Cost Behavior

Chapter 6

Objective 1

Describe key characteristics and graphs of various cost behaviors

Cost Behavior

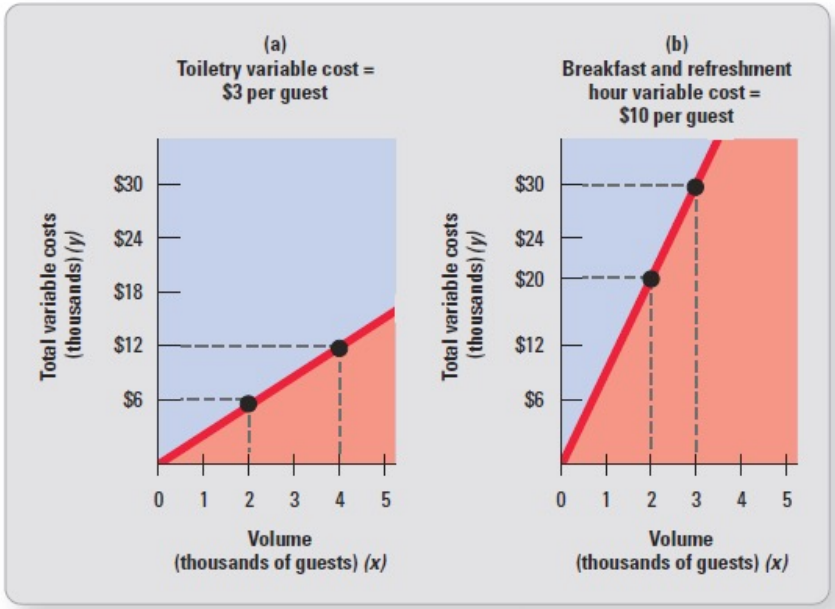
Cost behavior—how costs change as volume changes.

There are three common cost behaviors:

1. Variable costs
2. Fixed costs
3. Mixed costs

Cost Graphs

- Vertical (y-axis) always shows total costs
- Horizontal axis (x-axis) shows volume of activity



Note that the variable cost per customer remains constant in each of the graphs.

Key Characteristics of Variable Costs

- Total variable costs change in direct proportion to changes in volume
- Variable cost per unit remains constant
- Slope

Objective 2

Use cost equations to express and predict costs

Cost Equation

- Is a mathematical equation for a straight line, to predict total cost
- Variable cost line can be mathematically expressed

$$\text{Total variable cost } (y) = \text{Variable cost per unit of activity } (v) \times \text{Volume of activity } (x)$$

Variable Costs

- Variable Costs: costs that are incurred for every unit of volume.
- For example: morning breakfast , afternoon refreshment hours, and complimentary toiletries (shampoo, soap, lotion, and mouthwash)

Example of Variable Costs

- Variable cost per guest is $3
- If hotel has 2,000 guests

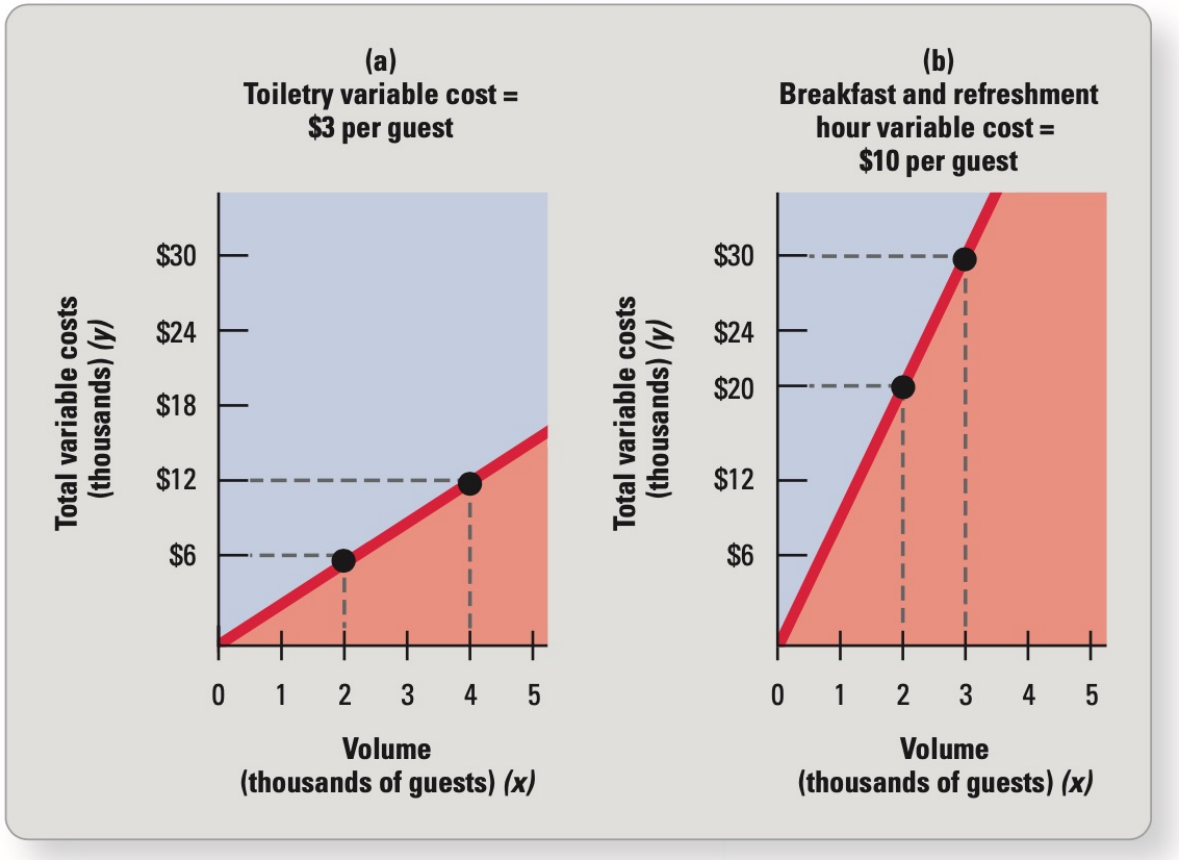
$$y = \$3 \text{ per guest} \times 2{,}000 \text{ guests}$$
$$= \$6{,}000$$

- If hotel has 4,000 guests

$$y = \$3 \text{ per guest} \times 4{,}000 \text{ guests}$$
$$= \$12{,}000$$

Variable Costs

EXHIBIT 6-1 Variable Costs



Key Characteristics of Variable Costs

- *Total* variable costs change in *direct proportion* to changes in volume
- The *variable cost per unit of activity* (v) remains constant and is the slope of the variable cost line
- Total variable cost graphs always begin at the origin (if volume is zero, total variable costs are zero)
- Total variable costs can be expressed as follows:

$$y = vx$$

where,

y = total variable cost
v = variable cost per unit of activity
x = volume of activity

Fixed Cost

- Costs that do not change in total despite wide changes in volume.
- Examples:

1) Property taxes and insurance
2) Depreciation and maintenance
3) Salaries of hotel department managers

Fixed Cost

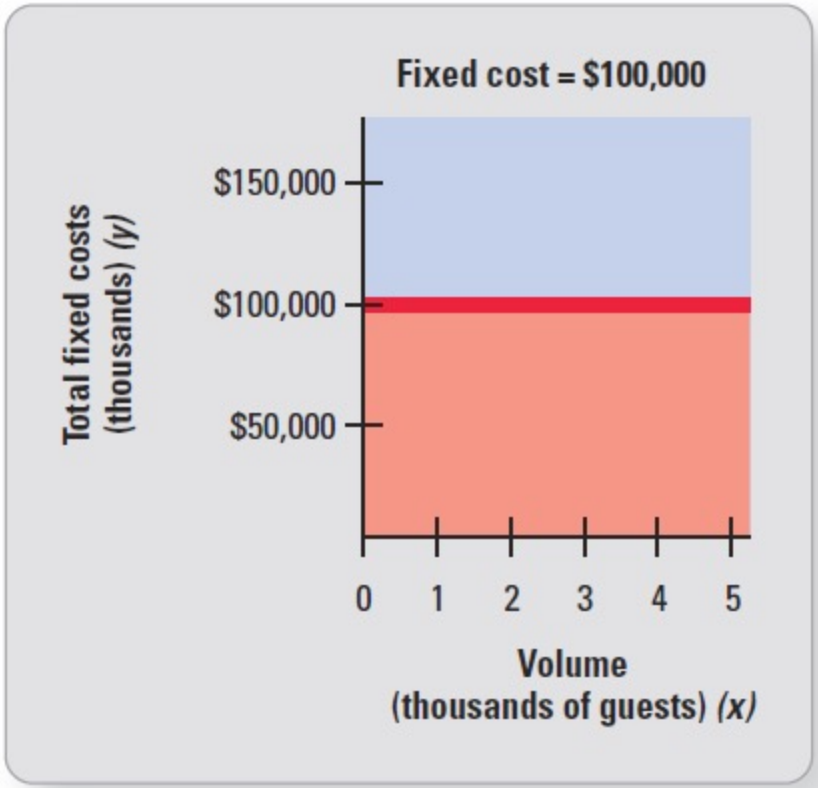
- Committed fixed costs: hotel is locked in to these costs because of previous management decisions.

For example: property taxes and depreciation

- Discretionary fixed costs: based on annual management decisions

For example: advertising expense

Total Fixed Costs



Key Characteristics of Fixed Costs

- *Total* fixed costs stay *constant* over a wide range of volume
- Fixed costs *per unit of activity* vary *inversely* with changes in volume:
  - Fixed cost per unit of activity *increases* when volume *decreases*
  - Fixed cost per unit of activity *decreases* when volume *increases*
- Total fixed cost graphs are always flat lines with no slope that intersect the y-axis at a level equal to total fixed costs
- Total fixed costs can be expressed as $y = f$

  where,

  y = total fixed cost

  f = fixed cost over a given period of time

Example of Total Fixed Costs

Total fixed cost (y) = Fixed amount over a period of time (f)

y = $100,000

y = total fixed cost per month

$100,000 ÷ 2,000 guests = $50/guest

$100,000 ÷ 4,000 guests = $25/guest

Mixed Costs

- Mixed costs: content both variable and fixed cost components.

$$\text{Total mixed costs} = \text{Variable cost component} + \text{Fixed cost component}$$
$$y = vx + f$$

$$y = \$8x + \$8{,}000$$

y = total utilities cost per month
x = number of guests

Mixed Costs

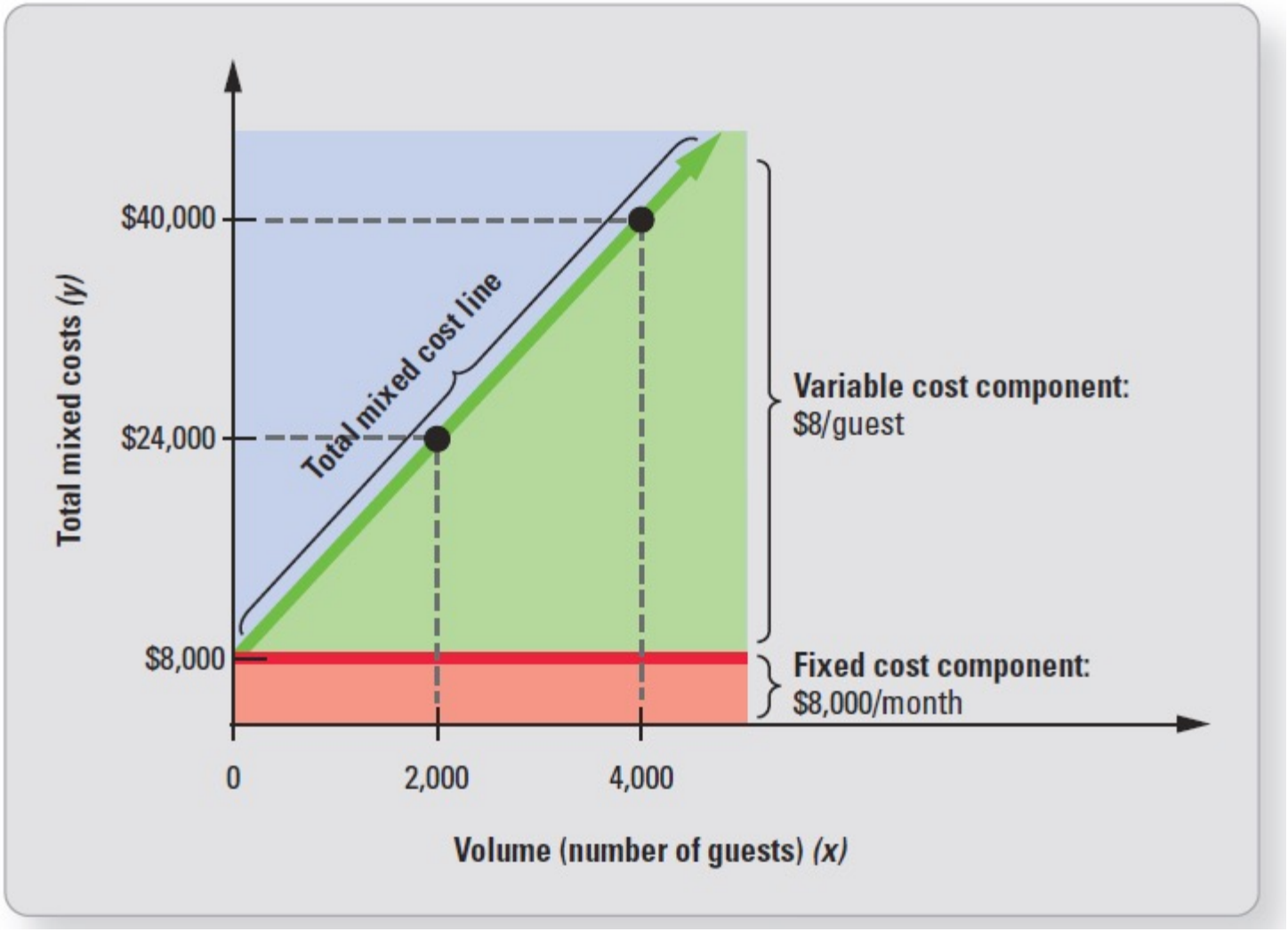
- If serves 2,000 guests

$$y = (\$8 \text{ per guest} \times 2{,}000 \text{ guests}) + \$8{,}000$$
$$= \$24{,}000$$

- If serves 4,000 guests

$$y = (\$8 \text{ per guest} \times 4{,}000 \text{ guests}) + \$8{,}000$$
$$= \$40{,}000$$

Mixed Costs



Key Characteristics of Mixed Costs

- *Total* mixed costs increase as volume increases because of the variable cost component
- Mixed costs *per unit* decrease as volume increases because of the fixed cost component
- Total mixed costs graphs slope upward but do *not* begin at the origin—they intersect the y-axis at the level of fixed costs
- Total mixed costs can be expressed as a *combination* of the variable and fixed cost equations:

  Total mixed costs = variable cost component + fixed cost component

  $$y = vx + f$$

  where,

  y = total mixed costs

  v = variable cost per unit of activity (slope)

  x = volume of activity

  f = fixed cost over a given period of time (vertical intercept)

Now turn to S6-1

The following chart shows three different costs: Cost A, Cost B, and Cost C. For each cost, the chart shows the total cost and cost per unit at two different volumes within the same relevant range. Based on this information, identify each cost as fixed, variable, or mixed. Explain your answers.

	A	B	C	D	E	F
1		At 4,000 units			At 5,000 units	
2			Cost per			Cost per
3		Total Cost	Unit		Total Cost	Unit
4	Cost A	$ 42,000	$ 10.50		$ 50,000	$ 10.00
5	Cost B	$ 60,000	$ 15.00		$ 60,000	$ 12.00
6	Cost C	$ 32,000	$ 8.00		$ 40,000	$ 8.00
7						

S6-1 Identify Cost Behavior

	A	B	C	D	E	F
1		At 4,000 units			At 5,000 units	
2			Cost per			Cost per
3		Total Cost	Unit		Total Cost	Unit
4	Cost A	$ 42,000	$ 10.50		$ 50,000	$ 10.00
5	Cost B	$ 60,000	$ 15.00		$ 60,000	$ 12.00
6	Cost C	$ 32,000	$ 8.00		$ 40,000	$ 8.00
7						

Cost A	**Mixed Cost**
Cost B	**Fixed Cost**
Cost C	**Variable Cost**

Relevant Range

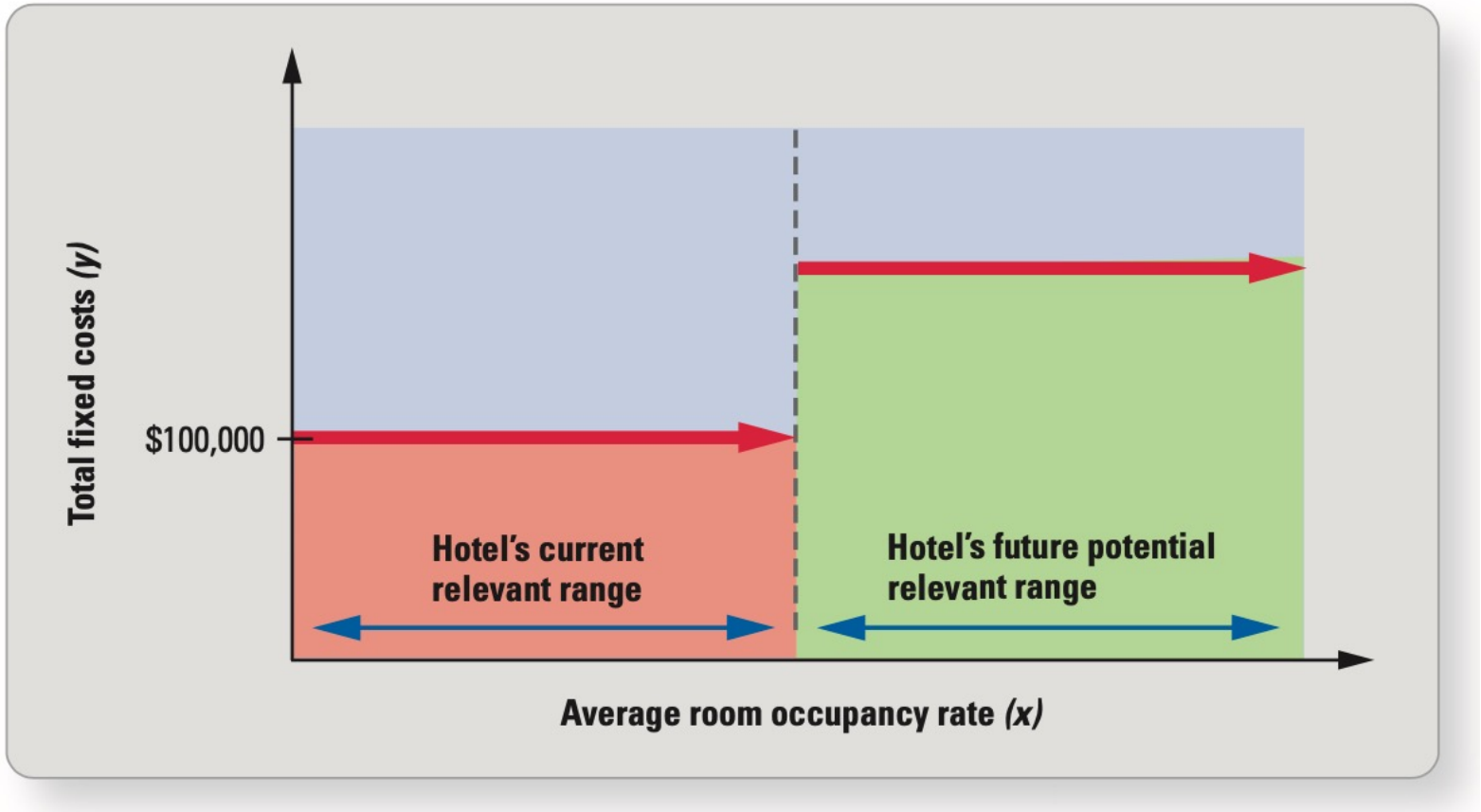
- When predicting total costs, managers need to keep their relevant range in mind!
- Two conditions:

1) Total fixed costs remain constant at a certain level

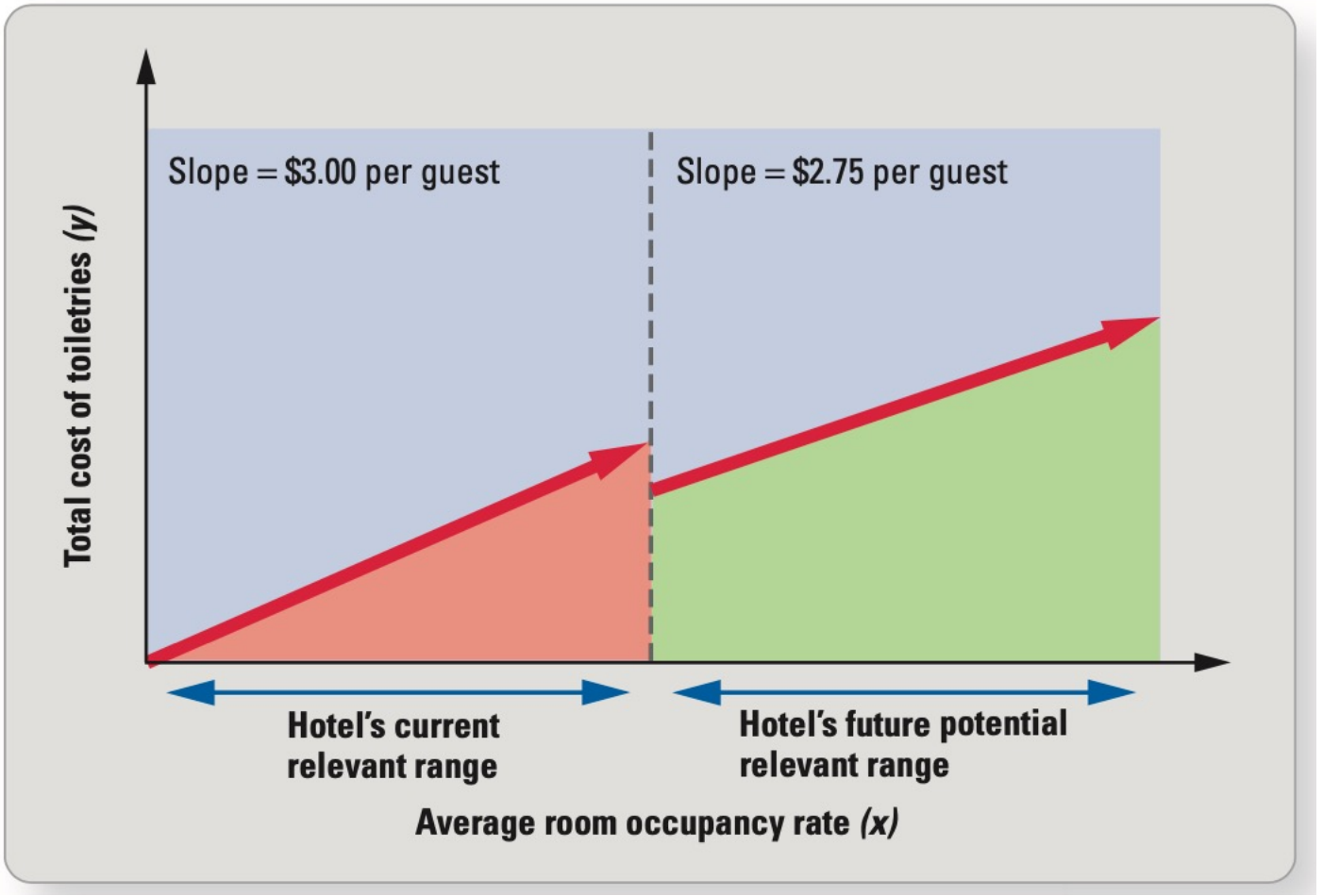
2) Variable costs per unit remain constant at a certain level

Example of Relevant Range

EXHIBIT 6-7 Examples of Different Relevant Ranges for Fixed Costs



Example of Relevant Range



Other Cost Behaviors

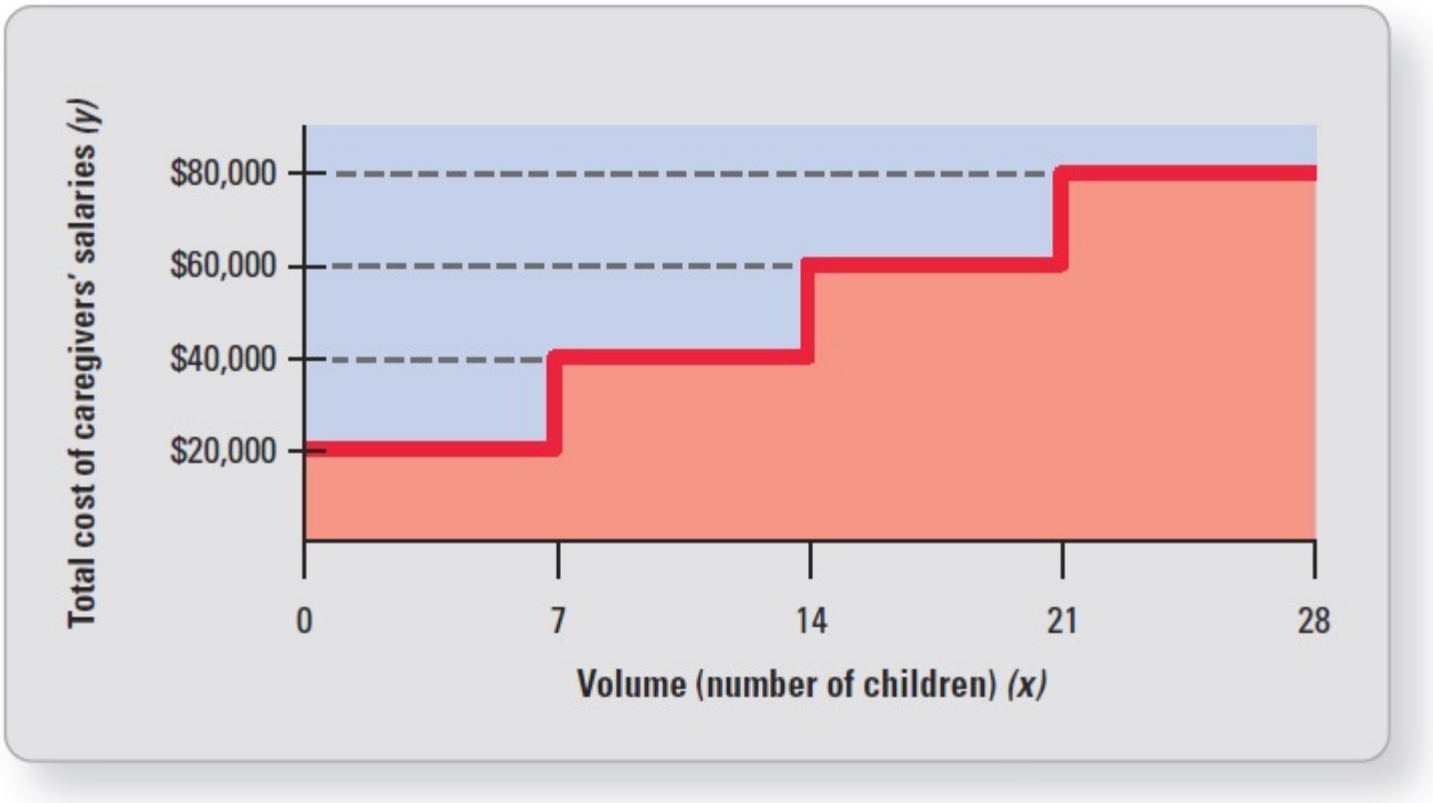
Other cost behaviors: some costs do not neatly fit variable, fixed, or mixed costs patterns

Step Costs: They are fixed over a small range of activity and the jump up to a new fixed level with moderately small changes in volume.

Example: Hospital, kindergarten etc.

Other Cost Behaviors

Step Costs



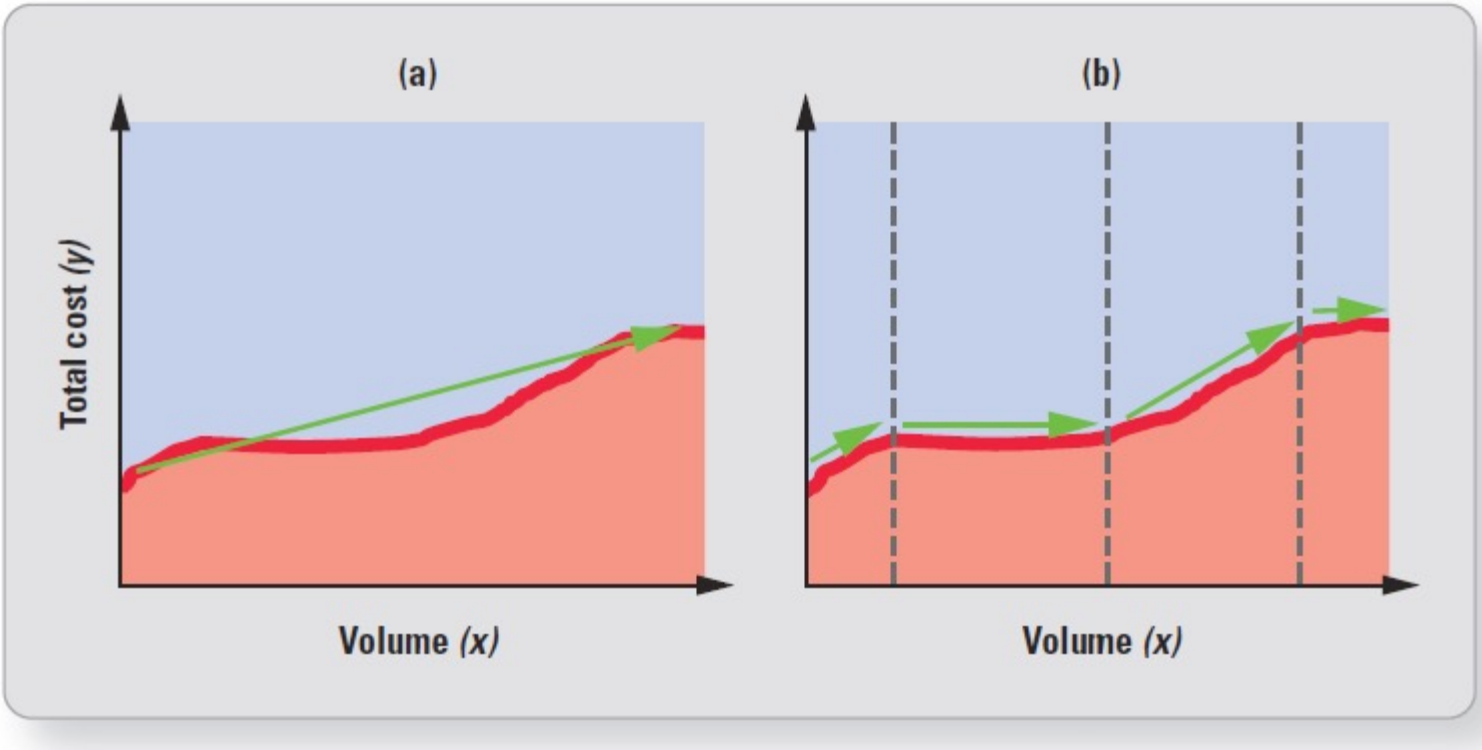
Step Cost VS. Fixed Cost

- Step costs differ from fixed costs only in that they “step up” to a new relevant range with relatively small changes in volume.

- Fixed costs hold constant over much larger ranges.

Other Cost Behaviors

Curvilinear Costs



Objective 3

Use account analysis and scatter plots to analyze cost behavior

Cost Behavior Analysis

- Four methods to analyze cost behavior
  - Account analysis
  - Scatter plots
  - High-low method
  - Regression analysis

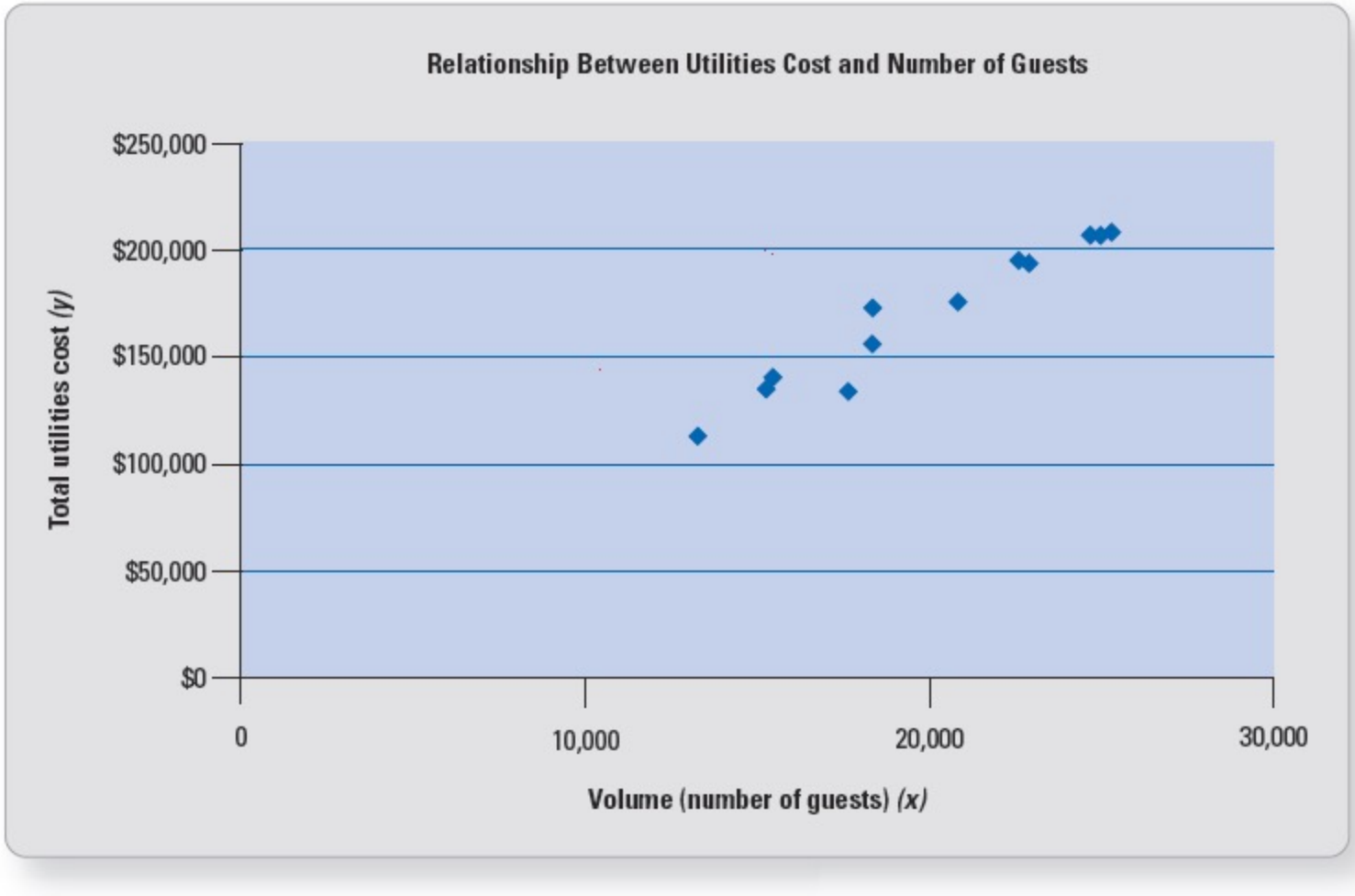
Account Analysis

- Use of judgment to classify each general ledger account as variable, fixed, or mixed
- For example, toiletries and depreciation
- Subjective by using managers' own judgements

Scatter Plots

- Use historical data to determine a cost's behavior
- Scatter plot is the graph of historical cost data on the y-axis and volume data on the x-axis
- Helps managers visually determine how strong the relationship is between the cost and the volume of the chosen activity base

Scatter Plot Example



Scatter Plot

- If weak relationship between the cost and the volume of the chosen activity:

1) Manager should consider using a different activity for predicting future costs

2) Determine and delete outliers (abnormal data points)

3) Determine cost behavior that best describes the historical data points: High-low method / Regression analysis

Objective 4

Use the high-low method to analyze cost behavior

High-Low Method

Step 1: Find variable cost per unit (slope) of cost line

Step 2: Find the fixed costs (vertical intercept)

Step 3: Create the cost equation

Advantage: Easy to use

Disadvantage: Only uses 2 data points

Turn to E6-27A

Refer to Flower Power's data in E6-26A. Use the high-low method to determine Flower Power's cost equation for van operating costs. Use your results to predict van operating costs at a volume of 16,000 miles.

Kara Woo, owner of Flower Power, operates a local chain of floral shops. Each shop has its own delivery van. Instead of charging a flat delivery fee, Woo wants to set the delivery fee based on the distance driven to deliver the flowers. Woo wants to separate the fixed and variable portions of her van operating costs so that she has a better idea how delivery distance affects these costs. She has the following data from the past seven months:

Month	Miles Driven	Van Operating Costs
January	16,000	$5,490
February	17,500	$5,700
March	14,900	$4,910
April	16,200	$5,340
May	16,900	$5,820
June	15,100	$5,410
July	14,500	$4,920

High-Low Method: E6-27A

- **NOTE: "High" and "Low" data points are based on with the highest volume of activity, rather than the cost!**

- **Step 1**: Find slope of the mixed cost line
  (variable cost/unit) = Δ in cost (y) / Δ in volume (x)

$$\text{Slope} = \text{Variable cost per unit of activity } (v) = \frac{\text{Rise}}{\text{Run}} = \frac{\text{Change in cost}}{\text{Change in volume}} = \frac{y\ (\text{high}) - y\ (\text{low})}{x\ (\text{high}) - x\ (\text{low})}$$

- The slope represents the variable cost per unit of activity

($5,820 - $4,910) ÷ (16,900 - 14,900)
$910 ÷ 2,000 = $0.455

High-Low Method: E6-27A (cont.)

- **Step 2**: Find the vertical intercept

  Fixed costs = Total mixed cost - total variable cost

  $5,820 - ($0.455 x 16,900) = $1,869.50

  OR

  $4,910 - ($0.455 x 14,900) = $1,869.50

High-Low Method: E6-27A (cont.)

- **Step 3**: Create and use an equation to show the behavior of a mixed cost

Y = $0.455 per mile + $1,869.50

Predicted operating costs at 16,000 miles:

($0.455 x 16,000) + $1,869.50 = $9,149.50

Objective 5

Use regression analysis to analyze cost behavior

Regression Analysis

- Regression analysis is a statistical procedure for determining the line, and associated cost equation, that best fits all of the data points in the data set, not just the high-volume and low-volume data points.

Regression Analysis—Exhibit 6-15

	A	B	C	D	E	F	G	H	I
1	**SUMMARY OUTPUT**								
2									
3	*Regression Statistics*								
4	Multiple R		0.973273						
5	R Square		0.94726						
6	Adjusted R Square		0.941986						
7	Standard Error		8053.744						
8	Observations		12						
9									
10	**ANOVA**								
11		*df*	*SS*	*MS*	*F*	*Significance F*			
12	Regression	1	11650074512	1.17E + 10	179.6110363	1.02696E-07			
13	Residual	10	648627988.2	64862799					
14	Total	11	12298702500						
15									
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
17	Intercept	14538.05	11898.3624	1.221853	0.249783701	-11973.15763	41049.25	-11973.16	41049.25
18	X Variable 1	7.849766	0.585720166	13.4019	1.02696E-07	6.5446997	9.154831	6.5447	9.154831

R-Square Value

- “Goodness of fit”
- How well does the line fit the data points?
- Ranges from 0 to 1. The closer to 1, the better fitness. Usually, over 0.8; between 0.8 to 0.5; less than 0.5.

Objective 6

Describe variable costing and prepare a contribution margin income statement

Absorption Costing

- GAAP requires absorption costing for external financial reporting and the Internal Revenue Service (IRS) requires it for tax preparation.

Absorption Costing

- Assign all manufacturing costs to products (DM, DL, Variable MOH, and Fixed MOH)
- Variable MOH: utilities expense
- Fixed MOH: property taxes and insurance

Variable Costing

- Assigns only variable manufacturing costs to products (DM, DL, and Variable MOH)
- Fixed manufacturing overhead = period cost, since it will be incurred regardless of the actual production volume.
- For internal management decisions
- Contribution margin income statement

Variable Costing

- Contribution margin:

Sales revenue minus variable expenses. It shows managers how much profit has been made on sales before considering fixed costs.

Comparison

	A	B	C
1	Manufacturing Costs Per Unit	Absorption Costing	Variable Costing
2	Direct material cost per unit	$ 35	$ 35
3	Direct labor cost per unit	10	10
4	Variable MOH cost per unit	5	5
5	Fixed MOH cost per unit ($1,000,000 ÷ 40,000 units)	25	0
6	Total cost per unit	$ 75	$ 50
7			

Under variable
fixed MOH is a
the product co

Traditional (Conventional) Income Statement

	A	B	C	D
1	ShredCo			
2	Traditional Income Statement (Absorption Costing)			
3	For the Year Ended December 31			
4				
5	Sales revenue (40,000 × $100)	$ 4,000,000		
6	Less: Cost of goods sold (40,000 × $75)	3,000,000		
7	Gross profit	$ 1,000,000		
8	Less: Operating expenses [$300,000 + (40,000 × $2)]	380,000		
9	Operating income	$ 620,000		
10				

Contribution Margin Income Statement

- An income statement organized by cost behavior.

	A	B	C	D
1	ShredCo			
2	Contribution Margin Income Statement (Variable Costing)			
3	For the Year Ended December 31			
4				
5	Sales revenue (40,000 × $100)	$ 4,000,000		
6	Less variable expenses:			
7	Variable cost of goods sold (40,000 × $50)	2,000,000		
8	Variable operating expenses (40,000 × $2)	80,000		
9	Contribution margin	$ 1,920,000		
10	Less fixed expenses:			
11	Fixed MOH	1,000,000		
12	Fixed operating expenses	300,000		
13	Operating income	$ 620,000		
14				

Rule of Thumb

The ONLY difference between absorption costing and variable costing is the treatment of Fixed MOH, and the *timing* with which it is expensed:

- Under variable costing, fixed MOH is expensed immediately as a period cost (operating expense).
- Under absorption costing, fixed MOH becomes part of the inventoriable product cost of each unit, which isn't expensed until the inventory is sold (as Cost of Goods Sold).

Reconciling Operating Income Between the Two Costing Systems

Difference in operating income = (Change in inventory level, in units) × (Fixed MOH per unit)

Key Points about Variable Costing and Absorption Costing

Variable Costing

- Treats all fixed MOH costs as operating expenses in the period incurred, rather than treating fixed MOH as an inventoriable product cost
- Can only be used for internal management purposes; never for external financial reporting or tax purposes
- Is often better for decision making than absorption costing because it clearly shows managers the additional cost of making one more unit of product (the variable cost per unit)
- Is often better for performance evaluation than absorption costing because it gives managers no incentive to build unnecessary inventory
- Will result in a different operating income than absorption costing for manufacturers whose inventory levels *increase* or *decrease* from the previous period

The Contribution Margin Income Statement

- Is organized by cost behavior. First, all variable expenses are deducted from sales revenue to arrive at the company's contribution margin. Next, all fixed expenses are deducted from the contribution margin to arrive at operating income
- Is often more useful than a traditional income statement for planning and decision making because it clearly distinguishes the costs that will be affected by changes in volume (the variable costs) from the costs that will be unaffected (fixed costs)
- Can only be used for internal management purposes, and never for external financial reporting
- Will show the same operating income as a traditional income statement for (1) service firms, (2) merchandising companies, and (3) manufacturers *only* if their inventory levels remain stable
- For retailers, all of Cost of Goods Sold is considered variable

Now turn to S6-15

O'Neill's Products manufactures a single product. Cost, sales, and production information for the company and its single product is as follows:

- Selling price per unit is $65
- Variable manufacturing costs per unit manufactured (includes direct materials [DM], direct labor [DL], and variable MOH) $35
- Variable operating expenses per unit sold $2
- Fixed manufacturing overhead (MOH) in total for the year $132,000
- Fixed operating expenses in total for the year $85,000
- Units manufactured and sold for the year 12,000 units

Requirements

1. Prepare an income statement for the upcoming year using variable costing.
2. Prepare an income statement for the upcoming year using absorption costing.

S6-15

O'Neill's Products		
Contribution Margin (Variable Costing) Income Statement		
Year Ended December 31		
Sales revenue (12,000 × $65)		$780,000
Variable expenses:		
Variable cost of goods sold (12,000 x $35)	$420,000	
Variable operating expense (12,000 x $2)	24,000	444,000
Contribution margin		336,000
Fixed expenses:		
Manufacturing overhead	132,000	
Operating expenses	85,000	217,000
Operating income		$ 119,000

S6-15

O'Neill's Products	
Conventional (Absorption Costing) Income Statement	
Year Ended December 31	
Sales revenue (12,000 × $65)	$780,000
Cost of goods sold [(12,000 x $35) + 132,000]	(552,000)
Gross profit	228,000
Operating expenses [(12,000 × $2) + $85,000]	(109,000)
Operating income	$119,000

Absorption Costing and Manager Incentives

- When inventories increase, absorption costing income is higher than variable costing income.
- When inventories decrease, absorption costing income is lower than variable costing income.
- Therefore . . . managers may increase production to build up inventory to maximize income and, therefore, their own bonus.

End of Chapter 6