Chapter
23

Managerial Accounting

Lecture 06: Cost-Volume-Profit (CVP) Analysis

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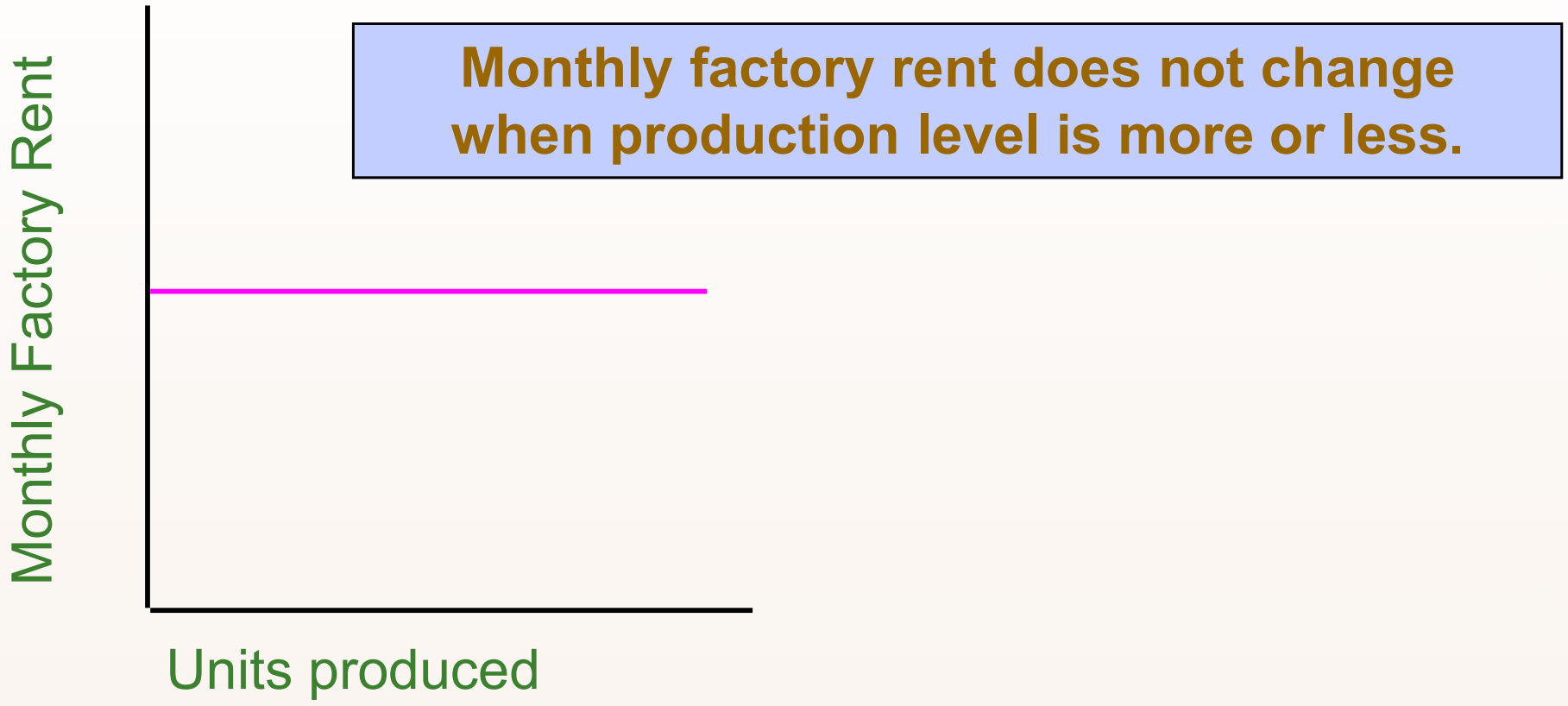
Cost-Volume-Profit Relationships

Cost-volume-profit (CVP) analysis is used to answer questions such as:

- How much must I sell to earn my desired income?
- How will income be affected if I reduce selling prices to increase sales volume?
- What will happen to profitability if I expand capacity?

Fixed Costs

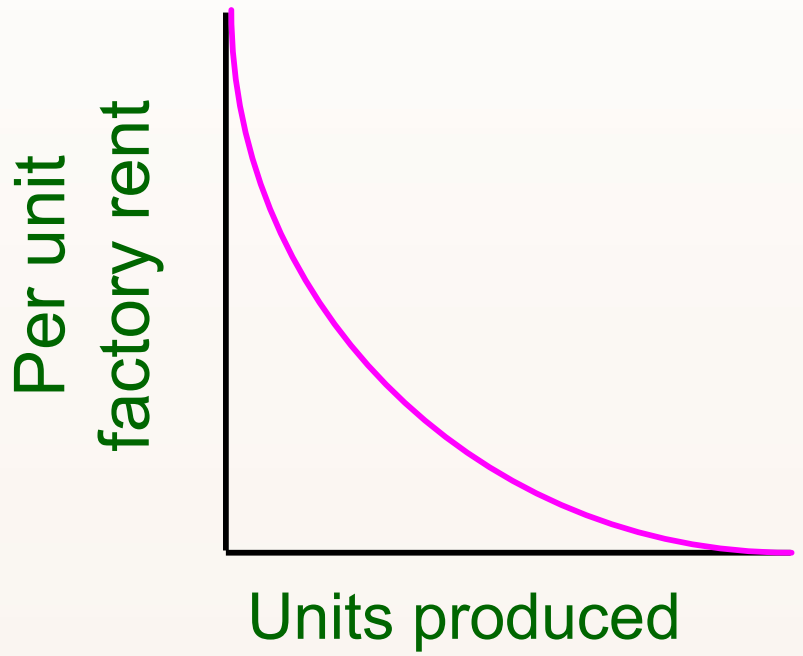
Total fixed costs remain unchanged when activity changes.



Fixed Costs

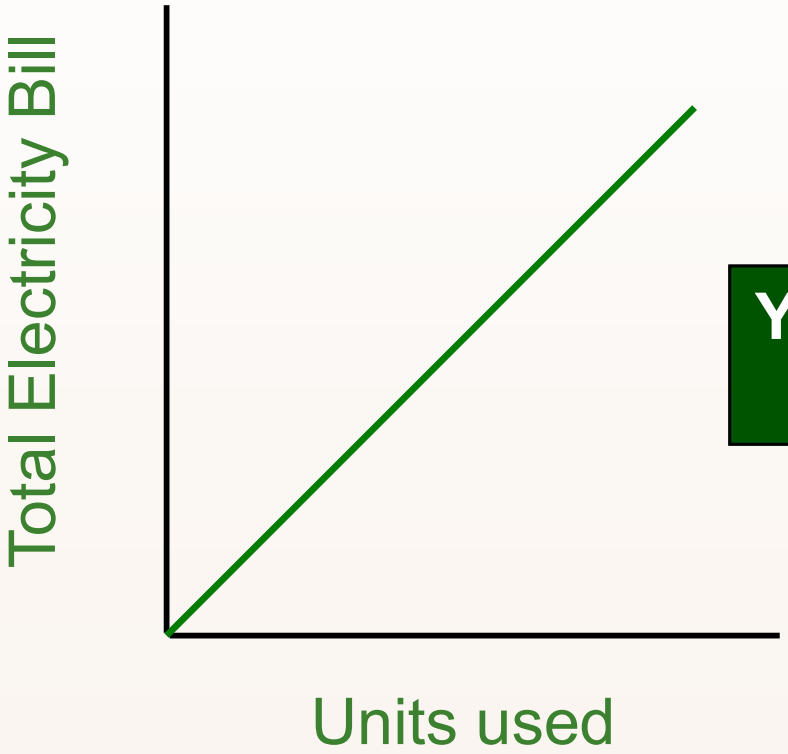
Fixed costs per unit decline as activity increases.

Factory rent per unit produced declines as more units are produced



Variable Costs

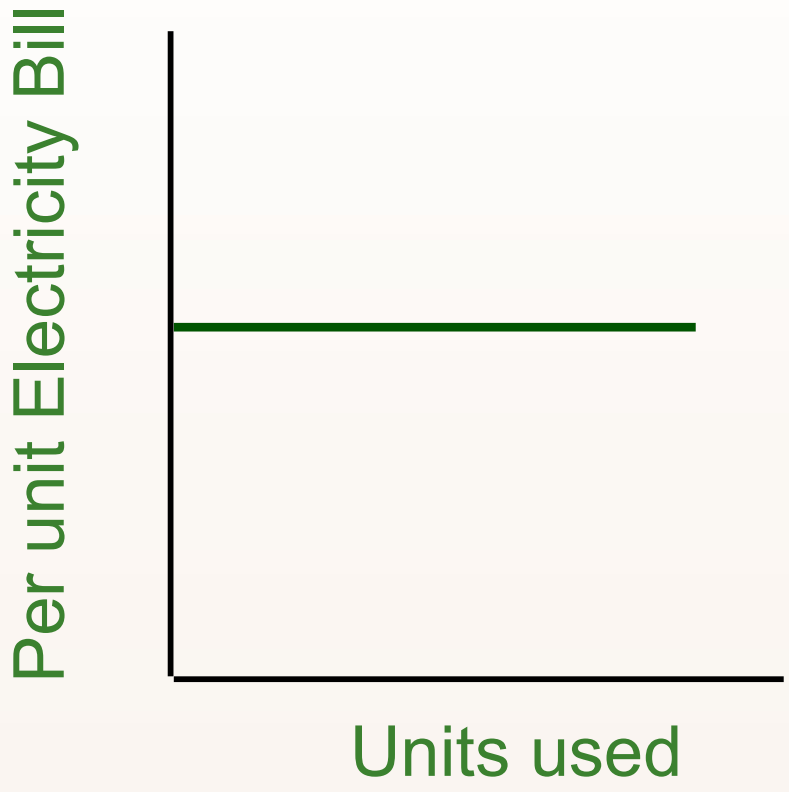
Total variable costs change when activity changes.



Your total Electricity bill is based on how many units you used.

Variable Costs

Variable costs per unit do not change as activity increases.



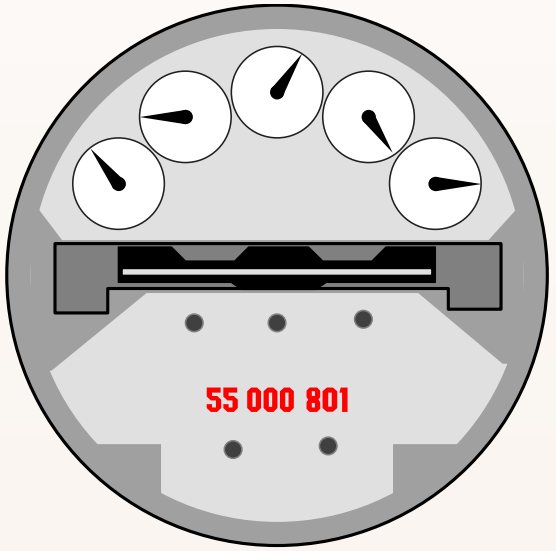
The cost per unit used is constant. For example, Tk 3 per unit .

Semi variable Costs (Mixed Costs)

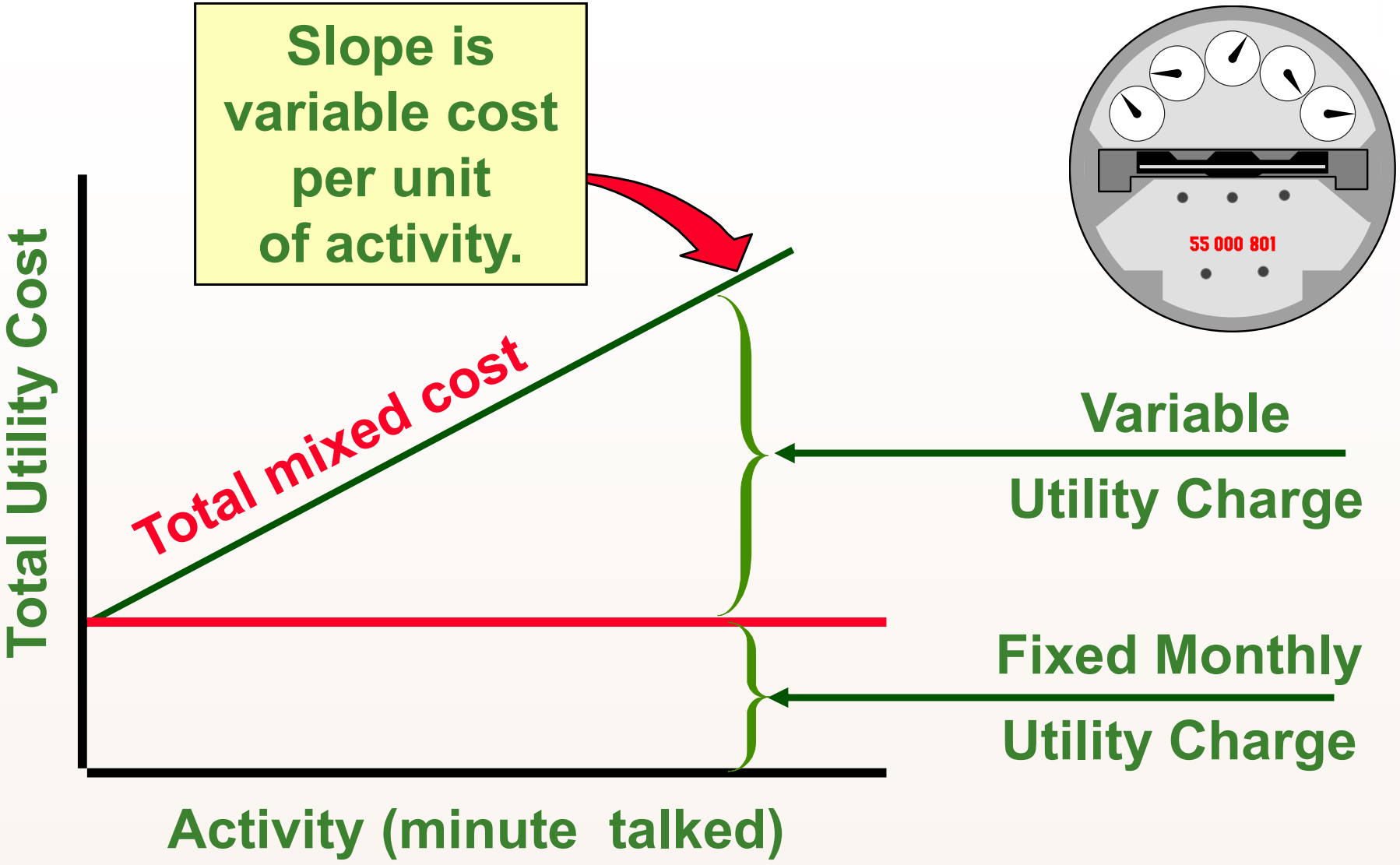
Mixed costs contain a fixed portion that is incurred even when facility is unused, and a variable portion that increases with usage.

Example: Monthly fixed phone bill

- Fixed line rent
- Variable charge per minute talked



Semi variable Costs (Mixed Costs)



Cost Behavior Summary

Summary of Variable and Fixed Cost Behavior		
	Variable Costs	Fixed costs
Per Unit	Remains the same even when activity level changes.	Dereases as activity level increases.
Total	Changes as activity level changes.	Remains the same over wide ranges of activity.

Learning Objective

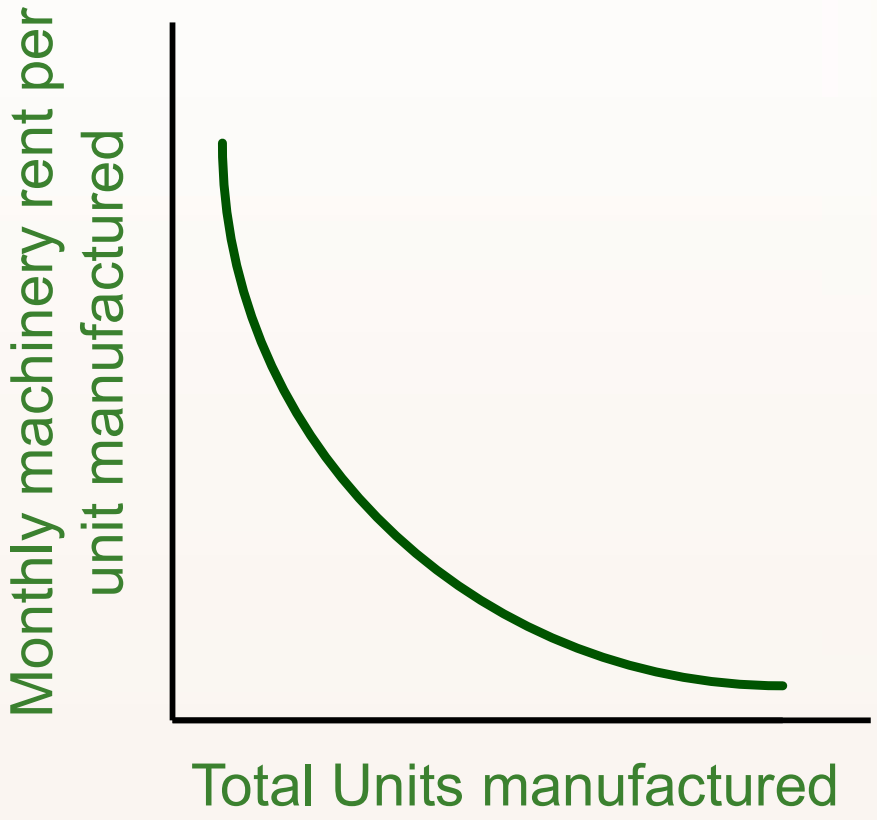
To explain how economies of scale can reduce unit costs.



LO2

Economies of Scale

Consider machinery rent example.



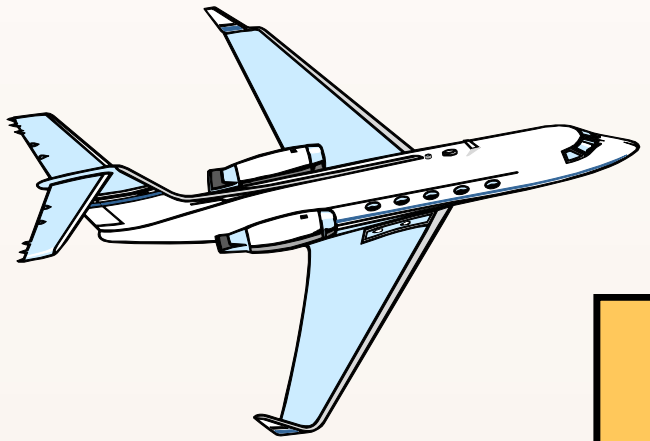
Fixed costs per unit decline as activity increases.

Economies of Scale

Economies of scale are most apparent in business with high fixed costs.

Utility Companies

Steel Mills



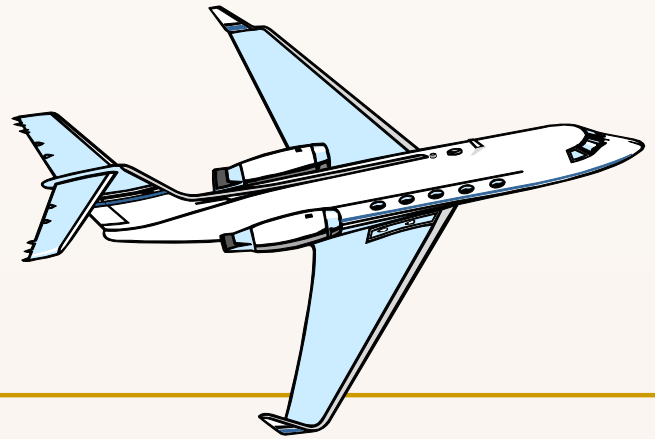
Oil Refineries

Airlines

Economies of Scale

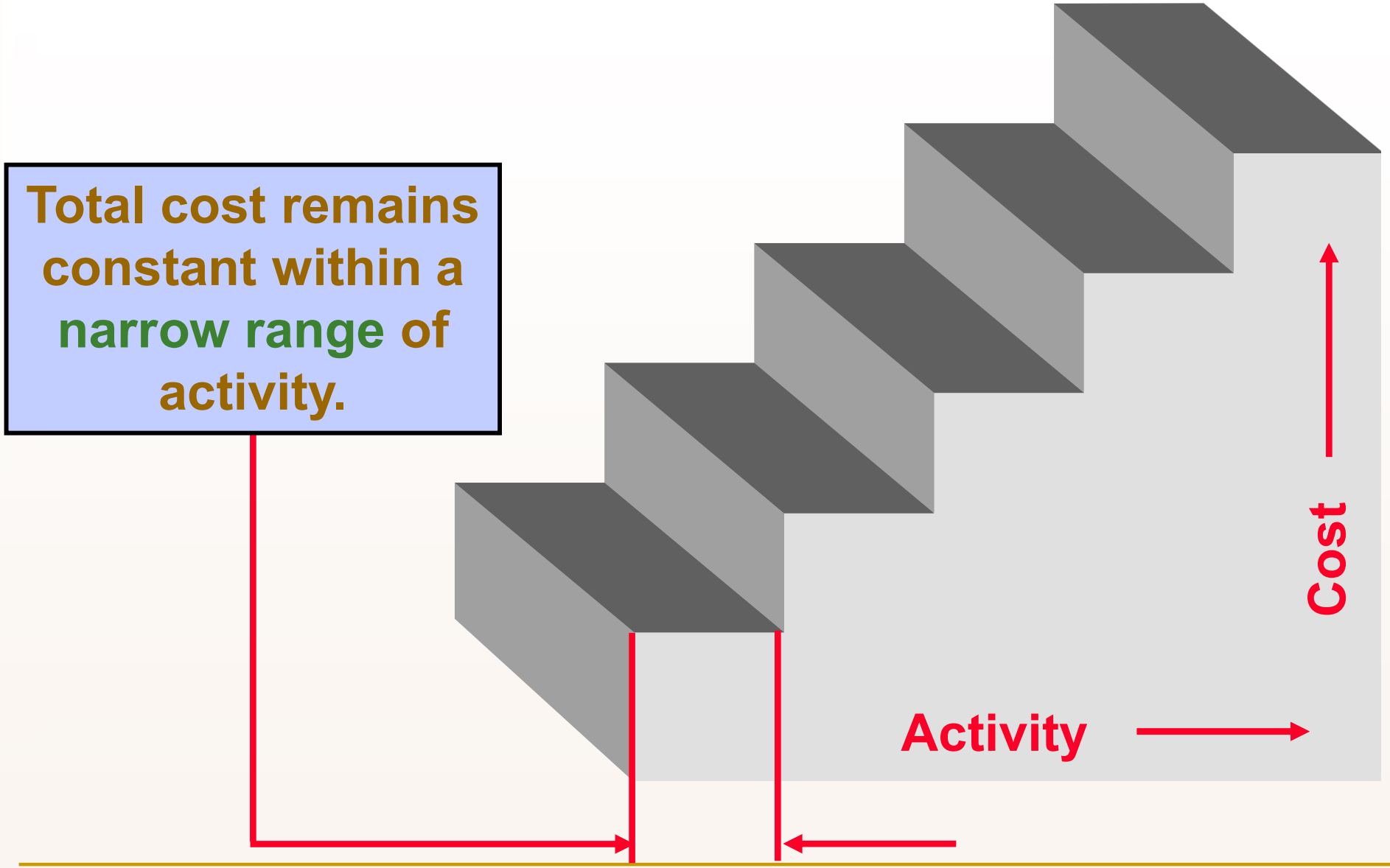
Economies of scale are most apparent in business with high fixed costs.

Fixed Costs per Month	Number of Flights per Month	Fixed Cost per Flight	Fixed Cost per Passenger (250 Passengers/Flight)
$ 100,000,000	1,000	$ 100,000	$400
$ 100,000,000	2,000	$ 50,000	$200
$ 100,000,000	4,000	$ 25,000	$100
$ 100,000,000	8,000	$ 12,500	$50



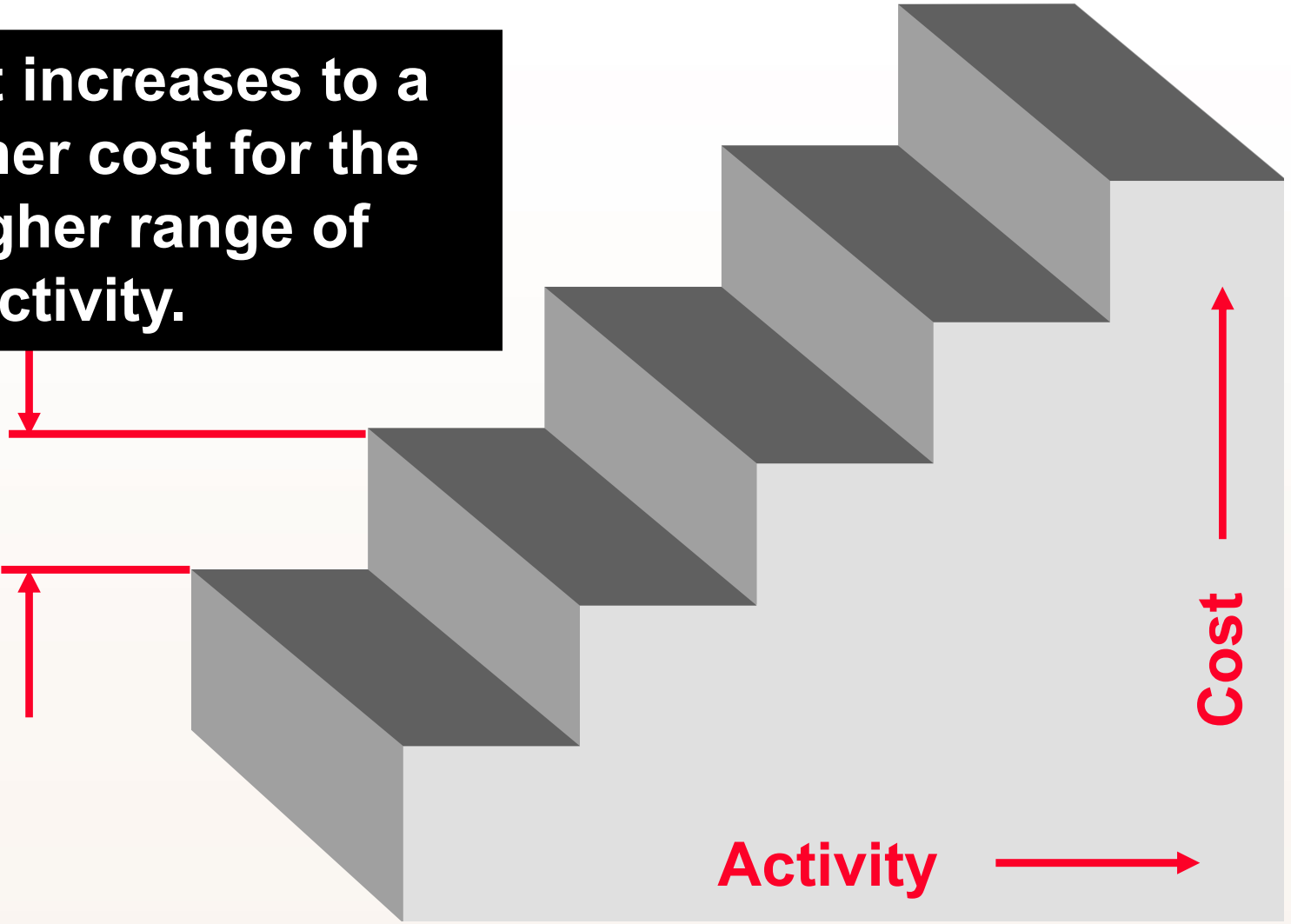
Airlines

Stair-Step Costs



Stair-Step Costs

Total cost increases to a new higher cost for the next higher range of activity.



Learning Objective

To prepare a cost-volume-profit graph.



LO3

The Basics of Cost-Volume-Profit (CVP) Analysis

CM can be expressed in total or per unit.



SPEEDO BICYCLE

Contribution Income Statement

For the Month of June

	Total	Per Unit
Sales (500 bikes)	$ 250,000	$ 500
Less: variable expenses	150,000	300
Contribution margin	100,000	$ 200

Contribution margin (CM) is the difference between sales revenue and variable expenses.

The CM ratio is computed by dividing the per unit contribution margin by the per unit selling price.

Tk 200 ÷ Tk 500 = 40%

The Basics of Cost-Volume-Profit (CVP) Analysis



SPEEDO BICYCLE CO.
Contribution Income Statement
For the Month of June

	Total	Per Unit
Sales (500 bikes)	$ 250,000	$ 500
Less: variable expenses	150,000	300
Contribution margin	100,000	$ 200
Less: fixed expenses	80,000	
Net income	$ 20,000	

After fixed expenses are covered, any additional contribution margin results in net income.

The Contribution Margin Format

Comparison of the Contribution Income Statement with the Traditional Income Statement

Traditional Format (expenses classified by function)		Contribution Format (expenses classified by behavior)	
Revenues	$250,000	Revenues	$250,000
Less cost of goods sold	90,000	Less variable expenses	150,000
Gross profit	$160,000	Contribution margin	$100,000
Less operating expenses	140,000	Less fixed expenses	80,000
Net income	$ 20,000	Net income	$ 20,000

Used primarily for external reporting.

Used primarily by management.

Break-Even Point

Speedo has $ 80,000 of fixed expenses.

If Speedo sells 400 units in a month, Speedo will generate $ 80,000 in total CM ($ 200 CM per unit x 400 units).

Speedo will be operating at its break-even point.

SPEEDO BICYCLE CO.
Contribution Income Statement
For the Month of June

	Total	Per Unit
Sales (400 bikes)	$ 200,000	$ 500
Less: variable expenses	120,000	300
Contribution margin	80,000	$ 200
Less: fixed expenses	80,000	
Net income	$ 0	



Additional Unit Sales

If Speedo sells one additional unit (that is, 401 bikes), net income will be $ 200.

SPEEDO BICYCLE CO.
Contribution Income Statement
For the Month of June

	Total	Per Unit
Sales (401 bikes)	$ 200,500	$ 500
Less: variable expenses	120,300	300
Contribution margin	80,200	$ 200
Less: fixed expenses	80,000	
Net income	$ 200	



Net income will increase by Tk 200 (the CM per unit) as each additional unit is sold.

The Contribution Approach

The break-even point can be defined as:

- **The point where total contribution margin equals total fixed expenses.**
- **The point where total sales revenue equals total expenses (variable and fixed).**

Break-even analysis can be approached in two ways - contribution margin method or equation method.

Covered here

CVP Relationships in Graphic Form

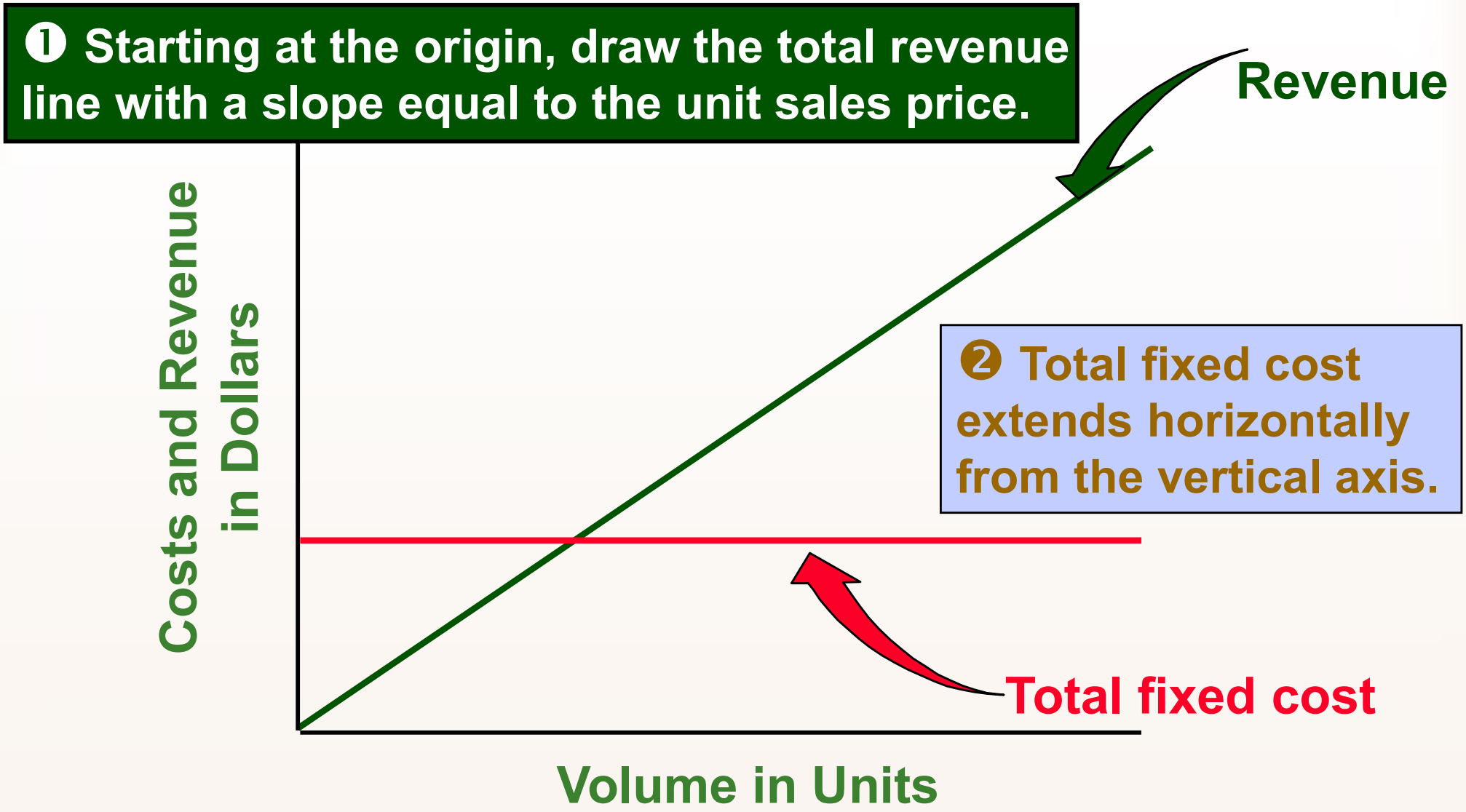
Viewing CVP relationships in a graph gives managers a perspective that can be obtained in no other way.

Consider the following information for Speedo Company:

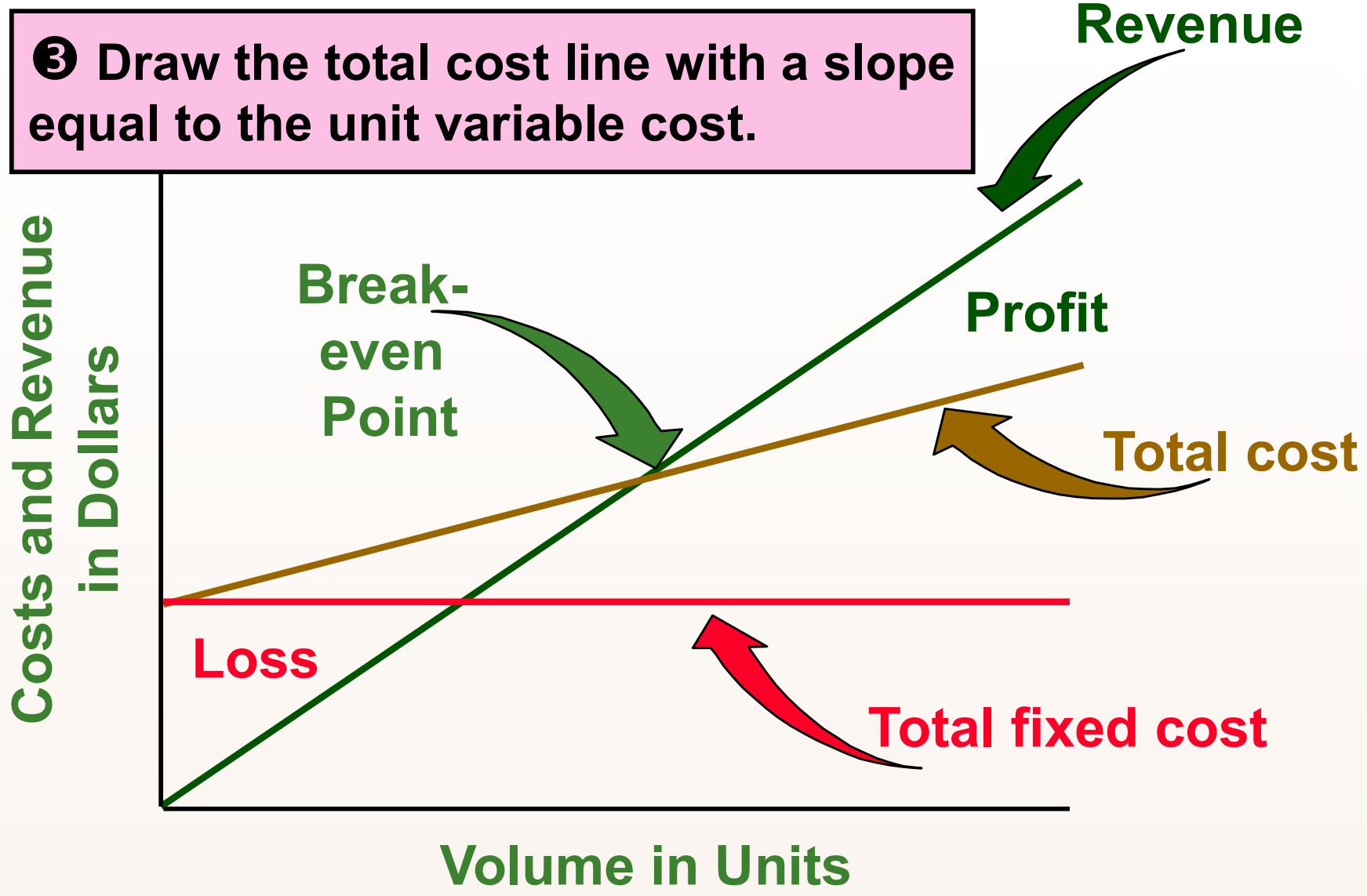
	Income 300 units	Income 400 units	Income 500 units
Sales	$ 150,000	$ 200,000	$250,000
Less: variable expenses	90,000	120,000	150,000
Contribution margin	$ 60,000	$ 80,000	$100,000
Less: fixed expenses	80,000	80,000	80,000
Net income (loss)	$ (20,000)	$ -	$ 20,000



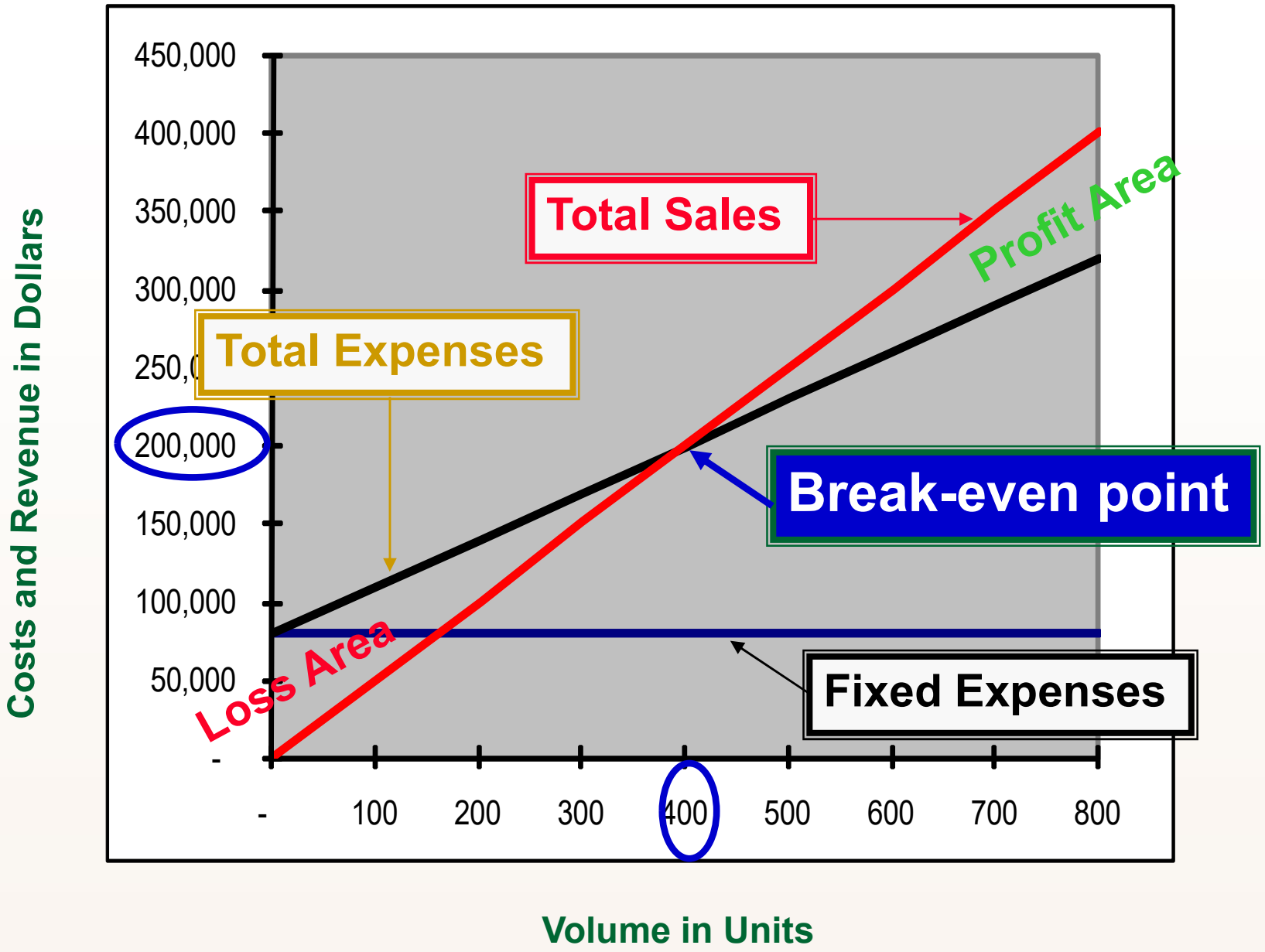
Preparing a CVP Graph



Preparing a CVP Graph



CVP Graph


Costs and Revenue in Dollars
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
Total Sales
Profit Area
Total Expenses
Break-even point
Loss Area
Fixed Expenses
-
100
200
300
400
500
600
700
800
Volume in Units

Learning Objective

To compute the contribution margin and explain its usefulness.



LO4

Computing Break-Even Point

The break-even point (expressed in units of product or Tk of sales) is the unique sales level at which a company neither earns a profit nor incurs a loss.



Formula for Computing Break-Even Sales (in Units)

We have just seen one of the basic CVP relationships – the break-even computation.

$$\text{Break-even point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

Unit sales price less unit variable cost (Tk 20 in previous example)

Formula for Computing Break-Even Sales (in Tk)

The break-even formula may also be expressed in sales Tk or $.

$$\text{Break-even point in Tk} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

$$\text{Contribution margin ratio} = \frac{\text{Contribution margin per unit}}{\text{Unit sales price}}$$

Computing Break-Even Sales

ABC Co. sells product XYZ at Tk 5.00 per unit. If fixed costs are Tk 200,000 and variable costs are Tk 3.00 per unit, how many units must be sold to break even?

a. 100,000 units
b. 40,000 units
c. 200,000 units
d. 66,667 units

Computing Break-Even Sales

ABC Co. sells product XYZ at Tk 5.00 per unit. If fixed costs are Tk 200,000 and variable costs are Tk 3.00 per unit, how many units must be sold to break even?

a. 100,000 units
b. 40,000 units
c. 200,000 units
d. 66,667 units

Unit contribution = Tk 5.00 - Tk 3.00 = Tk 2.00

$$\frac{\text{Fixed costs}}{\text{Unit contribution}} = \frac{\text{Tk 200,000}}{\text{Tk 2.00 per unit}}$$

= 100,000 units

Computing Break-Even Sales

Use the contribution margin ratio formula to determine the amount of sales revenue ABC must have to break even. All information remains unchanged: fixed costs are Tk 200,000; unit sales price is Tk 5.00; and unit variable cost is Tk 3.00.

a. Tk 200,000
b. Tk 300,000
c. Tk 400,000
d. Tk 500,000

Computing Break-Even Sales

Use the contribution margin ratio formula to determine the amount of sales revenue ABC must have to break even. All information remains unchanged: fixed costs are Tk 200,000; unit sales price is Tk 5.00; and unit variable cost is Tk 3.00.

Unit contribution = Tk 5.00 - Tk 3.00 = Tk 2.00

Contribution margin ratio = Tk 2.00 ÷ Tk 5.00 = .40

Break-even revenue = Tk 200,000 ÷ .4 = Tk 500,000

a. T

b. T

c. Tk 400,000

d. Tk 500,000

Learning Objective

Determine the sales volume required to earn a desired level of operating income.



LO5

Computing Sales Needed to Achieve Target Operating Income

Break-even formulas may be adjusted to show the sales volume needed to earn any amount of operating income.

$$\text{Unit sales} = \frac{\text{Fixed costs + Target income}}{\text{Contribution margin per unit}}$$

$$\text{Amount sales} = \frac{\text{Fixed costs + Target income}}{\text{Contribution margin ratio}}$$

Computing Sales Needed to Achieve Target Operating Income

ABC Co. sells product XYZ at Tk 5.00 per unit. If fixed costs are Tk 200,000 and variable costs are Tk 3.00 per unit, how many units must be sold to earn operating income of Tk 40,000?

a. 100,000 units

b. 120,000 units

c. 80,000 units

d. 200,000 units

Computing Sales Needed to Achieve Target Operating Income

ABC Co. sells product XYZ at Tk 5.00 per unit. If fixed costs are Tk 200,000 and variable costs are Tk 3.00 per unit, how many units must be sold to earn operating income of Tk 40,000?

a. 100,000

b. 120,000

c. 80,000

d. 200,000 units

Unit contribution = Tk 5.00 - Tk 3.00 = Tk 2.00

$$\frac{\text{Fixed costs + Target income}}{\text{Unit contribution}}$$

$$\frac{\text{Tk 200,000 + Tk 40,000}}{\text{Tk 2.00 per unit}} = \text{120,000 units}$$

What is our Margin of Safety?

Margin of safety is the amount by which sales may decline before reaching break-even sales:

Margin of safety = Actual sales - Break-even sales

Margin of safety provides a quick means of estimating operating income at any level of sales:

Operating Income = Margin of safety × Contribution margin ratio

What is our Margin of Safety?

ADM contribution margin ratio is 40 percent. If sales are Tk 100,000 and break-even sales are Tk 80,000, what is operating income?

Operating Income = Margin of safety × Contribution margin ratio

Operating Income = Tk 20,000 × .40 = Tk 8,000

Learning Objective

To use the contribution margin to estimate the change in operating income caused by a change in sales volume.



LO6

What Change In Operating Income Do We Anticipate?

Once break-even is reached, every additional Tk of contribution margin becomes operating income:

Change in operating income	=	Change in sales volume	×	Contribution margin ratio

ADM expects sales to increase by Tk 15,000 and has a contribution margin ratio of 40%. How much will operating income increase?

Change in operating income	=	Tk 15,000	×	.40	=	Tk 6,000

Learning Objective

To use CVP relationships to evaluate a new marketing strategy.



LO7

Business Applications of CVP

Consider the following information developed by the accountant at Speedo, a bicycle retailer:

	Total	Per Unit	Percent
Sales (500 bikes)	৳ 250,000.00	৳ 500.00	৳ 1.00
Less: variable expenses	৳ 150,000.00	৳ 300.00	৳ 0.60
Contribution margin	৳ 100,000.00	৳ 200.00	৳ 0.40
Less: fixed expenses	৳ 80,000.00		
Operating income	৳ 20,000.00		

Business Applications of CVP

Should Speedo spend Tk 12,000 on advertising to increase sales by 10 percent?

	Total	Per Unit	Percent
Sales (500 bikes)	৳ 250,000.00	৳ 500.00	৳ 1.00
Less: variable expenses	৳ 150,000.00	৳ 300.00	৳ 0.60
Contribution margin	৳ 100,000.00	৳ 200.00	৳ 0.40
Less: fixed expenses	৳ 80,000.00		
Operating income	৳ 20,000.00		

Business Applications of CVP

Should Speedo spend Tk 12,000 on advertising to increase sales by 10 percent?

	500 Bikes		550 Bikes
Sales	৳ 250,000.00	550 × Tk 500	৳ 275,000.00
Less: variable expenses	৳ 150,000.00	550 × Tk 300	৳ 165,000.00
Contribution margin	৳ 100,000.00		৳ 110,000.00
Less: fixed expenses	৳ 80,000.00	Tk 80K + Tk 12K	৳ 92,000.00
Operating income	৳ 20,000.00		৳ 18,000.00

No, income is decreased.

Business Applications of CVP

Now, in combination with the advertising, Speedo is considering a 10 percent price reduction that will increase sales by 25 percent. What is the income effect?

	500 Bikes		
Sales	৳ 250,000.00		
Less: variable expenses	৳ 150,000.00		
Contribution margin	৳ 100,000.00		
Less: fixed expenses	৳ 80,000.00		
Operating income	৳ 20,000.00		

Business Applications of CVP

Now, in combination with the advertising, Speedo is considering a 10 percent price reduction that will increase sales by 25 percent. What is the income effect?

	500 Bikes		625 Bikes
		1.25 × 500 →	
Sales	৳ 250,000.00	625 × Tk 450 →	৳ 281,250.00
Less: variable expenses	৳ 150,000.00	625 × Tk 300 →	৳ 187,500.00
Contribution margin	৳ 100,000.00		৳ 93,750.00
Less: fixed expenses	৳ 80,000.00	Tk 80K + Tk 12K →	৳ 92,000.00
Operating income	৳ 20,000.00		৳ 1,750.00

Income is decreased even more.

Business Applications of CVP

Now, in combination with advertising and a price cut, Speedo will replace Tk 50,000 in sales salaries with a Tk 25 per bike commission, increasing sales by 50 percent above the original 500 bikes. What is the effect on income?

	500 Bikes
Sales	৳ 250,000.00
Less: variable expenses	৳ 150,000.00
Contribution margin	৳ 100,000.00
Less: fixed expenses	৳ 80,000.00
Operating income	৳ 20,000.00

Business Applications of CVP

Now, in combination with advertising and a price cut, Speedo will replace Tk 50,000 in sales salaries with a Tk 25 per bike commission, increasing sales by 50 percent above the original 500 bikes. What is the effect on income?

	500 Bikes		750 Bikes
		1.5 × 500 →	
Sales	৳ 250,000.00	750 × Tk 450 →	৳ 337,500.00
Less: variable expenses	৳ 150,000.00	750 × Tk 325 →	৳ 243,750.00
Contribution margin	৳ 100,000.00		৳ 93,750.00
Less: fixed expenses	৳ 80,000.00	Tk 92K - Tk 50K →	৳ 42,000.00
Operating income	৳ 20,000.00		৳ 51,750.00

The combination of advertising, a price cut, and change in compensation increases income.

Business Applications of CVP

Should Speedo use higher quality parts would increase variable costs by Tk 10. However, the sales manager believes that the higher quality parts will increase bike sales from 500 units to 540 units.

Should the increase be approved?

	500 Bikes		
Sales	৳ 250,000.00		
Less: variable expenses	৳ 150,000.00		
Contribution margin	৳ 100,000.00		
Less: fixed expenses	৳ 80,000.00		
Operating income	৳ 20,000.00		

Business Applications of CVP

Should Speedo use higher quality parts would increase variable costs by Tk 10. However, the sales manager believes that the higher quality parts will increase bike sales from 500 units to 540 units.

Should the increase be approved?

	500 Bikes		540 Bikes
		500+40 →	
Sales	৳ 250,000.00	540 × Tk 500 →	৳ 270,000.00
Less: variable expenses	৳ 150,000.00	540 × Tk 310 →	৳ 167,400.00
Contribution margin	৳ 100,000.00		৳ 102,600.00
Less: fixed expenses	৳ 80,000.00		৳ 80,000.00
Operating income	৳ 20,000.00		৳ 22,600.00

Net income increases by Tk 2,600.
So, it's acceptable

Learning Objective

To determine semi variable cost elements.



LO8

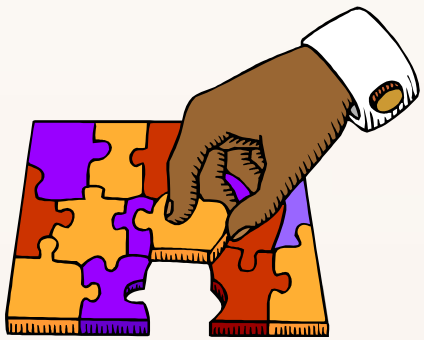
The High-Low Method

Matrix, Inc. recorded the following production activity and maintenance costs for two months:

	Units	Cost
High activity level	9,000	$ 9,700
Low activity level	5,000	6,100
Change	4,000	$ 3,600

Using these two levels of activity, compute:

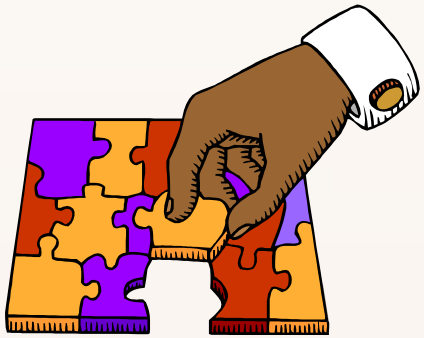
1. the variable cost per unit.
2. the total fixed cost.
3. total cost formula.



The High-Low Method

	Units	Cost
High activity level	9,000	$ 9,700
Low activity level	5,000	6,100
Change	4,000	$ 3,600

❶ Unit variable cost = $\frac{\Delta \text{ in cost}}{\Delta \text{ in units}} = \frac{\text{Tk } 3{,}600}{4{,}000}$ = Tk 0.90 per unit

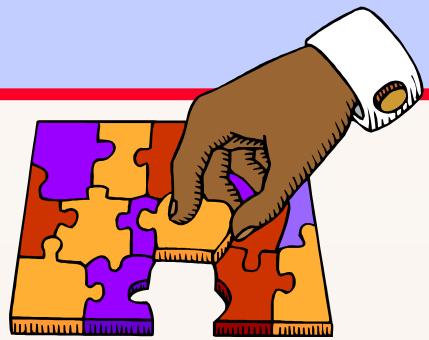


The High-Low Method

	Units	Cost
High activity level	9,000	$ 9,700
Low activity level	5,000	6,100
Change	4,000	$ 3,600

❶ Unit variable cost = $\frac{\Delta \text{ in cost}}{\Delta \text{ in units}} = \frac{\text{Tk } 3{,}600}{4{,}000}$ = Tk 0.90 per unit

❷ Fixed cost = Total cost – Total variable cost



The High-Low Method

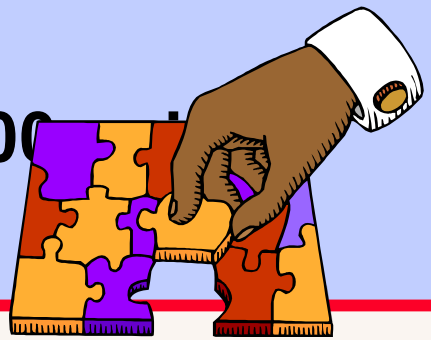
	Units	Cost
High activity level	9,000	$ 9,700
Low activity level	5,000	6,100
Change	4,000	$ 3,600

❶ Unit variable cost = $\frac{\Delta \text{ in cost}}{\Delta \text{ in units}} = \frac{\text{Tk } 3{,}600}{4{,}000}$ = Tk 0.90 per unit

❷ Fixed cost = Total cost – Total variable cost

Fixed cost = Tk 9,700 – (Tk 0.90 per unit × 9,000

Fixed cost = Tk 9,700 – Tk 8,100 = Tk 1,600



The High-Low Method

	Units	Cost
High activity level	9,000	$ 9,700
Low activity level	5,000	6,100
Change	4,000	$ 3,600

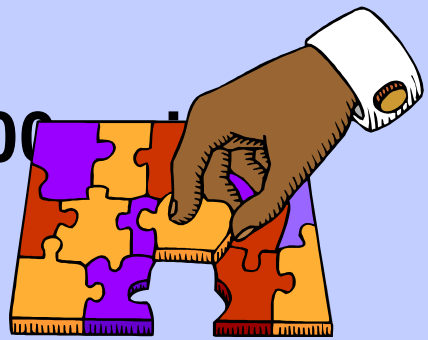
❶ Unit variable cost = $\frac{\Delta \text{ in cost}}{\Delta \text{ in units}} = \frac{\text{Tk } 3{,}600}{4{,}000}$ = Tk 0.90 per unit

❷ Fixed cost = Total cost – Total variable cost

Fixed cost = Tk 9,700 – (Tk 0.90 per unit × 9,000

Fixed cost = Tk 9,700 – Tk 8,100 = Tk 1,600

❸ Total cost = Tk 1,600 + Tk .90 per unit



The High-Low Method

If sales commissions are Tk 10,000 when 80,000 units are sold and Tk 14,000 when 120,000 units are sold, what is the variable portion of sales commission per unit sold?

a. Tk .08 per unit
b. Tk .10 per unit
c. Tk .12 per unit
d. Tk .125 per unit

The High-Low Method

If sales commissions are Tk 10,000 when 80,000 units are sold and Tk 14,000 when 120,000 units are sold, what is the variable portion of sales commission per unit sold?

a. Tk .08 per un

b. Tk .10 per un

c. Tk .12 per un

d. Tk .125 per u

	Units	Cost
High level	120,000	$ 14,000
Low level	80,000	10,000
Change	40,000	$ 4,000

Tk 4,000 ÷ 40,000 units

= Tk .10 per unit

The High-Low Method

If sales commissions are Tk 10,000 when 80,000 units are sold and Tk 14,000 when 120,000 units are sold, what is the fixed portion of the sales commission?

a. Tk 2,000
b. Tk 4,000
c. Tk 10,000
d. Tk 12,000

The High-Low Method

If sales commissions are Tk 10,000 when 80,000 units are sold and Tk 14,000 when 120,000 units are sold, what is the fixed portion of the sale

a. Tk 2,000
b. Tk 4,000
c. Tk 10,000
d. Tk 12,000

Total cost	**=**	**Total fixed cost + Total variable cost**
$14,000	**=**	**Total fixed cost + ($.10 × 120,000 units)**
Total fixed cost	**=**	**$14,000 - $12,000**
Total fixed cost	**=**	**$2,000**

Assumptions Underlying CVP Analysis

❶ A limited range of activity, called the relevant range, where CVP relationships are linear.

- ❑Unit selling price remains constant.
- ❑Unit variable costs remain constant.
- ❑Total fixed costs remain constant.

❷ Sales mix remains constant.

❸ Production = sales (no inventory changes).

End of Lecture 06

THANK YOU ALL...