Survey of Accounting, 9e

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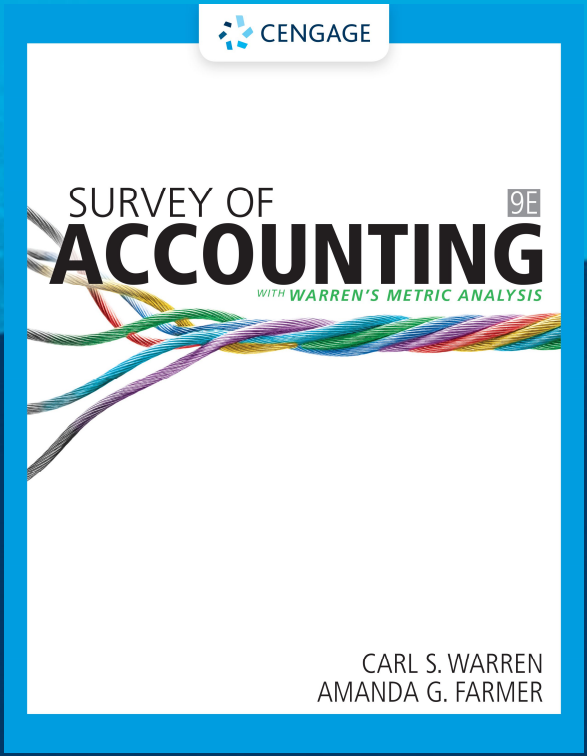

Chapter 11

Cost-Volume-Profit Analysis

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Learning Objectives

- Classify costs as variable costs, fixed costs, or mixed costs
- Compute the contribution margin, the contribution margin ratio, and the unit contribution margin
- Using cost-volume-profit equations, determine the break-even point and sales necessary to achieve a target profit
- Using cost-volume-profit and profit-volume graphs, determine the break-even point and sales necessary to achieve a target profit

Learning Objectives (continued)

- Apply cost-volume-profit relationships to more than one product and in computing operating leverage
- List the assumptions underlying cost-volume-profit analysis
- Describe and illustrate the use of the margin of safety for managerial decision making and performance analysis

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Learning Objective 1

Classify costs as variable costs, fixed costs, or mixed costs

Cost Behavior

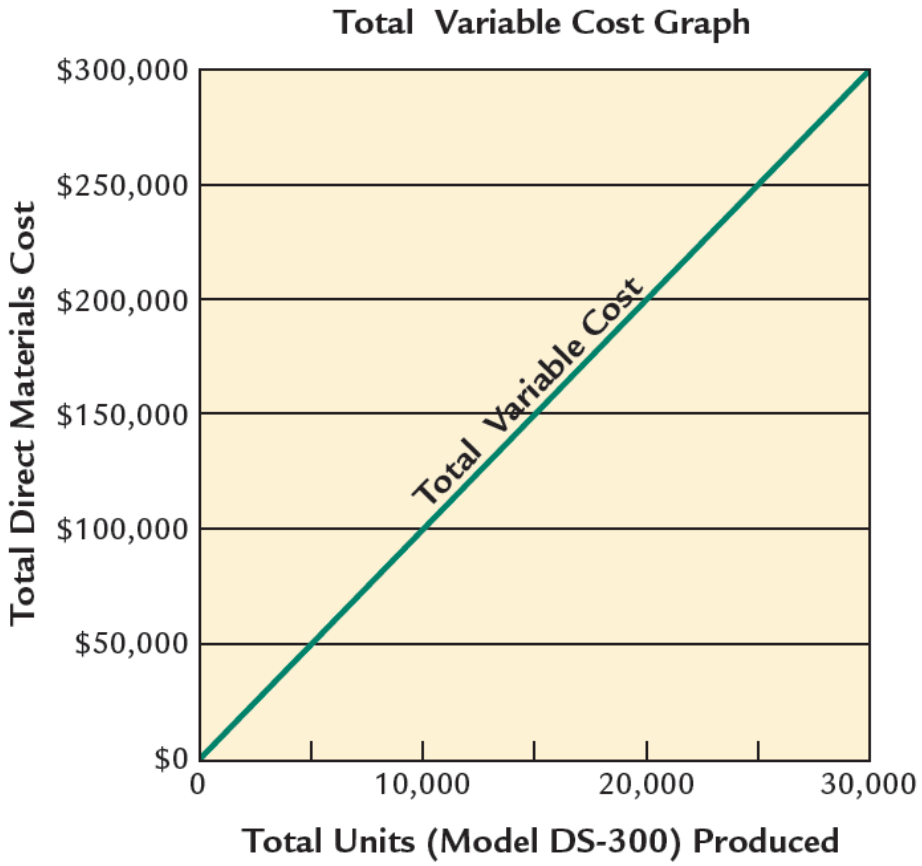
- Manner in which a cost changes as a related activity changes
- Factors to consider in cost behavior
  - **Activity bases**
  - **Relevant range**
- Costs are classified as variable, fixed, or mixed costs

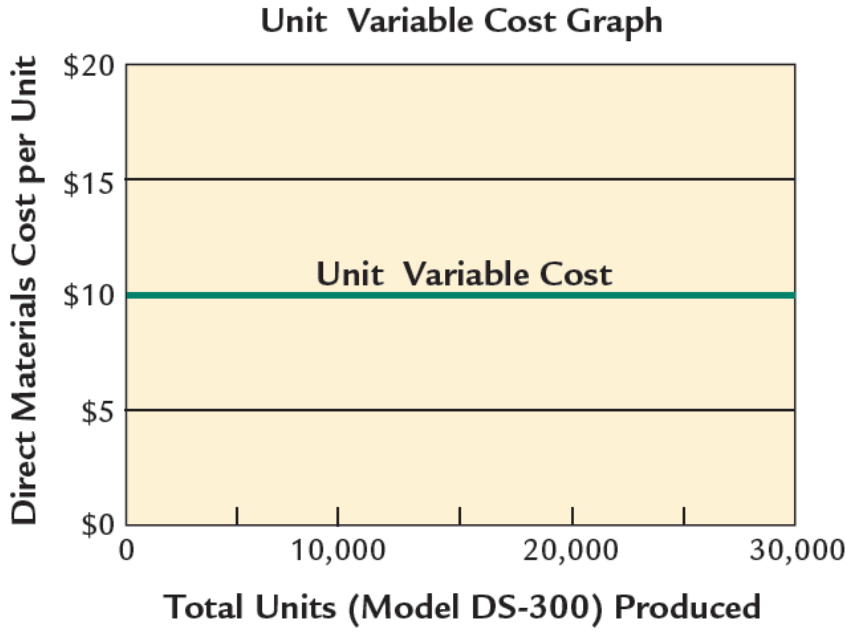
Variable Costs

- Costs that vary in proportion to changes in the activity base
  - Direct materials and direct labor costs are classified as variable costs when the activity base is units produced
- Direct materials costs for Dynamic Sound Inc.

Number of Units of Model DS-300 Produced	Direct Materials Cost per Unit	Total Direct Materials Cost
5,000 units	$10	$ 50,000
10,000	10	100,000
15,000	10	150,000
20,000	10	200,000
25,000	10	250,000
30,000	10	300,000

Exhibit 1: Variable Cost Graphs



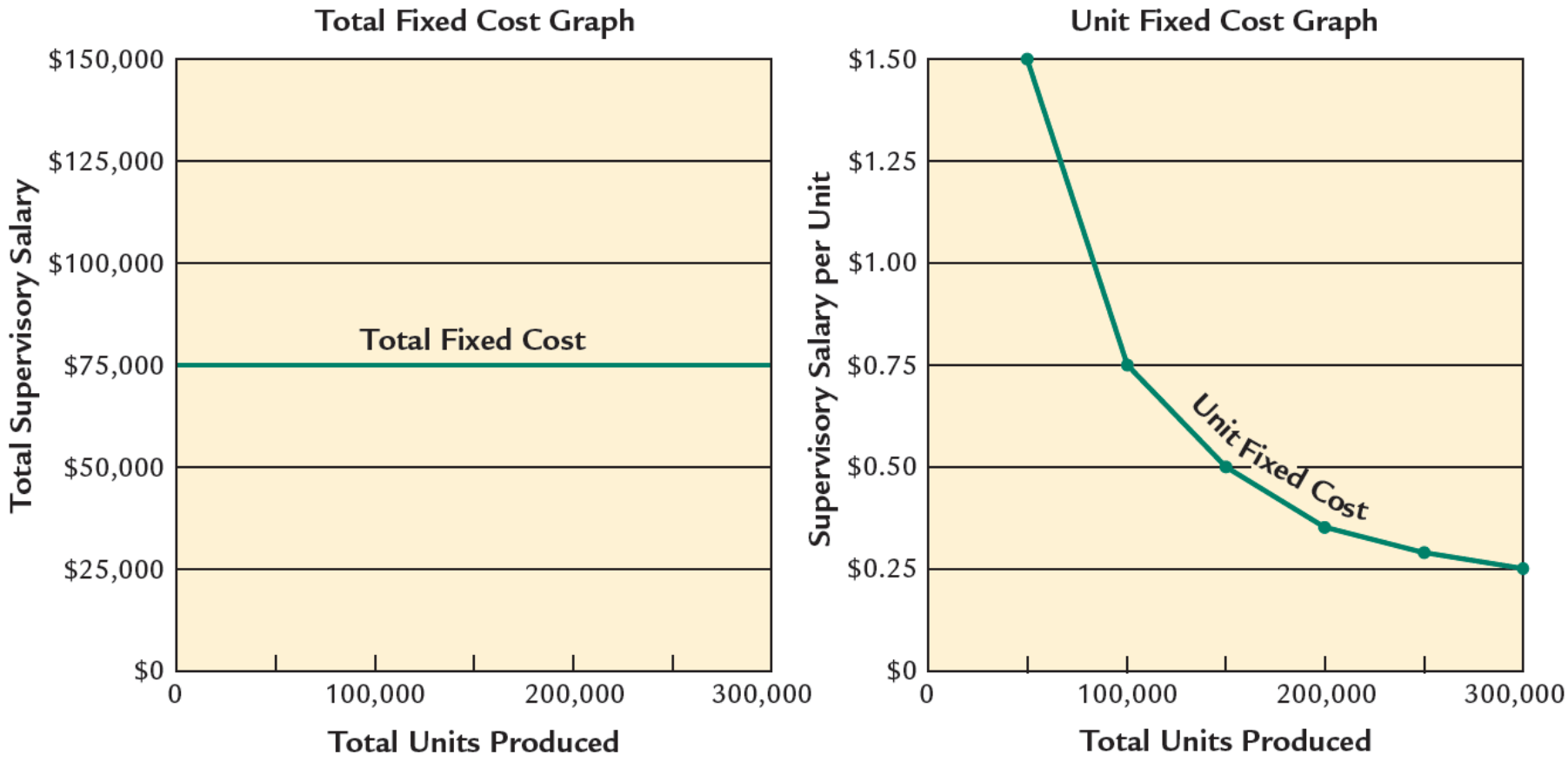


Fixed Costs

- Costs that remain the same in total dollar amount as the activity base changes
- Fixed costs for Hahn Inc.

Number of Bottles of Perfume Produced	Total Salary for Molly Hahn	Salary per Bottle of Perfume Produced
50,000 bottles	$75,000	$1.500
100,000	75,000	0.750
150,000	75,000	0.500
200,000	75,000	0.375
250,000	75,000	0.300
300,000	75,000	0.250

Exhibit 3: Fixed Cost Graphs

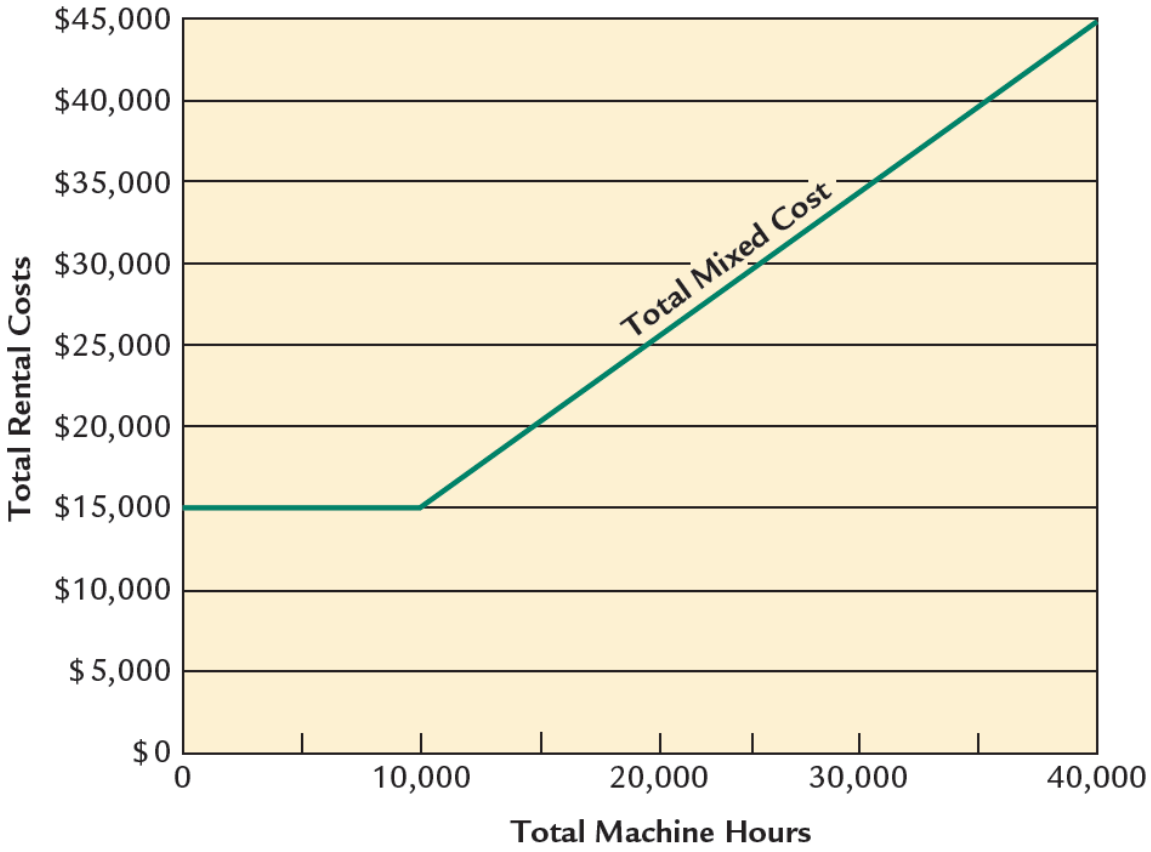


Mixed Costs

- Costs that share characteristics of both variable and fixed costs
  - Known as semivariable or semifixed costs
- For Simpson Inc., rental charges for the hours used within the relevant range of 8,000 hours to 40,000 hours are as follows:

Hours Used	Rental Charge
8,000 hours	$15,000
12,000	$17,000 {$15,000 + [(12,000 hrs. − 10,000 hrs.) × $1]}
20,000	$25,000 {$15,000 + [(20,000 hrs. − 10,000 hrs.) × $1]}
40,000	$45,000 {$15,000 + [(40,000 hrs. − 10,000 hrs.) × $1]}

Exhibit 5: Mixed Cost



High-Low Method

- Helps estimate the difference between the units produced and total costs at the highest and lowest levels of production
- Total maintenance costs between June and October for Elgen Inc.

	Production	Total Cost
June	1,000 units	$45,550
July	1,500	52,000
August	2,100	61,500
September	1,800	57,500
October	750	41,250

High-Low Method (continued)

$$\text{Variable Cost per Unit} = \frac{\text{Difference in Total Cost}}{\text{Difference in Production}}$$

$$= \frac{\$20{,}250}{1{,}350 \text{ units}} = \$15 \text{ per unit}$$

Highest level (2,100 units):

$$\begin{aligned}\text{Fixed Cost} &= \text{Total Cost} - (\text{Variable Cost per Unit} \times \text{Units Produced}) \\ &= \$61{,}500 - (\$15 \times 2{,}100 \text{ units}) \\ &= \$61{,}500 - \$31{,}500 \\ &= \$30{,}000\end{aligned}$$

Lowest level (750 units):

$$\begin{aligned}\text{Fixed Cost} &= \text{Total Cost} - (\text{Variable Cost per Unit} \times \text{Units Produced}) \\ &= \$41{,}250 - (\$15 \times 750 \text{ units}) \\ &= \$41{,}250 - \$11{,}250 \\ &= \$30{,}000\end{aligned}$$

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Exhibit 7: Variable, Fixed, Mixed Cost Examples

Variable Cost	Fixed Cost	Mixed Cost
Direct materials	Straight-line depreciation	Quality Control Department wages
Direct labor	Property taxes	Purchasing Department wages
Electricity expense	Production supervisor salaries	Maintenance expenses
Supplies	Insurance expense	Warehouse expenses

Learning Objective 2

Compute the contribution margin, the contribution margin ratio, and the unit contribution margin

Cost-Volume-Profit Relationships

- Cost-volume-profit analysis
  - Examination of the relationships among selling prices, sales and production volume, costs, expenses, and profits
  - Uses
    - Analyzing the effects of changes in:
      - Selling prices on profits
      - Costs on profits
      - Volume on profits
    - Setting selling prices
    - Selecting the mix of products to sell
    - Choosing among marketing strategies

Contribution Margin

- Excess of sales over variable costs

$$\text{Contribution Margin} = \text{Sales} - \text{Variable Costs}$$

- Assume the following data for Waddell Inc.:

Sales	50,000 units
Sales price per unit	$20 per unit
Variable cost per unit	$12 per unit
Fixed costs	$300,000

Exhibit 8: Contribution Margin Income Statement

Sales (50,000 units × $20)	$1,000,000
Variable costs (50,000 units × $12)	(600,000)
Contribution margin (50,000 units × $8)	$ 400,000
Fixed costs	(300,000)
Operating income	$ 100,000

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Contribution Margin Ratio

- Helps develop business strategies
- Percentage of each sales dollar available to cover fixed costs and to provide operating income

$$\text{Contribution Margin Ratio} = \frac{\text{Contribution Margin}}{\text{Sales}}$$

$$\text{Contribution Margin Ratio} = \frac{\$400{,}000}{\$1{,}000{,}000} = 40\%$$

Contribution Margin Ratio (continued 1)

- Useful when the increase or decrease in sales volume is measured in sales dollars
  - Change in Operating Income = Change in Sales Dollars × Contribution Margin Ratio
  - Waddell Inc. adds $80,000 in sales orders
    - Change in Operating Income = $80,000 × 40% = $32,000

Contribution Margin Ratio (continued 2)

- The change in operating income is confirmed by the following contribution margin income statement of Waddell Inc.:
  - Sales increases to $1,080,000
  - Variable costs: 60% of sales
  - Total contribution margin worth $432,000 can be computed directly by multiplying the total sales by the contribution margin ratio

Sales (54,000 units × $20)	$1,080,000
Variable costs ($1,080,000 × 60%)	(648,000)
Contribution margin ($1,080,000 × 40%)	$ 432,000
Fixed costs	(300,000)
Operating income	$ 132,000

Unit Contribution Margin

- Unit Contribution Margin = Sales Price per Unit − Variable Cost per Unit
  - Waddell Inc.'s selling price is $20 per unit, and variable cost is $12 per unit
    - Unit Contribution Margin = $20 − $12 = $8
- Change in Operating Income = Change in Sales Units × Unit Contribution Margin
  - Waddell Inc.'s sales increases by 15,000 units
    - Change in Operating Income = 15,000 units × $8 = $120,000

Unit Contribution Margin (continued)

- Based on the previous analysis, if sales increases from 50,000 units to 65,000 units, income increases to $220,000

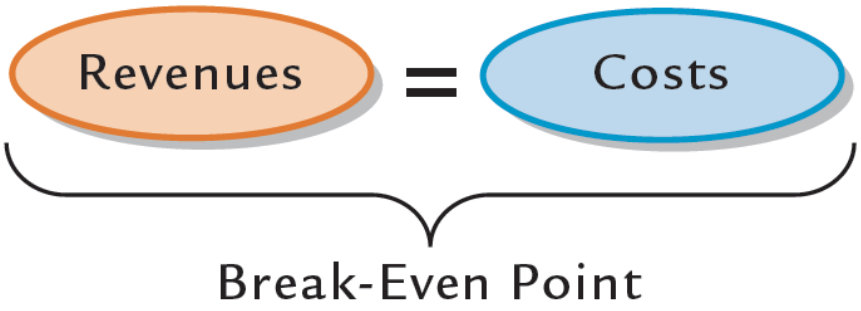
Sales (65,000 units × $20)	$1,300,000
Variable costs (65,000 units × $12)	(780,000)
Contribution margin (65,000 units × $8)	$ 520,000
Fixed costs	(300,000)
Operating income	$ 220,000

Learning Objective 3

Using cost-volume-profit equations, determine the break-even point and sales necessary to achieve a target profit

Break-Even Point

- Level of operations at which revenues and costs of a company are equal



$$\text{Break-Even Sales (units)} = \frac{\text{Fixed Costs}}{\text{Unit Contribution Margin}}$$

Break-Even Point for Baker Corporation

- Data for Baker Corporation

Unit selling price	$25
Unit variable cost	(15)
Unit contribution margin	$10
Fixed costs	$90,000

$$\textbf{Break-Even Sales (units)} = \frac{\$90{,}000}{\$10} = 9{,}000 \text{ units}$$

- Income statement

Sales (9,000 units × $25)	$ 225,000
Variable costs (9,000 units × $15)	(135,000)
Contribution margin	$ 90,000
Fixed costs	(90,000)
Operating income	$ 0

Break-Even Point for Baker Corporation (continued)

$$\text{Contribution Margin Ratio} = \frac{\text{Unit Contribution Margin}}{\text{Unit Selling Price}}$$

$$\text{Contribution Margin Ratio} = \frac{\$10}{\$25} = 40\%$$

$$\text{Break-Even Sales (dollars)} = \frac{\text{Fixed Costs}}{\text{Contribution Margin Ratio}}$$

$$\text{Break-Even Sales (dollars)} = \frac{\$90{,}000}{40\%} = \$225{,}000$$

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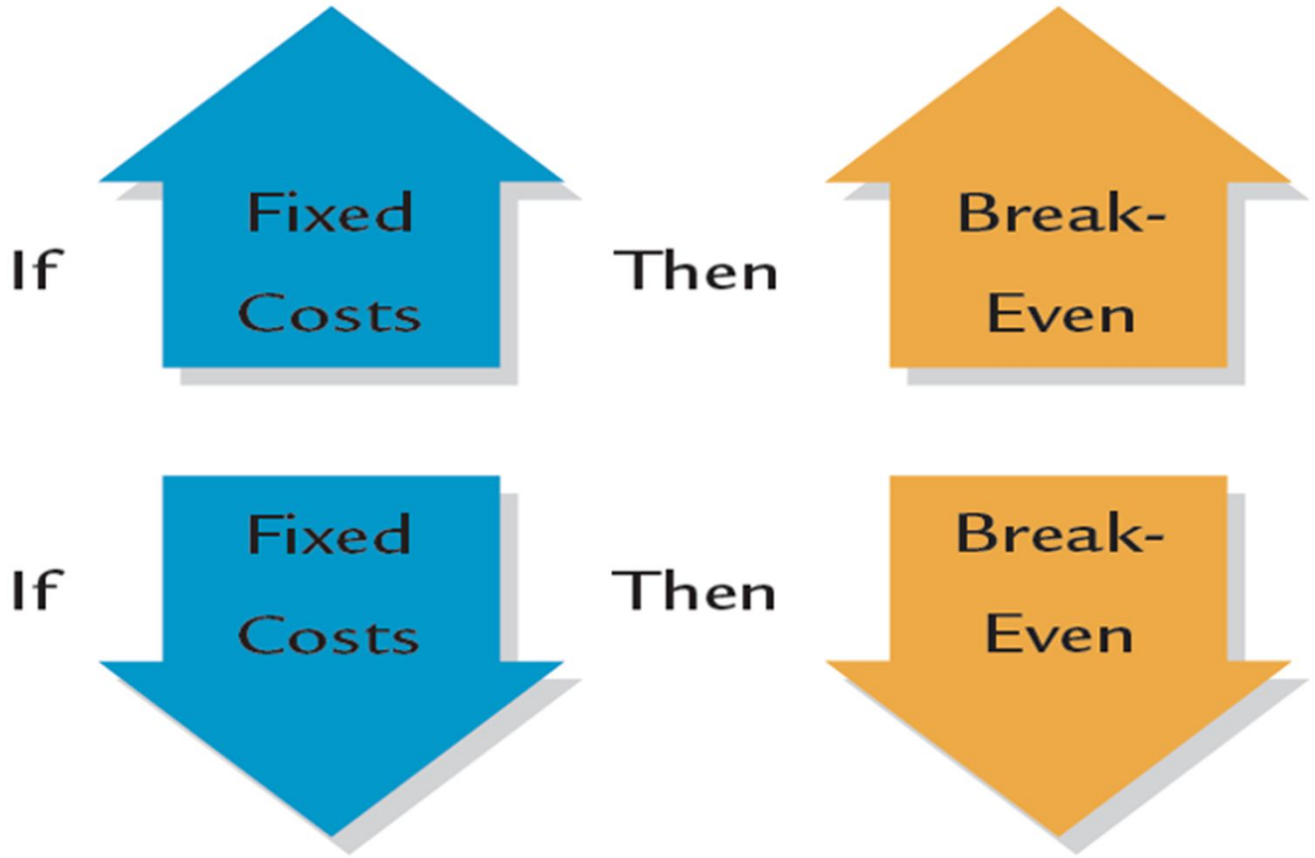
Exhibit 10: Effect of Changes in Fixed Costs on Break-Even Point



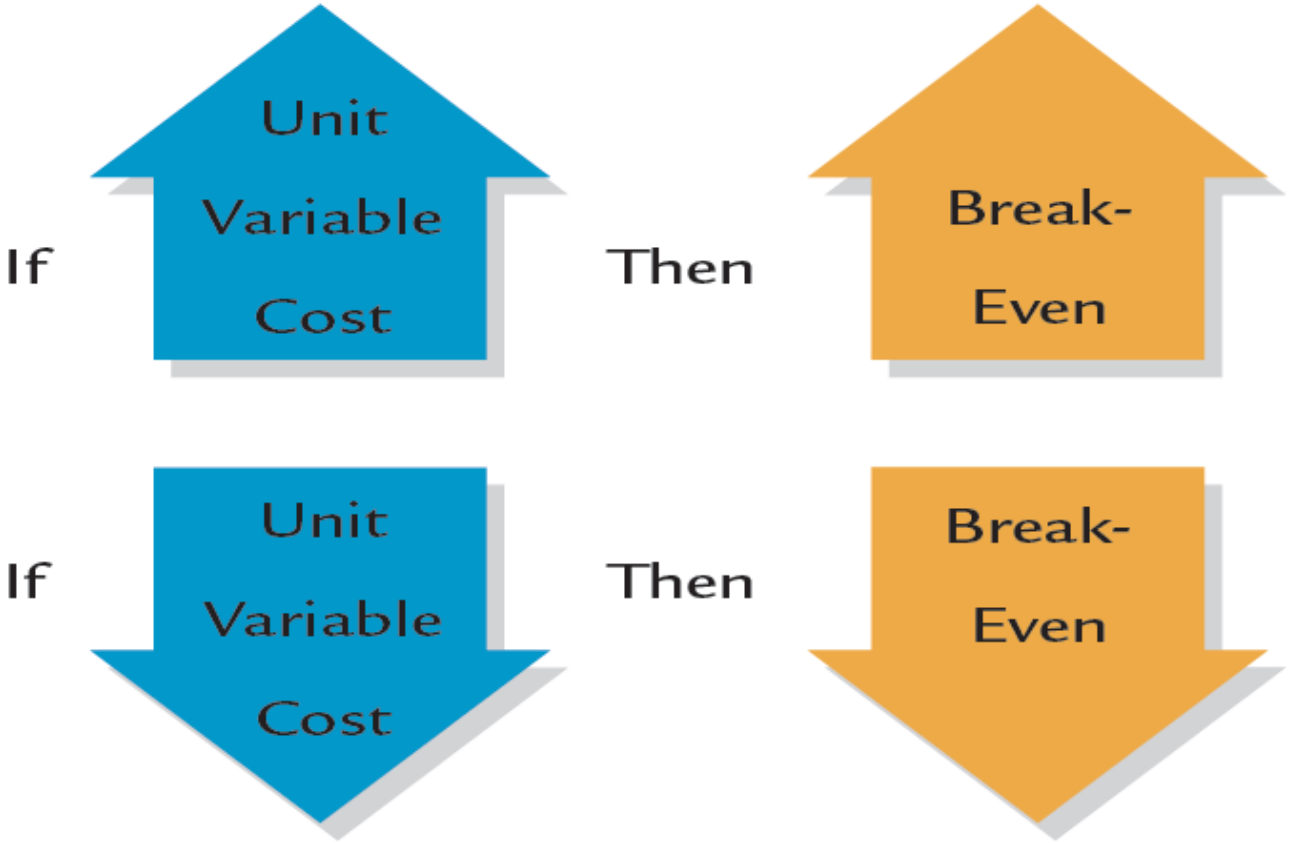
Effect of Changes in Fixed Costs

- Steiner Co. is evaluating a proposal to budget an additional $100,000 for advertising

	Current	Proposed
Unit selling price	$90	$90
Unit variable cost	(70)	(70)
Unit contribution margin	$20	$20
Fixed costs	$600,000	$700,000

- Break-even sales (units)
  - Current: $600,000 ÷ $20 = 30,000 units
  - Proposed: $700,000 ÷ $20 = 35,000 units

Exhibit 11: Effect of Changes in Variable Costs on Break-Even Point



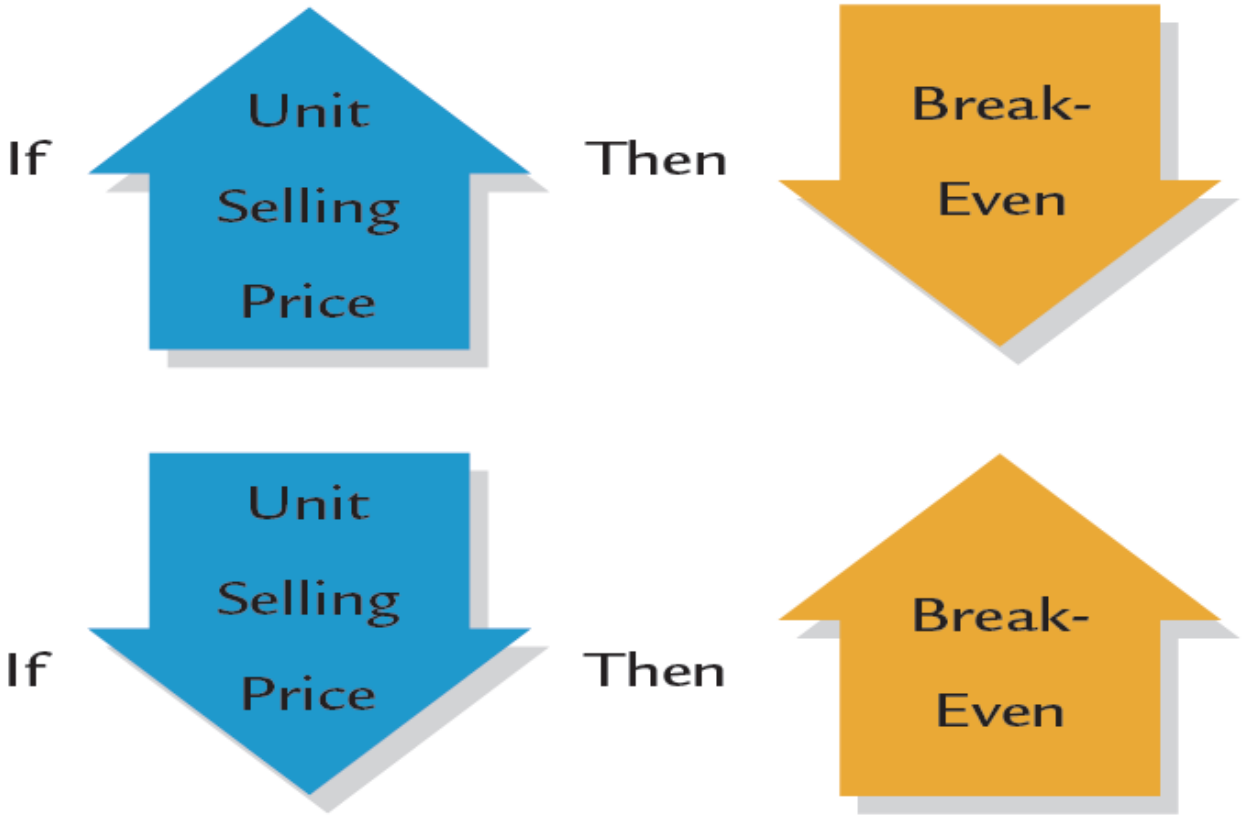
Effect of Changes in Unit Variable Costs

- Nagel Co. is evaluating a proposal to pay an additional 2% commission on sales to its salespeople as an incentive to increase sales

	Current	Proposed
Unit selling price	$ 250	$ 250
Unit variable cost	(145)	(150)
Unit contribution margin	$ 105	$ 100
Fixed costs	$840,000	$840,000

- Break-even sales (units)
  - Current: $840,000 ÷ $105 = 8,000 units
  - Proposed: $840,000 ÷ $100 = 8,400 units

Exhibit 12: Effect of Changes in Unit Selling Price on Break-Even Point



Effect of Changes in Unit Selling Price

- Fraser Co. is evaluating a proposal to increase the unit selling price of its product from $50 to $60

	Current	Proposed
Unit selling price	$ 50	$ 60
Unit variable cost	(30)	(30)
Unit contribution margin	$ 20	$ 30
Fixed costs	$600,000	$600,000

- Break-even sales (units)
  - Current: $600,000 ÷ $20 = 30,000 units
  - Proposed: $600,000 ÷ $30 = 20,000 units

Target Profit

- Sales required to earn a target or desired amount of profit may be computed as follows:

$$\text{Sales (units)} = \frac{\text{Fixed Costs} + \text{Target Profit}}{\text{Unit Contribution Margin}}$$

- Assume the following data for Waltham Co.:

Unit selling price	$75
Unit variable cost	(45)
Unit contribution margin	$30
Fixed costs	$200,000
Target profit	100,000

Calculating Sales Units for Target Profit

- Based on the data provided, the sales is computed as follows:

$$\text{Sales (units)} = \frac{\$200{,}000 + \$100{,}000}{\$30} = 10{,}000 \text{ units}$$

- Income statement of Waltham Co.

Sales (10,000 units × $75)	$ 750,000
Variable costs (10,000 units × $45)	(450,000)
Contribution margin (10,000 units × $30)	$ 300,000
Fixed costs	(200,000)
Operating income	$ 100,000 ← Target profit

Computation of Sales (Dollars) for Target Profit

$$\text{Contribution Margin Ratio} = \frac{\text{Unit Contribution Margin}}{\text{Unit Selling Price}} = \frac{\$30}{\$75} = 40\%$$

$$\text{Sales (dollars)} = \frac{\text{Fixed Costs} + \text{Target Profit}}{\text{Contribution Margin Ratio}}$$

$$= \frac{\$200,000 + \$100,000}{40\%} = \frac{\$300,000}{40\%} = \$750,000$$

Learning Objective 4

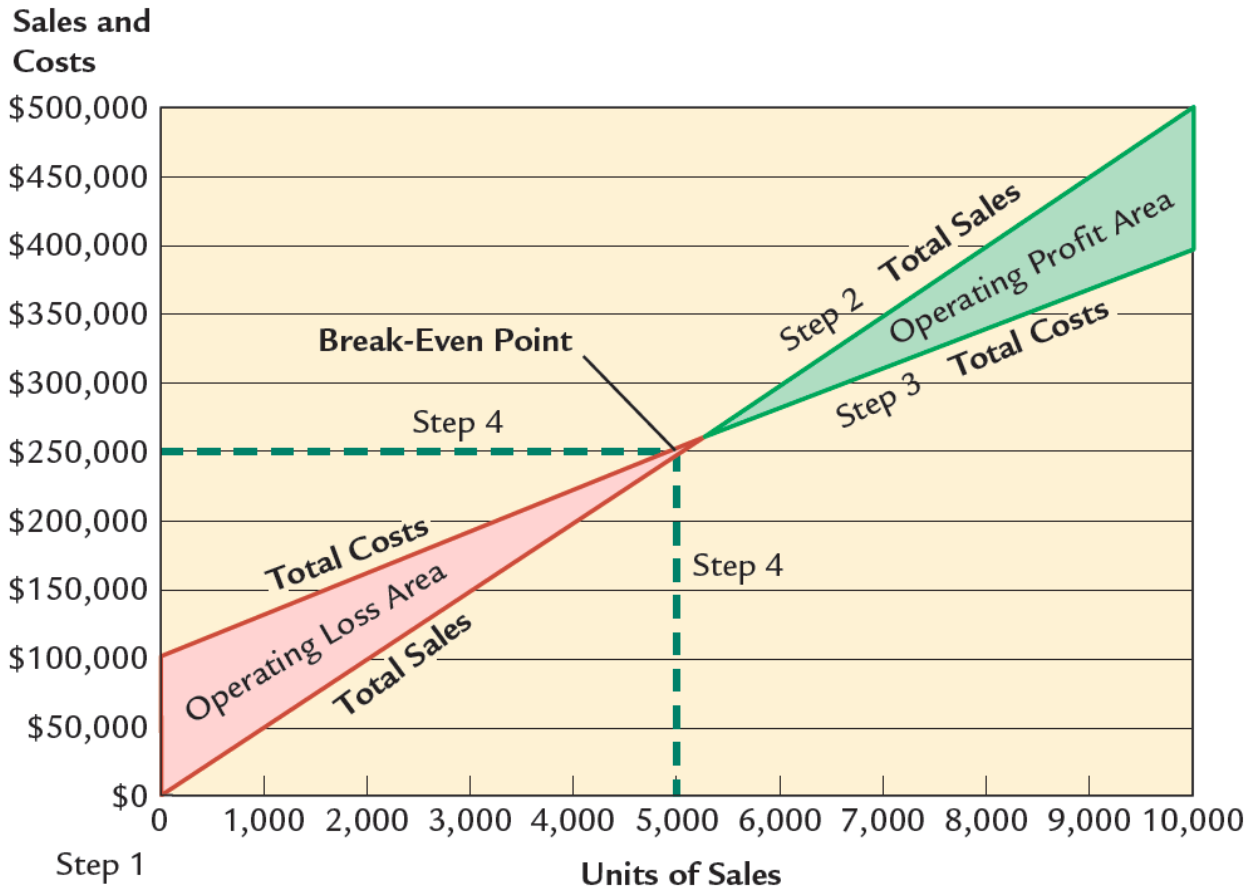
Using cost-volume-profit and profit-volume graphs, determine the break-even point and sales necessary to achieve a target profit

Cost-Volume-Profit Graphs

- Show the relationship among costs, sales, and operating profit or loss graphically
- Assume the following data for a cost-volume-profit graph:

Unit selling price	$ 50
Unit variable cost	(30)
Unit contribution margin	$ 20
Total fixed costs	$100,000

Exhibit 14: Cost-Volume-Profit Graph

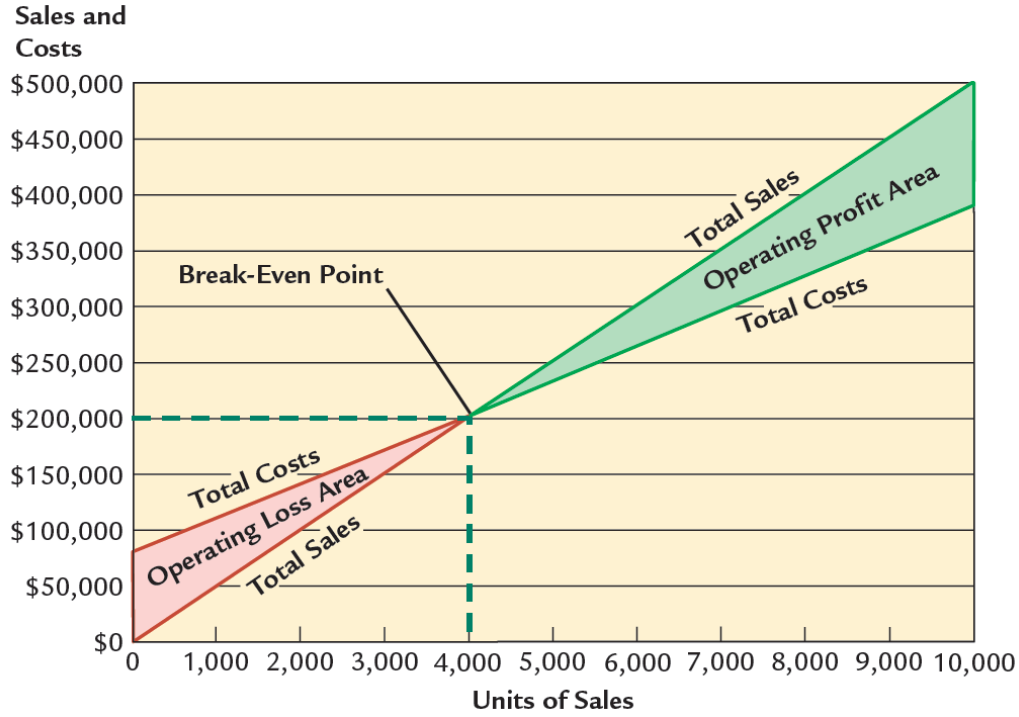


Construction of Cost-Volume-Profit Graph

- Horizontal axis displays the volume in units of sales, and the vertical axis displays dollar amounts of total sales and costs
- A sales line is plotted by beginning at zero on the left corner of the graph
- A cost line is plotted by beginning with total fixed costs, $100,000, on the vertical axis
- Break-even point is the intersection point of the total sales and total cost lines

Exhibit 15: Revised Cost-Volume-Profit Graph

- When total fixed costs are $80,000

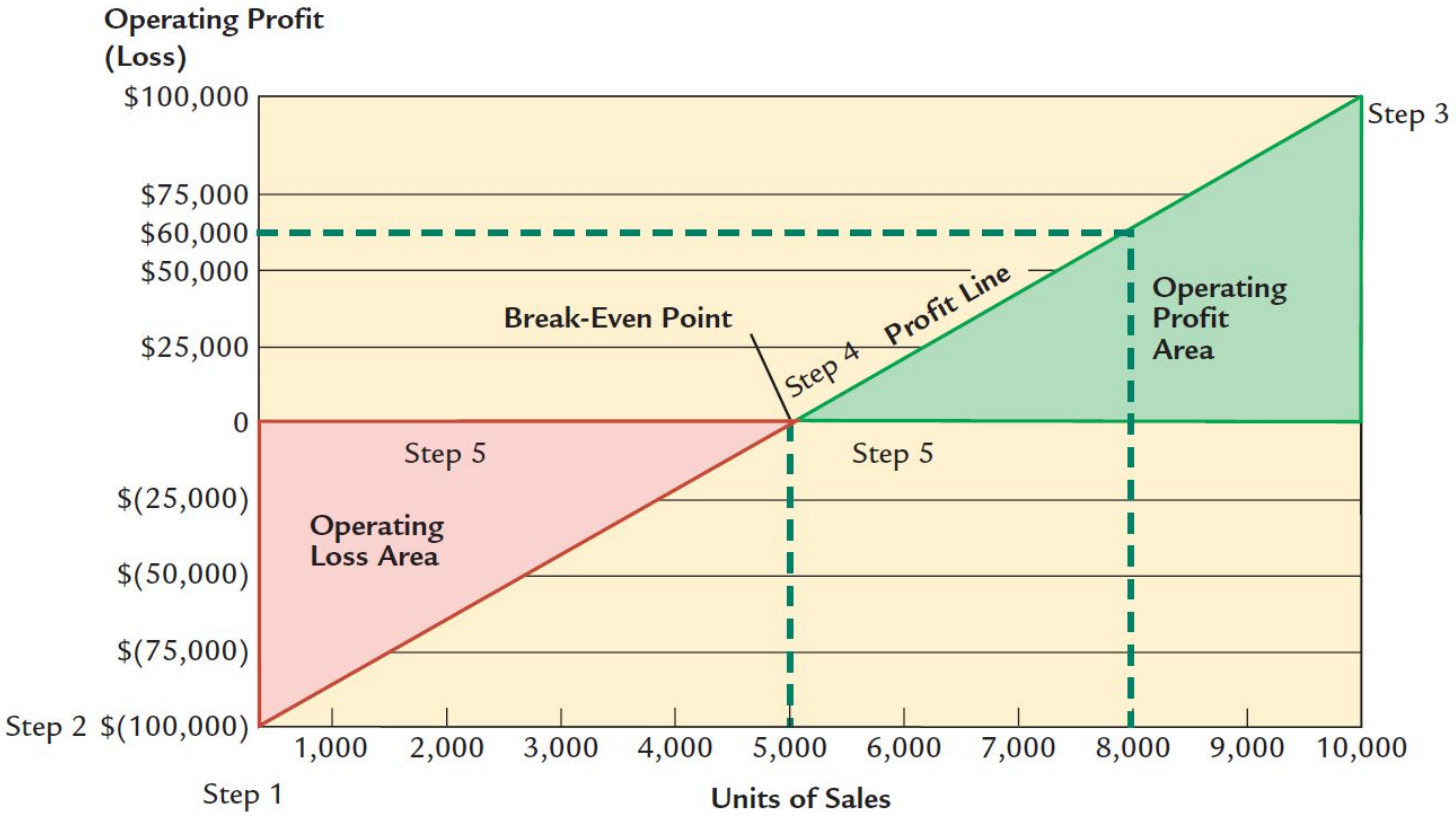


Profit-Volume Graph

- Plots the difference between total sales and total costs
- Data for the profit-volume graph

Unit selling price	$ 50
Unit variable cost	(30)
Unit contribution margin	$ 20
Total fixed costs	$100,000

Exhibit 16: Profit-Volume Graph



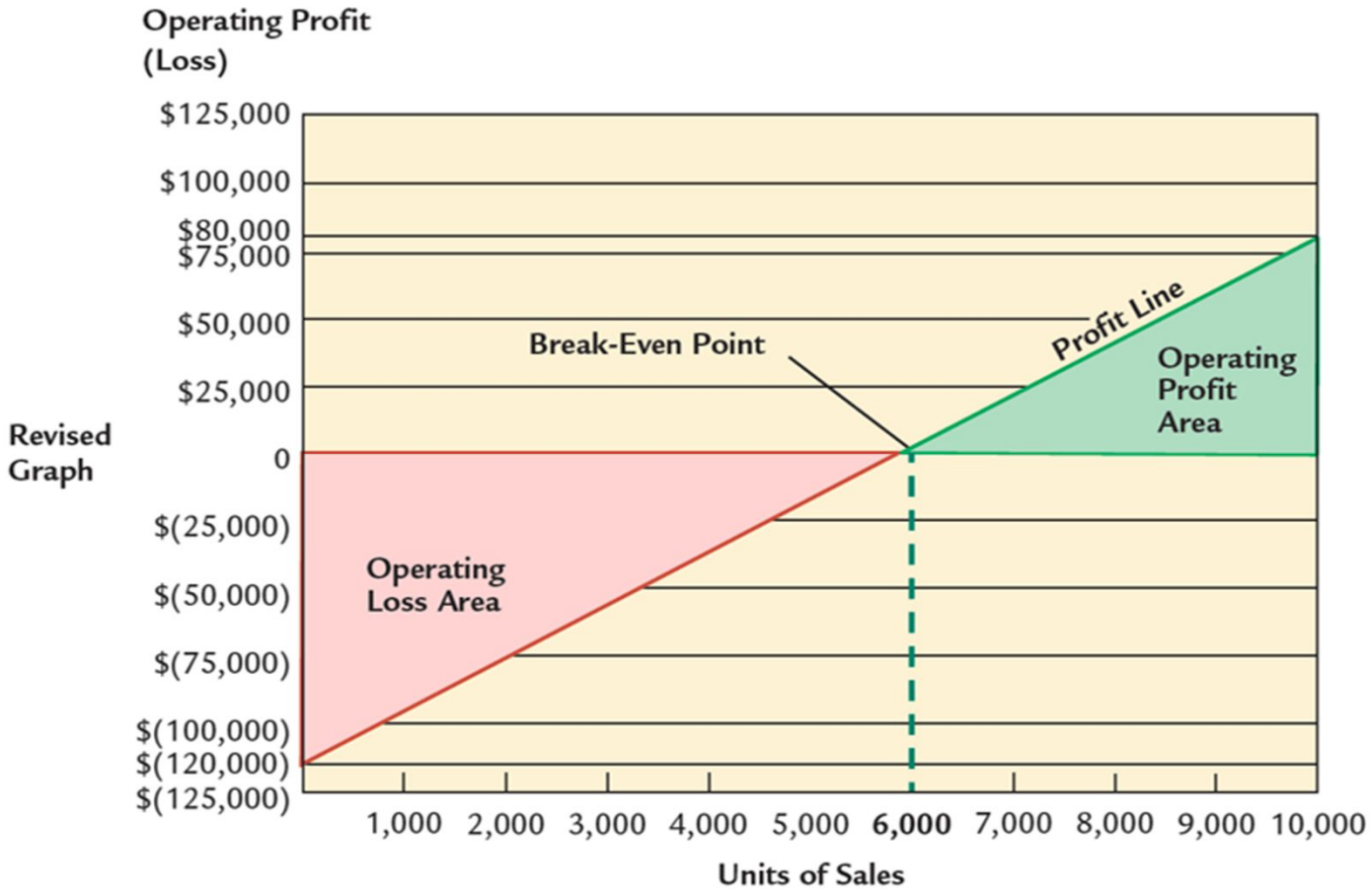
Effect on Profit Due to the Increase in Fixed Costs

- Fixed cost increases by $20,000

Sales (10,000 units × $50)	$ 500,000
Variable costs (10,000 units × $30)	(300,000)
Contribution margin (10,000 units × $20)	$ 200,000
Fixed costs	(120,000)
Operating profit	$ 80,000

← Revised maximum profit

Exhibit 17: Revised Profit-Volume Graph



Learning Objective 5

Apply cost-volume-profit relationships to more than one product and in computing operating leverage

Sales Mix Considerations

- Cost-volume-profit analysis is performed by considering the sales mix
  - **Sales mix:** Relative distribution of sales among the products sold by a company
- Products under a sales mix have different unit variable costs and thus different unit contribution margins

Sales Mix

- Assume that Burr Company sold Products A and B during the past year as follows:

	Product A	Product B
Unit selling price	$ 90	$140
Unit variable cost	(70)	(95)
Unit contribution margin	$ 20	$ 45
Units sold	8,000	2,000
Sales mix	80%	20%
Total fixed costs	$200,000	

Break-Even Analysis: Burr Company

- Products A and B are considered components of one overall enterprise product called E
- Computation of the unit selling price, unit variable cost, and unit contribution margin for E

Product E			Product A		Product B
Unit selling price of E	$100	=	($90 × 0.8)	+	($140 × 0.2)
Unit variable cost of E	(75)	=	($70 × 0.8)	+	($95 × 0.2)
Unit contribution margin of E	$ 25	=	($20 × 0.8)	+	($45 × 0.2)

$$\text{Break-Even Sales (units) for E} = \frac{\text{Fixed Costs}}{\text{Unit Contribution Margin}}$$

$$= \frac{\$200{,}000}{\$25} = 8{,}000 \text{ units}$$

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Break-Even Analysis: Burr Company (continued)

- Break-Even Quantity for Product A = 8,000 × 80% = 6,400 units
- Break-Even Quantity for Product B = 8,000 × 20% = 1,600 units
- Income statement of Burr Company

	Product A	Product B	Total	
Sales:				
6,400 units × $90	$ 576,000		$ 576,000	
1,600 units × $140		$ 224,000	224,000	
Total sales	$ 576,000	$ 224,000	$ 800,000	
Variable costs:				
6,400 units × $70	$(448,000)		$ (448,000)	
1,600 units × $95		$(152,000)	(152,000)	
Total variable costs	$(448,000)	$(152,000)	$ (600,000)	
Contribution margin	$ 128,000	$ 72,000	$ 200,000	
Fixed costs			(200,000)	
Operating income			$ 0	← Break-even point

Target Profit: Burr Company

- Sales required to earn a target profit may also be computed for a sales mix of products
- Sales necessary for Burr Company to earn a target profit of $50,000 would be 10,000 units

$$\text{Sales (units)} = \frac{\text{Fixed Cost + Target Profit}}{\text{Unit Contribution Margin}} = \frac{\$200{,}000 + \$50{,}000}{\$25} = 10{,}000 \text{ units}$$

- Sales Quantity of Product A = 10,000 units × 80% = 8,000 units
- Sales Quantity of Product B = 2,000 units × 20% = 2,000 units

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Income Statement for Verifying the Target Profit

	Product A	Product B	Total	
Sales:				
8,000 units × $90	$ 720,000		$ 720,000	
2,000 units × $140		$ 280,000	280,000	
Total sales	$ 720,000	$ 280,000	$ 1,000,000	
Variable costs:				
8,000 units × $70	$(560,000)		$ (560,000)	
2,000 units × $95		$(190,000)	(190,000)	
Total variable costs	$(560,000)	$(190,000)	$ (750,000)	
Contribution margin	$ 160,000	$ 90,000	$ 250,000	
Fixed costs			(200,000)	
Operating income			$ 50,000	← Target profit

Operating Leverage

- Measures the relationship of a company's contribution margin to operating income

$$\text{Operating Leverage} = \frac{\text{Contribution Margin}}{\text{Operating Income}}$$

- Companies with high fixed costs (capital intensive) have a high operating leverage
- Companies with low operating leverage are usually labor intensive

Operating Leverage (continued)

- Assume the following data for Lund Inc. and Yates Inc.:

	Lund Inc.	Yates Inc.
Sales	$ 400,000	$ 400,000
Variable costs	(300,000)	(300,000)
Contribution margin	$ 100,000	$ 100,000
Fixed costs	(80,000)	(50,000)
Operating income	$ 20,000	$ 50,000

Operating Leverage for Lund Inc. and Yates Inc.

$$\text{Operating Leverage for Lund Inc.} = \frac{\text{Contribution Margin}}{\text{Operating Income}} = \frac{\$100{,}000}{\$20{,}000} = 5$$

$$\text{Operating Leverage for Yates Inc.} = \frac{\text{Contribution Margin}}{\text{Operating Income}} = \frac{\$100{,}000}{\$50{,}000} = 2$$

- Computation of the effect of changes in sales on operating income

$$\text{Percent Change in Operating Income} = \text{Percent Change in Sales} \times \text{Operating Leverage}$$

Operating Leverage for Lund Inc. and Yates Inc.
(continued)

- Assume that sales increased by 10%, or $40,000 ($400,000 × 10%), for Lund Inc. and Yates Inc.
  - Percent change in operating income for Lund Inc.
    - 10% × 5 = 50%
  - Percent change in operating income for Yates Inc.
    - 10% × 2 = 20%

Revised Income Statements for Lund Inc. and Yates Inc.

	Lund Inc.	Yates Inc.
Sales	$ 440,000	$440,000
Variable costs	(330,000)	(330,000)
Contribution margin	$ 110,000	$110,000
Fixed costs	(80,000)	(50,000)
Operating income	$ 30,000	$ 60,000

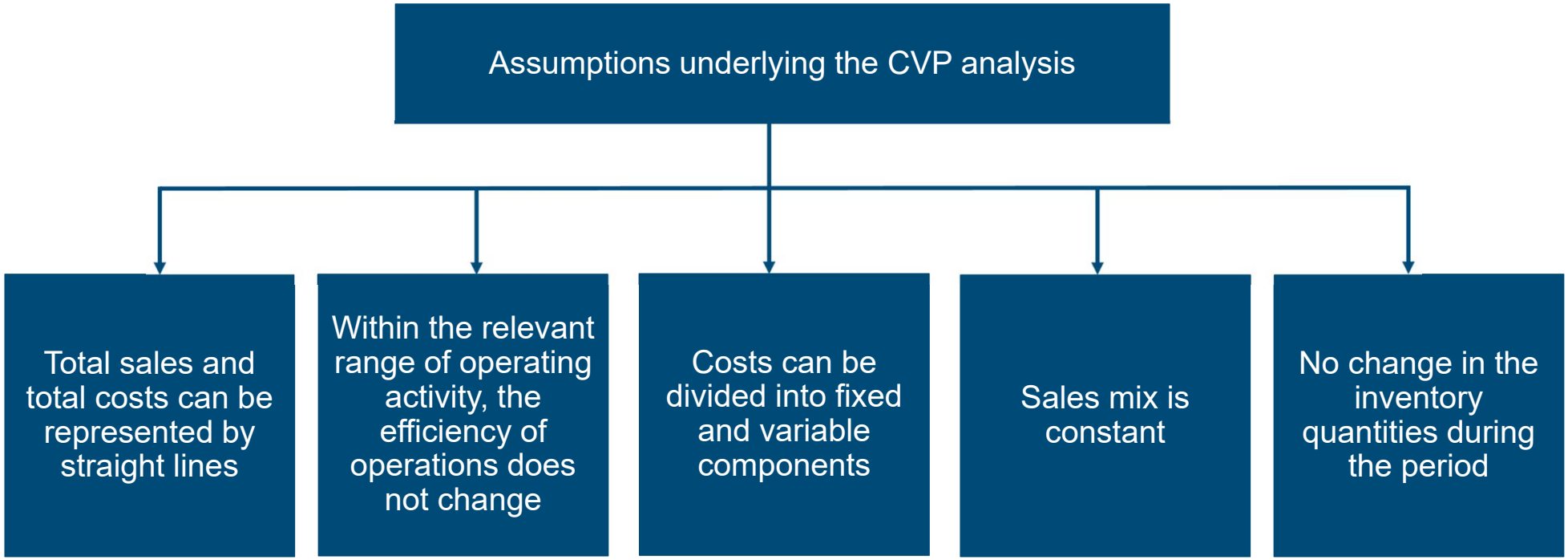
Exhibit 19: Effect of Operating Leverage on Operating Income

Operating Leverage	Percentage Impact on Operating Income from a Change in Sales
High	Large
Low	Small

Learning Objective 6

List the assumptions underlying cost-volume-profit analysis

Cost-Volume-Profit Assumptions



Learning Objective 7

Describe and illustrate the use of the margin of safety for managerial decision making and performance analysis

Margin of Safety

- Indicates the possible decrease in sales that may occur before an operating loss results
- Assume the following data:

Sales	$250,000
Sales at the break-even point	200,000
Unit selling price	25

Margin of Safety (continued)

Margin of Safety in Dollars of Sales

$$= \text{Current Sales Dollars} - \text{Break-Even Sales Dollars}$$

$$= \$250{,}000 - \$200{,}000 = \$50{,}000$$

Margin of Safety in Units of Sales

$$= \text{Current Unit Sales} - \text{Break-Even Unit Sales}$$

$$= (\$250{,}000 \div \$25) - (\$200{,}000 \div \$25)$$

$$= 10{,}000 \text{ units} - 8{,}000 \text{ units} = 2{,}000 \text{ units}$$

Margin of Safety in Percentage of Current Sales

$$= \frac{\text{Current Sales Dollars (or Units)} - \text{Break-Even Sales Dollars (or Units)}}{\text{Current Sales Dollars (or Units)}}$$

$$= \frac{\$250{,}000 - \$200{,}000}{\$250{,}000} = \frac{\$50{,}000}{\$250{,}000} = 20\%$$

or

$$= \frac{10{,}000 \text{ units} - 8{,}000 \text{ units}}{10{,}000 \text{ units}} = \frac{2{,}000 \text{ units}}{10{,}000 \text{ units}} = 20\%$$

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End of Chapter 11