increase the number of passengers or cut its variable costs for those flights. Its fixed costs will not change.
2. If Ford Motor Company meets workers' demands for higher wages, what increase in sales revenue will be needed to maintain current profit levels?
   Answer: Higher wages at Ford Motor Company will increase the variable costs of manufacturing automobiles. To maintain present profit levels, Ford will have to cut other variable costs or increase the price of its automobiles.
3. If United States Steel Corp.'s program to modernize plant facilities through significant equipment purchases reduces the work force by 50%, what will be the effect on the cost of producing one ton of steel?
   Answer: The modernizing of plant facilities at United States Steel Corp. changes the proportion of fixed and variable costs of producing one ton of steel. Fixed costs increase because of higher depreciation charges, whereas variable costs decrease due to the reduction in the number of steelworkers.
4. What happens if Kellogg Company increases its advertising expenses but cannot increase prices because of competitive pressure?
   Answer: Sales volume must be increased to cover the increase in fixed advertising costs.

DO IT!

HIGH-LOW METHOD

Byrnes Company accumulates the following data concerning a mixed cost, using units produced as the activity level.

	Units Produced	Total Cost
March	9,800	$14,740
April	8,500	13,250
May	7,000	11,100
June	7,600	12,000
July	8,100	12,460

(a) Compute the variable and fixed cost elements using the high-low method.
(b) Estimate the total cost if the company produces 6,000 units.

action plan

- ✔ Determine the highest and lowest levels of activity.
- ✔ Compute variable cost per unit as: Change in total costs ÷ High ÷ Low activity level = Variable cost per unit.
- ✔ Compute fixed cost as: Total cost − (Variable cost per unit × Units produced) = Fixed cost.

Solution

(a) Variable cost: ($14,740 − $11,100) ÷ (9,800 − 7,000) = $1.30 per unit
Fixed cost: $14,740 − $12,740 ($1.30 × 9,800 units) = $2,000
or $11,100 − $9,100 ($1.30 × 7,000) = $2,000

(b) Total cost to produce 6,000 units: $2,000 + $7,800 ($1.30 × 6,000) = $9,800

Related exercise material: **BE22-3, BE22-4, E22-1, E22-2, E22-3,** and **DO IT! 22-2.**

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COST-VOLUME-PROFIT ANALYSIS

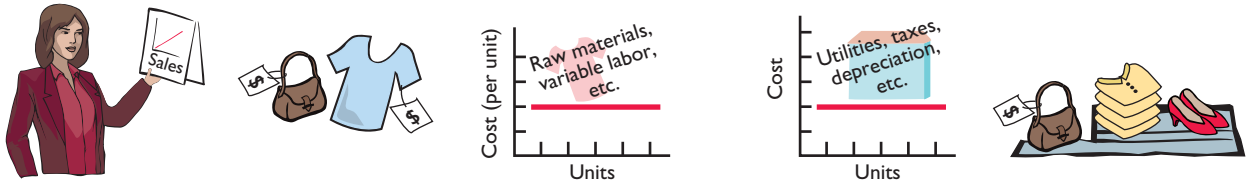
STUDY OBJECTIVE 4
List the five components of cost-volume-profit analysis.

Cost-volume-profit (CVP) analysis is the study of the effects of changes in costs and volume on a company's profits. CVP analysis is important in profit planning. It also is a critical factor in such management decisions as setting selling prices, determining product mix, and maximizing use of production facilities.

Basic Components

CVP analysis considers the interrelationships among the components shown in Illustration 22-9.

Illustration 22-9
Components of CVP analysis



Volume or level of activity | **Unit selling prices** | **Variable cost per unit** | **Total fixed costs** | **Sales mix**

The following assumptions underlie each CVP analysis.

1. The behavior of both costs and revenues is linear throughout the relevant range of the activity index.
2. Costs can be classified accurately as either variable or fixed.

3. Changes in activity are the only factors that affect costs.
4. All units produced are sold.
5. When more than one type of product is sold, the sales mix will remain constant. That is, the percentage that each product represents of total sales will stay the same. Sales mix complicates CVP analysis because different products will have different cost relationships. In this chapter we assume a single product.

When these assumptions are not valid, the CVP analysis may be inaccurate.

CVP Income Statement

STUDY OBJECTIVE 5
Indicate what contribution margin is and how it can be expressed.

Because CVP is so important for decision making, management often wants this information reported in a **CVP income statement** format for internal use. The CVP income statement classifies costs as variable or fixed and computes a contribution margin. **Contribution margin** is the amount of revenue remaining after deducting variable costs. It is often stated both as a total amount and on a per unit basis.

We will use Vargo Video Company to illustrate a CVP income statement. Vargo Video produces a high-end, progressive-scan DVD player/recorder with up to 160-hour recording capacity and MP3 playback capability. Relevant data for the DVD players sold by this company in June 2010 are as follows.

Illustration 22-10
Assumed selling and cost data for Vargo Video

Unit selling price of DVD player	$500
Unit variable costs	$300
Total monthly fixed costs	$200,000
Units sold	1,600

The CVP income statement for Vargo Video therefore would be reported as follows.

Illustration 22-11
CVP income statement, with net income

VARGO VIDEO COMPANY
CVP Income Statement
For the Month Ended June 30, 2010

	Total	Per Unit
Sales (1,600 DVD players)	$800,000	$ 500
Variable costs	480,000	300
Contribution margin	**320,000**	**$200**
Fixed costs	200,000	
Net income	**$120,000**	

A traditional income statement and a CVP income statement both report the same net income of $120,000. However a traditional income statement does not classify costs as variable or fixed, and therefore it does not report a contribution margin. In addition, both a total and a per unit amount are often shown on a CVP income statement to facilitate CVP analysis.

In the applications of CVP analysis that follow, we assume that the term "cost" includes all costs and expenses related to production and sale of the product. That is, cost includes manufacturing costs plus selling and administrative expenses.

CONTRIBUTION MARGIN PER UNIT

Vargo Video's CVP income statement shows a contribution margin of $320,000, and a contribution margin per unit of $200 ($500 $300). The formula for **contribution margin per unit** and the computation for Vargo Video are:

Unit Selling Price	–	Unit Variable Costs	=	Contribution Margin per Unit
$500		$300		**$200**

Illustration 22-12
Formula for contribution margin per unit

Contribution margin per unit indicates that for every DVD player sold, Vargo has $200 to cover fixed costs and contribute to net income. Because Vargo Video has fixed costs of $200,000, it must sell 1,000 DVD players ($200,000 $200) before it earns any net income. Vargo's CVP income statement, assuming a zero net income, is as follows.

VARGO VIDEO COMPANY
CVP Income Statement
For the Month Ended June 30, 2010

	Total	Per Unit
Sales (1,000 DVD players)	$500,000	$500
Variable costs	300,000	300
Contribution margin	**200,000**	**$200**
Fixed costs	200,000	
Net income	**$ –0–**	

Illustration 22-13
CVP income statement, with zero net income

It follows that for every DVD player sold above 1,000 units, net income increases $200. For example, assume that Vargo sold one more DVD player, for a total of 1,001 DVD players sold. In this case Vargo reports net income of $200 as shown in Illustration 22-14.

VARGO VIDEO COMPANY
CVP Income Statement
For the Month Ended June 30, 2010

	Total	Per Unit
Sales (1,001 DVD players)	$500,500	$500
Variable costs	300,300	300
Contribution margin	**200,200**	**$200**
Fixed costs	200,000	
Net income	**$ 200**	

Illustration 22-14
CVP income statement, with net income

CONTRIBUTION MARGIN RATIO

Some managers prefer to use a contribution margin ratio in CVP analysis. The **contribution margin ratio** is the contribution margin per unit divided by the unit selling price. For Vargo Video, the ratio is shown in illustration 22-15 on the next page.

Illustration 22-15
Formula for contribution margin ratio

Contribution Margin per Unit	÷	Unit Selling Price	=	Contribution Margin Ratio
$200		$500		40%

The contribution margin ratio of 40% means that $0.40 of each sales dollar ($1 40%) is available to apply to fixed costs and to contribute to net income.

This expression of contribution margin is very helpful in determining the effect of changes in sales dollars on net income. For example, if sales increase $100,000, net income will increase $40,000 (40% $100,000). Thus, by using the contribution margin ratio, managers can quickly determine increases in net income from any change in sales dollars.

We can also see this effect through a CVP income statement. Assume that Vargo Video's current sales are $500,000 and it wants to know the effect of a $100,000 increase in sales. Vargo prepares a comparative CVP income statement analysis as follows.

Illustration 22-16
Comparative CVP income statements

VARGO VIDEO COMPANY
CVP Income Statements
For the Month Ended June 30, 2010

	No Change		With Change	
	Total	Per Unit	Total	Per Unit
Sales	$500,000	$500	$600,000	$500
Variable costs	300,000	300	360,000	300
Contribution margin	**200,000**	**$200**	**240,000**	**$200**
Fixed costs	200,000		200,000	
Net income	**$ –0–**		**$ 40,000**	

Study these CVP income statements carefully. The concepts presented in these statements are used extensively in this and later chapters.

Break-even Analysis

STUDY OBJECTIVE 6
Identify the three ways to determine the break-even point.

A key relationship in CVP analysis is the level of activity at which total revenues equal total costs (both fixed and variable). This level of activity is called the **break-even point**. At this volume of sales, the company will realize no income but will suffer no loss. The process of finding the break-even point is called **break-even analysis**. Knowledge of the break-even point is useful to management when it decides whether to introduce new product lines, change sales prices on established products, or enter new market areas.

The break-even point can be:

1. Computed from a mathematical equation.
2. Computed by using contribution margin.
3. Derived from a cost-volume-profit (CVP) graph.

The break-even point can be expressed either in **sales units** or **sales dollars**.

MATHEMATICAL EQUATION

Illustration 22-17 shows a common equation used for CVP analysis.

Illustration 22-17
Basic CVP equation

Sales	=	Variable Costs	+	Fixed Costs	+	Net Income

Identifying the break-even point is a special case of CVP analysis. Because at the break-even point net income is zero, **break-even occurs where total sales equal variable costs plus fixed costs**.

We can compute the break-even point **in units** directly from the equation by **using unit selling prices** and **unit variable costs**. The computation for Vargo Video is:

Sales	=	Variable Costs	+	Fixed Costs	+	Net Income
$500Q		$300Q		$200,000		$0

$200Q $200,000
Q **1,000 units**

where

Q	sales volume in units
$500	selling price
$300	variable cost per unit
$200,000	total fixed costs

Illustration 22-18 Computation of break-even point

Thus, Vargo Video must sell 1,000 units to break even.

To find **sales dollars** required to break even, we multiply the units sold at the break-even point times the selling price per unit, as shown below.

1,000 $500 $500,000 (break-even sales dollars)

CONTRIBUTION MARGIN TECHNIQUE

We know that contribution margin equals total revenues less variable costs. It follows that at the break-even point, **contribution margin must equal total fixed costs**. On the basis of this relationship, we can compute the break-even point using either the contribution margin per unit or the contribution margin ratio.

When a company uses the contribution margin per unit, the formula to compute break-even point in units is fixed costs divided by contribution margin per unit. For Vargo Video the computation is as follows.

Fixed Costs	÷	Contribution Margin per Unit	=	Break-even Point in Units
$200,000		$200		**1,000 units**

Illustration 22-19 Formula for break-even point in units using contribution margin

One way to interpret this formula is that Vargo Video generates $200 of contribution margin with each unit that it sells. This $200 goes to pay off fixed costs. Therefore, the company must sell 1,000 units to pay off $200,000 in fixed costs.

When a company uses the contribution margin ratio, the formula to compute break-even point in dollars is fixed costs divided by the contribution margin ratio. We know that the contribution margin ratio for Vargo Video is 40% ($200 $500), which means that every dollar of sales generates 40 cents to pay off fixed costs. Thus, the break-even point in dollars is:

Fixed Costs	÷	Contribution Margin Ratio	=	Break-even Point in Dollars
$200,000		40%		**$500,000**

Illustration 22-20 Formula for break-even point in dollars using contribution margin ratio

ACCOUNTING ACROSS THE ORGANIZATION

Charter Flights Offer a Good Deal

The Internet is wringing inefficiencies out of nearly every industry. While commercial aircraft spend roughly 4,000 hours a year in the air, chartered aircraft spend only 500 hours flying. That means that they are sitting on the ground—not making any money—about 90% of the time. One company, FlightServe, saw a business opportunity in that fact. For about the same cost as a first-class ticket, FlightServe decided to match up executives with charter flights in small "private jets." The executive would get a more comfortable ride and could avoid the hassle of big airports. FlightServe noted that the average charter jet has eight seats. When all eight seats were full, the company would have an 80% profit margin. It would break even at an average of 3.3 full seats per flight.

Source: "Jet Set Go," *The Economist*, March 18, 2000, p. 68.

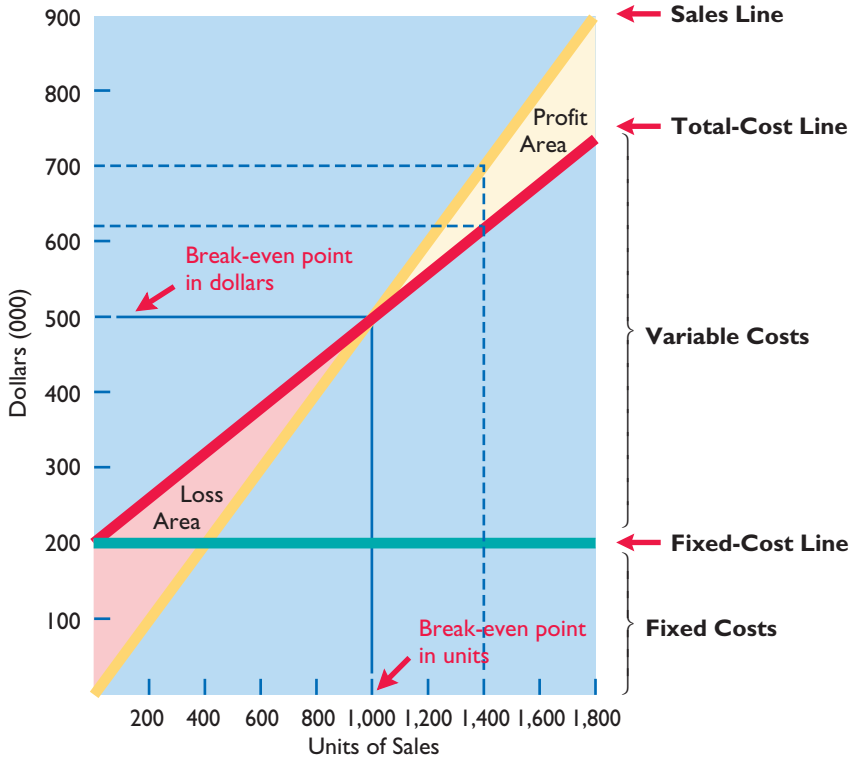
How did FlightServe determine that it would break even with 3.3 seats full per flight?

GRAPHIC PRESENTATION

An effective way to find the break-even point is to prepare a break-even graph. Because this graph also shows costs, volume, and profits, it is referred to as a **cost-volume-profit (CVP) graph**.

As the CVP graph in Illustration 22-21 shows, sales volume is recorded along the horizontal axis. This axis should extend to the maximum level of expected sales. Both total revenues (sales) and total costs (fixed plus variable) are recorded on the vertical axis.

Illustration 22-21
CVP graph



The construction of the graph, using the data for Vargo Video, is as follows.

1. Plot the total-sales line, starting at the zero activity level. For every DVD player sold, total revenue increases by $500. For example, at 200 units, sales are $100,000. At the upper level of activity (1,800 units), sales are $900,000. The revenue line is assumed to be linear through the full range of activity.
2. Plot the total fixed cost using a horizontal line. For the DVD players, this line is plotted at $200,000. The fixed cost is the same at every level of activity.
3. Plot the total-cost line. This starts at the fixed-cost line at zero activity. It increases by the variable cost at each level of activity. For each DVD player, variable costs are $300. Thus, at 200 units, total variable cost is $60,000, and the total cost is $260,000. At 1,800 units total variable cost is $540,000, and total cost is $740,000. On the graph, the amount of the variable cost can be derived from the difference between the total cost and fixed cost lines at each level of activity.
4. Determine the break-even point from the intersection of the total-cost line and the total-revenue line. The break-even point in dollars is found by drawing a horizontal line from the break-even point to the vertical axis. The break-even point in units is found by drawing a vertical line from the break-even point to the horizontal axis. For the DVD players, the break-even point is $500,000 of sales, or 1,000 units. At this sales level, Vargo Video will cover costs but make no profit.

The CVP graph also shows both the net income and net loss areas. Thus, the amount of income or loss at each level of sales can be derived from the total sales and total cost lines.

A CVP graph is useful because the effects of a change in any element in the CVP analysis can be quickly seen. For example, a 10% increase in selling price will change the location of the total revenue line. Likewise, the effects on total costs of wage increases can be quickly observed.

DO IT!

Lombardi Company has a unit selling price of $400, variable costs per unit of $240, and fixed costs of $180,000. Compute the break-even point in units using **(a)** a mathematical equation and **(b)** contribution margin per unit.

BREAK-EVEN ANALYSIS

action plan

- ✔ Apply the formula: Sales Variable costs Fixed costs Net income.
- ✔ Apply the formula: Fixed costs Contribution margin per unit Break-even point in units.

Solution

(a) The formula is $400Q $240Q $180,000. The break-even point in units is 1,125 ($180,000 $160).

(b) The contribution margin per unit is $160 ($400 $240). The formula therefore is $180,000 $160, and the break-even point in units is 1,125.

Related exercise material: **BE22-5, BE22-6, E22-4, E22-5, E22-6, E22-7, E22-8,** and **DO IT! 22-3.**

The Navigator

Target Net Income

STUDY OBJECTIVE 7

Give the formulas for determining sales required to earn target net income.

Rather than simply "breaking even," management usually sets an income objective often called **target net income**. It indicates the sales necessary to achieve a specified level of income. Companies determine the sales necessary to achieve target net income by using one of the three approaches discussed earlier.

MATHEMATICAL EQUATION

We know that at the break-even point no profit or loss results for the company. By adding an amount for target net income to the same basic equation, we obtain the following formula for determining required sales.

Illustration 22-22
Formula for required sales to meet target net income

Required Sales	=	Variable Costs	+	Fixed Costs	+	Target Net Income

Required sales may be expressed in either **sales units** or **sales dollars**. Assuming that target net income is $120,000 for Vargo Video, the computation of required sales in units is as follows.

Illustration 22-23
Computation of required unit sales

Required Sales	=	Variable Costs	+	Fixed Costs	+	Target Net Income
$500Q		$300Q		$200,000		$120,000

$200Q $320,000
Q **1,600**

where

Q	sales volume
$500	selling price
$300	variable costs per unit
$200,000	total fixed costs
$120,000	target net income

The sales dollars required to achieve the target net income is found by multiplying the units sold by the unit selling price [(1,600 $500) $800,000].

CONTRIBUTION MARGIN TECHNIQUE

As in the case of break-even sales, we can compute in either units or dollars the sales required to meet a target net income. The formula to compute required sales in units for Vargo Video using the contribution margin per unit is as follows.

Illustration 22-24
Formula for required sales in units using contribution margin per unit

Fixed Costs + Target Net Income	÷	Contribution Margin Per Unit	=	Required Sales in Units
($200,000 $120,000)		$200		**1,600 units**

This computation tells Vargo that to achieve its desired target net income of $120,000, it must sell 1,600 DVD players.

The formula to compute the required sales in dollars for Vargo Video using the contribution margin ratio is as follows.

Illustration 22-25
Formula for required sales in dollars using contribution margin ratio

Fixed Costs + Target Net Income	÷	Contribution Margin Ratio	=	Required Sales in Dollars
($200,000 $120,000)		40%		**$800,000**

This computation tells Vargo that to achieve its desired target net income of $120,000, it must generate sales of $800,000.

GRAPHIC PRESENTATION

We also can use the CVP graph in Illustration 22-21 (on page 988) to find the sales required to meet target net income. In the profit area of the graph, the distance between the sales line and the total cost line at any point equals net income. We can find required sales by analyzing the differences between the two lines until the desired net income is found.

For example, suppose Vargo Video sells 1,400 DVD players. Illustration 22-21 shows that a vertical line drawn at 1,400 units intersects the sales line at $700,000 and the total cost line at $620,000. The difference between the two amounts represents the net income (profit) of $80,000.

Margin of Safety

STUDY OBJECTIVE 8
Define margin of safety, and give the formulas for computing it.

The margin of safety is another relationship used in CVP analysis. **Margin of safety** is the difference between actual or expected sales and sales at the break-even point. This relationship measures the "cushion" that management has, allowing it to still break even if expected sales fail to materialize. The margin of safety is expressed in dollars or as a ratio.

The formula for stating the **margin of safety in dollars** is actual (or expected) sales minus break-even sales. Assuming that actual (expected) sales for Vargo Video are $750,000, the computation is:

Actual (Expected) Sales	–	Break-even Sales	=	Margin of Safety in Dollars
$750,000		$500,000		**$250,000**

Illustration 22-26
Formula for margin of safety in dollars

Vargo's margin of safety is $250,000. Its sales must fall $250,000 before it operates at a loss.

The **margin of safety ratio** is the margin of safety in dollars divided by actual (or expected) sales. The formula and computation for determining the margin of safety ratio are:

Margin of Safety in Dollars	÷	Actual (Expected) Sales	=	Margin of Safety Ratio
$250,000		$750,000		**33%**

Illustration 22-27
Formula for margin of safety ratio

This means that the company's sales could fall by 33% before it would be operating at a loss.

The higher the dollars or the percentage, the greater the margin of safety. Management continuously evaluates the adequacy of the margin of safety in terms of such factors as the vulnerability of the product to competitive pressures and to downturns in the economy.

MANAGEMENT INSIGHT

How a Rolling Stones' Tour Makes Money

Computation of break-even and margin of safety is important for service companies as well. Consider how the promoter for the Rolling Stones' tour used the break-even point and margin of safety. For example, one outdoor show should bring 70,000 individuals for a gross of $2.45 million. The promoter guarantees $1.2 million to the Rolling Stones. In addition, 20% of gross goes to the stadium in which the performance is staged. Add another $400,000 for other expenses such as ticket takers, parking attendants, advertising, and so on. The promoter also shares in sales of T-shirts and memorabilia for which the promoter will net over $7 million during the tour. From a successful Rolling Stones' tour, the promoter could make $35 million!

What amount of sales dollars are required for the promoter to break even?

CVP and Changes in the Business Environment

When the personal computer was introduced, it sold for $2,500; today similar computers sell for much less. Recently, when oil prices rose, the break-even point for airline companies such as American and Northwest rose dramatically. Because of lower prices for imported steel, the demand for domestic steel dropped significantly. The point should be clear: Business conditions change rapidly, and management must respond intelligently to these changes. CVP analysis can help.

To better understand how CVP analysis works, lets's look at three independent situations that might occur at Vargo Video. Each case uses the original DVD player sales and cost data, which were:

Illustration 22-28
Original DVD player sales and cost data

Unit selling price	$500
Unit variable cost	$300
Total fixed costs	$200,000
Break-even sales	$500,000 or 1,000 units

Case 1. A competitor is offering a 10% discount on the selling price of its DVD players. Management must decide whether to offer a similar discount.

Question: What effect will a 10% discount on selling price have on the break-even point for DVD players?

Answer: A 10% discount on selling price reduces the selling price per unit to $450 [$500 ($500 10%)]. Variable costs per unit remain unchanged at $300. Thus, the contribution margin per unit is $150. Assuming no change in fixed costs, break-even point is 1,333 units, computed as follows.

Illustration 22-29
Computation of break-even sales in units

Fixed Costs	÷	Contribution Margin per Unit	=	Break-even Point in Units
$200,000		$150		**1,333 units (rounded)**

For Vargo Video, this change requires monthly sales to increase by 333 units, or 33⅓%, in order to break even. In reaching a conclusion about offering a 10% discount to customers, management must determine how likely it is to achieve the increased sales. Also, management should estimate the possible loss of sales if the competitor's discount price is not matched.

Case 2. To meet the threat of foreign competition, management invests in new robotic equipment that will lower the amount of direct labor required to make DVD players. The company estimates that total fixed costs will increase 30% and that variable cost per unit will decrease 30%.

Question: What effect will the new equipment have on the sales volume required to break even?

Answer: Total fixed costs become $260,000 [$200,000 (30% $200,000)]. The variable cost per unit becomes $210 [$300 (30% $300)]. The new break-even point is approximately 897 units, computed as follows.

Fixed Costs	÷	Contribution Margin per Unit	=	Break-even Point in Units
$260,000		($500 $210)		897 units (rounded)

Illustration 22-30 Computation of break-even sales in units

These changes appear to be advantageous for Vargo Video. The break-even point is reduced by 10%, or 100 units.

Case 3. Vargo's principal supplier of raw materials has just announced a price increase. The higher cost is expected to increase the variable cost of DVD players by $25 per unit. Management decides to hold the line on the selling price of the DVD players. It plans a cost-cutting program that will save $17,500 in fixed costs per month. Vargo is currently realizing monthly net income of $80,000 on sales of 1,400 DVD players.

Question: What increase in units sold will be needed to maintain the same level of net income?

Answer: The variable cost per unit increases to $325 ($300 $25). Fixed costs are reduced to $182,500 ($200,000 $17,500). Because of the change in variable cost, the contribution margin per unit becomes $175 ($500 $325). The required number of units sold to achieve the target net income is computed as follows.

Fixed Costs + Target Net Income	÷	Contribution Margin per Unit	=	Required Sales in Units
($182,500 $80,000)		$175		1,500

Illustration 22-31 Computation of required sales

To achieve the required sales, Vargo will have to sell 1,500 DVD players, an increase of 100 units. If this does not seem to be a reasonable expectation, management will either have to make further cost reductions or accept less net income if the selling price remains unchanged.

CVP Income Statement Revisited

STUDY OBJECTIVE 9
Describe the essential features of a cost-volume-profit income statement.

Earlier in the chapter we presented a simple CVP income statement. When companies prepare a CVP income statement, they provide more detail about specific variable and fixed-cost items.

To illustrate a more detailed CVP income statement, we will assume that Vargo Video reaches its target net income of $120,000 (see Illustration 22-23 on page 990). The following information is obtained on the $680,000 of costs that were incurred in June to produce and sell 1,600 units.

	Variable	Fixed	Total
Cost of goods sold	$400,000	$120,000	$520,000
Selling expenses	60,000	40,000	100,000
Administrative expenses	20,000	40,000	60,000
	$480,000	$200,000	$680,000

Illustration 22-32 Assumed cost and expense data

The detailed CVP income statement for Vargo is shown on page 994.

Illustration 22-33
Detailed CVP income statement

VARGO VIDEO COMPANY
CVP Income Statement
For the Month Ended June 30, 2010

	Total		Per Unit
Sales		$800,000	$500
Variable expenses			
Cost of goods sold	$400,000		
Selling expenses	60,000		
Administrative expenses	20,000		
Total variable expenses		480,000	300
Contribution margin		**320,000**	**$200**
Fixed expenses			
Cost of goods sold	120,000		
Selling expenses	40,000		
Administrative expenses	40,000		
Total fixed expenses		200,000	
Net income		**$120,000**	

DO IT!

MARGIN OF SAFETY; REQUIRED SALES

Mabo Company makes calculators that sell for $20 each. For the coming year, management expects fixed costs to total $220,000 and variable costs to be $9 per unit.

(a) Compute break-even point in dollars using the contribution margin (CM) ratio.

(b) Compute the margin of safety percentage assuming actual sales are $500,000.

(c) Compute the sales required in dollars to earn net income of $165,000.

action plan

- ✔ Know the formulas.
- ✔ Recognize that variable costs change with sales volume; fixed costs do not.
- ✔ Avoid computational errors.

Solution

(a) Contribution margin per unit = Unit selling price − Unit variable costs
$11 = $20 − $9

Contribution margin ratio = Contribution margin per unit ÷ Unit selling price
55% = $11 ÷ $20

Break-even point in dollars = Fixed cost ÷ Contribution margin ratio
$220,000 ÷ 55%
$400,000

(b) Margin of safety = (Actual sales − Break-even sales) ÷ Actual sales

($500,000 − $400,000) ÷ $500,000

20%

(c) Required sales = Variable costs + Fixed costs + Net income

$20Q = $9Q + $220,000 + $165,000

$11Q = $385,000

Q = 35,000 units

35,000 units × $20 = $700,000 required sales

Related exercise material: **BE22-6, BE22-7, BE22-8, E22-5, E22-6, E22-7, E22-8, E22-9, E22-10,** and **DO IT! 22-4.**

The Navigator

Be sure to read **ALL ABOUT YOU: *A Hybrid Dilemma*** on the next page for information on how topics in this chapter apply to your personal life.

all about YOU

A Hybrid Dilemma

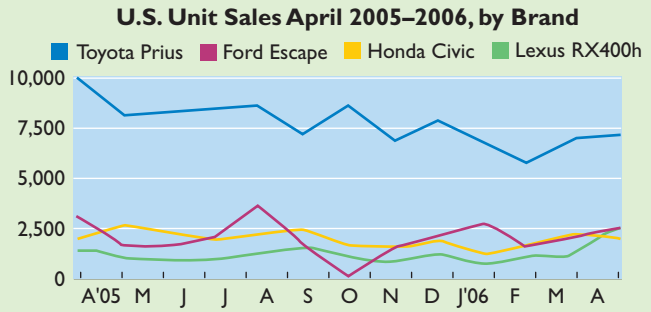
Have high gas prices got you down? Maybe you should consider a hybrid. These half-gas and half-electric vehicles are generating a lot of interest. They burn less fuel and therefore are easier on the environment. But are they easier on your pocketbook? Is a hybrid car at least a break-even investment, or is it more likely a losing proposition?

Some Facts

* Ford plans to sell at least seven different models of hybrid cars, about 250,000 vehicles annually, by the end of the decade.
* Hybrid vehicles typically cost $3,000 to $5,000 more than their conventional counterpart, although for some models the premium is higher.
* Bank of America and Timberland offer $3,000 to employees who purchase hybrids. Google offers $5,000 to employees who purchase cars that get at least 45 miles per gallon.
* The most fuel-efficient hybrids–the Toyota Prius and the Honda Civic–can save about $630 per year in fuel costs relative to a similar conventional car. However some other hybrids provide only slight fuel savings.
* Each gallon of gasoline that is not consumed reduces carbon dioxide emissions by 19 pounds. Many believe carbon dioxide contributes to global warming.
* The federal government initially provided tax credits of up to $3,400 to buyers of hybrids. These credits are to be phased out as automakers reach sales caps determined by the Internal Revenue Service (IRS).

About the Numbers

Sales of hybrid cars started very strong in 2005, but then tapered off. The following graph shows that sales of the Toyota Prius far exceed other brands.



Source: J.D. Power and Associates, 2006, "Happening Hybrids," as reported in the *Wall Street Journal*, May 23, 2006.

What Do You Think?

Gas prices are depleting your wallet so fast that you might even have to give up your old car and resort to walking or riding your bike on occasion. Will making the investment in a hybrid slow the outflow from your wallet and spare your feet?

YES: At 44 miles per gallon, I can drive forever without ever having to fill up.

NO: Because of the premium price charged for hybrids, I will never drive enough miles to break even on my investment.

Sources: "The Dollars and Sense of Hybrids," *Consumer Reports*, April, 2006, pp. 18-22.; John D. Stoll and Gina Chon, "Consumer Drive for Hybrid Autos Is Slowing Down," *Wall Street Journal*, April 7, 2006, p. A2. Associated Press, "Bank Workers Get Hybrid Reward," *Wall Street Journal*, June 8, 2006, p. D2.

The authors' comments on this situation appear on page 1014.

Comprehensive DO IT!

B.T. Hernandez Company, maker of high-quality flashlights, has experienced steady growth over the last 6 years. However, increased competition has led Mr. Hernandez, the president, to believe that an aggressive campaign is needed next year to maintain the company's present growth. The company's accountant has presented Mr. Hernandez with the following data for the current year, 2010, for use in preparing next year's advertising campaign.

Cost Schedules

Variable costs	
Direct labor per flashlight	$ 8.00
Direct materials	4.00
Variable overhead	3.00
Variable cost per flashlight	$15.00
Fixed costs	
Manufacturing	$ 25,000
Selling	40,000
Administrative	70,000
Total fixed costs	$135,000
Selling price per flashlight	$25.00
Expected sales, 2010 (20,000 flashlights)	$500,000

Mr. Hernandez has set the sales target for the year 2011 at a level of $550,000 (22,000 flashlights).

Instructions

(Ignore any income tax considerations.)

(a) What is the projected operating income for 2010?
(b) What is the contribution margin per unit for 2010?
(c) What is the break-even point in units for 2010?
(d) Mr. Hernandez believes that to attain the sales target in the year 2011, the company must incur an additional selling expense of $10,000 for advertising in 2011, with all other costs remaining constant. What will be the break-even point in dollar sales for 2011 if the company spends the additional $10,000?
(e) If the company spends the additional $10,000 for advertising in 2011, what is the sales level in dollars required to equal 2010 operating income?

action plan

- ✔ Know the formulas.
- ✔ Recognize that variable costs change with sales volume; fixed costs do not.
- ✔ Avoid computational errors.

Solution to Comprehensive DO IT!

(a)

Expected sales			$500,000
Less:			
Variable cost (20,000 flashlights	$15)	$300,000	
Fixed costs		135,000	435,000
Projected operating income			$ 65,000

(b)

Selling price per flashlight	$25
Variable cost per flashlight	15
Contribution margin per unit	$10

(c)

Fixed costs	Contribution margin per unit	Break-even point in units
$135,000	$10	13,500 units

(d) Fixed costs Contribution margin ratio Break-even point in dollars
$145,000 40% $362,500

Fixed costs (from 2010)	$135,000
Additional advertising expense	10,000
Fixed costs (2011)	$145,000

Contribution margin per unit (b) $10
Contribution margin ratio Contribution margin per unit Unit selling price
40% $10 $25

(e) Required sales (Fixed costs Target net income) Contribution margin ratio
$525,000 ($145,000 $65,000) 40%

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SUMMARY OF STUDY OBJECTIVES

1 **Distinguish between variable and fixed costs.** Variable costs are costs that vary in total directly and proportionately with changes in the activity index. Fixed costs are costs that remain the same in total regardless of changes in the activity index.

2 **Explain the significance of the relevant range.** The relevant range is the range of activity in which a company expects to operate during a year. It is important in CVP analysis because the behavior of costs is assumed to be linear throughout the relevant range.

3 **Explain the concept of mixed costs.** Mixed costs increase in total but not proportionately with changes in the activity level. For purposes of CVP analysis, mixed costs must be classified into their fixed and variable elements. One method that management may use to classify these costs is the high-low method.

4 **List the five components of cost-volume-profit analysis.** The five components of CVP analysis are (a) volume or level of activity, (b) unit selling prices, (c) variable cost per unit, (d) total fixed costs, and (e) sales mix.

5 **Indicate what contribution margin is and how it can be expressed.** Contribution margin is the amount of revenue remaining after deducting variable costs. It is identified in a CVP income statement, which classifies costs as variable or fixed. It can be expressed as a per unit amount or as a ratio.

6 **Identify the three ways to determine the break-even point.** The break-even point can be (a) computed from a mathematical equation, (b) computed by using a contribution margin technique, and (c) derived from a CVP graph.

7 **Give the formulas for determining sales required to earn target net income.** The general formula is: Required sales Variable costs Fixed costs Target net income. Two other formulas are: Required sales in units (Fixed costs Target net income) Contribution margin per unit, and Required sales in dollars (Fixed costs Target net income) Contribution margin ratio.

8 **Define margin of safety, and give the formulas for computing it.** Margin of safety is the difference between actual or expected sales and sales at the break-even point. The formulas for margin of safety are: Actual (expected) sales Break-even sales Margin of safety in dollars; Margin of safety in dollars Actual (expected) sales Margin of safety ratio.

9 **Describe the essential features of a cost-volume-profit income statement.** The CVP income statement classifies costs and expenses as variable or fixed and reports contribution margin in the body of the statement.

The Navigator

GLOSSARY

Activity index The activity that causes changes in the behavior of costs. (p. 976).

Break-even point The level of activity at which total revenues equal total costs. (p. 986).

Contribution margin (CM) The amount of revenue remaining after deducting variable costs. (p. 984).

Contribution margin per unit The amount of revenue remaining per unit after deducting variable costs; calculated as unit selling price minus unit variable cost. (p. 985).

Contribution margin ratio The percentage of each dollar of sales that is available to apply to fixed costs and contribute to net income; calculated as contribution margin per unit divided by unit selling price. (p. 985).

Cost behavior analysis The study of how specific costs respond to changes in the level of business activity. (p. 976).

Cost-volume-profit (CVP) analysis The study of the effects of changes in costs and volume on a company's profits. (p. 983).

Cost-volume-profit (CVP) graph A graph showing the relationship between costs, volume, and profits. (p. 988).

Cost-volume-profit (CVP) income statement A statement for internal use that classifies costs as fixed or variable and reports contribution margin in the body of the statement. (p. 984).

Fixed costs Costs that remain the same in total regardless of changes in the activity level. (p. 977).

High-low method A mathematical method that uses the total costs incurred at the high and low levels of activity to classify mixed costs into fixed and variable components. (p. 981).

Margin of safety The difference between actual or expected sales and sales at the break-even point. (p. 991).

Mixed costs Costs that contain both a variable and a fixed cost element and change in total but not proportionately with changes in the activity level. (p. 980).

Relevant range The range of the activity index over which the company expects to operate during the year. (p. 979).

Target net income The income objective set by management. (p. 989).

Variable costs Costs that vary in total directly and proportionately with changes in the activity level. (p. 977).

APPENDIX Variable Costing

STUDY OBJECTIVE 10

Explain the difference between absorption costing and variable costing.

In earlier chapters, we classified both variable and fixed manufacturing costs as product costs. In job order costing, for example, a job is assigned the costs of direct materials, direct labor, and both variable and fixed manufacturing overhead. This costing approach is called **absorption costing** (or **full costing**). It is so named because all manufacturing costs are charged to, or absorbed by, the product.

An alternative approach is to use variable costing. Under **variable costing** only direct materials, direct labor, and variable manufacturing overhead costs are considered product costs. Companies recognize fixed manufacturing overhead costs as period costs (expenses) when incurred. Illustration 22A-1 shows the difference between absorption costing and variable costing.

Illustration 22A-1 Difference between absorption costing and variable costing

Under both absorption and variable costing selling and administrative expenses are period costs.

To illustrate the computation of unit production cost under absorption and variable costing, assume that Premium Products Corporation manufactures a polyurethane sealant, called Fix-It, for car windshields. Relevant data for Fix-It in January 2010, the first month of production, are as follows.

Illustration 22A-2 Sealant sales and cost data for Premium Products Corporation

Selling price	$20 per unit.
Units	Produced 30,000; sold 20,000; beginning inventory zero.
Variable unit costs	Manufacturing $9 (direct materials $5, direct labor $3, and variable overhead $1). Selling and administrative expenses $2.
Fixed costs	Manufacturing overhead $120,000. Selling and administrative expenses $15,000.

The per unit production cost of Fix-It under each costing approach is:

Type of Cost	Absorption Costing	Variable Costing
Direct materials	$ 5	$5
Direct labor	3	3
Variable manufacturing overhead	1	1
Fixed manufacturing overhead ($120,000 ÷ 30,000 units produced)	**4**	**0**
Total unit cost	**$13**	**$9**

Illustration 22A-3
Computation of per unit production cost

The total unit cost is $4 higher ($13 $9) for absorption costing. This occurs because fixed manufacturing costs are a product cost under absorption costing. Under variable costing, they are, instead, a period cost, and so are expensed. Based on these data, each unit sold and each unit remaining in inventory is costed at $13 under absorption costing and at $9 under variable costing.

Effects of Variable Costing on Income

Illustrations 22A-4 below and 22A-5 (page 1000) show the income statements under the two costing approaches. Absorption costing uses the traditional income statement format. Variable costing uses the cost-volume-profit format. We have inserted computations parenthetically in the statements to facilitate your understanding of the amounts.

PREMIUM PRODUCTS CORPORATION
Income Statement
For the Month Ended January 31, 2010
(Absorption Costing)

Sales (20,000 units $20)		$400,000
Cost of goods sold		
Inventory, January 1	$ –0–	
Cost of goods manufactured (30,000 units $13)	390,000	
Cost of goods available for sale	390,000	
Inventory, January 31 (10,000 units × $13)	**130,000**	
Cost of goods sold (20,000 units $13)		260,000
Gross profit		140,000
Selling and administrative expenses (Variable 20,000 units $2 fixed $15,000)		55,000
Income from operations		**$ 85,000**

Illustration 22A-4
Absorption costing income statement

HELPFUL HINT
This is the traditional statement that would result from job order and processing costing explained in Chapters 20 and 21.

Income from operations under absorption costing (Illustration 22A-4) is $40,000 ($85,000 $45,000) higher than under variable costing (Illustration 22A-5). The reason: There is a $40,000 difference in the ending inventories ($130,000 under absorption costing versus $90,000 under variable costing). Under absorption costing, the company defers $40,000 of the fixed overhead costs (10,000 units $4) to a future period as a product cost. In contrast, under variable costing the company expenses the entire fixed manufacturing costs when incurred.

Illustration 22A-5
Variable costing income statement

PREMIUM PRODUCTS CORPORATION
Income Statement
For the Month Ended January 31, 2010
(Variable Costing)

Sales (20,000 units $20)			$400,000
Variable expenses			
Variable cost of goods sold			
Inventory, January 1		$ –0–	
Variable manufacturing costs (30,000 units $9)		270,000	
Cost of goods available for sale		270,000	
Inventory, January 31 (10,000 units × $9)		**90,000**	
Variable cost of goods sold		180,000	
Variable selling and administrative expenses (20,000 units $2)		40,000	
Total variable expenses			220,000
Contribution margin			180,000
Fixed expenses			
Manufacturing overhead		120,000	
Selling and administrative expenses		15,000	
Total fixed expenses			135,000
Income from operations			**$ 45,000**

HELPFUL HINT

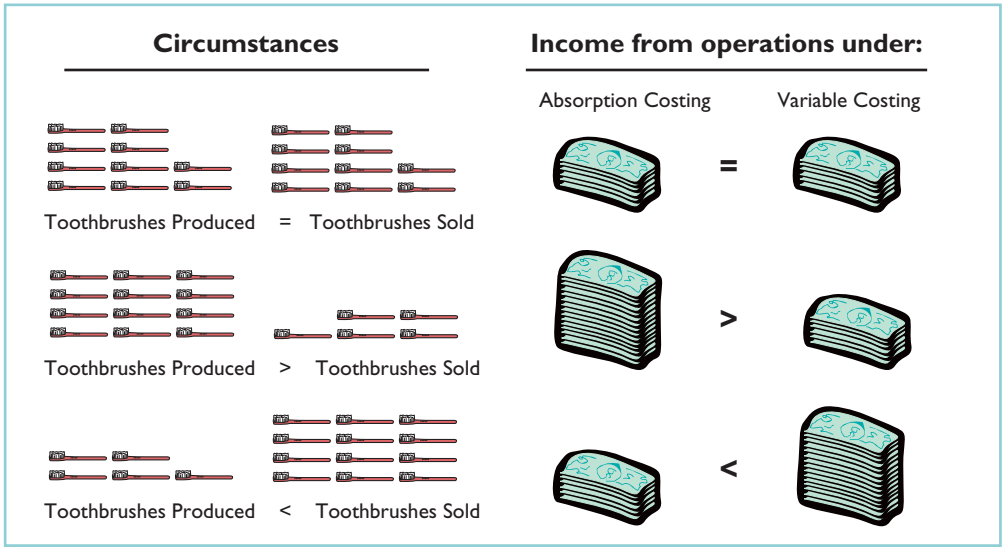
Note the difference in the computation of the ending inventory: $9 per unit here, $13 per unit in Illustration 22A-4.

The following relationships apply:

- When units produced exceed units sold (as shown), income from operations under absorption costing is higher.
- When units produced are less than units sold, income from operations under absorption costing is lower.
- When units produced and sold are the same, income from operations will be equal under the two costing approaches. In this case, there is no increase in ending inventory. So fixed overhead costs of the current period are not deferred to future periods through the ending inventory.

Illustration 22A-6 summarizes the foregoing effects of the two costing approaches on income from operations.

Illustration 22A-6
Summary of income effects



Rationale for Variable Costing

The purpose of fixed manufacturing costs is **to have productive facilities available for use**. A company incurs these costs whether it operates at zero or at 100% of capacity. Thus, proponents of variable costing argue that these costs are period costs and therefore should be expensed when incurred.

Supporters of absorption costing defend the assignment of fixed manufacturing overhead costs to inventory. They say that these costs are as much a cost of getting a product ready for sale as direct materials or direct labor. Accordingly, they contend, these costs should not be matched with revenues until the product is sold.

The use of variable costing is acceptable **only for internal use by management**. It cannot be used in determining product costs in financial statements prepared in accordance with generally accepted accounting principles because it understates inventory costs. To comply with the matching principle, a company must use absorption costing for its work in process and finished goods inventories. Similarly, companies must use absorption costing for income tax purposes.

SUMMARY OF STUDY OBJECTIVE FOR APPENDIX

10 Explain the difference between absorption costing and variable costing. Under absorption costing, fixed manufacturing costs are product costs. Under variable costing, fixed manufacturing costs are period costs.

GLOSSARY FOR APPENDIX

Absorption costing A costing approach in which all manufacturing costs are charged to the product. (p. 998).

Variable costing A costing approach in which only variable manufacturing costs are product costs, and fixed manufacturing costs are period costs (expenses). (p. 998).

*__Note__: All **asterisked** Questions, Exercises, and Problems relate to material in the appendix to the chapter.

SELF-STUDY QUESTIONS

Answers are at the end of the chapter.

(SO 1) **1.** Variable costs are costs that:
- **a.** vary in total directly and proportionately with changes in the activity level.
- **b.** remain the same per unit at every activity level.
- **c.** Neither of the above.
- **d.** Both (a) and (b) above.

(SO 2) **2.** The relevant range is:
- **a.** the range of activity in which variable costs will be curvilinear.
- **b.** the range of activity in which fixed costs will be curvilinear.
- **c.** the range over which the company expects to operate during a year.
- **d.** usually from zero to 100% of operating capacity.

(SO 3) **3.** Mixed costs consist of a:
- **a.** variable cost element and a fixed cost element.
- **b.** fixed cost element and a controllable cost element.
- **c.** relevant cost element and a controllable cost element.
- **d.** variable cost element and a relevant cost element.

(SO 3) **4.** Your phone service provider offers a plan that is classified as a mixed cost. The cost per month for 1,000 minutes is $50. If you use 2,000 minutes this month, your cost will be:
- **a.** $50.
- **b.** $100.
- **c.** more than $100.
- **d.** between $50 and $100.

(SO 4) **5.** One of the following is *not* involved in CVP analysis. That factor is:
- **a.** sales mix.
- **b.** unit selling prices.
- **c.** fixed costs per unit.
- **d.** volume or level of activity.

(SO 5) **6.** Contribution margin:
- **a.** is revenue remaining after deducting variable costs.
- **b.** may be expressed as contribution margin per unit.
- **c.** is selling price less cost of goods sold.
- **d.** Both (a) and (b) above.

(SO 5) **7.** When comparing a traditional income statement to a CVP income statement:
- **a.** net income will always be greater on the traditional statement.
- **b.** net income will always be less on the traditional statement.

c. net income will always be identical on both.
d. net income will be greater or less depending on the sales volume.

(SO 6) **8.** Brownstone Company's contribution margin ratio is 30%. If Brownstone's sales revenue is $100 greater than its break-even sales in dollars, its net income:
a. will be $100.
b. will be $70.
c. will be $30.
d. cannot be determined without knowing fixed costs.

(SO 6) **9.** Gossen Company is planning to sell 200,000 pliers for $4 per unit. The contribution margin ratio is 25%. If Gossen will break even at this level of sales, what are the fixed costs?
a. $100,000. **c.** $200,000.
b. $160,000. **d.** $300,000.

(SO 7) **10.** The mathematical equation for computing required sales to obtain target net income is: Required sales
a. Variable costs Target net income.
b. Variable costs Fixed costs Target net income.
c. Fixed costs Target net income.
d. No correct answer is given.

(SO 8) **11.** Marshall Company had actual sales of $600,000 when break-even sales were $420,000. What is the margin of safety ratio?
a. 25%. **c.** 33⅓%.
b. 30%. **d.** 45%.

12. Margin of safety is computed as: (SO 8)
a. Actual sales Break-even sales.
b. Contribution margin Fixed costs.
c. Break-even sales Variable costs.
d. Actual sales Contribution margin.

13. On a CVP income statement: (SO 9)
a. Sales Cost of goods sold Contribution margin.
b. Sales Variable costs Fixed costs Contribution margin.
c. Sales Variable costs Contribution margin.
d. Sales Fixed costs Contribution margin.

14. Cournot Company sells 100,000 wrenches for $12 a unit. (SO 9) Fixed costs are $300,000, and net income is $200,000. What should be reported as variable expenses in the CVP income statement?
a. $700,000. **c.** $500,000.
b. $900,000. **d.** $1,000,000.

*__15.__ Under variable costing, fixed manufacturing costs are (SO 10) classified as:
a. period costs. **c.** both (a) and (b).
b. product costs. **d.** neither (a) nor (b).

Go to the book's companion website, **www.wiley.com/college/weygandt**, for Additional Self-Study questions.

The Navigator

QUESTIONS

1. **(a)** What is cost behavior analysis?
(b) Why is cost behavior analysis important to management?

2. **(a)** Jenny Kent asks your help in understanding the term "activity index." Explain the meaning and importance of this term for Jenny.
(b) State the two ways that variable costs may be defined.

3. Contrast the effects of changes in the activity level on total fixed costs and on unit fixed costs.

4. A. J. Hernandez claims that the relevant range concept is important only for variable costs.
(a) Explain the relevant range concept.
(b) Do you agree with A. J.'s claim? Explain.

5. "The relevant range is indispensable in cost behavior analysis." Is this true? Why or why not?

6. Ryan Ricketts is confused. He does not understand why rent on his apartment is a fixed cost and rent on a Hertz rental truck is a mixed cost. Explain the difference to Ryan.

7. How should mixed costs be classified in CVP analysis? What approach is used to effect the appropriate classification?

8. At the high and low levels of activity during the month, direct labor hours are 90,000 and 40,000, respectively. The related costs are $160,000 and $100,000. What are the fixed and variable costs at any level of activity?

9. "Cost-volume-profit (CVP) analysis is based entirely on unit costs." Do you agree? Explain.

10. Jill Nott defines contribution margin as the amount of profit available to cover operating expenses. Is there any truth in this definition? Discuss.

11. Kosko Company's Speedo calculator sells for $40. Variable costs per unit are estimated to be $28. What are the contribution margin per unit and the contribution margin ratio?

12. "Break-even analysis is of limited use to management because a company cannot survive by just breaking even." Do you agree? Explain.

13. Total fixed costs are $25,000 for Haag Inc. It has a contribution margin per unit of $15, and a contribution margin ratio of 25%. Compute the break-even sales in dollars.

14. Nancy Tobias asks your help in constructing a CVP graph. Explain to Nancy (a) how the break-even point is plotted, and (b) how the level of activity and dollar sales at the break-even point are determined.

15. Define the term "margin of safety." If Peine Company expects to sell 1,250 units of its product at $12 per unit, and break-even sales for the product are $12,000, what is the margin of safety ratio?

16. Ortega Company's break-even sales are $600,000. Assuming fixed costs are $180,000, what sales volume is needed to achieve a target net income of $60,000?

17. The traditional income statement for Mallon Company shows sales $900,000, cost of goods sold $500,000, and operating expenses $200,000. Assuming all costs and

expenses are 70% variable and 30% fixed, prepare a CVP income statement through contribution margin.

*18. Distinguish between absorption costing and variable costing.

*19. (a) What is the major rationale for the use of variable costing? (b) Discuss why variable costing may not be used for financial reporting purposes.

BRIEF EXERCISES

BE22-1 Monthly production costs in Pesavento Company for two levels of production are as follows.

Classify costs as variable, fixed, or mixed. (SO 1, 3)

Cost	3,000 units	6,000 units
Indirect labor	$10,000	$20,000
Supervisory salaries	5,000	5,000
Maintenance	4,000	7,000

Indicate which costs are variable, fixed, and mixed, and give the reason for each answer.

BE22-2 For Loder Company, the relevant range of production is 40–80% of capacity. At 40% of capacity, a variable cost is $4,000 and a fixed cost is $6,000. Diagram the behavior of each cost within the relevant range assuming the behavior is linear.

Diagram the behavior of costs within the relevant range. (SO 2)

BE22-3 For Hunt Company, a mixed cost is $20,000 plus $16 per direct labor hour. Diagram the behavior of the cost using increments of 500 hours up to 2,500 hours on the horizontal axis and increments of $20,000 up to $80,000 on the vertical axis.

Diagram the behavior of a mixed cost. (SO 3)

BE22-4 Deines Company accumulates the following data concerning a mixed cost, using miles as the activity level.

Determine variable and fixed cost elements using the high-low method. (SO 3)

	Miles Driven	Total Cost		Miles Driven	Total Cost
January	8,000	$14,150	March	8,500	$15,000
February	7,500	13,600	April	8,200	14,490

Compute the variable and fixed cost elements using the high-low method.

BE22-5 Determine the missing amounts.

Determine missing amounts for contribution margin. (SO 5)

	Unit Selling Price	Unit Variable Costs	Contribution Margin per Unit	Contribution Margin Ratio
1.	$250	$170	(a)	(b)
2.	$500	(c)	$200	(d)
3.	(e)	(f)	$300	30%

BE22-6 Hamby Company has a unit selling price of $400, variable costs per unit of $260, and fixed costs of $210,000. Compute the break-even point in units using (a) the mathematical equation and (b) contribution margin per unit.

Compute the break-even point. (SO 6)

BE22-7 For Markowis Company, variable costs are 70% of sales, and fixed costs are $210,000. Management's net income goal is $60,000. Compute the required sales needed to achieve management's target net income of $60,000. (Use the mathematical equation approach.)

Compute sales for target net income. (SO 7)

BE22-8 For Briggs Company actual sales are $1,200,000 and break-even sales are $900,000. Compute (a) the margin of safety in dollars and (b) the margin of safety ratio.

Compute the margin of safety and the margin of safety ratio. (SO 8)

BE22-9 Dilts Manufacturing Inc. had sales of $1,800,000 for the first quarter of 2010. In making the sales, the company incurred the following costs and expenses.

Prepare CVP income statement. (SO 9)

	Variable	Fixed
Cost of goods sold	$760,000	$540,000
Selling expenses	95,000	60,000
Administrative expenses	79,000	66,000

Prepare a CVP income statement for the quarter ended March 31, 2010.

Compute net income under absorption and variable costing. (SO 10)

***BE22-10** Gore Company's fixed overhead costs are $3 per unit, and its variable overhead costs are $8 per unit. In the first month of operations, 50,000 units are produced, and 47,000 units are sold. Write a short memo to the chief financial officer explaining which costing approach will produce the higher income and what the difference will be.

DO IT! REVIEW

Classify types of costs. (SO 1, 3)

DO IT! 22-1 Montana Company reports the following total costs at two levels of production.

	5,000 Units	10,000 Units
Indirect labor	$ 3,000	$ 6,000
Property taxes	7,000	7,000
Direct labor	27,000	54,000
Direct materials	22,000	44,000
Depreciation	4,000	4,000
Utilities	3,000	5,000
Maintenance	9,000	11,000

Classify each cost as variable, fixed, or mixed.

Compute costs using high-low method and estimate total cost. (SO 3)

DO IT! 22-2 Amanda Company accumulates the following data concerning a mixed cost, using units produced as the activity level.

	Units Produced	Total Cost
March	10,000	$18,000
April	9,000	16,650
May	10,500	18,750
June	8,800	16,200
July	9,500	17,100

(a) Compute the variable and fixed cost elements using the high-low method.
(b) Estimate the total cost if the company produces 8,500 units.

Compute break-even point in units. (SO 6)

DO IT! 22-3 Vince Company has a unit selling price of $250, variable cost per unit of $160, and fixed costs of $135,000. Compute the breakeven point in units using (a) a mathematical equation and (b) contribution margin per unit.

Compute margin of safety percentage and required sales. (SO 8, 9)

DO IT! 22-4 Queensland Company makes radios that sell for $30 each. For the coming year, management expects fixed costs to total $200,000 and variable costs to be $20 per unit.

(a) Compute the break-even point in dollars using the contribution margin (CM) ratio.
(b) Compute the margin of safety percentage assuming actual sales are $750,000.
(c) Compute the sales required in dollars to earn net income of $120,000.

EXERCISES

Define and classify variable, fixed, and mixed costs. (SO 1, 3)

E22-1 Dye Company manufactures a single product. Annual production costs incurred in the manufacturing process are shown below for two levels of production.

	Costs Incurred			
Production in Units	**5,000**		**10,000**	
Production Costs	**Total Cost**	**Cost/ Unit**	**Total Cost**	**Cost/ Unit**
Direct materials	$8,250	$1.65	$16,500	$1.65
Direct labor	9,500	1.90	19,000	1.90
Utilities	1,500	0.30	2,500	0.25
Rent	4,000	0.80	4,000	0.40
Maintenance	800	0.16	1,100	0.11
Supervisory salaries	1,000	0.20	1,000	0.10

Instructions
(a) Define the terms variable costs, fixed costs, and mixed costs.
(b) Classify each cost above as either variable, fixed, or mixed.

E22-2 The controller of Dugan Industries has collected the following monthly expense data for use in analyzing the cost behavior of maintenance costs.

Determine fixed and variable costs using the high-low method and prepare graph.
(SO 1, 3)

Month	Total Maintenance Costs	Total Machine Hours
January	$2,400	300
February	3,000	400
March	3,600	600
April	4,500	790
May	3,200	500
June	4,900	800

Instructions
(a) Determine the fixed and variable cost components using the high-low method.
(b) Prepare a graph showing the behavior of maintenance costs, and identify the fixed and variable cost elements. Use 200 unit increments and $1,000 cost increments.

E22-3 Black Brothers Furniture Corporation incurred the following costs.

Classify variable, fixed, and mixed costs.
(SO 1, 3)

1. Wood used in the production of furniture.
2. Fuel used in delivery trucks.
3. Straight-line depreciation on factory building.
4. Screws used in the production of furniture.
5. Sales staff salaries.
6. Sales commissions.
7. Property taxes.
8. Insurance on buildings.
9. Hourly wages of furniture craftsmen.
10. Salaries of factory supervisors.
11. Utilities expense.
12. Telephone bill.

Instructions
Identify the costs above as variable, fixed, or mixed.

E22-4 Jim Thome wants Thome Company to use CVP analysis to study the effects of changes in costs and volume on the company. Thome has heard that certain assumptions must be valid in order for CVP analysis to be useful.

Explain assumptions underlying CVP analysis.
(SO 4)

Instructions
Prepare a memo to Jim Thome concerning the assumptions that underlie CVP analysis.

E22-5 In the month of June, Barbara's Beauty Salon gave 2,700 haircuts, shampoos, and permanents at an average price of $30. During the month, fixed costs were $18,000 and variable costs were 70% of sales.

Compute contribution margin, break-even point, and margin of safety.
(SO 5, 6, 8)

Instructions
(a) Determine the contribution margin in dollars, per unit, and as a ratio.
(b) Using the contribution margin technique, compute the break-even point in dollars and in units.
(c) Compute the margin of safety in dollars and as a ratio.

E22-6 Grissom Company estimates that variable costs will be 60% of sales, and fixed costs will total $800,000. The selling price of the product is $4.

Prepare a CVP graph and compute break-even point and margin of safety.
(SO 6, 8)

Instructions
(a) Prepare a CVP graph, assuming maximum sales of $3,200,000. (*Note*: Use $400,000 increments for sales and costs and 100,000 increments for units.)
(b) Compute the break-even point in (1) units and (2) dollars.
(c) Compute the margin of safety in (1) dollars and (2) as a ratio, assuming actual sales are $2.5 million.

Compute variable cost per unit, contribution margin ratio, and increase in fixed costs.
(SO 5, 6)

E22-7 In 2010, Hadicke Company had a break-even point of $350,000 based on a selling price of $7 per unit and fixed costs of $105,000. In 2011, the selling price and the variable cost per unit did not change, but the break-even point increased to $420,000.

Instructions
(a) Compute the variable cost per unit and the contribution margin ratio for 2010.
(b) Compute the increase in fixed costs for 2011.

Prepare CVP income statements.
(SO 5, 6)

E22-8 NIU Company has the following information available for September 2010.

Unit selling price of video game consoles	$ 400
Unit variable costs	$ 270
Total fixed costs	$52,000
Units sold	620

Instructions
(a) Prepare a CVP income statement that shows both total and per unit amounts.
(b) Compute NIU's breakeven point in units.
(c) Prepare a CVP income statement for the breakeven point that shows both total and per unit amounts.

Compute various components to derive target net income under different assumptions.
(SO 6, 7)

E22-9 Lynn Company had $150,000 of net income in 2010 when the selling price per unit was $150, the variable costs per unit were $90, and the fixed costs were $570,000. Management expects per unit data and total fixed costs to remain the same in 2011. The president of Lynn Company is under pressure from stockholders to increase net income by $60,000 in 2011.

Instructions
(a) Compute the number of units sold in 2010.
(b) Compute the number of units that would have to be sold in 2011 to reach the stockholders' desired profit level.
(c) Assume that Lynn Company sells the same number of units in 2011 as it did in 2010. What would the selling price have to be in order to reach the stockholders' desired profit level?

Compute net income under different alternatives.
(SO 7)

E22-10 Moran Company reports the following operating results for the month of August: Sales $350,000 (units 5,000); variable costs $210,000; and fixed costs $90,000. Management is considering the following independent courses of action to increase net income.

1. Increase selling price by 10% with no change in total variable costs.
2. Reduce variable costs to 55% of sales.
3. Reduce fixed costs by $10,000.

Instructions
Compute the net income to be earned under each alternative. Which course of action will produce the highest net income?

Prepare a CVP income statement before and after changes in business environment.
(SO 9)

E22-11 Polzin Company had sales in 2010 of $1,500,000 on 60,000 units. Variable costs totaled $840,000, and fixed costs totaled $500,000.

A new raw material is available that will decrease the variable costs per unit by 20% (or $2.80). However, to process the new raw material, fixed operating costs will increase by $60,000. Management feels that one-half of the decline in the variable costs per unit should be passed on to customers in the form of a sales price reduction. The marketing department expects that this sales price reduction will result in a 7% increase in the number of units sold.

Instructions
Prepare a CVP income statement for 2010, assuming the changes are made as described.

Compute total product cost and prepare an income statement using variable costing.
(SO 10)

***E22-12** Titus Equipment Company manufactures and distributes industrial air compressors. The following costs are available for the year ended December 31, 2010. The company has no beginning inventory. In 2010, 1,500 units were produced, but only 1,300 units were sold. The unit selling price was $4,500. Costs and expenses were:

Variable costs per unit	
Direct materials	$ 1,000
Direct labor	1,500
Variable manufacturing overhead	300
Variable selling and administrative expenses	70
Annual fixed costs and expenses	
Manufacturing overhead	$1,400,000
Selling and administrative expenses	100,000

Instructions
(a) Compute the manufacturing cost of one unit of product using variable costing.
(b) Prepare a 2010 income statement for Titus Company using variable costing.

***E22-13** Cowell Corporation produces one product. Its cost includes direct materials ($10 per unit), direct labor ($8 per unit), variable overhead ($6 per unit), fixed manufacturing ($250,000), and fixed selling and administrative ($30,000). In October 2010, Cowell produced 25,000 units and sold 20,000 at $50 each.

Prepare absorption cost and variable cost income statements.
(SO 10)

Instructions
(a) Prepare an absorption costing income statement.
(b) Prepare a variable costing income statement.
(c) Explain the difference in net income in the two income statements.

EXERCISES: SET B

Visit the book's compaion website at **www.wiley.com/college/weygandt**, and choose the Student Companion site, to access Exercise Set B.

PROBLEMS: SET A

P22-1A Matt Reiss owns the Fredonia Barber Shop. He employs five barbers and pays each a base rate of $1,000 per month. One of the barbers serves as the manager and receives an extra $500 per month. In addition to the base rate, each barber also receives a commission of $5.50 per haircut.

Determine variable and fixed costs, compute break-even point, prepare a CVP graph, and determine net income.
(SO 1, 3, 5, 6)

Other costs are as follows.

Advertising	$200 per month
Rent	$900 per month
Barber supplies	$0.30 per haircut
Utilities	$175 per month plus $0.20 per haircut
Magazines	$25 per month

Matt currently charges $10 per haircut.

Instructions
(a) Determine the variable cost per haircut and the total monthly fixed costs.
(b) Compute the break-even point in units and dollars.
(c) Prepare a CVP graph, assuming a maximum of 1,800 haircuts in a month. Use increments of 300 haircuts on the horizontal axis and $3,000 on the vertical axis.
(d) Determine net income, assuming 1,900 haircuts are given in a month.

P22-2A Utech Company bottles and distributes Livit, a diet soft drink. The beverage is sold for 50 cents per 16-ounce bottle to retailers, who charge customers 75 cents per bottle. For the year 2010, management estimates the following revenues and costs.

Prepare a CVP income statement, compute break-even point, contribution margin ratio, margin of safety ratio, and sales for target net income.
(SO 5, 6, 7, 8, 9)

Net sales	$1,800,000	Selling expenses—variable	$70,000
Direct materials	430,000	Selling expenses—fixed	65,000
Direct labor	352,000	Administrative expenses—variable	20,000
Manufacturing overhead—variable	316,000	Administrative expenses—fixed	60,000
Manufacturing overhead—fixed	283,000		

Instructions
(a) Prepare a CVP income statement for 2010 based on management's estimates.
(b) Compute the break-even point in (1) units and (2) dollars.
(c) Compute the contribution margin ratio and the margin of safety ratio. (Round to full percents.)
(d) Determine the sales dollars required to earn net income of $238,000.

Compute break-even point under alternative courses of action.
(SO 5, 6)

P22-3A Gorham Manufacturing's sales slumped badly in 2010. For the first time in its history, it operated at a loss. The company's income statement showed the following results from selling 600,000 units of product: Net sales $2,400,000; total costs and expenses $2,540,000; and net loss $140,000. Costs and expenses consisted of the amounts shown below.

	Total	Variable	Fixed
Cost of goods sold	$2,100,000	$1,440,000	$660,000
Selling expenses	240,000	72,000	168,000
Administrative expenses	200,000	48,000	152,000
	$2,540,000	$1,560,000	$980,000

Management is considering the following independent alternatives for 2011.

1. Increase unit selling price 20% with no change in costs, expenses, and sales volume.
2. Change the compensation of salespersons from fixed annual salaries totaling $150,000 to total salaries of $60,000 plus a 3% commission on net sales.
3. Purchase new automated equipment that will change the proportion between variable and fixed cost of goods sold to 54% variable and 46% fixed.

Instructions

(a) Compute the break-even point in dollars for 2010.
(b) Compute the break-even point in dollars under each of the alternative courses of action. (Round all ratios to nearest full percent.) Which course of action do you recommend?

Compute break-even point and margin of safety ratio, and prepare a CVP income statement before and after changes in business environment.
(SO 6, 8, 9)

P22-4A Alice Shoemaker is the advertising manager for Value Shoe Store. She is currently working on a major promotional campaign. Her ideas include the installation of a new lighting system and increased display space that will add $34,000 in fixed costs to the $270,000 currently spent. In addition, Alice is proposing that a 5% price decrease ($40 to $38) will produce a 20% increase in sales volume (20,000 to 24,000). Variable costs will remain at $22 per pair of shoes. Management is impressed with Alice's ideas but concerned about the effects that these changes will have on the break-even point and the margin of safety.

Instructions

(a) Compute the current break-even point in units, and compare it to the break-even point in units if Alice's ideas are used.
(b) Compute the margin of safety ratio for current operations and after Alice's changes are introduced. (Round to nearest full percent.)
(c) Prepare a CVP income statement for current operations and after Alice's changes are introduced. Would you make the changes suggested?

Compute break-even point and margin of safety ratio, and prepare a CVP income statement before and after changes in business environment.
(SO 5, 6, 7, 8)

P22-5A Poole Corporation has collected the following information after its first year of sales. Net sales were $1,600,000 on 100,000 units; selling expenses $240,000 (40% variable and 60% fixed); direct materials $511,000; direct labor $285,000; administrative expenses $280,000 (20% variable and 80% fixed); manufacturing overhead $360,000 (70% variable and 30% fixed). Top management has asked you to do a CVP analysis so that it can make plans for the coming year. It has projected that unit sales will increase by 10% next year.

Instructions

(a) Compute (1) the contribution margin for the current year and the projected year, and (2) the fixed costs for the current year. (Assume that fixed costs will remain the same in the projected year.)
(b) Compute the break-even point in units and sales dollars for the current year.
(c) The company has a target net income of $310,000. What is the required sales in dollars for the company to meet its target?
(d) If the company meets its target net income number, by what percentage could its sales fall before it is operating at a loss? That is, what is its margin of safety ratio?
(e) The company is considering a purchase of equipment that would reduce its direct labor costs by $104,000 and would change its manufacturing overhead costs to 30% variable and 70% fixed (assume total manufacturing overhead cost is $360,000, as above). It is also

considering switching to a pure commission basis for its sales staff. This would change selling expenses to 90% variable and 10% fixed (assume total selling expense is $240,000, as above). Assuming that net sales remain at first-year levels, compute (1) the contribution margin and (2) the contribution margin ratio, and recompute (3) the break-even point in sales dollars. Comment on the effect each of management's proposed changes has on the break-even point.

***P22-6A** TLR produces plastic that is used for injection molding applications such as gears for small motors. In 2010, the first year of operations, TLR produced 6,000 tons of plastic and sold 5,000 tons. In 2011, the production and sales results were exactly reversed. In each year, selling price per ton was $1,000, variable manufacturing costs were 15% of the sales price of units produced, variable selling expenses were 10% of the selling price of units sold, fixed manufacturing costs were $2,100,000, and fixed administrative expenses were $500,000.

Prepare income statements under absorption and variable costing.
(SO 10)

Instructions

(a) Prepare comparative income statements for each year using variable costing.
(b) Prepare comparative income statements for each year using absorption costing.
(c) Reconcile the differences each year in income from operations under the two costing approaches.
(d) Comment on the effects of production and sales on net income under the two costing approaches.

PROBLEMS: SET B

P22-1B The McCune Barber Shop employs four barbers. One barber, who also serves as the manager, is paid a salary of $3,900 per month. The other barbers are paid $1,900 per month. In addition, each barber is paid a commission of $2 per haircut. Other monthly costs are: store rent $700 plus 60 cents per haircut, depreciation on equipment $500, barber supplies 40 cents per haircut, utilities $300, and advertising $100. The price of a haircut is $10.

Determine variable and fixed costs, compute break-even point, prepare a CVP graph, and determine net income.
(SO 1, 3, 5, 6)

Instructions

(a) Determine the variable cost per haircut and the total monthly fixed costs.
(b) Compute the break-even point in units and dollars.
(c) Prepare a CVP graph, assuming a maximum of 1,800 haircuts in a month. Use increments of 300 haircuts on the horizontal axis and $3,000 increments on the vertical axis.
(d) Determine the net income, assuming 1,700 haircuts are given in a month.

P22-2B Huber Company bottles and distributes No-FIZZ, a fruit drink. The beverage is sold for 50 cents per 16-ounce bottle to retailers, who charge customers 70 cents per bottle. For the year 2010, management estimates the following revenues and costs.

Prepare a CVP income statement, compute break-even point, contribution margin ratio, margin of safety ratio, and sales for target net income.
(SO 5, 6, 7, 8, 9)

Net sales	$2,000,000	Selling expenses—variable	$ 80,000
Direct materials	360,000	Selling expenses—fixed	150,000
Direct labor	450,000	Administrative expenses—variable	40,000
Manufacturing overhead—variable	270,000	Administrative expenses—fixed	70,000
Manufacturing overhead—fixed	280,000		

Instructions

(a) Prepare a CVP income statement for 2010 based on management's estimates.
(b) Compute the break-even point in (1) units and (2) dollars.
(c) Compute the contribution margin ratio and the margin of safety ratio.
(d) Determine the sales dollars required to earn net income of $390,000.

P22-3B Keppel Manufacturing had a bad year in 2010. For the first time in its history it operated at a loss. The company's income statement showed the following results from selling 60,000 units of product: Net sales $1,500,000; total costs and expenses $1,890,000; and net loss $390,000. Costs and expenses consisted of the amounts shown on the next page.

Compute break-even point under alternative courses of action.
(SO 5, 6)

	Total	Variable	Fixed
Cost of goods sold	$1,350,000	$930,000	$420,000
Selling expenses	420,000	65,000	355,000
Administrative expenses	120,000	55,000	65,000
	$1,890,000	$1,050,000	$840,000

Management is considering the following independent alternatives for 2011.

1. Increase unit selling price 40% with no change in costs, expenses, and sales volume.
2. Change the compensation of salespersons from fixed annual salaries totaling $200,000 to total salaries of $30,000 plus a 4% commission on net sales.
3. Purchase new high-tech factory machinery that will change the proportion between variable and fixed cost of goods sold to 50:50.

Instructions

(a) Compute the break-even point in dollars for 2010.

(b) Compute the break-even point in dollars under each of the alternative courses of action. Which course of action do you recommend?

Compute break-even point and margin of safety ratio, and prepare a CVP income statement before and after changes in business environment.

(SO 6, 8, 9)

P22-4B Jane Greinke is the advertising manager for Payless Shoe Store. She is currently working on a major promotional campaign. Her ideas include the installation of a new lighting system and increased display space that will add $24,000 in fixed costs to the $210,000 currently spent. In addition, Jane is proposing that a 6⅔% price decrease (from $30 to $28) will produce an increase in sales volume from 16,000 to 20,000 units. Variable costs will remain at $15 per pair of shoes. Management is impressed with Jane's ideas but concerned about the effects that these changes will have on the break-even point and the margin of safety.

Instructions

(a) Compute the current break-even point in units, and compare it to the break-even point in units if Jane's ideas are used.

(b) Compute the margin of safety ratio for current operations and after Jane's changes are introduced. (Round to nearest full percent.)

(c) Prepare a CVP income statement for current operations and after Jane's changes are introduced. Would you make the changes suggested?

Compute break-even point and margin of safety ratio, and prepare a CVP income statement before and after changes in business environment.

(SO 5, 6, 7, 8)

P22-5B Mortonsen Corporation has collected the following information after its first year of sales. Net sales were $2,000,000 on 100,000 units; selling expenses $400,000 (30% variable and 70% fixed); direct materials $600,000; direct labor $340,000; administrative expenses $500,000 (30% variable and 70% fixed); manufacturing overhead $480,000 (20% variable and 80% fixed). Top management has asked you to do a CVP analysis so that it can make plans for the coming year. It has projected that unit sales will increase by 20% next year.

Instructions

(a) Compute (1) the contribution margin for the current year and the projected year, and (2) the fixed costs for the current year. (Assume that fixed costs will remain the same in the projected year.)

(b) Compute the break-even point in units and sales dollars.

(c) The company has a target net income of $374,000. What is the required sales in dollars for the company to meet its target?

(d) If the company meets its target net income number, by what percentage could its sales fall before it is operating at a loss? That is, what is its margin of safety ratio?

(e) The company is considering a purchase of equipment that would reduce its direct labor costs by $140,000 and would change its manufacturing overhead costs to 10% variable and 90% fixed (assume total manufacturing overhead cost is $480,000, as above). It is also considering switching to a pure commission basis for its sales staff. This would change selling expenses to 80% variable and 20% fixed (assume total selling expense is $400,000, as above). Compute (1) the contribution margin and (2) the contribution margin ratio, and recompute (3) the break-even point in sales dollars. Comment on the effect each of management's proposed changes has on the break-even point.

Prepare income statements under absorption and variable costing.

(SO 10)

***P22-6B** Blanco Metal Company produces the steel wire that goes into the production of paper clips. In 2010, the first year of operations, Blanco produced 50,000 miles of wire and sold 45,000 miles. In 2011, the production and sales results were exactly reversed. In each year, selling price per

mile was $60, variable manufacturing costs were 20% of the sales price, variable selling expenses were $8.00 per mile sold, fixed manufacturing costs were $1,200,000, and fixed administrative expenses were $230,000.

Instructions

(a) Prepare comparative income statements for each year using variable costing.
(b) Prepare comparative income statements for each year using absorption costing.
(c) Reconcile the differences each year in income from operations under the two costing approaches.
(d) Comment on the effects of production and sales on net income under the two costing approaches.

PROBLEMS: SET C

Visit the book's companion website at **www.wiley.com/college/weygandt**, and choose the Student Companion site, to access Problem Set C.

WATERWAYS CONTINUING PROBLEM

(*Note:* This is a continuation of the Waterways Problem from Chapters 19 through 21.)

WCP22 The Vice President for Sales and Marketing at Waterways Corporation is planning for production needs to meet sales demand in the coming year. He is also trying to determine how the company's profits might be increased in the coming year. This problem asks you to use cost-volume-profit concepts to help Waterways understand contribution margins of some of its products and to decide whether to mass-produce certain products.

Go to the book's companion website, **www.wiley.com/college/weygandt**, *to find the remainder of this problem.*

BROADENING YOUR PERSPECTIVE

Decision Making Across the Organization

BYP22-1 Gagliano Company has decided to introduce a new product. The new product can be manufactured by either a capital-intensive method or a labor-intensive method. The manufacturing method will not affect the quality of the product. The estimated manufacturing costs by the two methods are as follows.

	Capital-Intensive	Labor-Intensive
Direct materials	$5 per unit	$5.50 per unit
Direct labor	$6 per unit	$8.00 per unit
Variable overhead	$3 per unit	$4.50 per unit
Fixed manufacturing costs	$2,508,000	$1,538,000

Gagliano's market research department has recommended an introductory unit sales price of $30. The incremental selling expenses are estimated to be $502,000 annually plus $2 for each unit sold, regardless of manufacturing method.

Instructions

With the class divided into groups, answer the following.

(a) Calculate the estimated break-even point in annual unit sales of the new product if Gagliano Company uses the:
  (1) capital-intensive manufacturing method.
  (2) labor-intensive manufacturing method.

(b) Determine the annual unit sales volume at which Gagliano Company would be indifferent between the two manufacturing methods.

(c) Explain the circumstance under which Gagliano should employ each of the two manufacturing methods.

(CMA adapted)

Managerial Analysis

BYP22-2 The condensed income statement for the Terri and Jerri partnership for 2010 is as follows.

TERRI AND JERRI COMPANY
Income Statement
For the Year Ended December 31, 2010

Sales (200,000 units)		$1,200,000
Cost of goods sold		800,000
Gross profit		400,000
Operating expenses		
Selling	$280,000	
Administrative	160,000	440,000
Net loss		($40,000)

A cost behavior analysis indicates that 75% of the cost of goods sold are variable, 50% of the selling expenses are variable, and 25% of the administrative expenses are variable.

Instructions

(Round to nearest unit, dollar, and percentage, where necessary. Use the CVP income statement format in computing profits.)

(a) Compute the break-even point in total sales dollars and in units for 2010.

(b) Terri has proposed a plan to get the partnership "out of the red" and improve its profitability. She feels that the quality of the product could be substantially improved by spending $0.25 more per unit on better raw materials. The selling price per unit could be increased to only $6.25 because of competitive pressures. Terri estimates that sales volume will increase by 30%. What effect would Terri's plan have on the profits and the break-even point in dollars of the partnership? (Round the contribution margin ratio to two decimal places.)

(c) Jerri was a marketing major in college. She believes that sales volume can be increased only by intensive advertising and promotional campaigns. She therefore proposed the following plan as an alternative to Terri's. (1) Increase variable selling expenses to $0.79 per unit, (2) lower the selling price per unit by $0.30, and (3) increase fixed selling expenses by $35,000. Jerri quoted an old marketing research report that said that sales volume would increase by 60% if these changes were made. What effect would Jerri's plan have on the profits and the break-even point in dollars of the partnership?

(d) Which plan should be accepted? Explain your answer.

Real-World Focus

BYP22-3 The Coca-Cola Company hardly needs an introduction. A line taken from the cover of a recent annual report says it all: If you measured time in servings of Coca-Cola, "a billion Coca-Cola's ago was yesterday morning." On average, every U.S. citizen drinks 363 8-ounce servings of Coca-Cola products each year. Coca-Cola's primary line of business is the making and selling of syrup to bottlers. These bottlers then sell the finished bottles and cans of Coca-Cola to the consumer.

The annual report of Coca-Cola provided the following information.

THE COCA-COLA COMPANY
Management Discussion

Our gross margin declined to 61 percent this year from 62 percent in the prior year, primarily due to costs for materials such as sweeteners and packaging.

The increases [in selling expenses] in the last two years were primarily due to higher marketing expenditures in support of our Company's volume growth.

We measure our sales volume in two ways: (1) gallon shipments of concentrates and syrups and (2) unit cases of finished product (bottles and cans of Coke sold by bottlers).

Instructions
Answer the following questions.

(a) Are sweeteners and packaging a variable cost or a fixed cost? What is the impact on the contribution margin of an increase in the per unit cost of sweeteners or packaging? What are the implications for profitability?
(b) In your opinion, are marketing expenditures a fixed cost, variable cost, or mixed cost to The Coca-Cola Company? Give justification for your answer.
(c) Which of the two measures cited for measuring volume represents the activity index as defined in this chapter? Why might Coca-Cola use two different measures?

Exploring the Web

BYP22-4 Ganong Bros. Ltd., located in St. Stephen, New Brunswick, is Canada's oldest independent candy company. Its products are distributed worldwide. In 1885, Ganong invented the popular "chicken bone," a cinnamon flavored, pink, hard candy jacket over a chocolate center. The home page of Ganong, listed below, includes information about the company and its products.

Address: www.ganong.com/retail/chicken_bones.html, or go to **www.wiley.com/college/weygandt**

Instructions
Read the description of "chicken bones," and answer the following.

(a) Describe the steps in making "chicken bones."
(b) Identify at least two variable and two fixed costs that are likely to affect the production of "chicken bones."

Communication Activity

BYP22-5 Your roommate asks your help on the following questions about CVP analysis formulas.

(a) How can the mathematical equation for break-even sales show both sales units and sales dollars?
(b) How do the formulas differ for contribution margin per unit and contribution margin ratio?
(c) How can contribution margin be used to determine break-even sales in units and in dollars?

Instructions
Write a memo to your roommate stating the relevant formulas and answering each question.

Ethics Case

BYP22-6 Kenny Hampton is an accountant for Bartley Company. Early this year Kenny made a highly favorable projection of sales and profits over the next 3 years for Bartley's hot-selling

computer PLEX. As a result of the projections Kenny presented to senior management, they decided to expand production in this area. This decision led to dislocations of some plant personnel who were reassigned to one of the company's newer plants in another state. However, no one was fired, and in fact the company expanded its work force slightly.

Unfortunately Kenny rechecked his computations on the projections a few months later and found that he had made an error that would have reduced his projections substantially. Luckily, sales of PLEX have exceeded projections so far, and management is satisfied with its decision. Kenny, however, is not sure what to do. Should he confess his honest mistake and jeopardize his possible promotion? He suspects that no one will catch the error because sales of PLEX have exceeded his projections, and it appears that profits will materialize close to his projections.

Instructions

(a) Who are the stakeholders in this situation?
(b) Identify the ethical issues involved in this situation.
(c) What are the possible alternative actions for Kenny? What would you do in Kenny's position?

"All About You" Activity

BYP22-7 In the **All About You** feature in this chapter, you learned that cost-volume-profit analysis can be used in making personal financial decisions. The purchase of a new car is one of your biggest personal expenditures. It is important that you carefully analyze your options.

Suppose that you are considering the purchase of a hybrid vehicle. Let's assume the following facts: The hybrid will initially cost an additional $3,000 above the cost of a traditional vehicle. The hybrid will get 40 miles per gallon of gas, and the traditional car will get 25 miles per gallon. Also, assume that the cost of gas is $4 per gallon.

Instructions

Using the facts above, answer the following questions.

(a) What is the variable gasoline cost of going one mile in the hybrid car? What is the variable cost of going one mile in the traditional car?
(b) Using the information in part (a), if "miles" is your unit of measure, what is the "contribution margin" of the hybrid vehicle relative to the traditional vehicle? That is, express the variable cost savings on a per-mile basis.
(c) How many miles would you have to drive in order to break even on your investment in the hybrid car?
(d) What other factors might you want to consider?

Answers to Insight and Accounting Across the Organization Questions

p. 988 Charter Flights Offer a Good Deal

Q: How did FlightServe determine that it would break even with 3.3 seats full per flight?
A: *FlightServe determined its break-even point with the following formula:*
Fixed costs ÷ Contribution margin per seat occupied = Break-even point in seats.

p. 991 How a Rolling Stones' Tour Makes Money

Q: What amount of sales dollars are required for the promoter to break even?
A: Fixed costs $1,200,000 $400,000 $1,600,000
Contribution margin ratio 80%
Break-even sales $1,600,000 .80 $2,000,000

Authors' Comments on All About You: A Hybrid Dilemma (p. 995)

Just like the break-even analysis that a company would perform on an investment in a new piece of equipment, the break-even analysis of a hybrid car requires a lot of assumptions. After deciding on a car, you need to estimate how many miles you would drive each year and how many years you would own the car. If you trade cars every two or three years, it is unlikely, with the hybrids available today, that you will recoup your initial investment. Your chances of recouping

the investment increase the longer you keep the car and the more miles you drive. You need to determine whether you will get a federal tax credit or a rebate from your employer. You also need to estimate what the car would be worth when you sell it. Based on assumed values for the average driver, *Consumer Reports* determined that only the most fuel-efficient hybrids save enough on fuel to cover their additional costs, but individual results will vary depending on the factors mentioned above.

Answers to Self-Study Questions

1. d **2.** c **3.** a **4.** d **5.** c **6.** d **7.** c **8.** c **9.** c **10.** b **11.** b **12.** a **13.** c **14.** a **15.** a