

University of Rome



DEPT. MANAGEMENT & LAW
BACHELOR DEGREE IN BUSINESS ADMINISTRATION & ECONOMICS

COURSE

Cost Analysis for Business Decisions

**Cost Behavior,
Operating Leverage,
and Profitability Analysis**

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Learning Objective



Identify and describe fixed, variable, and mixed cost behavior.



LO1

Cost Classifications for Predicting Cost Behavior



How a cost will react to changes in the level of activity within the relevant range.

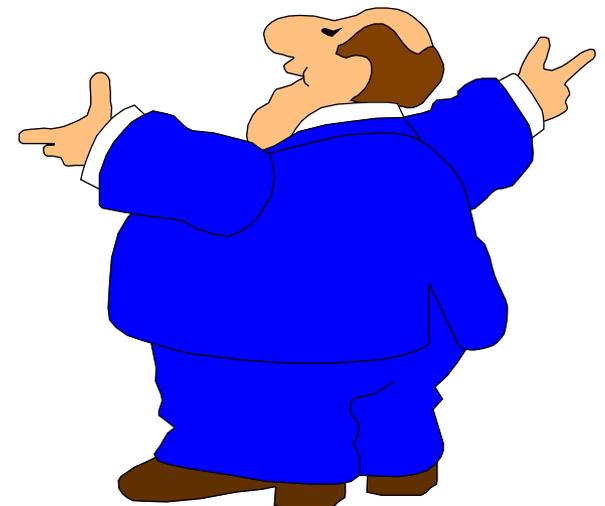
- Total **variable costs** change when activity changes.
- Total **fixed costs** remain unchanged when activity changes.

Fixed Cost Behavior

When activity

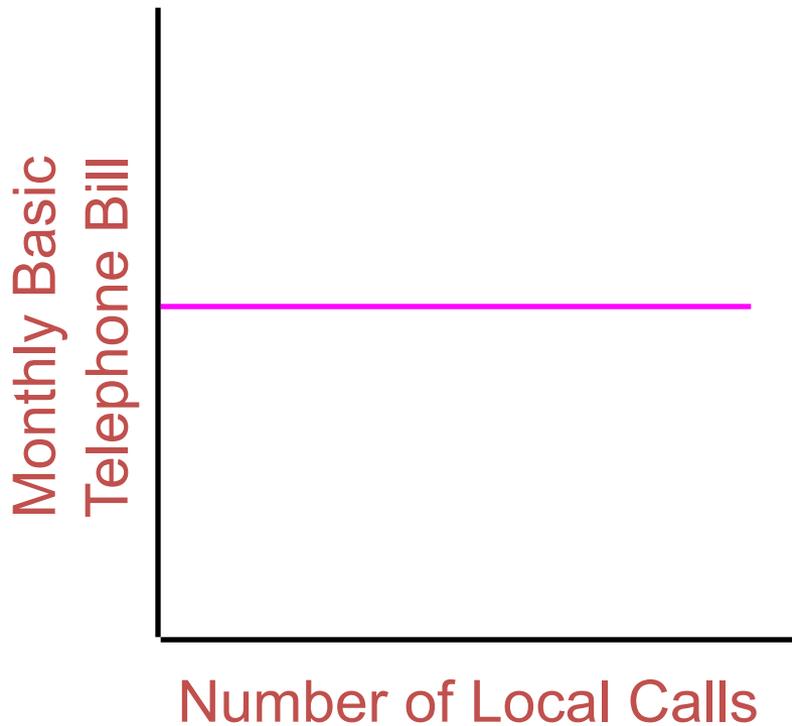
| | Increases | Decreases |
|----------------------------|------------------|------------------|
| Total Fixed Cost | Remains constant | Remains Constant |
| Fixed Cost Per Unit | Decreases | Increases |

Consider the following concert example where the band will be paid \$48,000 regardless of the number of tickets sold.



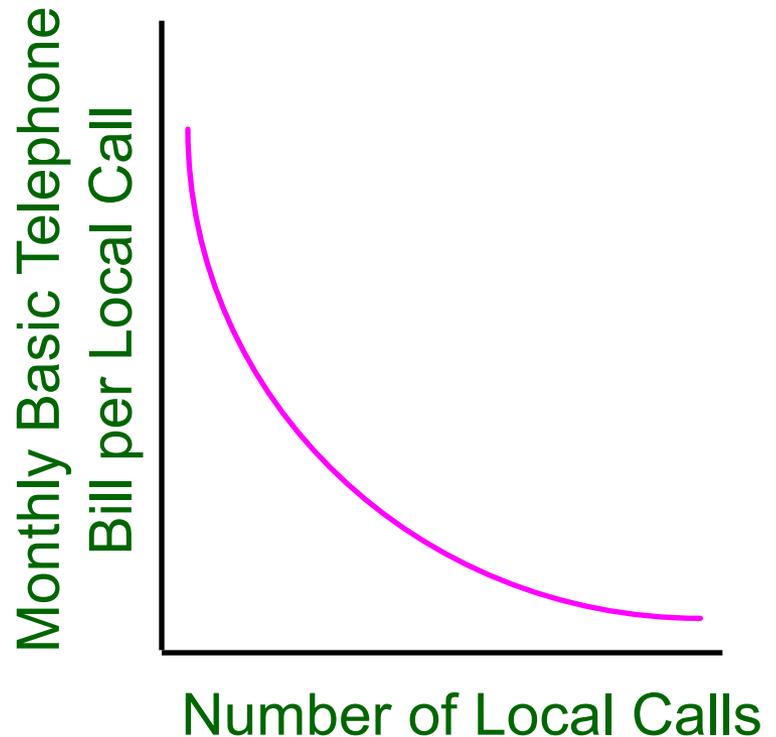
Fixed Cost

Your monthly **basic telephone bill** probably does not change when you make more local calls.



Fixed Cost Per Unit

The average fixed cost **per local call** decreases as more local calls are made.

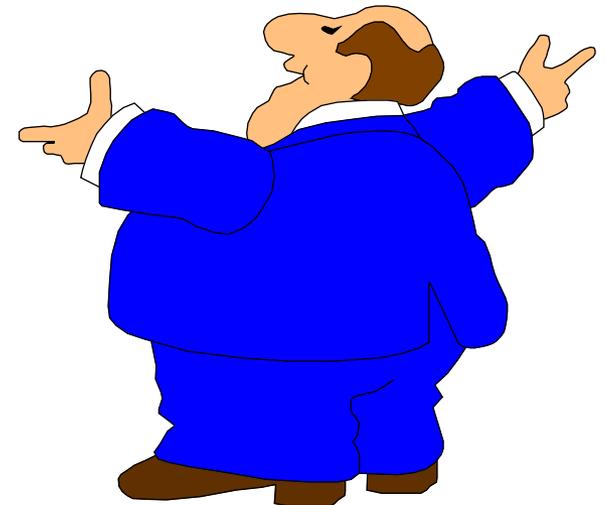


Variable Cost Behavior

When activity . . .

| | Increases | Decreases |
|-------------------------------|----------------------------------|----------------------------------|
| Total Variable Cost | Increases Proportionately | Decreases Proportionately |
| Variable Cost Per Unit | Remains Constant | Remains Constant |

Consider the concert example where a band receives \$16 for each ticket sold. The more sold will increase the band's take from the concert, but they can only receive a constant \$16 from each individual ticket sold.



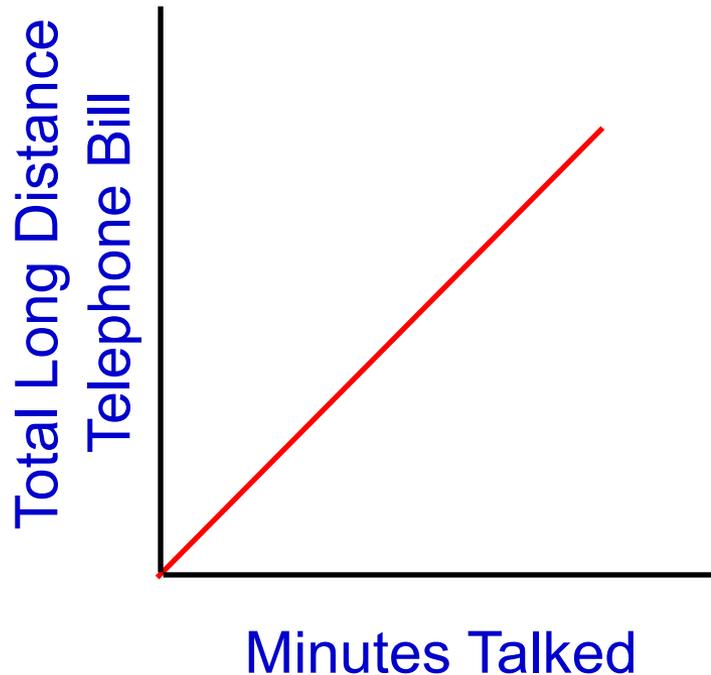
Variable Cost Behavior

Total variable cost increases in direct proportion to the number of units sold.

The behavior of variable cost *per unit* is **contradictory to the word variable, because variable cost per unit remains constant regardless of how many units are sold.**

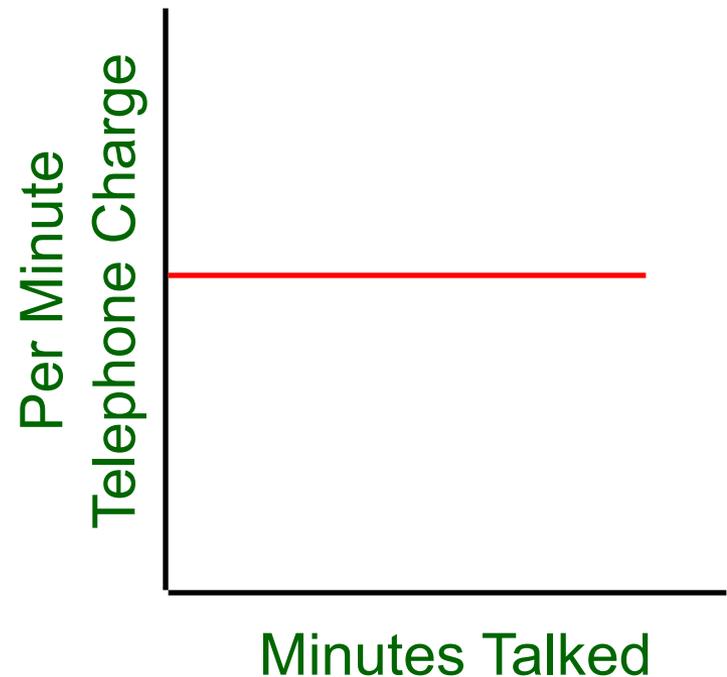
Variable Cost

Your **total long distance** telephone bill is based on how many minutes you talk.



Variable Cost Per Unit

The **cost per long distance minute** talked is constant. For example, 10 cents per minute.



Example: Star Production Inc.

SPI specializes in promoting rock concerts; it could consider the following alternative structures of costs:

- 1) It can pay the rock band as fixed cost (\$) irrespective to the number of tickets sold;
- 2) It can pay the rock band an amount (\$) for each ticket sold.

Let's see what happened by choosing the different alternatives.



Fixed Cost Behavior

| | | | |
|--------------------------------|------------------|------------------|------------------|
| Tickets sold | 2,700 | 3,000 | 3,300 |
| Total cost of band | \$ 48,000 | \$ 48,000 | \$ 48,000 |
| Per ticket cost of band | \$ 17.78 | \$ 16.00 | \$ 14.55 |

$$\text{\$48,000} \div \text{3,000 Tickets} = \text{\$16.00 per Ticket}$$



Variable Cost Behavior

| | | | |
|----------------------------------|------------------|------------------|------------------|
| Tickets sold | 2,700 | 3,000 | 3,300 |
| Band cost per ticket sold | \$ 16 | \$ 16 | \$ 16 |
| Total cost of band | \$ 43,200 | \$ 48,000 | \$ 52,800 |

The total variable cost increases in direct proportion to the number of tickets sold.

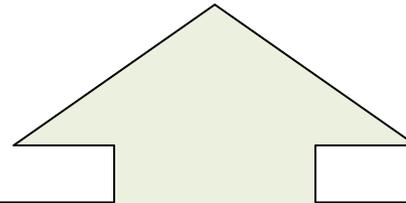
Variable unit cost per ticket remains at \$16 regardless of the number of tickets sold.



Mixed, or Semivariable, Costs



Mixed costs (or semivariable costs) include both fixed and variable components.



For example, Star Productions, Inc., has to pay a janitorial company a base fee of \$1,000 plus \$20 per hour required to do each cleanup job. The \$1,000 base fee is fixed. The \$20 per hour is variable. If 60 hours are required to accomplish a cleanup, the total mixed cost is:

$$\text{\$1,000} + (\text{\$20} \times \text{60 hours}) = \text{\$2,200}$$



Extent of Variable Costs

The proportion of variable costs *differs* across organizations. For example . . .

A public utility with large investments in equipment will tend to have *fewer* variable costs.

A manufacturing company will often have *many* variable costs.

A service company will normally have a *high proportion* of variable costs.

A merchandising company usually will have a *high proportion* of variable costs, like cost of sales.

Examples of Variable Costs

Merchandising companies – cost of goods sold.

Manufacturing companies – direct materials, direct labor, and variable overhead.

Merchandising and manufacturing companies – commissions, shipping costs, and clerical costs, such as invoicing.

Service companies – supplies, travel, and clerical.

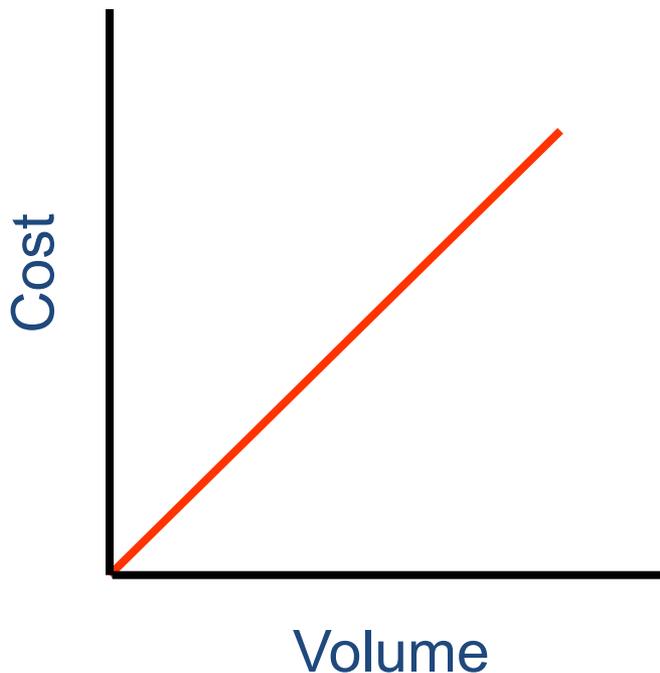
Cost Classifications for Predicting Cost Behavior

| Behavior of Cost (within the relevant range) | | |
|---|--|--|
| Cost | In Total | Per Unit |
| Variable | Total variable cost changes as activity level changes. | Variable cost per unit remains the same over wide ranges of activity. |
| Fixed | Total fixed cost remains the same even when the activity level changes. | Average fixed cost per unit goes down as activity level goes up. |

FOCUS ON VARIABLE COST

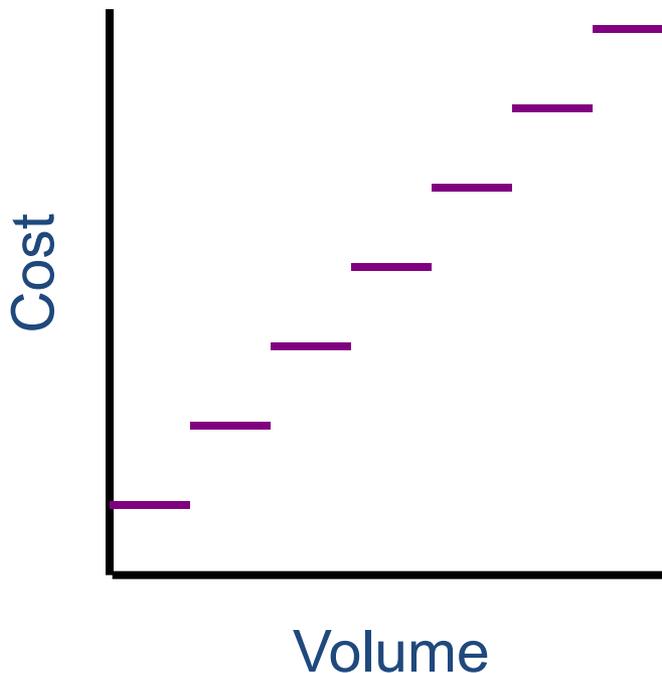
True Variable Cost

Direct materials is a true or proportionately variable cost because the amount used during a period will vary in direct proportion to the level of production activity.



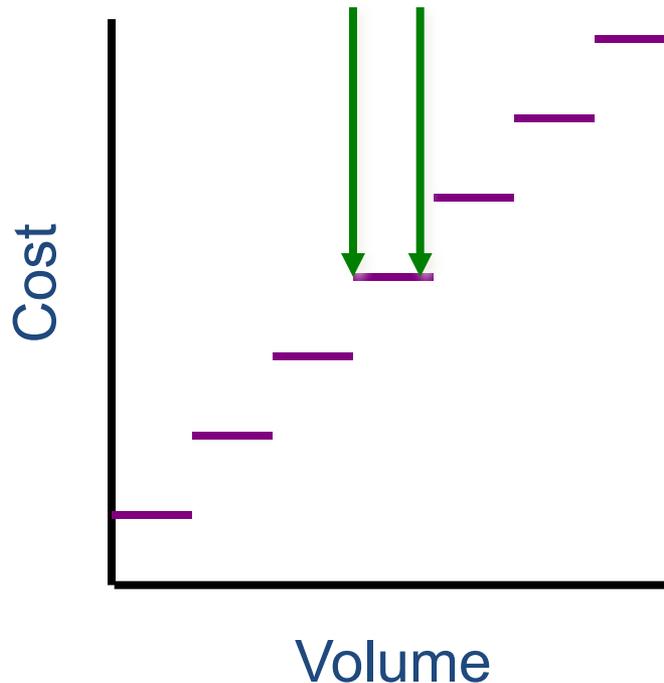
Step-Variable Costs

A resource that is obtainable only in large chunks (such as maintenance workers) and whose costs increase or decrease only in response to fairly wide changes in activity is known as a ***step-variable cost***.



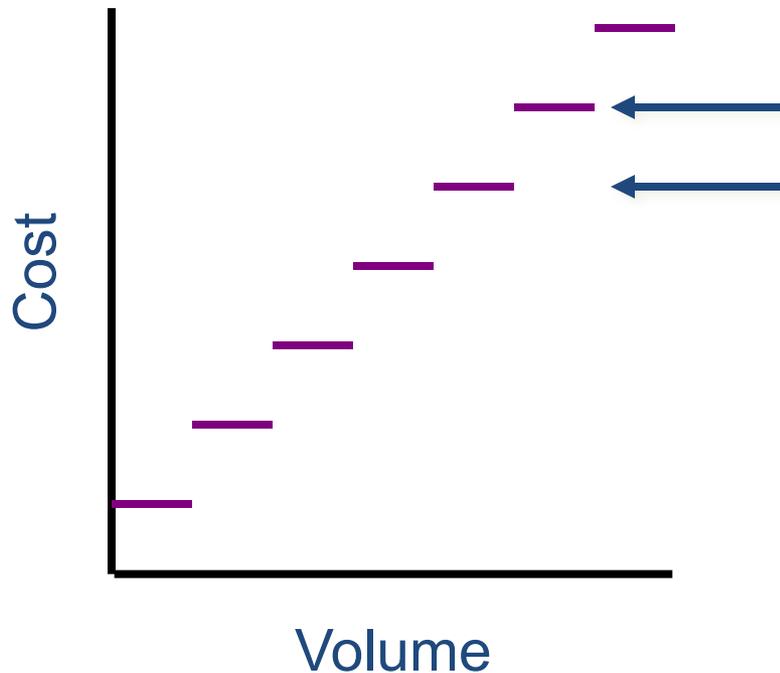
Step-Variable Costs

Small changes in the level of production are not likely to have any effect on the number of maintenance workers employed.



Step-Variable Costs

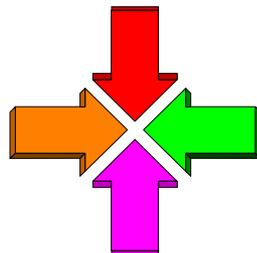
Only fairly wide changes in the activity level will cause a change in the number of maintenance workers employed



Assigning Costs to Cost Objects

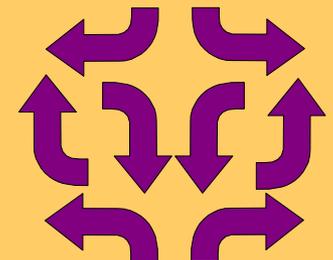
Direct costs

- **Costs that can be easily and conveniently traced to a unit of product or other cost object.**
- **Examples: direct material and direct labor**



Indirect costs

- **Costs that cannot be easily and conveniently traced to a unit of product or other cost object.**
- **Example: manufacturing overhead**



Cost Classifications for Decision Making

- Every decision involves a choice between at least two alternatives.
- Only those costs and benefits that differ between alternatives are relevant in a decision. All other costs and benefits can and should be ignored.

Differential Cost and Revenue

Costs and revenues that differ among alternatives.

Example: You have a job paying \$1,500 per month in your hometown. You have a job offer in a neighboring city that pays \$2,000 per month. The commuting cost to the city is \$300 per month.

Differential revenue is:
 $\$2,000 - \$1,500 = \$500$

Differential cost is:
 $\$300$

Sunk Costs

Sunk costs have already been incurred and cannot be changed now or in the future. They should be ignored when making decisions.

Example: You bought an automobile that cost \$10,000 two years ago. The \$10,000 cost is sunk because whether you drive it, park it, trade it, or sell it, you cannot change the \$10,000 cost.



Opportunity Cost

The potential benefit that is given up when one alternative is selected over another.

Example: If you were not attending University, you could be earning \$15,000 per year. Your opportunity cost of attending it for one year is \$15,000.



Learning Objective



Demonstrate the effects of operating leverage on profitability.



LO2

Basics for Profitability Analysis



| | A | B | C | D | E | F | | | | | | | | | | | | |
|--|---|---|---|---|---|---|--|--|----------------------|------------|--------------------------|---------|---------------------|---------|----------------------|--------|------------|-----------|
| 1 | <table border="1"> <thead> <tr> <th colspan="2">Racing Bicycle Company Contribution Income Statement For the Month of June</th> </tr> </thead> <tbody> <tr> <td>Sales (500 bicycles)</td> <td>\$ 250,000</td> </tr> <tr> <td>Less: Variables expenses</td> <td>150,000</td> </tr> <tr> <td>Contribution margin</td> <td>100,000</td> </tr> <tr> <td>Less: Fixed expenses</td> <td>80,000</td> </tr> <tr> <td>Net income</td> <td>\$ 20,000</td> </tr> </tbody> </table> | | | | | | Racing Bicycle Company Contribution Income Statement For the Month of June | | Sales (500 bicycles) | \$ 250,000 | Less: Variables expenses | 150,000 | Contribution margin | 100,000 | Less: Fixed expenses | 80,000 | Net income | \$ 20,000 |
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| Contribution margin | | | | | | | 100,000 | | | | | | | | | | | |
| Less: Fixed expenses | | | | | | | 80,000 | | | | | | | | | | | |
| Net income | | | | | | | \$ 20,000 | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
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| 10 | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | |

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

Basics for Profitability Analysis



| | A | B | C | D | E | F | | | | | | | | | | | | |
|--|---|---|---|---|---|---|--|--|----------------------|------------|--------------------------|---------|---------------------|---------|----------------------|--------|------------|-----------|
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| Sales (500 bicycles) | | | | | | | \$ 250,000 | | | | | | | | | | | |
| Less: Variables expenses | | | | | | | 150,000 | | | | | | | | | | | |
| Contribution margin | | | | | | | 100,000 | | | | | | | | | | | |
| Less: Fixed expenses | | | | | | | 80,000 | | | | | | | | | | | |
| Net income | | | | | | | \$ 20,000 | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
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| 10 | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | |

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

The Contribution Approach

Sales, variable expenses, and contribution margin can 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: Variables expenses | 150,000 | 300 | |
| Contribution margin | 100,000 | \$ 200 | |
| Less: Fixed expenses | 80,000 | | |
| Net income | \$ 20,000 | | |

Cost Analysis for Business Decisions
A.Y. 23-24

The Contribution Approach

Each month, Racing must generate at least **\$80,000** in total CM to cover fixed expenses.



| | A | B | C | D | E | F | G | H |
|----|--------------------------------------|---|---------------------------------|-------------------|---|-----------------|---|---|
| 1 | | | | | | | | |
| 2 | Racing Bicycle Company | | | | | | | |
| 3 | Contribution Income Statement | | | | | | | |
| 4 | For the Month of June | | | | | | | |
| 5 | | | | Total | | Per Unit | | |
| 6 | | | Sales (500 bicycles) | \$ 250,000 | | \$ 500 | | |
| 7 | | | Less: Variables expenses | 150,000 | | 300 | | |
| 8 | | | Contribution margin | 100,000 | | \$ 200 | | |
| 9 | | | Less: Fixed expenses | 80,000 | | | | |
| 10 | | | Net income | \$ 20,000 | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |

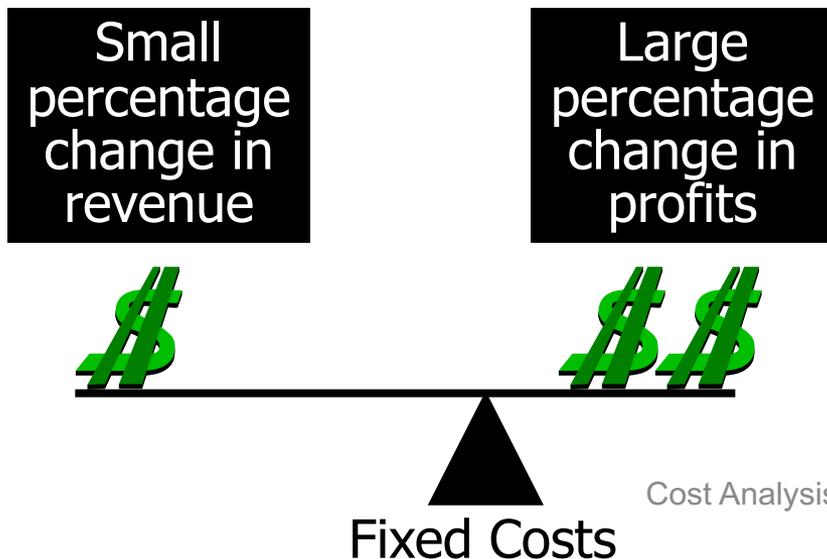
Cost Analysis for Business Decisions

A.Y. 23-24

Operating Leverage

A measure of the extent to which fixed costs are being used in an organization.

Operating leverage is greatest in companies that have a high proportion of fixed costs in relation to variable costs.



Consider the following concert example where all costs are fixed.

SPI example: Operating Leverage

Contribution Margin

10% Revenue Increase

| | | | | |
|---------------------------|----|--------|--------|--------|
| Tickets sold | | 2,700 | 3,000 | 3,300 |
| Revenue (\$18 per ticket) | \$ | 48,600 | 54,000 | 59,400 |
| Cost of band (Fixed) | | 48,000 | 48,000 | 48,000 |
| Gross profit | \$ | 600 | 6,000 | 11,400 |

90% Gross Profit Increase

When all costs are fixed, every additional sales dollar contributes one dollar to gross profit.



SPI example: Risk and Reward Assessment

Risk refers to the possibility that sacrifices may exceed benefits.

Risk may be reduced by converting fixed costs into variable costs.

Let's see what happens to the concert example if the band receives \$16 per ticket sold instead of a fixed \$48,000.



SPI example: Risk and Reward Assessment

Contribution Margin

10% Revenue Increase

| | | | |
|--------------------------------|-----------|-----------|-----------|
| Tickets sold | 2,700 | 3,000 | 3,300 |
| Revenue (\$18 per ticket) | \$ 48,600 | \$ 54,000 | \$ 59,400 |
| Cost of band (\$16 per ticket) | 43,200 | 48,000 | 52,800 |
| Gross profit | \$ 5,400 | \$ 6,000 | \$ 6,600 |

10% Gross Profit Increase

Shifting the cost structure from fixed to variable not only reduces risk but also the potential for profits.

Effect of Cost Structure on Profit Stability

| | All Fixed Company | Combination Company | All Variable Company |
|-------------------------------|-------------------|---------------------|----------------------|
| Units sold | 10 | 10 | 10 |
| Selling price per unit | \$ 10 | \$ 10 | \$ 10 |
| Variable cost per unit | 0 | 3 | 6 |
| Sales revenue | \$ 100 | \$ 100 | \$ 100 |
| Total variable cost | 0 | (30) | (60) |
| Total fixed cost | (60) | (30) | 0 |
| Net income | <u>\$ 40</u> | <u>\$ 40</u> | <u>\$ 40</u> |

Now let's see what happens when the number of units sold increases.

Cost Analysis for Business Decisions

Effect of Cost Structure on Profit Stability

| | All Fixed Company | Combination Company | All Variable Company |
|-------------------------------|---------------------|---------------------|----------------------|
| Units sold | 11 | 11 | 11 |
| Selling price per unit | \$ 10 | \$ 10 | \$ 10 |
| Variable cost per unit | 0 | 3 | 6 |
| Sales revenue | \$ 110 | \$ 110 | \$ 110 |
| Total variable cost | 0 | (33) | (66) |
| Total fixed cost | (60) | (30) | 0 |
| Net income | <u>\$ 50</u> | <u>\$ 47</u> | <u>\$ 44</u> |

The increase in income is greater in the All Fixed Company.

Effect of Cost Structure on Profit Stability

| | All Fixed Company | Combination Company | All Variable Company |
|------------------------|-------------------|---------------------|----------------------|
| Units sold | 9 | 9 | 9 |
| Selling price per unit | \$ 10 | \$ 10 | \$ 10 |
| Variable cost per unit | 0 | 3 | 6 |
| Sales revenue | \$ 90 | \$ 90 | \$ 90 |
| Total variable cost | 0 | (27) | (54) |
| Total fixed cost | (60) | (30) | 0 |
| Net income | <u>\$ 30</u> | <u>\$ 33</u> | <u>\$ 36</u> |

Yes, the decrease in income is greater in the All Fixed Company.

Cost Analysis for Business Decisions

Effect of Cost Structure on Profit Stability

| Level of Fixed Cost | Earnings Volatility |
|---------------------|---------------------|
| High | High |
| Low | Low |

Fixed Costs

Variable Costs



EXERCISE:

Demonstration Problem 1

Art On Tour, Inc. (AOTI) contracts with artists to exhibit their work to the public. AOTI has agreed to pay a well known artist a \$20,000 commission for the right to exhibit his work for one month.

Required

Part a – Identifying Cost Behavior

1. Determine the total commission cost and the commission cost per person if 1,000, 2,000, or 4,000 people attend the exhibition. Is the commission cost fixed or variable?
2. AOTI sells to patrons books illustrating the artist's work. The books cost AOTI \$5 each. Determine the total cost of books and the cost per person if 1,000, 2,000, or 4,000 people attend the exhibition and wish to purchase the books. Is the book cost fixed or variable?

..continue..

Part b - Operating Leverage and Risk/Reward Relationship

1. AOTI pays an artist a \$20,000 commission. It sells 4,000 tickets at \$6 each. Prepare an income statement. Then prepare revised income statements assuming 10 percent more than 4,000 and 10 percent fewer than 4,000 patrons attend the exhibition. Calculate the percentage changes in revenue and net income if attendance increases or decreases 10 percent.
2. Alternatively, AOTI pays the artist a commission of \$5 per ticket sold. It sells 4,000 tickets at \$6 each. Prepare an income statement. Then prepare revised income statements assuming 10 percent more than 4,000 and 10 percent fewer than 4,000 patrons attend the exhibition. Calculate the percentage change in revenue and net income if attendance increases or decreases 10 percent.

Part c - Fixed and Variable Cost Definitions are Context Sensitive

1. AOTI pays the artist a commission of \$20,000 per exhibition. What is the total commission cost and the commission cost per person if 1,000, 2,000, or 4,000 people attend the exhibition? (Same as part a.1.)
2. AOTI pays the artist a commission of \$20,000 per exhibition. What is the total commission cost and the commission cost per exhibition if AOTI sponsors 1, 2, or 3 exhibitions?



EXERCISE:

Demonstration Problem 2:

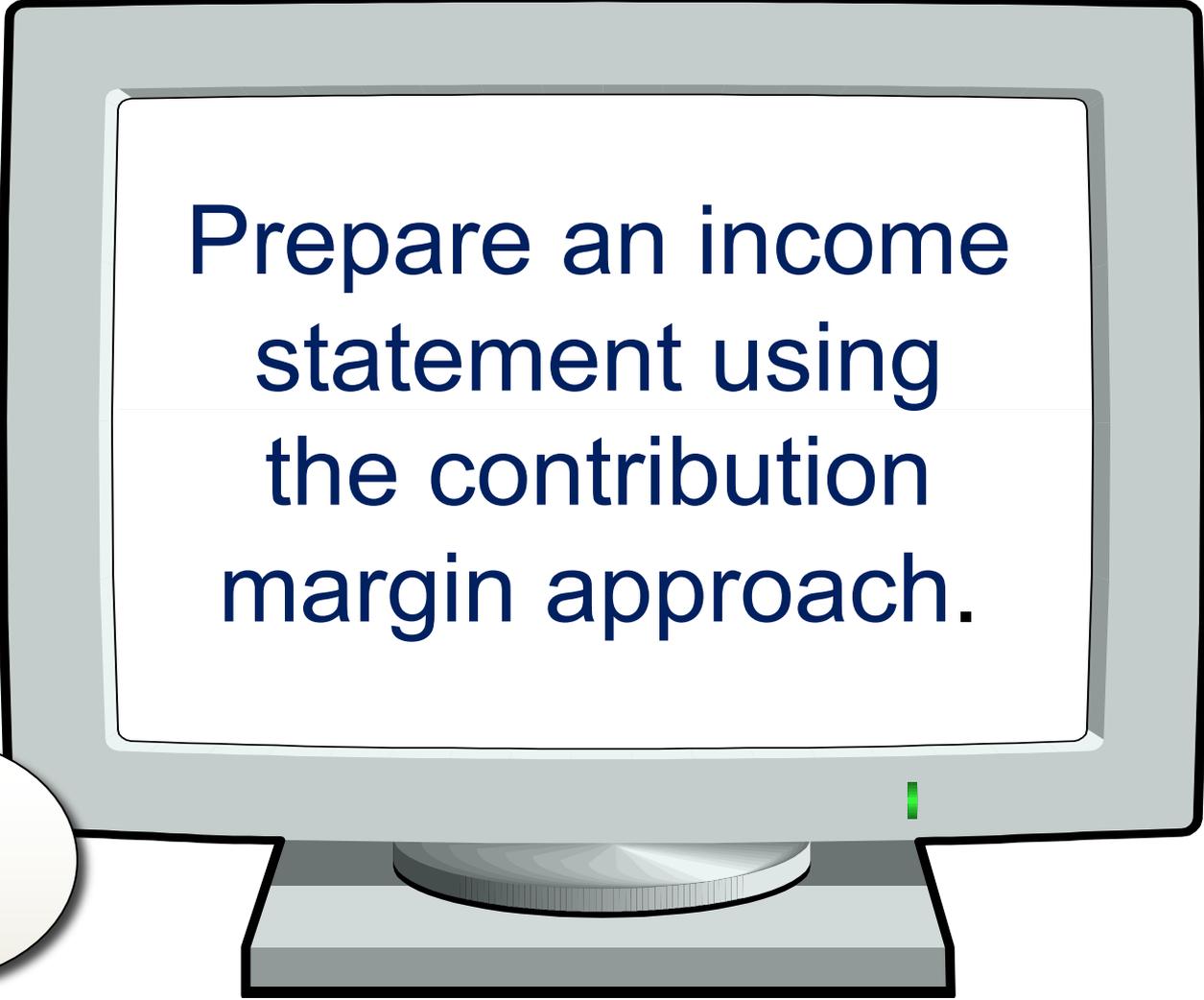
Effect of Cost Structure

My Company and Your Company provide rafting tours on Big Bear River. My Company pays tour guides fixed salaries. It budgets salaries expense at \$160,000 per year. Your Company pays tour guides \$40 per rafter served. Rafters are charged \$50 per tour. Both companies expect to carry approximately 4,000 rafters during the year.

Required

- Prepare budgeted annual income statements for the two companies.
- In an effort to lure rafters away from Your Company, My Company lowers the price per rafter to \$39. Prepare revised income statements for both companies. Assume that My Company serves 6,000 rafters who each pay \$39 per tour, while Your Company serves only 2,000 rafters who pay \$50 per tour.
- Assume you are president of Your Company. Offer defensive strategies.
- Suppose Your Company matches the \$39 price set by My Company. Prepare income statements for both companies assuming that each company serves 4,000 customers.

Learning Objective



Prepare an income statement using the contribution margin approach.



LO3

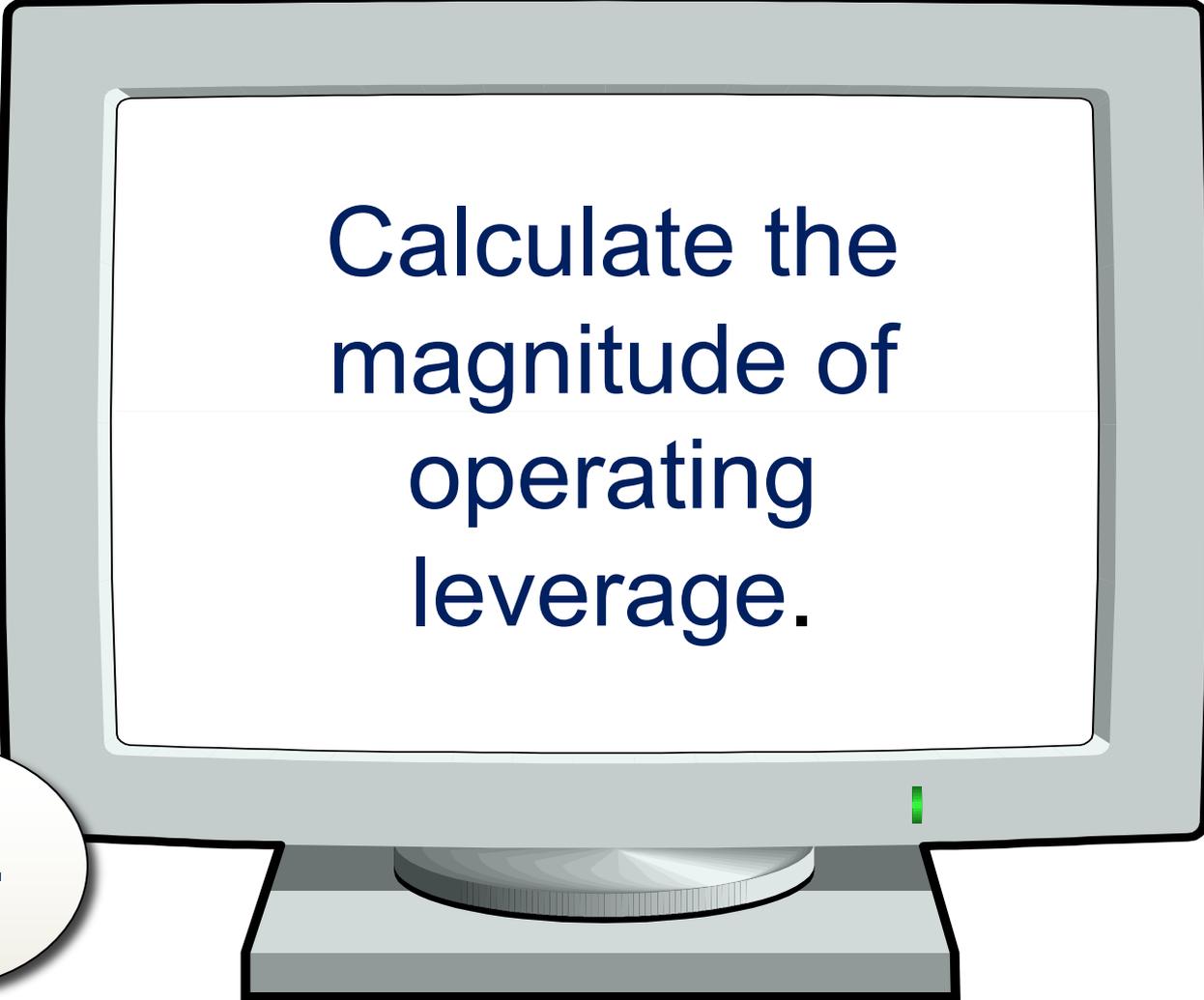
An Income Statement under the Contribution Margin Approach

EXHIBIT 2.11

Income Statements

| | Company Name | |
|---------------------------------|---------------------|-----------------|
| | Bragg | Biltmore |
| Variable cost per unit (a) | \$ 6 | \$ 12 |
| Sales revenue (10 units × \$20) | \$ 200 | \$ 200 |
| Variable cost (10 units × a) | <u>(60)</u> | <u>(120)</u> |
| Contribution margin | 140 | 80 |
| Fixed cost | <u>(120)</u> | <u>(60)</u> |
| Net income | <u>\$ 20</u> | <u>\$ 20</u> |

Learning Objective



Calculate the
magnitude of
operating
leverage.

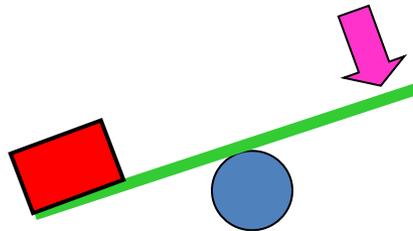


LO4

Operating Leverage

A measure of how sensitive net operating income is to percentage changes in sales.

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



* or simply Operating leverage

Operating Leverage

At Racing, the degree of operating leverage is 5.

| | Actual sales 500 Bikes |
|---|-----------------------------------|
|  Sales | \$ 250,000 |
| Less: variable expenses | 150,000 |
| Contribution margin | 100,000 |
| Less: fixed expenses | 80,000 |
| Net income | <u>\$ 20,000</u> |

$$\frac{\$100,000}{\$20,000} = 5$$

Operating Leverage

With an operating leverage of 5, if Racing 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% |



Operating Leverage

| | 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.**

Contribution Margin Ratio

The contribution margin **ratio** is:

$$\text{CM Ratio} = \frac{\text{Total CM}}{\text{Total sales}}$$

For Racing Bicycle Company the ratio is:

$$\frac{\$80,000}{\$200,000} = 40\%$$

Each \$1.00 increase in sales results in a total contribution margin increase of 40¢.



Contribution Margin Ratio

Or, in terms of **units**, the contribution margin **ratio** is:

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

For Racing Bicycle Company the ratio is:

$$\frac{\$200}{\$500} = 40\%$$



Contribution Margin Ratio

| | 400 Bikes | 500 Bikes |
|--------------------------------|-------------------|-------------------|
| 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)**

Measuring Operating Leverage Using Contribution Margin: EXAMPLE

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

Show me an example.



Measuring Operating Leverage Using Contribution Margin

| | | | |
|---|--------------------------------|------------------|--|
|  | Actual sales | 5,000 | |
| | | Hammers | |
| | Sales | \$ 50,000 | |
| | Less: variable expenses | 30,000 | |
| | Contribution margin | 20,000 | |
| | Less: fixed expenses | 15,000 | |
| Net income | \$ 5,000 | | |

$$\text{Operating Leverage} = \frac{\$20,000}{\$5,000} = 4$$

A measure of how a percentage change in sales will effect profits.

Measuring Operating Leverage Using Contribution Margin

| | Current sales 5,000 Hammers | Increased sales 5,500 Hammers |
|---|--|--|
|  Sales | \$ 50,000 | \$ 55,000 |
| Less: Variable expenses | 30,000 | 33,000 |
| Contribution margin | 20,000 | 22,000 |
| Less: Fixed expenses | 15,000 | 15,000 |
| Net income | \$ 5,000 | \$ 7,000 |

A 10 percent increase in sales results in a 40 percent increase in net income.

$$(10\% \times 4 = 40\%)$$

EXERCISES:

Demonstration Problem 3: Effect of Operating Leverage

Sharon Virgil owns a delivery service company. She charges customers \$10 per delivery. The company's variable expenses average \$2 per delivery and fixed costs are \$600 per month. Ms. Virgil provided 100 deliveries during the most recent month.

Required

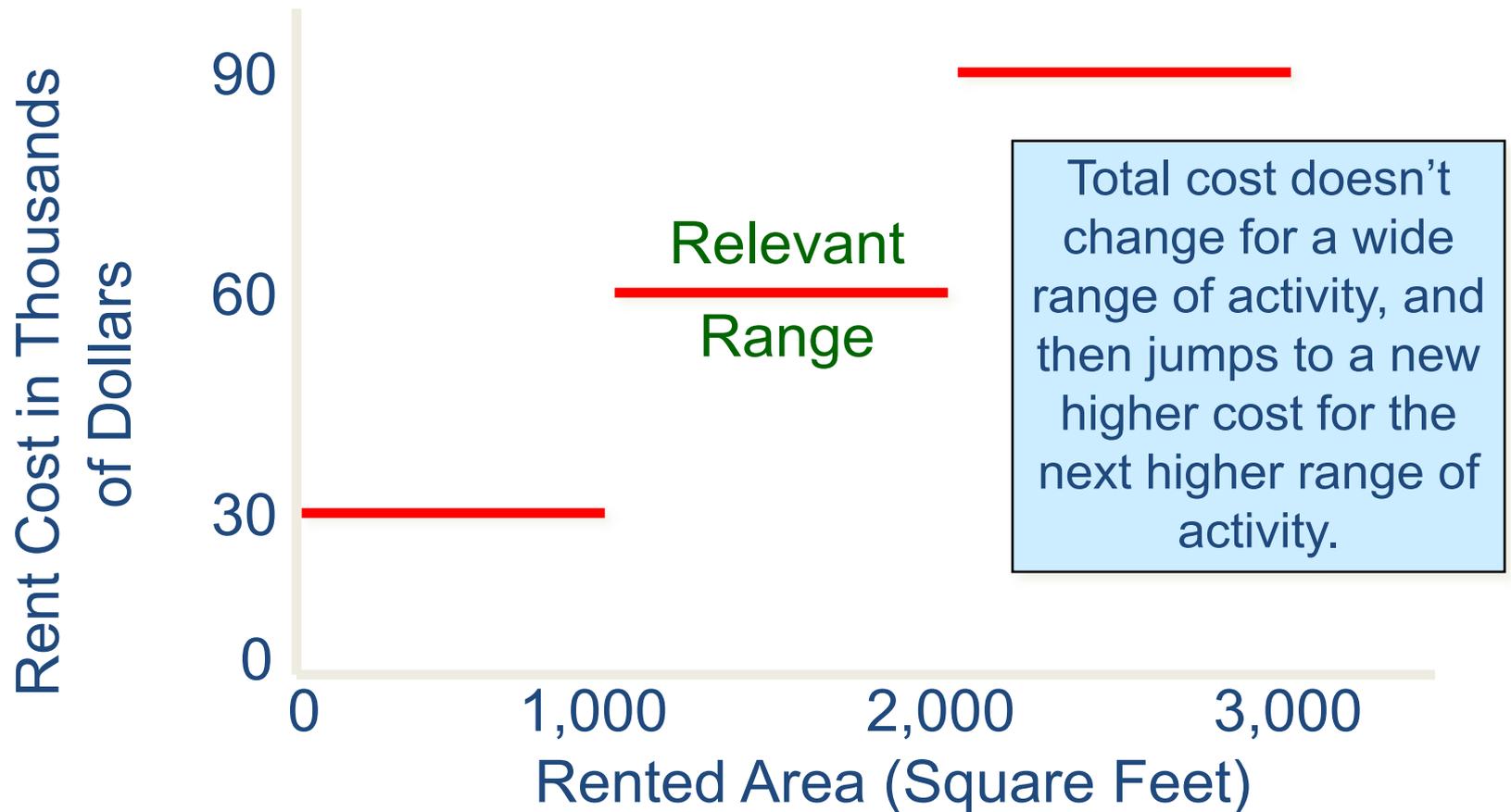
- Prepare an income statement using a contribution margin format.
- Determine the magnitude of operating leverage. Use your answer to determine the percentage change in net income if sales increase by 10%.
- Assume that sales increase by 10% (deliveries increase to 110). Prepare a contribution margin format income statement assuming 110 deliveries. Calculate the percentage change in net income and compare your answer with your solution to part b.

The Relevant Range

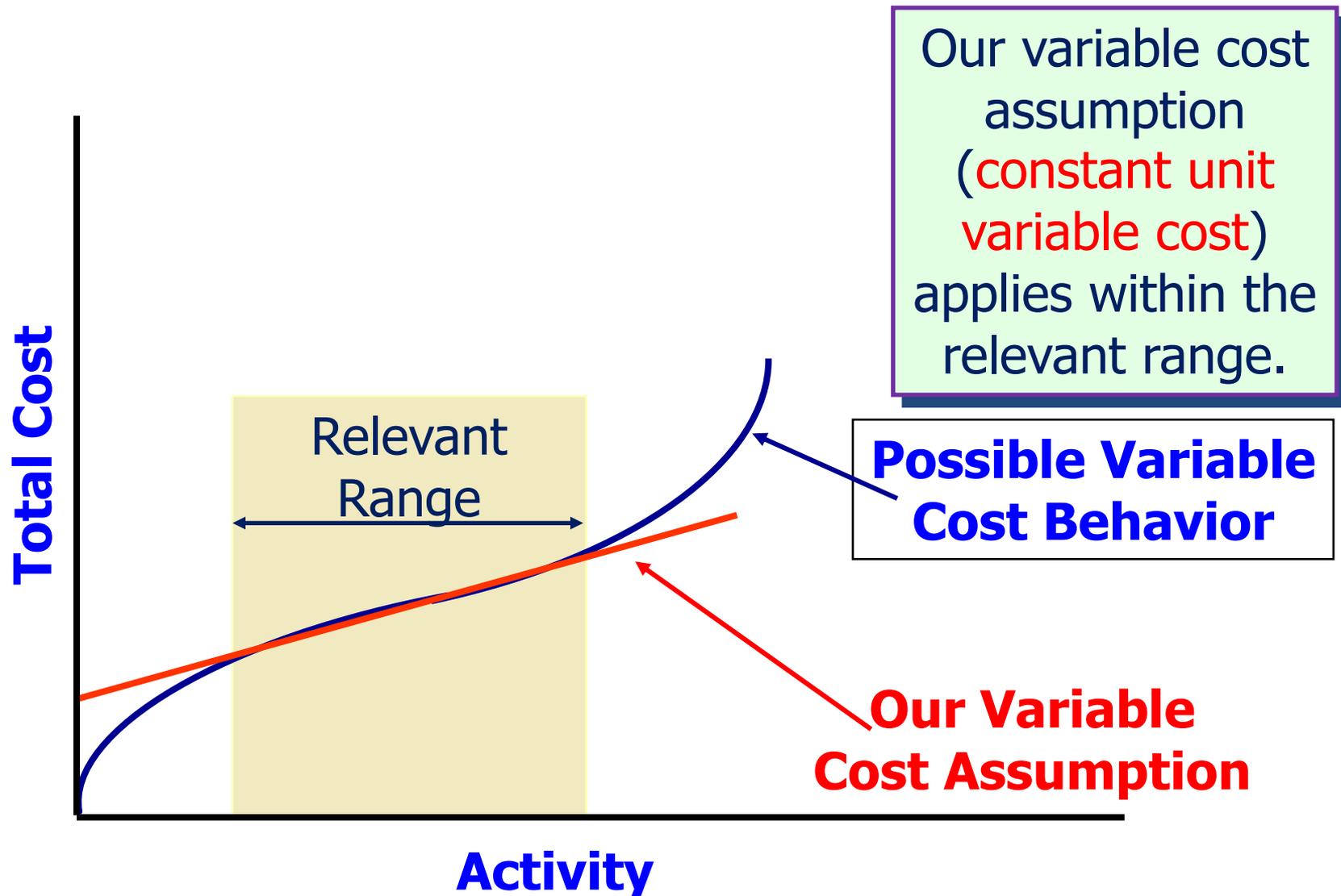
Example: Office space is available at a fixed rental rate of \$30,000 per year in increments of 1,000 square feet. As the business grows more space is rented, increasing the total cost.



Fixed Costs and Relevant Range



The Relevant Range



Context Sensitive Definitions of Fixed and Variable

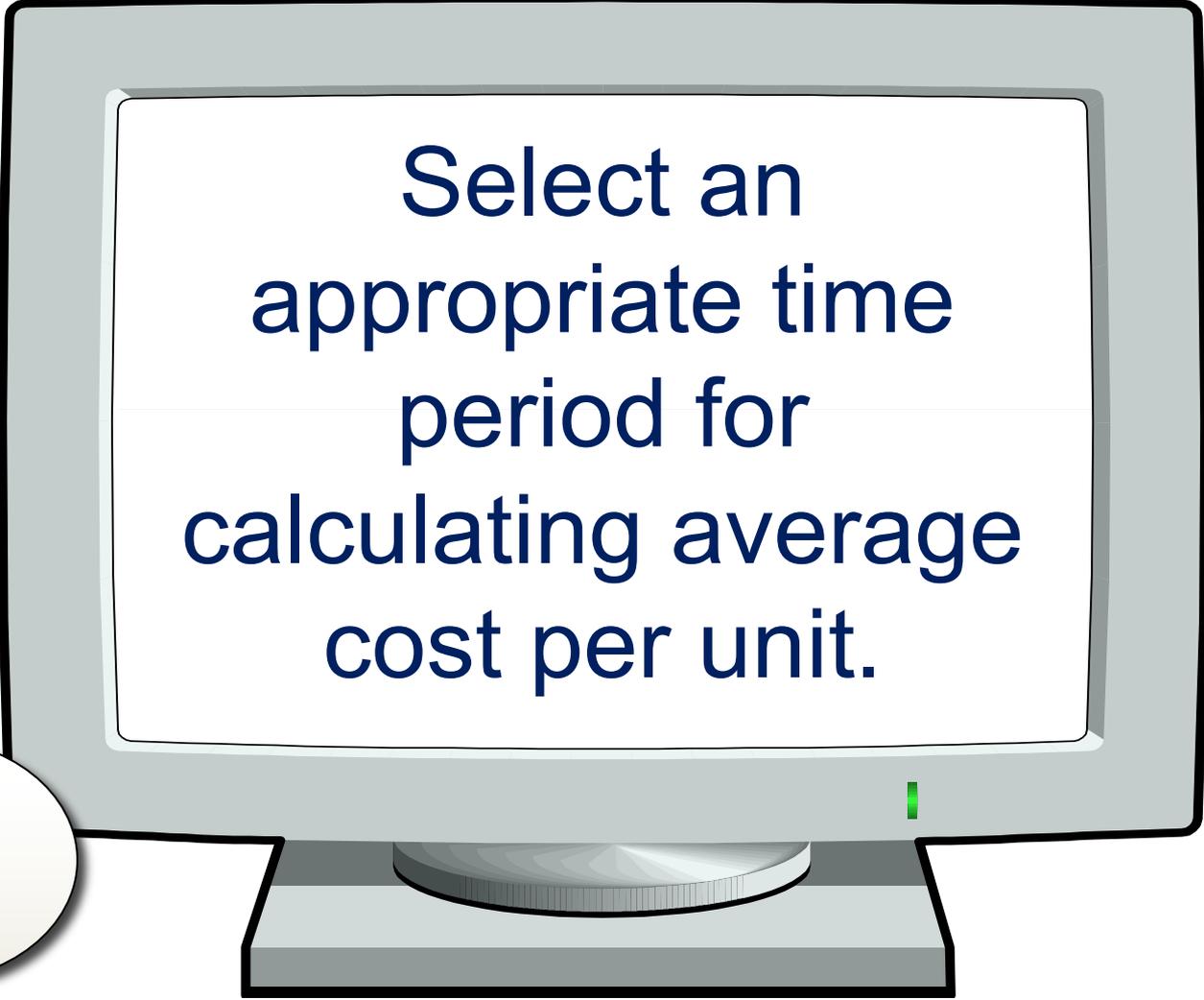
Recall the earlier concert example, where the band was paid \$48,000 regardless of the number of tickets sold.

The cost of the band is fixed relative to the number of tickets sold for a specific concert.

| Number of concerts | 1 | 2 | 3 | 4 | 5 |
|--------------------|-----------|-----------|------------|------------|------------|
| Cost per concert | \$ 48,000 | \$ 48,000 | \$ 48,000 | \$ 48,000 | \$ 48,000 |
| Total cost | \$ 48,000 | \$ 96,000 | \$ 144,000 | \$ 192,000 | \$ 240,000 |

The cost of the band is variable relative to the number of concerts produced.

Learning Objective

A stylized illustration of a computer monitor with a grey frame and a white screen. The screen displays the learning objective text in blue. The monitor has a small green light indicator on the bottom right corner of the bezel.

Select an appropriate time period for calculating average cost per unit.

A white oval with a black border containing the text 'LO5' in blue.

LO5

Cost Averaging

Lake Resorts provides water-skiing lessons for its guests with the following costs:

| | |
|-------------------------|----------------------|
| Equipment rental | \$80 per day |
| Instructor pay | \$15 per hour |
| Fuel | \$ 2 per hour |

What is the average cost per one-hour lesson for 2 lessons per day? 5 lessons per day? 10 lessons per day?



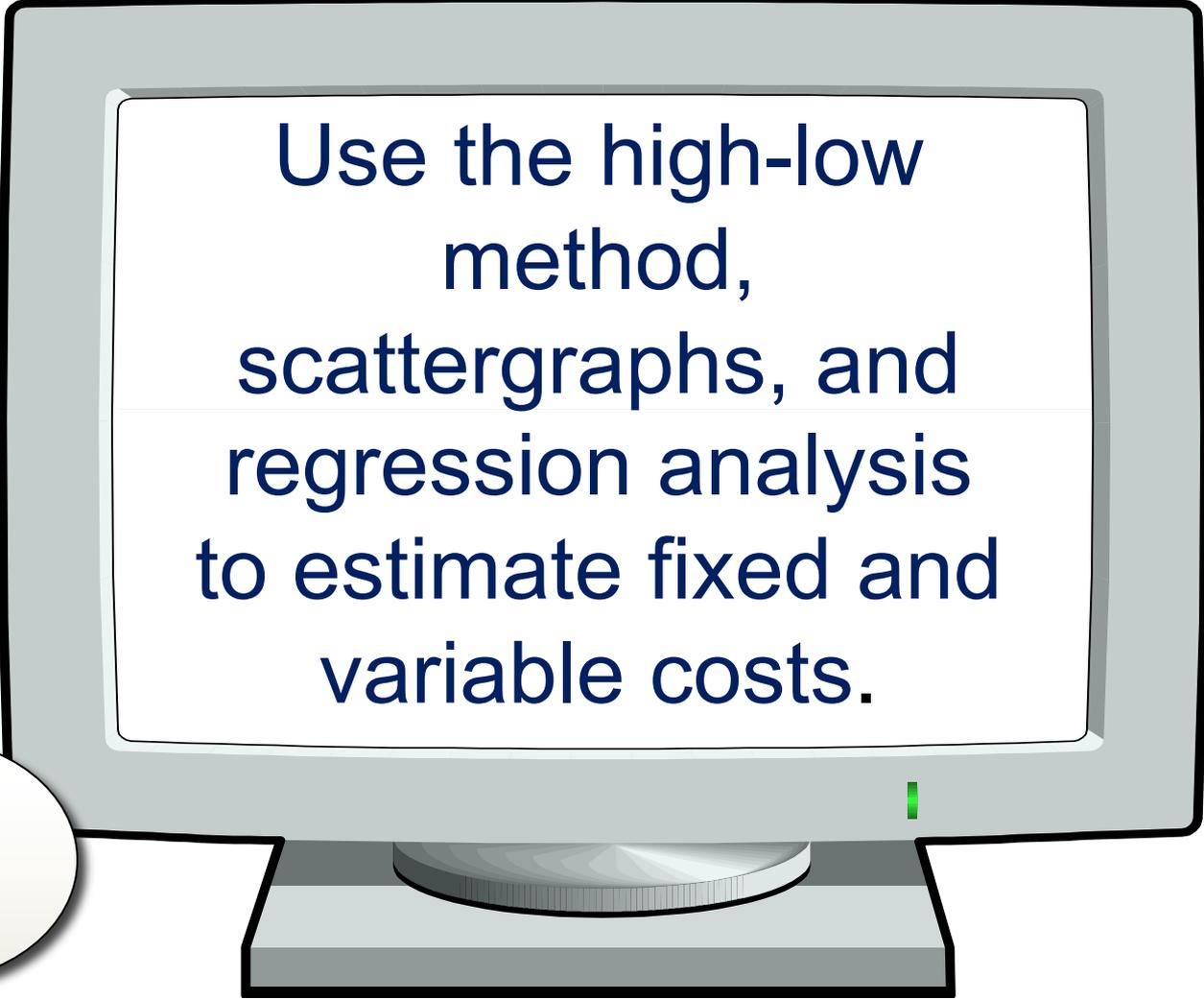
Cost Averaging

| | | | |
|---------------------------------|----------------------|----------------------|----------------------|
| Number of lessons | 2 | 10 | 20 |
| Cost of equipment rental | \$ 80 | \$ 80 | \$ 80 |
| Cost of instruction | 30 | 150 | 300 |
| Cost of fuel | 4 | 20 | 40 |
| Total cost | <u>\$ 114</u> | <u>\$ 250</u> | <u>\$ 420</u> |
| Cost per lesson | \$ 57 | \$ 25 | \$ 21 |

Average costs decline as activity increases when fixed costs such as equipment rental are involved.

Managers must use these average costs with caution as they differ at every level of activity.

Learning Objective

A stylized illustration of a computer monitor with a grey frame and a white screen. The screen contains the learning objective text. The monitor has a small green light on the bottom right corner.

Use the high-low method, scattergraphs, and regression analysis to estimate fixed and variable costs.

A white oval with a black border containing the text 'LO6' in blue.

LO6

The High-Low Method

Iris Company recorded the following production activity and maintenance costs for two months:

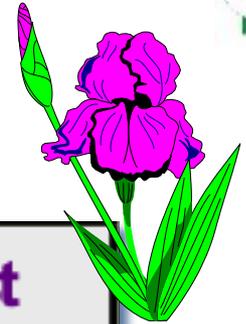
| | Units | Cost |
|----------------------------|---------------|----------------|
| High activity level | 10,000 | \$9,700 |
| Low activity level | 5,000 | 5,700 |

Using these two levels of activity, compute:

- ① the variable cost per unit.
- ② the fixed cost.
- ③ the total cost.



The High-Low Method



| | Units | Cost |
|---------------------|--------------|----------------|
| High activity level | 10,000 | \$9,700 |
| Low activity level | 5,000 | 5,700 |
| Change | <u>5,000</u> | <u>\$4,000</u> |

① Unit variable cost = \$4,000 ÷ 5,000 units = \$.80 per unit

② Fixed cost = Total cost – Total variable cost

Fixed cost = \$9,700 – (\$.80 per unit × 10,000 units)

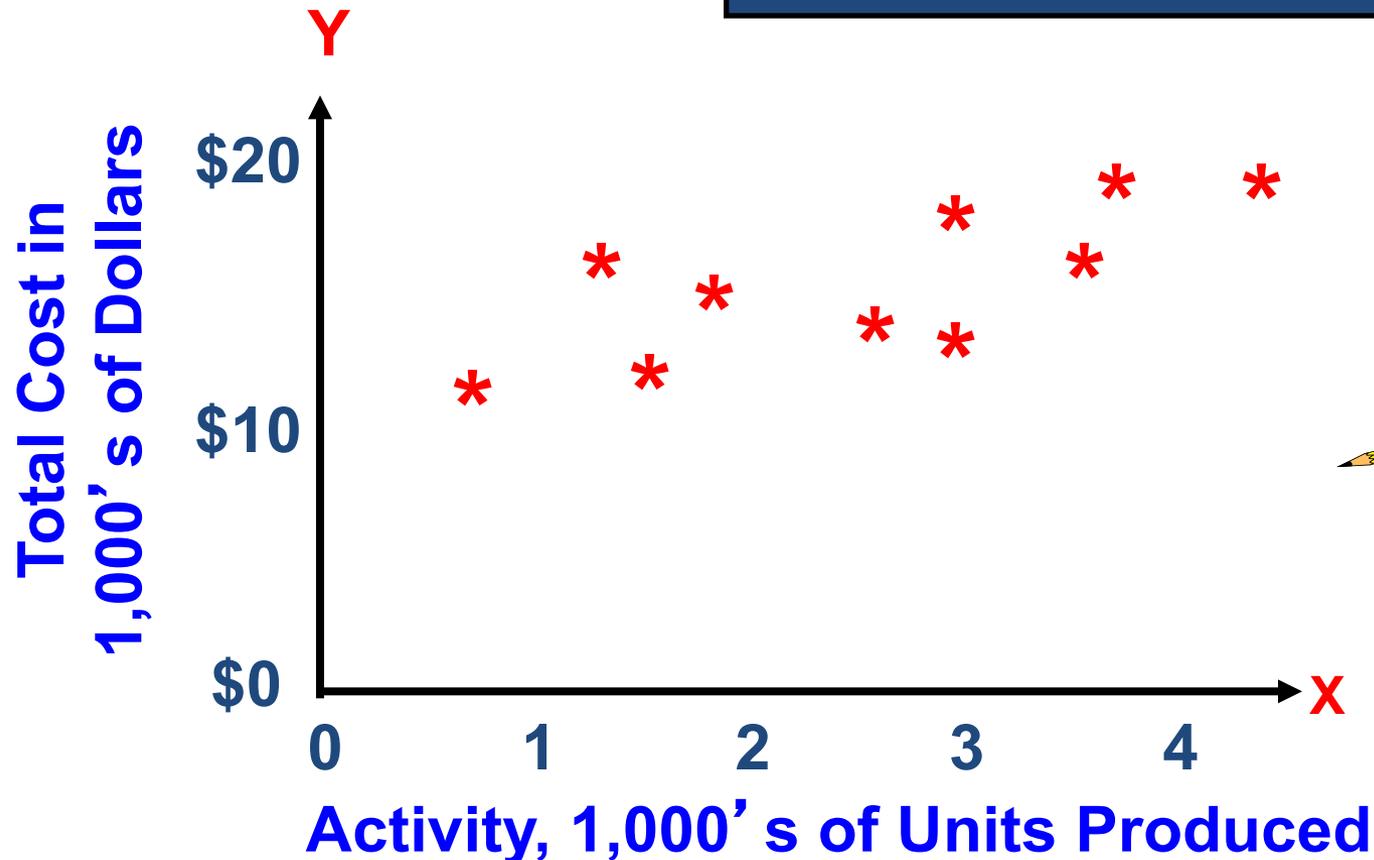
Fixed cost = \$9,700 – \$8,000 = \$1,700

③ Total cost = Fixed cost + Variable cost

Total cost = \$1,700 + \$0.80X

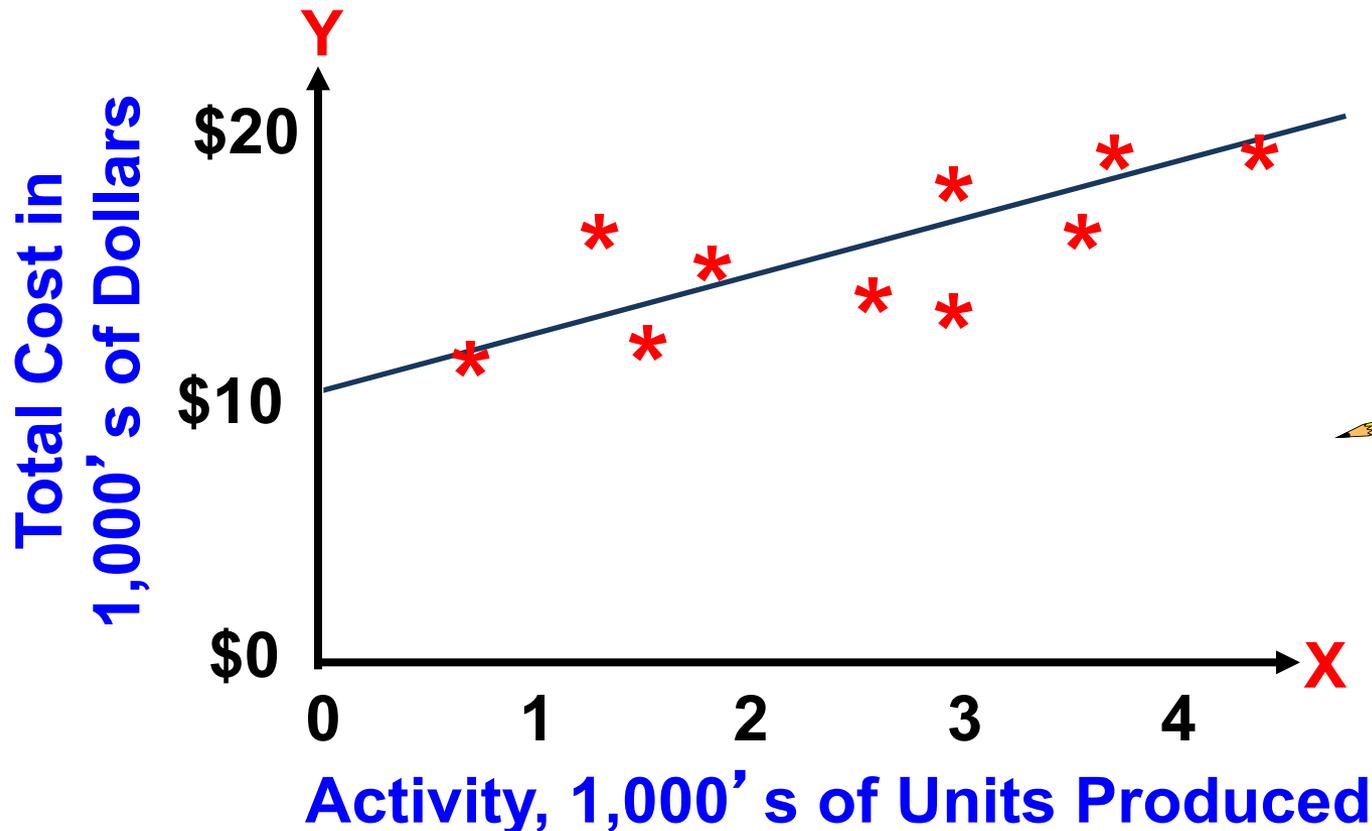
The Scattergraph Method

Plot the data points on a graph (total cost vs. activity).

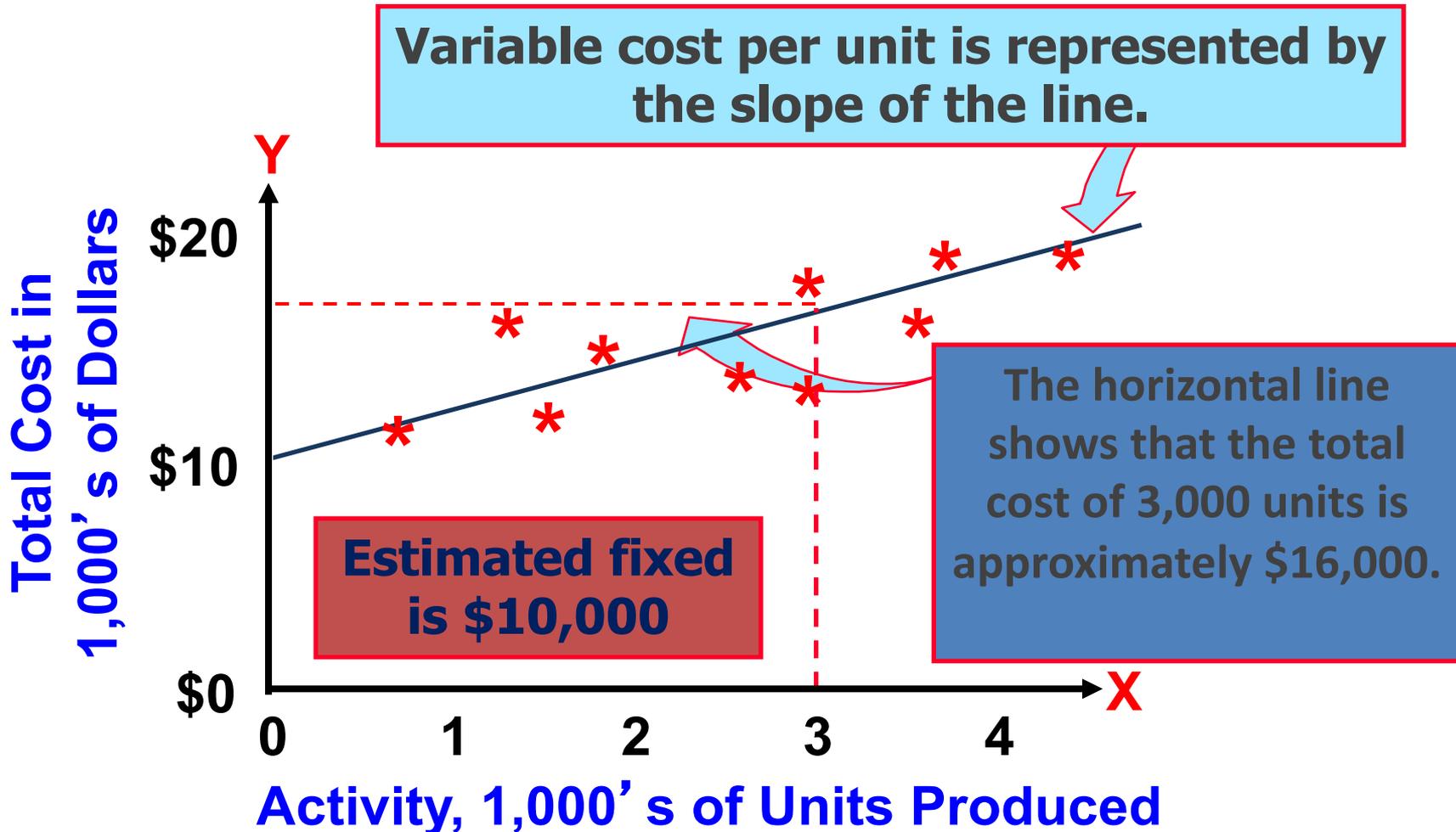


The Scattergraph Method

Draw a line through the data points with about an equal numbers of points above and below the line.

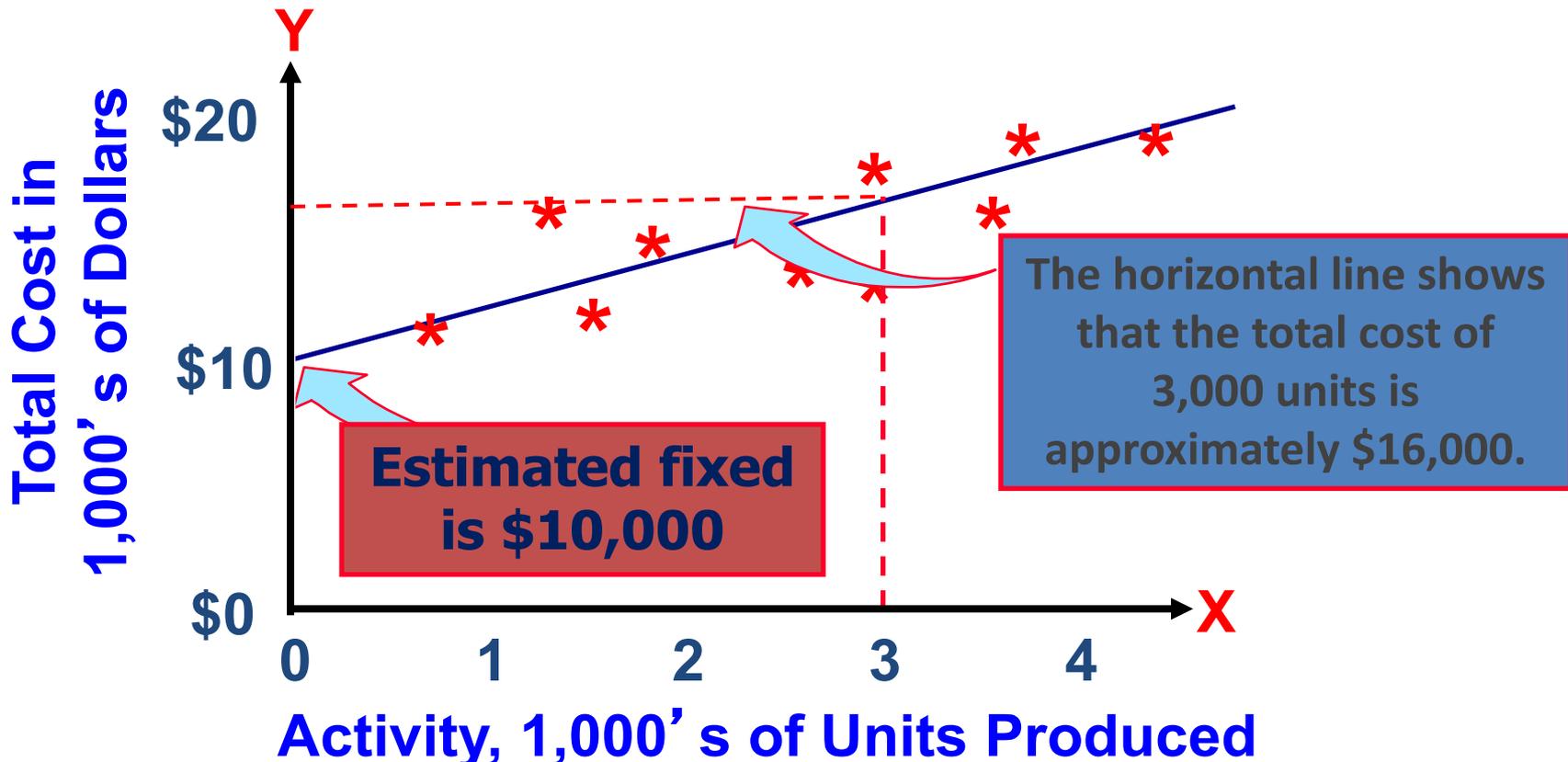


The Scattergraph Method



The Scattergraph Method

Total variable cost = Total cost – Total fixed cost
Total variable cost = \$16,000 – \$10,000 = \$6,000
Unit variable cost = \$6,000 ÷ 3,000 units = \$2



Regression Method of Cost Estimation

A method used to analyze mixed costs if a scattergraph plot reveals an approximately linear relationship between the X and Y variables.

This method uses *all* of the data points to estimate the fixed and variable cost components of a mixed cost.

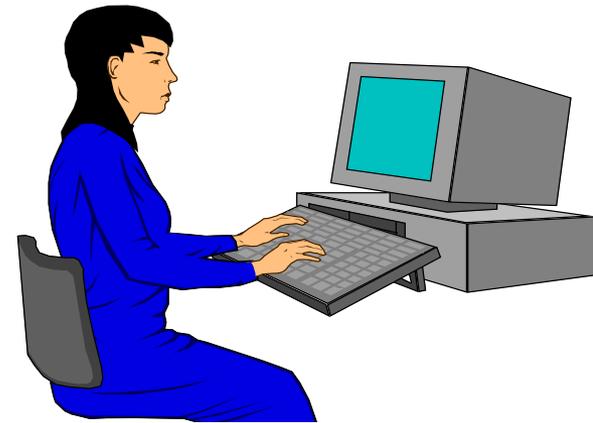
$$\begin{array}{r} 10784.36 \\ 5 \overline{) 53913.72} \\ \underline{27157} \\ 2675672 \end{array}$$

The goal of this method is to fit a straight line to the data that *minimizes the sum of the squared errors*.

Regression Method of Cost Estimation

- Software can be used to fit a regression line through the data points.
- The cost analysis objective is the same:

$$Y = a + bX$$

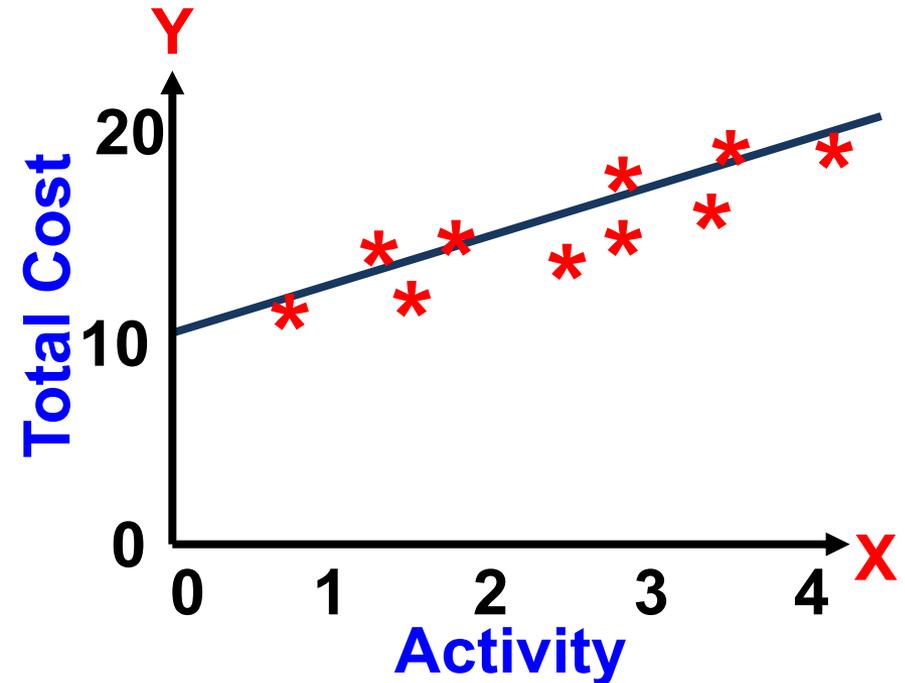


Least-squares regression also provides a statistic, called the R^2 , that is a measure of the goodness of fit of the regression line to the data points.

Regression Method of Cost Estimation

Follow these steps in Excel to perform regression analysis:

1. Enter the data in spreadsheet columns.
2. Click *Tools*.
3. Click *Data Analysis*.
4. Click *Regression* and then *OK*.
5. Define data ranges and click *Line Fit Plot*.
6. Click *OK*.



The regression function will return an estimate for fixed cost and variable cost per unit.