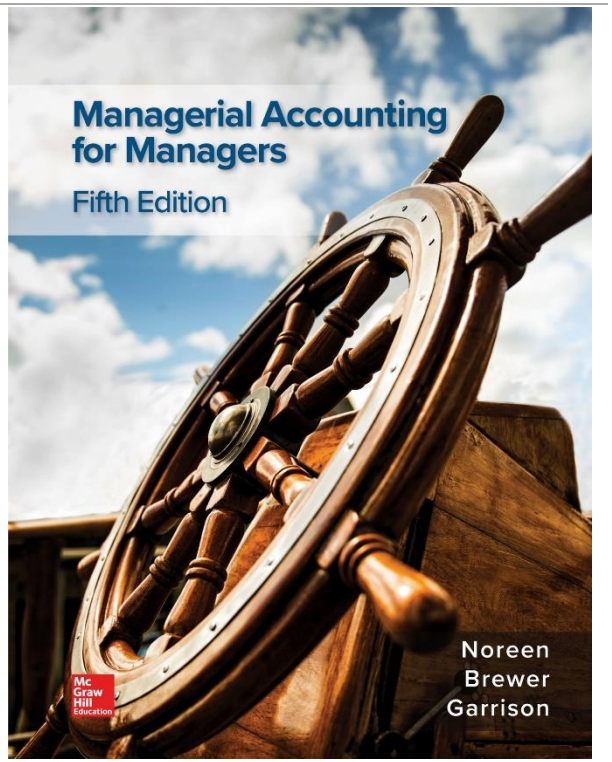
Cost-Volume-Profit Relationships

CHAPTER 2



PowerPoint Authors:
Susan Coomer Galbreath, Ph.D., CPA
Jon A. Booker, Ph.D., CPA, CIA
Cynthia J. Rooney, Ph.D., CPA

Cost-Volume-Profit Analysis: Key Assumptions

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

1. Selling price is constant. The price of a product or service will not change as volume changes.

2. Costs are linear and can be accurately divided into variable and fixed components. The variable costs are constant per unit and the fixed costs are constant in total over the entire relevant range.

3. In multiproduct companies, the mix of products sold remains constant.

Learning Objective 1

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

Basics of Cost-Volume-Profit Analysis – Part 1

The contribution income statement is helpful to managers in judging the impact on profits of changes in selling price, cost, or volume. The emphasis is on cost behavior.

Racing Bicycle Company Contribution Income Statement For the Month of June		
Sales (500 bicycles)	$	250,000
Less: Variable expenses		150,000
Contribution margin		100,000
Less: Fixed expenses		80,000
Net operating income	$	20,000

Contribution Margin (CM) is the amount remaining from sales revenue after variable expenses have been deducted.

Basics of Cost-Volume-Profit Analysis – Part 2

Racing Bicycle Company Contribution Income Statement For the Month of June		
Sales (500 bicycles)	$	250,000
Less: Variable expenses		150,000
Contribution margin		100,000
Less: Fixed expenses		80,000
Net operating income	$	20,000

CM is used first to cover fixed expenses. Any remaining CM contributes to net operating income.

The Contribution Approach – Part 1

Sales, variable expenses, and contribution margin can also be expressed on a per unit basis. If Racing sells an additional bicycle, $200 additional CM will be generated to cover fixed expenses and profit.

Racing Bicycle Company
Contribution Income Statement
For the Month of June

	Total	Per Unit
Sales (500 bicycles)	$ 250,000	$ 500
Less: Variable expenses	150,000	300
Contribution margin	100,000	$ 200
Less: Fixed expenses	80,000	
Net operating income	$ 20,000	

The Contribution Approach – Part 2

Each month, RBC must generate at least $80,000 in total contribution margin to break-even (which is the level of sales at which profit is zero).

Racing Bicycle Company
Contribution Income Statement
For the Month of June

	Total	Per Unit
Sales (500 bicycles)	$ 250,000	$ 500
Less: Variable expenses	150,000	300
Contribution margin	100,000	$ 200
Less: Fixed expenses	80,000	
Net operating income	$ 20,000	

The Contribution Approach – Part 3

If RBC sells 400 units in a month, it will be operating at the *break-even point*.

Racing Bicycle Company Contribution Income Statement For the Month of June	Total	Per Unit
Sales (400 bicycles)	$ 200,000	$ 500
Less: Variable expenses	120,000	300
Contribution margin	80,000	$ 200
Less: Fixed expenses	80,000	
Net operating income	$ -	

The Contribution Approach – Part 4

If RBC sells one more bike (401 bikes), net operating income will increase by *$200*.

Racing Bicycle Company
Contribution Income Statement
For the Month of June

	Total	Per Unit
Sales (401 bicycles)	$ 200,500	$ 500
Less: Variable expenses	120,300	300
Contribution margin	80,200	$ 200
Less: Fixed expenses	80,000	
Net operating income	$ 200	

The Contribution Approach – Part 5

We do not need to prepare an income statement to estimate profits at a particular sales volume. Simply multiply the number of units sold above break-even by the contribution margin per unit.

If Racing sells 430 bikes, its net operating income will be $6,000 (30 units x $200 per unit).

CVP Relationships in Equation Form

The contribution format income statement can be expressed in the following equation:

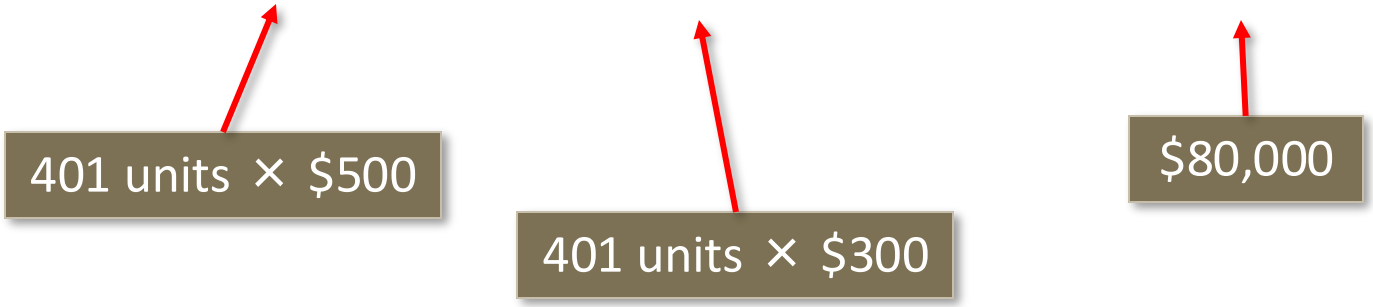
Profit = (Sales – Variable expenses) – Fixed expenses

Racing Bicycle Company Contribution Income Statement For the Month of June	Total	Per Unit
Sales (401 bicycles)	$ 200,500	$ 500
Less: Variable expenses	120,300	300
Contribution margin	80,200	$ 200
Less: Fixed expenses	80,000	
Net operating income	$ 200	

CVP Relationships in Equation Form - Example

This equation can be used to show the profit RBC earns if it sells 401. Notice, the answer of $200 mirrors our earlier solution.

Profit = (Sales – Variable expenses) – Fixed expenses



Profit = ($200,500 – $120,300) – $80,000

$200 = ($200,500 – $120,300) – $80,000

CVP Relationships in Equation Form – Detail Breakdown

When a company has only one product we can further refine this equation as shown on this slide.

Profit = (Sales – Variable expenses) – Fixed expenses

Quantity sold (Q)	
× Selling price per unit (P)	
= Sales (Q × P)	

Quantity sold (Q)	
× Variable expenses per unit (V)	
= Variable expenses (Q × V)	

Profit = (P × Q – V × Q) – Fixed expenses

CVP Relationships in Equation Form – Example Showing Detail

This equation can also be used to show the $200 profit RBC earns if it sells 401 bikes.

Profit = (Sales – Variable expenses) – Fixed expenses

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

$$\$200 = (\$500 \times 401 - \$300 \times 401) - \$80{,}000$$

CVP Relationships in Equation Form – Using Unit Contribution Margin

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

Unit CM = Selling price per unit – Variable expenses per unit

Unit CM = P – V

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

CVP Relationships in Equation Form – Example Using Unit CM

Profit = (P × Q – V × Q) – Fixed expenses
Profit = (P – V) × Q – Fixed expenses
Profit = Unit CM × Q – Fixed expenses

Profit = ($500 – $300) × 401 – $80,000
Profit = $200 × 401 – $80,000
Profit = $80,200 – $80,000
Profit = $200

This equation can also be used to compute RBC's $200 profit if it sells 401 bikes.

Learning Objective 2

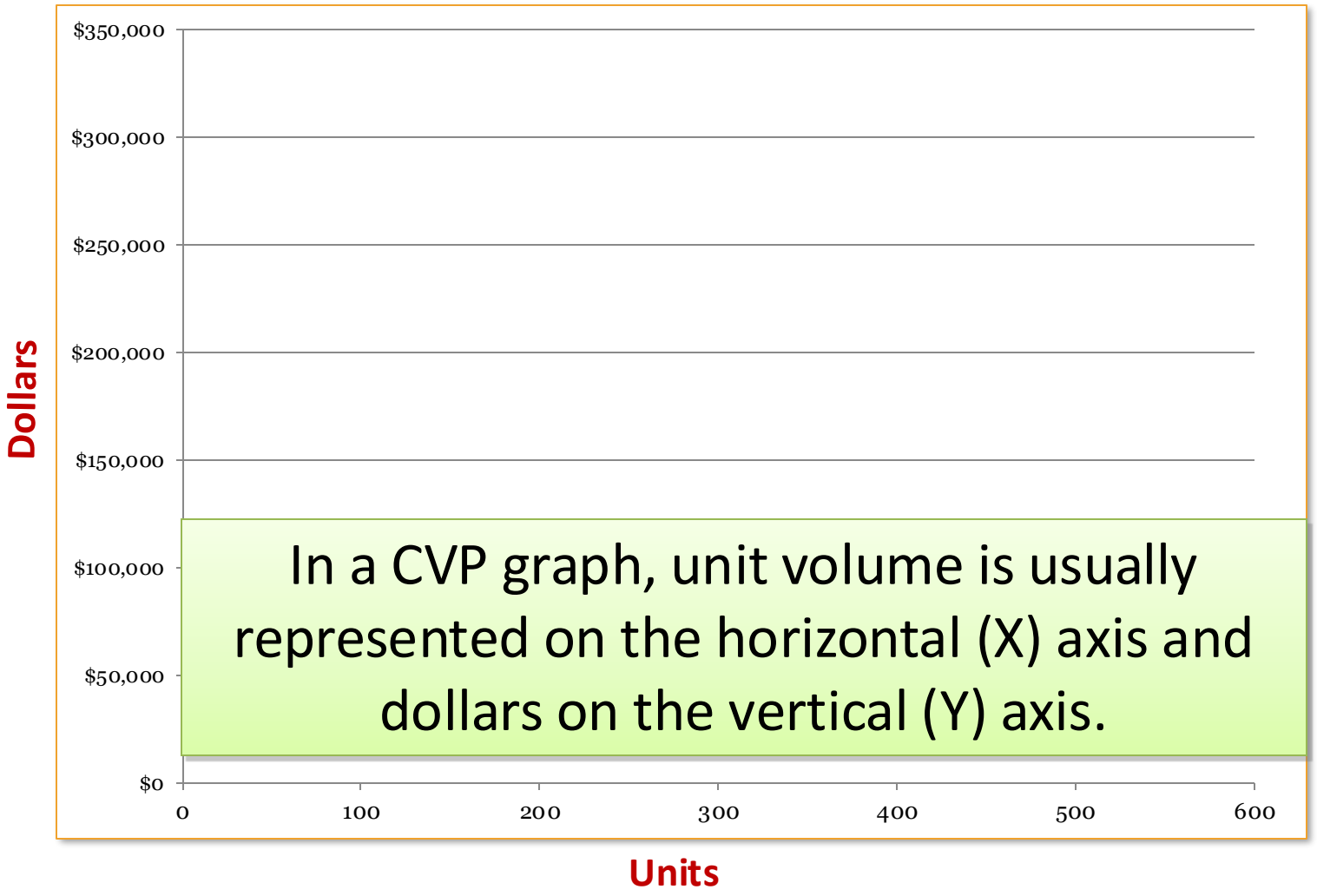
Prepare and interpret a cost-volume-profit (CVP) graph and a profit graph.

CVP Relationships in Graphic Form

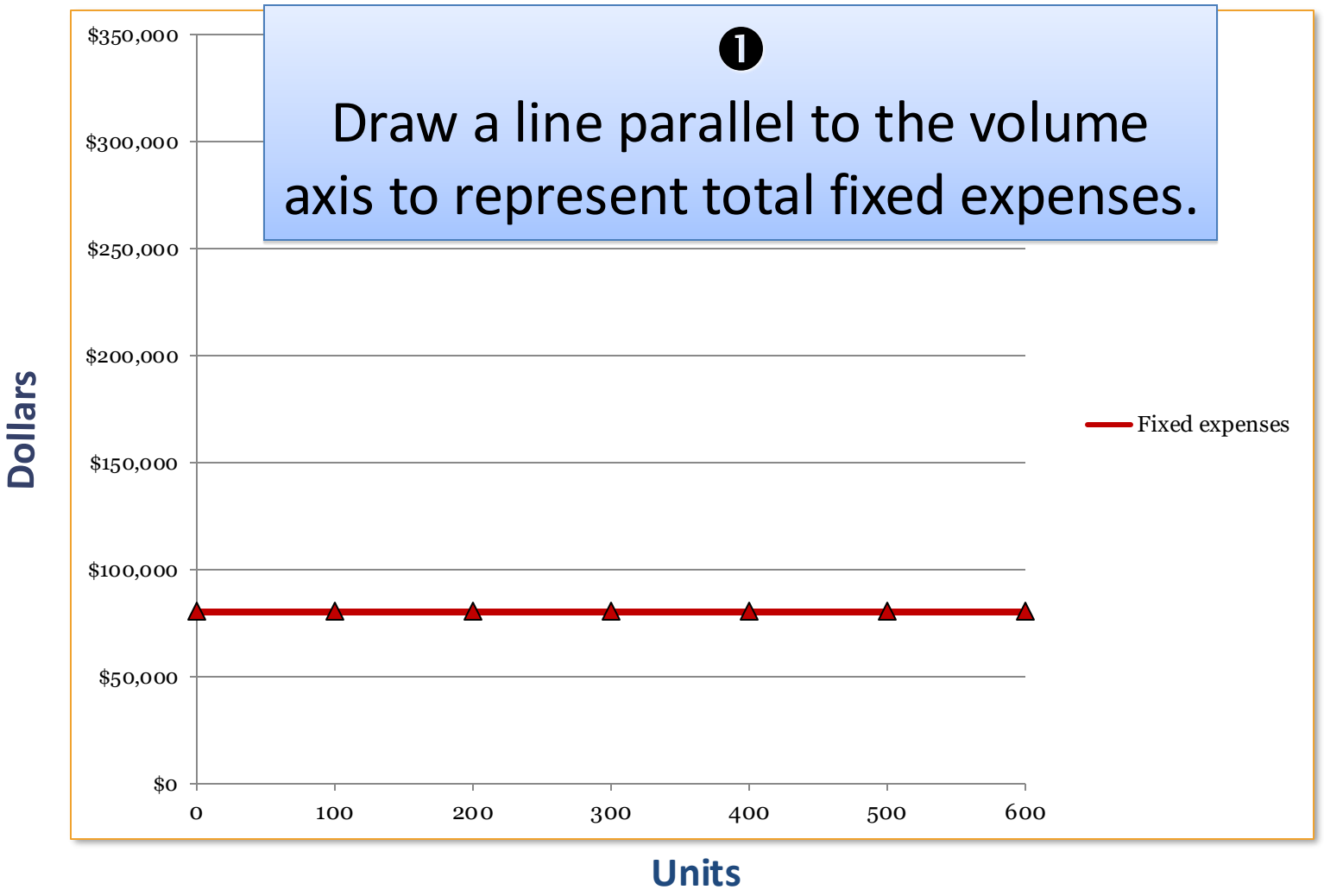
The relationships among revenue, cost, profit, and volume can be expressed graphically by preparing a CVP graph. Racing Bicycle developed contribution margin income statements at 0, 200, 400, and 600 units sold. We will use this information to prepare the CVP graph.

	Units Sold			
	0	200	400	600
Sales	$ -	$ 100,000	$ 200,000	$ 300,000
Total variable expenses	-	60,000	120,000	180,000
Contribution margin	-	40,000	80,000	120,000
Fixed expenses	80,000	80,000	80,000	80,000
Net operating income (loss)	$ (80,000)	$ (40,000)	$ -	$ 40,000

Preparing the CVP Graph – Step 1



Preparing the CVP Graph – Step 2



Preparing the CVP Graph – Step 3

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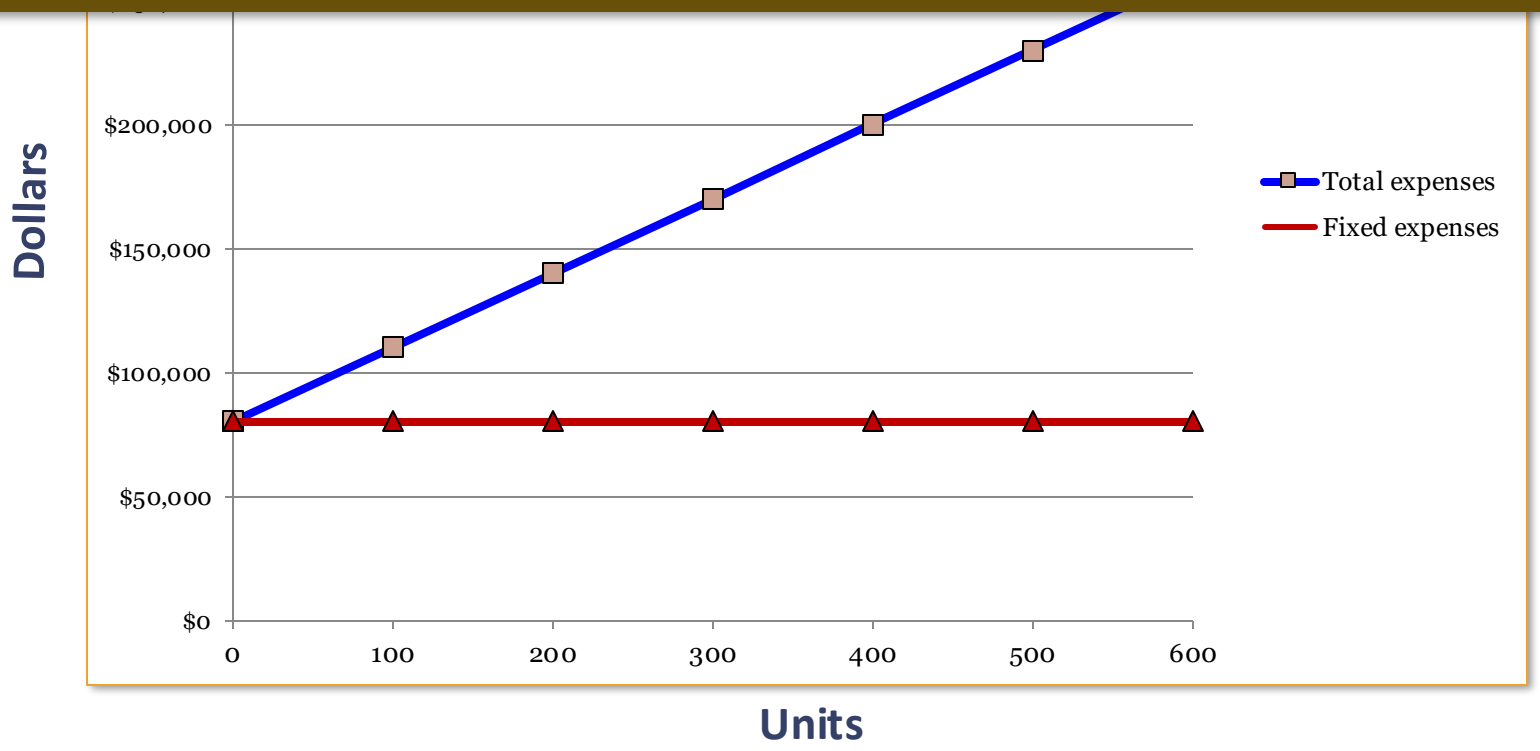
Choose some sales volume, say 400 units, and plot the point representing total expenses (fixed and variable). Draw a line through the data point back to where the fixed expenses line intersects the dollar axis.



Preparing the CVP Graph – Step 4

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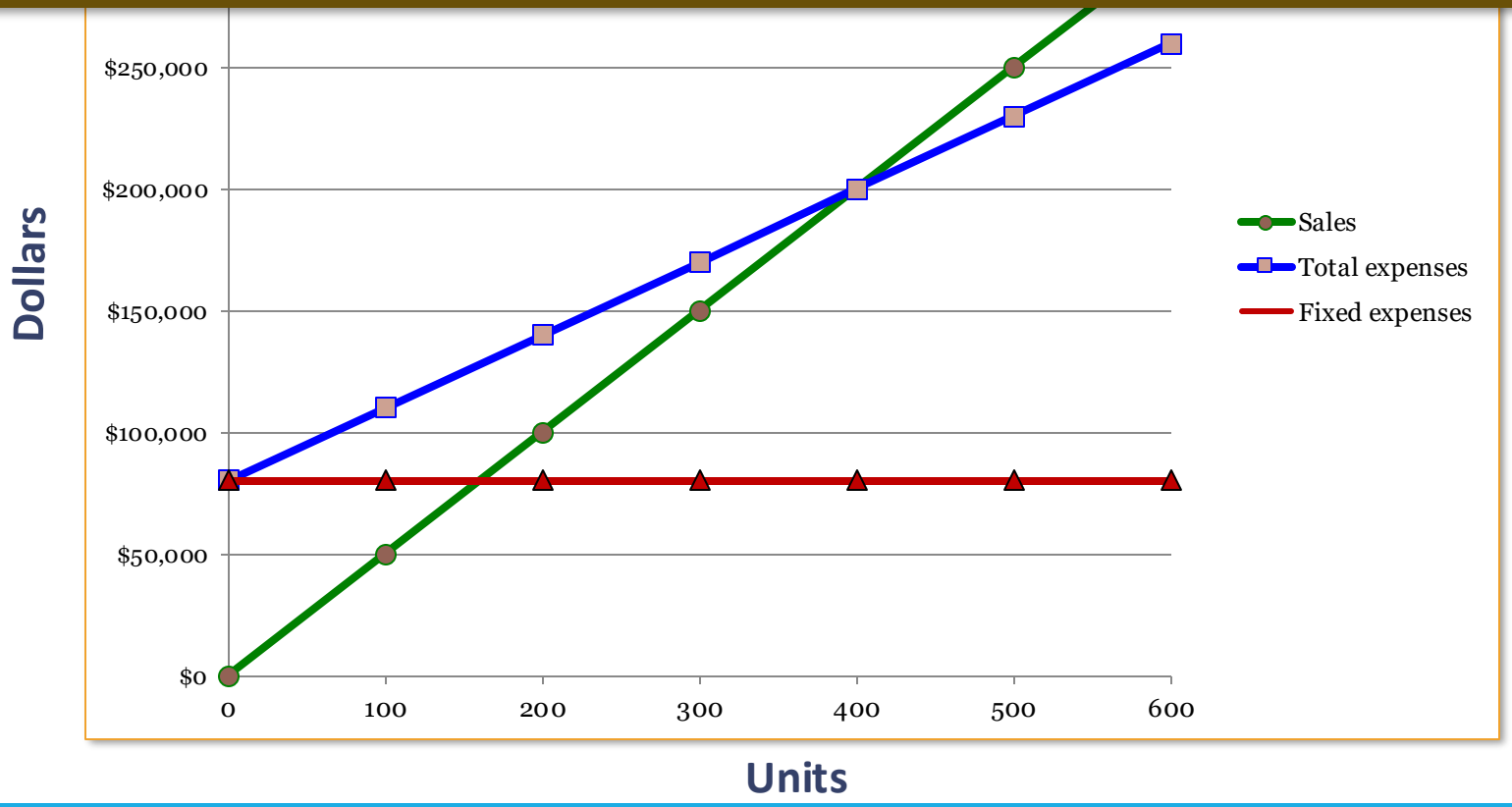
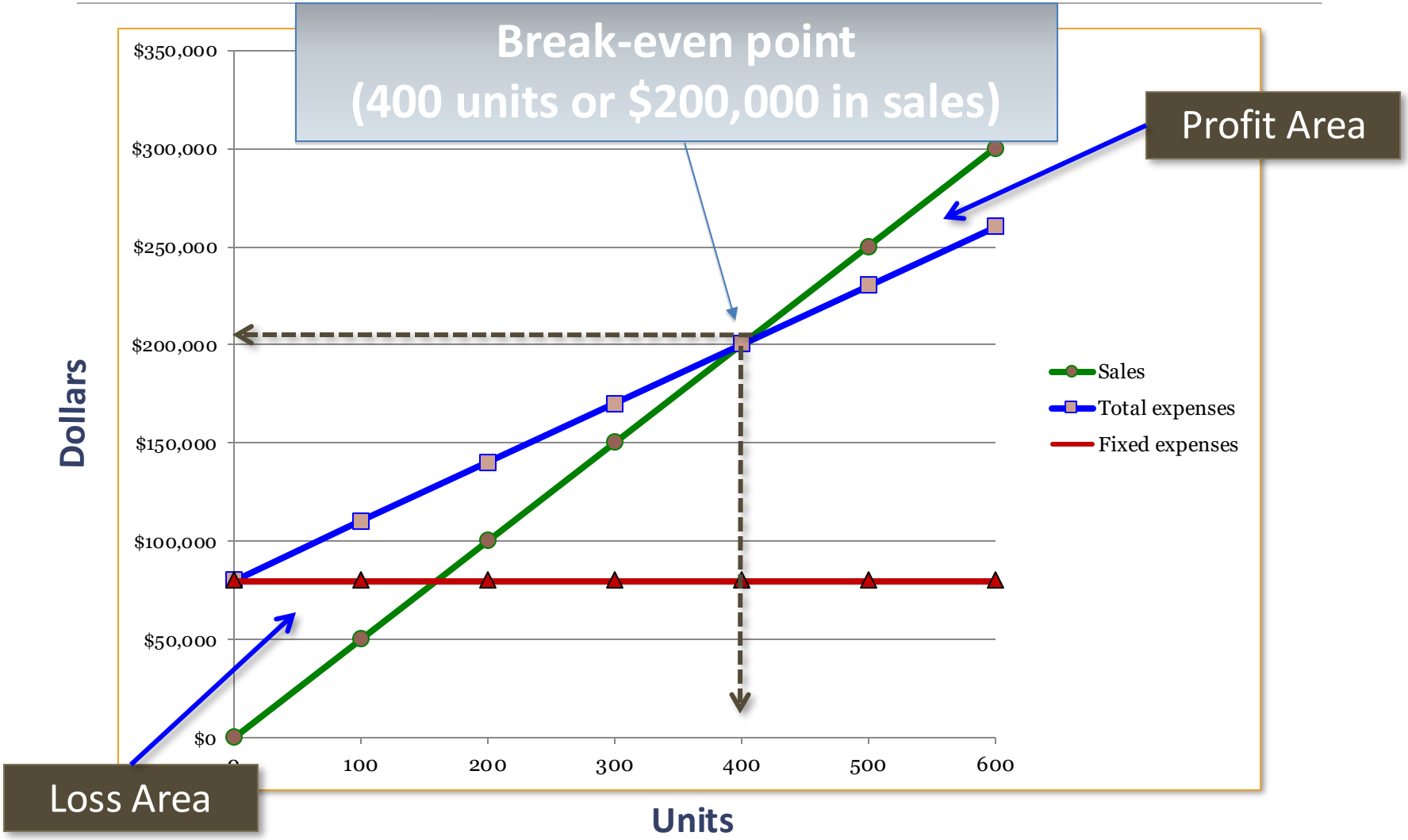
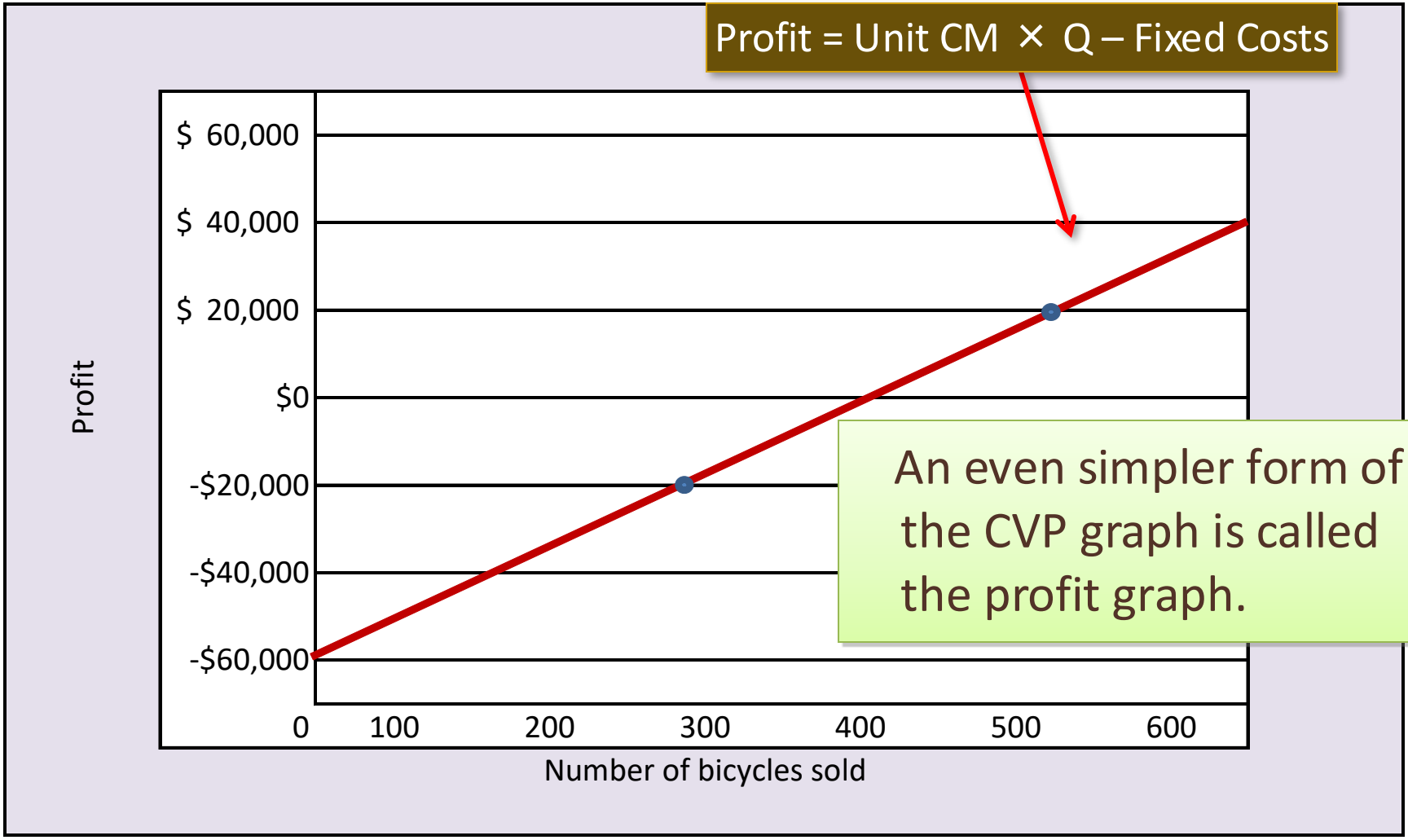
Choose some sales volume, say 400 units, and plot the point representing total sales. Draw a line through the data point back to the point of origin.



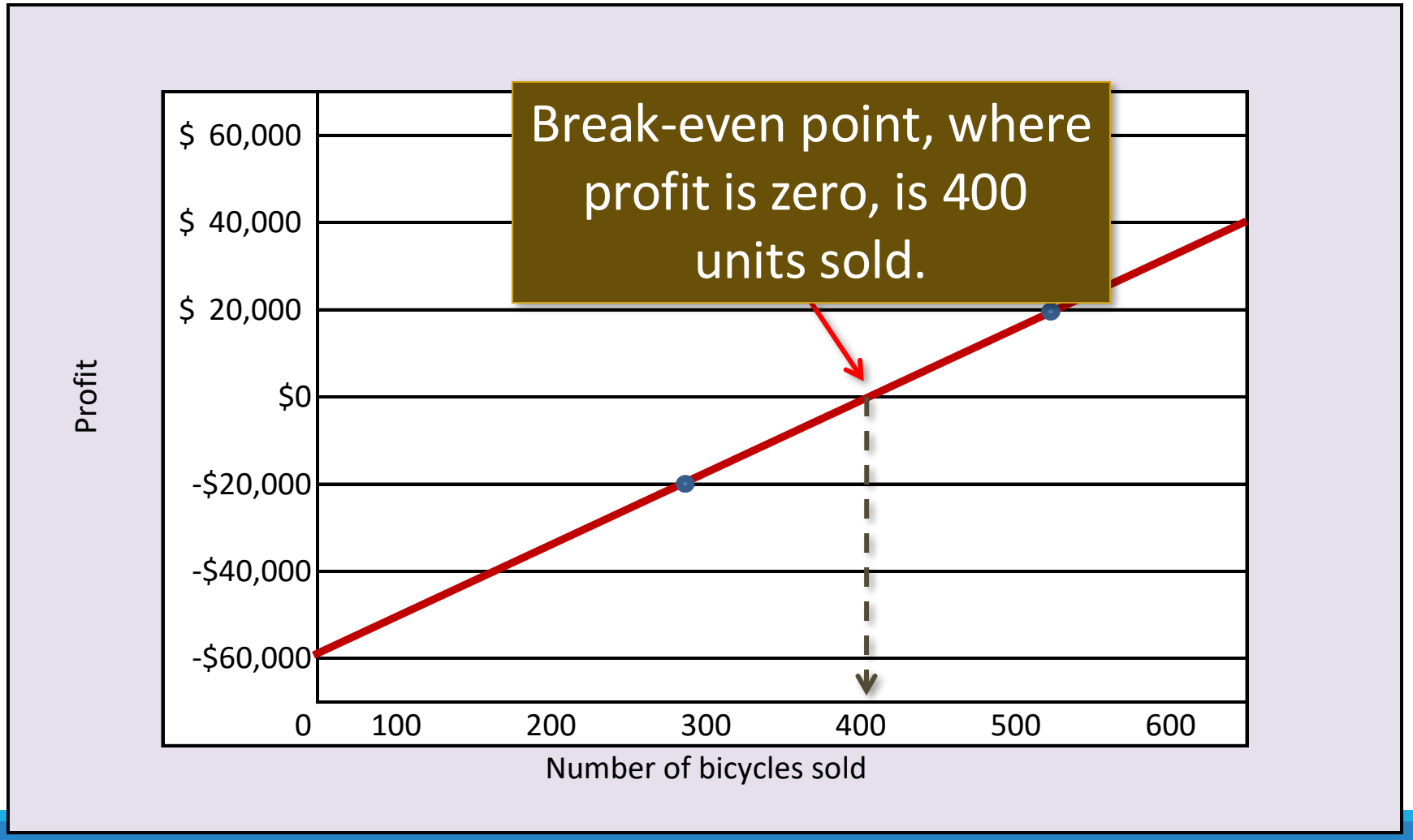
Preparing the CVP Graph – Break-Even Point



Preparing the CVP Graph – Simple Form



Preparing the CVP Graph – Showing Break-Even Point



Learning Objective 3

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

Contribution Margin Ratio (CM Ratio) and the Variable Expense Ratio – Step 1

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

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

For RBC, the contribution margin ratio is calculated as follows:

$$\text{CM Ratio} \quad \frac{\$80{,}000}{\$200{,}000} = 40\%$$

For each $1.00 increase in sales results in a total contribution margin increase of 40¢.

Contribution Margin Ratio (CM Ratio) and the Variable Expense Ratio – Step 2

The CM ratio can also be calculated by dividing the contribution margin per unit by the selling price per unit.

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

$$\text{CM Ratio} = \frac{\$200}{\$500} = 40\%$$

Contribution Margin Ratio (CM Ratio) and the Variable Expense Ratio – Step 3

The variable expenses as a percentage of sales is referred to as the variable expense ratio. This ratio is computer as follows:

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

For RBC, the variable expense ratio is calculated as follows:

$$\text{Variable Expense Ratio} \quad \frac{\$120{,}000}{\$200{,}000} = 60\%$$

Contribution Margin Ratio (CM Ratio) and the Variable Expense Ratio – Step 4

Having defined the two terms, it bears emphasizing that the contribution margin ratio and the variable expense ratio can be mathematically related to one another:

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

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

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

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

$$= 1 - 60\%$$

$$= 40\%$$

Applications of Contribution Ratio

If RBC increases sales from 400 to 500 bikes ($50,000), contribution margin will increase by $20,000 ($50,000 × 40%). Here is the proof:

	400 Units	500 Units
Sales	$200,000	$250,000
Less: variable expenses	120,000	150,000
Contribution margin	80,000	100,000
Less: fixed expenses	80,000	80,000
Net operating income	$ -	$ 20,000

A $50,000 increase in sales revenue results in a $20,000 increase in CM ($50,000 × 40% = $20,000).

Quick Check 1

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. An average of 2,100 cups are sold each month. What is the CM Ratio for Coffee Klatch?

a. 1.319

b. 0.758

c. 0.242

d. 4.139

Quick Check 1a

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. An average of 2,100 cups are sold each month. What is the CM Ratio for Coffee Klatch?

a. 1.319

b. 0.758

c. 0.242

d. 4.139

$$\text{CM Ratio} = \frac{\text{Unit contribution margin}}{\text{Unit selling price}}$$

$$= \frac{(\$1.49 - \$0.36)}{\$1.49}$$

$$= \frac{\$1.13}{\$1.49} = 0.758$$

Applications of Contribution Ratio – Increase in Sales Volume

The relationship between profit and the CM ratio can be expressed using the following equation:

Profit = (CM ratio × Sales) – Fixed expenses

If RBC increased its sales volume to 500 bikes, what would management expect profit or net operating income to be?

Profit = (40% × $250,000) – $80,000
Profit = $100,000 – $80,000
Profit = $20,000

Learning Objective 4

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

Additional Applications of CVP Concepts – Example 1

Example 1: Change in Fixed Cost and Sales Volume

What is the profit impact if Racing Bicycle can increase unit sales from 500 to 540 by increasing the monthly advertising budget by $10,000?

Additional Applications of CVP Concepts – Solution to Example 1

Example 1: Change in Fixed Cost and Sales Volume

$80,000 + $10,000 advertising = $90,000

	500 units	540 units
Sales	$ 250,000	$ 270,000
Less: Variable expenses	150,000	162,000
Contribution margin	100,000	108,000
Less: Fixed expenses	80,000	90,000
Net operating income	$ 20,000	$ 18,000

Sales *increased* by $20,000, but net operating income *decreased* by $2,000.

Additional Applications of CVP Concepts – A Shortcut

Example 1: Change in Fixed Cost and Sales Volume

A shortcut solution using incremental analysis

Increase in CM (40 units X $200)	$ 8,000
Increase in advertising expenses	10,000
Decrease in net operating income	$ (2,000)

Additional Applications of CVP Concepts –Example 2

Example 2: Change in Variable Costs and Sales Volume

What is the profit impact if Racing Bicycle can use higher quality raw materials, thus increasing variable costs per unit by $10, to generate an increase in unit sales from 500 to 580?

Additional Applications of CVP Concepts – Solution to Example 2

Example 2: Change in Variable Costs and Sales Volume

580 units × $310 variable cost/unit = $179,800

	500 units	580 units
Sales	$ 250,000	$ 290,000
Less: Variable expenses	150,000	179,800
Contribution margin	100,000	110,200
Less: Fixed expenses	80,000	80,000
Net operating income	$ 20,000	$ 30,200

Sales *increase* by $40,000 and net operating income *increases* by $10,200.

Additional Applications of CVP Concepts – Example 3

Example 3: Change in Fixed Cost, Selling Price, and Sales Volume

What is the profit impact if RBC:

(1) cuts its selling price $20 per unit,

(2) increases its advertising budget by $15,000 per month, and

(3) increases sales from 500 to 650 units per month?

Additional Applications of CVP Concepts – Solution to Example 3

Example 3: Change in Fixed Cost, Selling Price, and Sales Volume

650 units × $480 = $312,000

	500 units	650 units
Sales	$ 250,000	$ 312,000
Less: Variable expenses	150,000	195,000
Contribution margin	100,000	117,000
Less: Fixed expenses	80,000	95,000
Net operating income	$ 20,000	$ 22,000

Sales *increase* by $62,000, fixed costs *increase* by $15,000, and net operating income *increases* by $2,000.

Additional Applications of CVP Concepts – Example 4

Example 4: Change in Variable Cost, Fixed Cost, and Sales Volume

What is the profit impact if RBC:

(1) pays a $15 sales commission per bike sold instead of paying salespersons flat salaries that currently total $6,000 per month, and

(2) increases unit sales from 500 to 575 bikes?

Additional Applications of CVP Concepts – Solution to Example 4

Example 4: Change in Variable Cost, Fixed Cost, and Sales Volume

575 units × $315 = $181,125

	500 units	575 units
Sales	$ 250,000	$ 287,500
Less: Variable expenses	150,000	181,125
Contribution margin	100,000	106,375
Less: Fixed expenses	80,000	74,000
Net operating income	$ 20,000	$ 32,375

Sales *increase* by $37,500, fixed expenses *decrease* by $6,000, and net operating income *increases* by $12,375.

Additional Applications of CVP Concepts – Example 5

Example 5: Change in Selling Price

If RBC has an opportunity to sell 150 bikes to a wholesaler without disturbing sales to other customers or fixed expenses, what price would it quote to the wholesaler if it wants to increase monthly profits by $3,000?

Additional Applications of CVP Concepts – Solution to Example 5

Example 5: Change in Selling Price

$ 3,000 ÷ 150 bikes	=	$ 20 per bike
Variable cost per bike	=	300 per bike
Selling price required	=	$ 320 per bike

150 bikes × $320 per bike	=	$ 48,000
Total variable costs	=	45,000
Increase in net operating income	=	$ 3,000

Learning Objective 5

Determine the break-even point.

Break-even Analysis

The equation and formula methods can be used to determine the unit sales and dollar sales needed to achieve a target profit of zero. Let's use the RBC information to complete the break-even analysis.

Racing Bicycle Company
Contribution Income Statement
For the Month of June

	Total	Per Unit	CM Ratio
Sales (500 bicycles)	$ 250,000	$ 500	100%
Less: Variable expenses	150,000	300	60%
Contribution margin	100,000	$ 200	40%
Less: Fixed expenses	80,000		
Net operating income	$ 20,000		

Break-Even Analysis: Equation Method Part 1

The equation method relies on the basic profit equation introduced earlier in the chapter. Because Racing Bicycle has only one product, we'll use the contribution margin form of this equation to perform the break-even calculations. We calculate break-even by solving the equation below.

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

$$\$0 = \$200 \times Q - \text{Fixed expenses}$$

Break-Even Analysis: Equation Method Part 2

In a single product situation, the equation method for computer the unit sales at break-even is:

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

$$\$0 = \$200 \times Q - \text{Fixed expenses}$$

$$\$200 \times Q = \$0 + \$80{,}000$$

$$Q = \$80{,}000 \div \$200$$

$$Q = 400$$

Break-Even Analysis: Formula Method

The formula method is a shortcut version of the equation method. It centers on the idea discussed earlier in the chapter that each unit sold provides a certain amount of contribution margin that goes toward covering fixed expenses.

$$\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{CM per unit}}$$

$$\text{Unit sales} = \frac{\$80{,}000}{\$200}$$

$$\text{Unit sales} = 400$$

Break-Even Analysis: Dollar Sales

Suppose Racing Bicycle wants to compute the sales dollars required to break-even (earn a target profit of $0). Let's use the equation method and the formula method to solve this problem.

Break-Even Analysis: Dollar Sales Using Equation Method

The equation method is shown on this slide:

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

$$\$0 = 40\% \times \text{Sales} - \$80{,}000$$

$$40\% \times \text{Sales} = \$80{,}000$$

$$\text{Sales} = \$80{,}000 \div 40\%$$

$$\text{Sales} = \$200{,}000$$

Break-Even Analysis: Dollar Sales Using CM Ratio

Now, let's use the formula method to calculate the dollar sales at the break-even point.

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

$$\text{Dollar sales} = \frac{\$80{,}000}{40\%}$$

$$\text{Dollar sales} = \$200{,}000$$

Quick Check 2

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. An average of 2,100 cups are sold each month. What is the break-even sales dollars?

a. $1,300

b. $1,715

c. $1,788

d. $3,129

Quick Check 2a

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. An average of 2,100 cups are sold each month. What is the break-even sales dollars?

a. $1,300

b. $1,715

c. $1,788

d. $3,129

$$\text{Break-even sales} = \frac{\text{Fixed expenses}}{\text{CM Ratio}}$$

$$= \frac{\$1,300}{0.758}$$

$$= \$1,715$$

Quick Check 3

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. An average of 2,100 cups are sold each month. What is the break-even sales in units?

a. 872 cups

b. 3,611 cups

c. 1,200 cups

d. 1,150 cups

Quick Check 3a

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The av
$1,300. An average
month. What is the b

a. 872 cups

b. 3,611 cups

c. 1,200 cups

d. 1,150 cups

$$\text{Break-even} = \frac{\text{Fixed expenses}}{\text{CM per Unit}}$$

$$= \frac{\$1{,}300}{\$1.49/\text{cup} - \$0.36/\text{cup}}$$

$$= \frac{\$1{,}300}{\$1.13/\text{cup}}$$

$$= 1{,}150 \text{ cups}$$

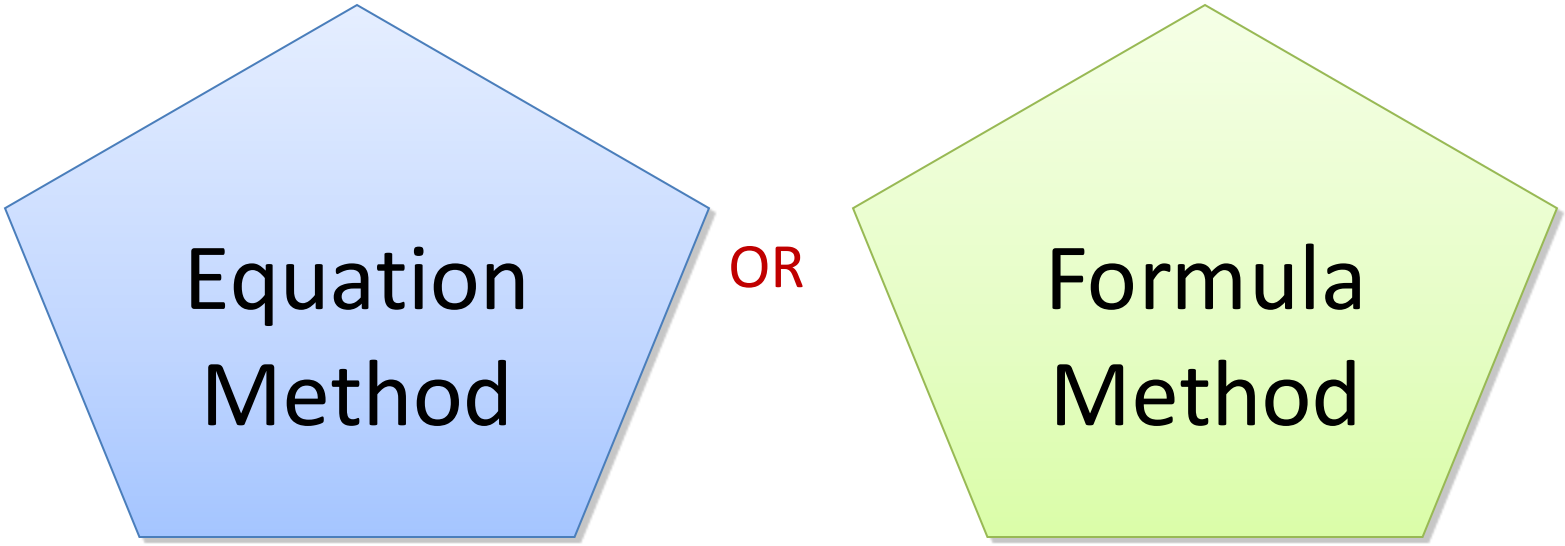
Learning Objective 6

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

Target Profit Analysis

In target profit analysis, we estimate what sales volume is needed to achieve a specific target profit.

We can also compute the number of units that must be sold to attain a target profit using either:



Target Profit Analysis – Equation Method

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

Our goal is to solve for the unknown "Q," which represents the quantity of units that must be sold to attain the target profit.

Suppose RBC's management wants to know the how many bikes must be sold to earn a target profit of $100,000.

Profit = Unit CM x Q – Fixed Expenses

$100,000 = $200 x Q – $80,000

$200 × Q = $100,000 + $80,000

Q = ($100,000 + $80,000) ÷ $200

Q = 900 units

Target Profit Analysis – Formula Method

The formula method uses the following equation.

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

Target Profit Analysis – Formula Method Solution

Suppose RBC wants to know how many bikes must be sold to earn a profit of $100,000.

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

$$\text{Unit sales} = \frac{\$100{,}000 + \$80{,}000}{\$200}$$

$$\text{Unit sales} = 900$$

Target Profit Analysis – Formula Method Sales Dollars

We can also compute the target profit in terms of sales dollars using either the equation method or the formula method.

Target Profit Analysis – Equation Method Sales Dollars Solution

Suppose RBC's management wants to know the sales volume that must be generated to earn a target profit of $100,000.

Profit = CM ratio x Sales – Fixed Expenses

$100,000 = 40% x Sales – $80,000

40% x Sales = $100,000 + $80,000

Sales = ($100,000 + $80,000) ÷ 40%

Sales = $450,000

Target Profit Analysis – Formula Method Sales Dollars Solution

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

$$\text{Dollar sales} = \frac{\$100{,}000 + \$80{,}000}{40\%}$$

$$\text{Dollar sales} = \$450{,}000$$

Quick Check 4

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. Use the *formula method* to determine how many cups of coffee would have to be sold to attain target profits of $2,500 per month.

a. 3,363 cups

b. 2,212 cups

c. 1,150 cups

d. 4,200 cups

Quick Check 4a

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. Use the *formula method* to deter
to be sold to att

a. 3,363 cups

b. 2,212 cups

c. 1,150 cups

d. 4,200 cups

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

$$= \frac{\$2{,}500 + \$1{,}300}{\$1.49 - \$0.36}$$

$$= \frac{\$3{,}800}{\$1.13}$$

$$= 3{,}363 \text{ cups}$$

Quick Check 5

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. Use the *formula method* to determine the sales dollars that must be generated to attain target profits of $2,500 per month.

a. $2,550

b. $5,013

c. $8,458

d. $10,555

Quick Check 5a

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1
cup is $0.3
$1,300. Us
sales dollar
profits of $2

a. $2,550

b. $5,013

c. $8,458

d. $10,555

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

$$= \frac{\$2{,}500 + \$1{,}300}{(\$1.49 - 0.36) \div \$1.49}$$

$$= \frac{\$3{,}800}{0.758}$$

$$= \$5{,}013$$

Learning Objective 7

Compute the margin of safety and explain its significance.

The Margin of Safety in Dollars

The **margin of safety** is the excess of budgeted or actual sales dollars over the break-even volume of sales dollars. It is the amount by which sales can drop before losses are incurred. The higher the margin of safety, the lower the risk of not breaking even and incurring a loss.

Margin of safety in dollars = Total sales - Break-even sales

Let's look at RBC and determine the margin of safety.

The Margin of Safety in Dollars - Example

If we assume that RBC has actual sales of $250,000, given that we have already determined the break-even sales to be $200,000, the margin of safety is $50,000 as shown.

	Break-even sales 400 units	Actual sales 500 units
Sales	$ 200,000	$ 250,000
Less: variable expenses	120,000	150,000
Contribution margin	80,000	100,000
Less: fixed expenses	80,000	80,000
Net operating income	$ -	$ 20,000

The Margin of Safety Percentage

RBC's margin of safety can be expressed as **20%** of sales.
($50,000 ÷ $250,000)

	Break-even sales 400 units	Actual sales 500 units
Sales	$ 200,000	$ 250,000
Less: variable expenses	120,000	150,000
Contribution margin	80,000	100,000
Less: fixed expenses	80,000	80,000
Net operating income	$ -	$ 20,000

The Margin of Safety in Units

The margin of safety can be expressed in terms of the number of units sold. The margin of safety at RBC is $50,000, and each bike sells for $500; hence, RBC's margin of safety is 100 bikes.

$$\text{Margin of Safety in units} = \frac{\$50{,}000}{\$500} = 100 \text{ bikes}$$

Quick Check 6

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. An average of 2,100 cups are sold each month. What is the margin of safety expressed in cups?

a. 3,250 cups

b. 950 cups

c. 1,150 cups

d. 2,100 cups

Quick Check 6a

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. An average of 2,100 cups are sold each month. What is the margin of safety expressed in cups?

a. 3,250 cups

b. 950 cups

c. 1,

d. 2,

Margin of safety = Total sales – Break-even sales
= 2,100 cups – 1,150 cups
= *950 cups*

Cost Structure and Profit Stability

Cost structure refers to the relative proportion of fixed and variable costs in an organization. Managers often have some latitude in determining their organization's cost structure.

Cost Structure and Profit Stability – High and Low Fixed Cost Structures

There are advantages and disadvantages to high fixed cost (or low variable cost) and low fixed cost (or high variable cost) structures.

An advantage of a high fixed cost structure is that income will be higher in good years compared to companies with lower proportion of fixed costs.

A disadvantage of a high fixed cost structure is that income will be lower in bad years compared to companies with lower proportion of fixed costs.

Companies with low fixed cost structures enjoy greater stability in income across good and bad years.

Learning Objective 8

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

Operating Leverage

Operating leverage is a measure of how sensitive net operating income is to percentage changes in sales. It is a measure, at any given level of sales, of how a percentage change in sales volume will affect profits.

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

Operating Leverage - Example

To illustrate, let's revisit the contribution income statement for RBC.

	Actual sales 500 Bikes
Sales	$ 250,000
Less: variable expenses	150,000
Contribution margin	100,000
Less: fixed expenses	80,000
Net income	$ 20,000

$$\text{Degree of Operating Leverage} = \frac{\$100{,}000}{\$20{,}000} = 5$$

Operating Leverage – Change in Profit

With an operating leverage of 5, if RBC increases its sales by 10%, net operating income would increase by 50%.

Percent increase in sales		**10%**
Degree of operating leverage	**×**	**5**
Percent increase in profits		**50%**

Here's the verification!

Operating Leverage – Proof of Changes

	Actual sales (500)	Increased sales (550)
Sales	$ 250,000	$ 275,000
Less variable expenses	150,000	165,000
Contribution margin	100,000	110,000
Less fixed expenses	80,000	80,000
Net operating income	$ 20,000	$ 30,000

10% increase in sales from $250,000 to $275,000 . . .

. . . results in a 50% increase in income from $20,000 to $30,000.

Quick Check 7

Coffee Klatch is an espresso stand in a downtown office building. The average selling price of a cup of coffee is $1.49 and the average variable expense per cup is $0.36. The average fixed expense per month is $1,300. An average of 2,100 cups are sold each month. What is the operating leverage?

a. 2.21

b. 0.45

c. 0.34

d. 2.92

Quick Check 7a

Coffee Klatch is an espres
building. The average selli
$1.49 and the average va
The average fixed expens
of 2,100 cups are sold eac
leverage?

a. 2.21

b. 0.45

c. 0.34

d. 2.92

	Actual sales 2,100 cups
Sales	$ 3,129
Less: Variable expenses	756
Contribution margin	2,373
Less: Fixed expenses	1,300
Net operating income	$ 1,073

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

$$= \frac{\$2,373}{\$1,073} = 2.21$$

Quick Check 8

At Coffee Klatch the average selling price of a cup of coffee is $1.49, the average variable expense per cup is $0.36, the average fixed expense per month is $1,300, and an average of 2,100 cups are sold each month.

If sales increase by 20%, by how much should net operating income increase?

a. 30.0%

b. 20.0%

c. 22.1%

d. 44.2%

Quick Check 8a

At Coffee Klatch the average selling price of a cup of coffee is $1.49, the average variable expense per cup is $0.36, the average fixed expense per month is $1,300, and an average of 2,100 cups are sold each month.

If sales increase by 20%, by how much should net operating income increase?

a. 30.0%

b. 20.0%

c. 22.1%

d. 44.2%

	Percent increase in sales	**20.0%**
×	**Degree of operating leverage**	**2.21**
	Percent increase in profit	**44.20%**

Verify Increase in Profit

	Actual sales	Increased sales
	2,100 cups	2,520 cups
Sales	$ 3,129	$ 3,755
Less: Variable expenses	756	907
Contribution margin	2,373	2,848
Less: Fixed expenses	1,300	1,300
Net operating income	$ 1,073	$ 1,548
% change in sales		20.0%
% change in net operating income		44.2%

Structuring Sales Commissions

Companies generally compensate salespeople by paying them either a commission based on sales or a salary plus a sales commission. Commissions based on sales dollars can lead to *lower profits* in a company.

Let's look at an example.

Structuring Sales Commissions - Example

Pipeline Unlimited produces two types of surfboards, the XR7 and the Turbo. The XR7 sells for $100 and generates a contribution margin per unit of $25. The Turbo sells for $150 and earns a contribution margin per unit of $18.

The sales force at Pipeline Unlimited is compensated based on sales commissions.

Structuring Sales Commissions - Solution

If you were on the sales force at Pipeline, you would push hard to sell the Turbo even though the XR7 earns a higher contribution margin per unit.

To eliminate this type of conflict, commissions can be based on contribution margin rather than on selling price alone.

Learning Objective 9

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

The Definition of Sales Mix

- Sales mix is the relative proportion in which a company's products are sold.
- Different products have different selling prices, cost structures, and contribution margins.
- When a company sells more than one product, break-even analysis becomes more complex as the following example illustrates.

Let's assume RBC sells bikes and carts and that the sales mix between the two products remains the same.

Sales Mix and Break-Even Analysis – Part 1

Bikes comprise 45% of RBC's total sales revenue and the carts comprise the remaining 55%. RBC provides the following information:

	Bicycle		Carts		Total	
Sales	$ 250,000	100%	$ 300,000	100%	$ 550,000	100.0%
Variable expenses	150,000	60%	135,000	45%	285,000	51.8%
Contribution margin	100,000	40.0%	165,000	55%	265,000	48.2%
Fixed expenses					170,000	
Net operating income					$ 95,000	
Sales mix	$ 250,000	45%	$ 300,000	55%	$ 550,000	100%

$$\frac{\$265,000}{\$550,000} = 48.2\% \text{ (rounded)}$$

Sales Mix and Break-Even Analysis – Part 2

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

$$\text{Dollar sales to break even} = \frac{\$170{,}000}{48.2\%} = \$352{,}697$$

	Bicycle		Carts		Total	
Sales	$ 158,714	100%	$ 193,983	100%	$ 352,697	100.0%
Variable expenses	95,228	60%	87,293	45%	182,521	51.8%
Contribution margin	63,485	40%	106,691	55%	170,176	48.2%
Fixed expenses					170,000	
Net operating income			Rounding error →		$ 176	
Sales mix	$ 158,714	45%	$ 193,983	55%	$ 352,697	100.0%

End of Chapter 2