

Management Accountancy

Unit 4

Cost Volume Profit Analysis Under Condition of Certainty

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Contents

- Concept, objectives, assumptions, of cost-volume-profit (CVP) analysis
- Application of cost-volume-profit for breakeven analysis and profit planning including multiple products with interpretation

Learning Objectives

- Understand the relationship between cost, sales volume and profit
- State the purposes and application of cost-volume-profit analysis
- Describe the various assumptions of break-even point
- Defined and determination of margin of safety
- Compute the break-even point and manage profit for a multi-product enterprise

Concept of CVP Analysis

- A technique that examines changes in profits in response to changes in sales volume, cost and prices
- There are three elements in cost-volume-profit analysis
 - Cost, sales or production volume and profit
 - All these terms are interconnected and dependent on one another.
 - For instance, profit per unit of a product depends on its selling price and cost of sales.
 - The selling price to a greater extent will depend upon the cost and cost depends upon the volume of production.
- It is highly essential for the management to have the complete knowledge about the interrelationship among the cost, volume and profit. A study concerning this inter-connection is undertaken through cost-volume-profit analysis. Cost-volume-profit analysis extremely helpful in profit planning and control, management decision, cost control, budgeting.

Concept of CVP Analysis

- Cost-volume-profit analysis can be regarded as a sophisticated method or analytical tool used in management.
- The use of this method helps in determining the different levels of product or sales to avoid losses, to earn a desired net profit and so on.
- The cost-volume-profit relationship also helps management to find out right solution for following questions :
 - What sales volume is needed to break even?
 - What sales volume is necessary to earn a desired net profit?
 - How will the change in selling price affect the profit position of the company?
 - How will the change in cost affect profit?
 - Which product or product mix is profitable?
 - Which product or operation of a plant should be discontinued?
 - What will be new break even sales if these certain changes on fixed and variable cost?

Objectives of CVP Analysis

- Calculation of profit resulting from a budgeted sales volume.
- Calculation of sales volume to break-even.
- Calculation of sales volume to produce desired profit.
- Effect of changes on price, costs and profits.
- Determination of new break-even point for changes in cost and selling price.
- Measurement of effect of changes in profit factors.
- Choosing the most profitable alternatives.
- Determining the optimum sales mix.
- Determination of capacity and equipment selection.
- Long term decision on continuance or discontinuance of products.
- Make or buy decisions on sub-assemble or part.
- To contemplate the increase or decrease in profits due to the change in method of production.

Objectives of CVP Analysis

- It helps in fixation of selling price.
- It is helpful in cost control.
- It also assists the management in understanding the behavior of cost and helps in budgetary control.
- It helps in determining the level of output where all the costs can be met.
- It assists the management in profit planning.
- It also assists management in performance evaluation for the purpose of management control.
- It helps very much in making managerial decisions such as make or buy a part, drop or continue a department or product line, accept or reject a special order, selection of a profitable product mix.

CVP Uses

1. Describe volume, revenues, cost and profits
 - Values at breakeven or target profit:
 - Units sold
 - Revenues
 - Variable, fixed and total costs
 - Sensitivity of results to changes in:
 - Levels of activities
 - Selling price
 - Cost function
 - Sales mix
 - Indifference point between alternatives
 - Feasibility of planned operations



CVP Uses (Contd.)

2. Assist with plans and decisions

- Budgets
- Product emphasis
- Selling price
- Production or activity levels
- Employee work schedules
- Raw material purchases
- Proportions of fixed versus variable cost

3. Monitor operations by comparing expected and actual performance

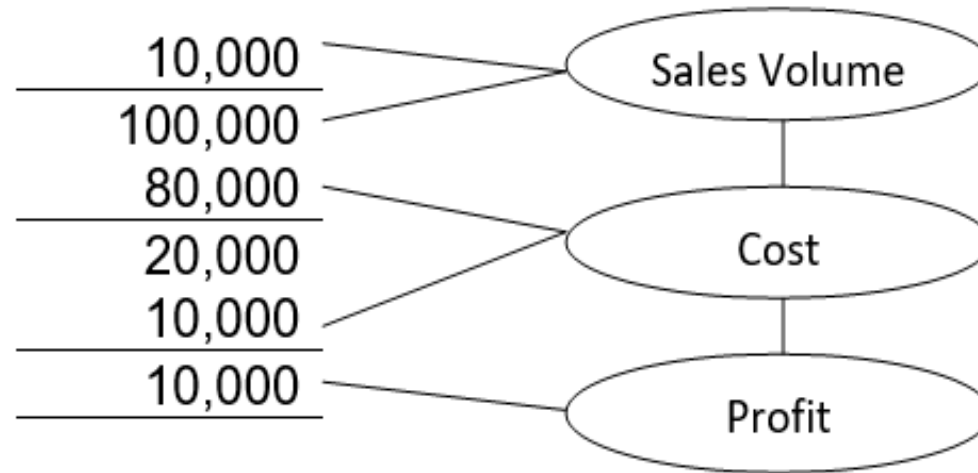
- Sales volumes (revenues + units), costs and profits
- Profitability risk

Assumptions of CVP Analysis

- Operations within a relevant range of activity
- All costs can be analyzed into fixed and variable elements
- Linear cost function
 - Fixed cost remain fixed
 - Variable cost per unit remains constant
 - (Variable costs always vary proportionately with activity)
- Linear revenue function
 - Sales mix remains constant
 - Prices remain constant
- Uncertainty does not exist
- Resources are available unlimitedly



Sales units		10,000
Sales Revenue	@ Rs. 10	100,000
Less: Variable Cost	@ Rs. 8	80,000
Contribution Margin	@ Rs. 2	20,000
Less: Fixed Cost		10,000
Profit before tax		10,000



What can we do?

- Analyse Contribution Margin
- Manage Profit
- Analyse Break Even Point (BEP)

To manage profit

- Option 1: Increase sales units
- Option 2: Increase selling price
- Option 3: Reduce unit variable cost

Option 1: Target Profit = Rs. 20,000

find out new sales units

Method 1: Income statement approach

Sales units		15,000 Step 3
Sales Revenue	@ Rs. 10	150,000 Step 4
Less: Variable Cost	@ Rs. 8	120,000 Step 5
Contribution Margin	@ Rs. 2	30,000 Step 2
Less: Fixed Cost		10,000 Step 0
Profit before tax		20,000 Step 1

Method 3: Contribution Margin approach

$$\begin{aligned}\text{Required Sales Units} &= \frac{\text{FC} + \text{DP}}{\text{CMPU}} \\ &= \frac{10,000 + 20,000}{10 - 8} \\ &= 15,000 \text{ units}\end{aligned}$$

Method 2: Equation approach

$$S/R = FC + VC + \text{Profit}$$

$$(\text{Sale units @ selling price}) = FC + (\text{sales units @ unit variable cost}) + \text{Desired Profit}$$

$$\text{Required sales units} = x$$

$$x10 = 10,000 + x8 + 20,000$$

$$10x - 8x = 10,000 + 20,000$$

$$\text{Therefore, } x = \frac{10,000 + 20,000}{10 - 8} = 15,000 \text{ units}$$

Option 2: Target Profit = Rs. 20,000

find out new selling price

Method 1: Income statement Approach

Sales units		10,000	Step 0
Sales Revenue	@ Rs. 11	110,000	Step 4
Less: Variable Cost	@ Rs. 8	80,000	Step 0
Contribution Margin	@ Rs. 3	30,000	Step 3
Less: Fixed Cost		10,000	Step 0
Profit before tax		20,000	Step 1

Method 2: Equation Approach

$$S/R = FC + VC + \text{Profit}$$

$$(\text{Sale units @ selling price}) = FC + (\text{sales units @ unit variable cost}) + \text{Desired Profit}$$

$$(10,000 \times \text{New SP}) = 10,000 + (10,000 \times 8) + 20,000$$

$$\text{New SP} = 11$$

Method 3: Contribution Margin Approach

$$\text{Sales Units} = \frac{FC + DP}{\text{CMPU}}$$

$$10,000 = \frac{10,000 + 20,000}{\text{New SP} - 8}$$

Therefore, New SP = 11 per unit

Option 3: Target Profit = Rs. 20,000

find out new unit variable cost

Method 1: Income Statement Approach

Sales units		10,000 Step 0
Sales Revenue	@ Rs. 10	100,000 Step 0
Less: Variable Cost	@ Rs. 7	70,000 Step 4
Contribution Margin	@ Rs. 3	30,000 Step 3
Less: Fixed Cost		10,000 Step 0
Profit before tax		20,000 Step 1

Method 3: Contribution Margin Approach

$$\text{Sales Units} = \frac{\text{FC} + \text{DP}}{\text{CMPU}}$$

$$10,000 = \frac{10,000 + 20,000}{10 - \text{UVC}}$$

Therefore, New UVC = 7 per unit

Method 2: Equation Approach

$$S/R = \text{FC} + \text{VC} + \text{Profit}$$

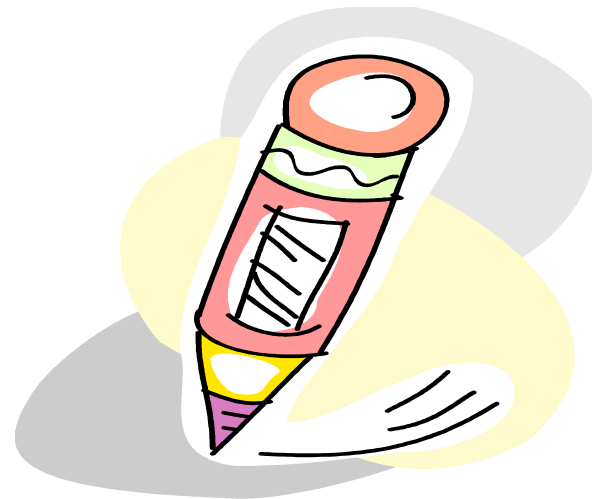
$$(\text{Sale units @ selling price}) = \text{FC} + (\text{sales units @ unit variable cost}) + \text{Desired Profit}$$

$$(10,000 \times 10) = 10,000 + (10,000 \times \text{UVC}) + 20,000$$

$$\text{UVC} = 7$$

Breakeven Point

- Level of operating activity at which revenues cover all fixed and variable costs, resulting in zero profit
- Sales volume at no loss and no gain situation
- Sales Revenue = Fixed Cost + Variable Cost



BEP

Question

Sales units		<u>10,000</u>
Sales Revenue	@ Rs. 10	1,00,000
Less: Variable Cost	<u>@ Rs. 8</u>	<u>80,000</u>
Contribution Margin	@ Rs. 2	20,000
Less: Fixed Cost		<u>10,000</u>
Profit before tax		<u>10,000</u>

Equation approach

$$S/R = FC + VC + \text{Profit}$$

$$S/R = FC + VC + 0$$

$$(\text{Sale units @ selling price}) = FC + (\text{sales units @ unit variable cost})$$

$$\text{Required Sales Units} = \text{BEP units, when profit is equal to zero} = x$$

$$x10 = 10,000 + x8$$

$$10x - 8x = 10,000$$

$$x = 10,000 / (10-8) = 5,000$$

$$\text{BEP (units)} = 5,000 \text{ units}$$

$$\text{BEP (Rs)} = \text{BEP (Units)} \times \text{SP} = 5,000 \text{ units} \times \text{Rs. } 10 = \text{Rs. } 50,000$$

BEP

Contribution Margin Approach

$$\text{Sales Units} = \frac{\text{FC} + \text{DP}}{\text{CMPU}}$$

$$\begin{aligned}\text{BEP (Units)} &= \frac{\text{FC}}{\text{CMPU}} \\ &= \frac{10,000}{10 - 8} \\ &= 5,000 \text{ units}\end{aligned}$$

$$\text{BEP (Rs)} = \frac{\text{FC}}{\text{P/V Ratio}} = \frac{10,000}{0.20} = \text{Rs. } 50,000$$

$$\text{P/V ratio} = \frac{\text{CM}}{\text{Sales}} = \frac{20,000}{100,000} = 0.20, \text{ Using total value}$$

$$\text{Or} \quad = \frac{2}{10} = 0.20, \text{ Using per unit value}$$

Verification

Sales units		5,000 units
Sales Revenue	@ Rs. 10	50,000
Less: Variable Cost	@ Rs. 8	40,000
Contribution Margin	@ Rs. 2	10,000
Less: Fixed Cost		10,000
Profit before tax		0

Margin of Safety (MoS)

- The soundness of business is indicated by margin of safety.
- The difference between total sales and break-even sales is identified by margin of safety. The high margin of safety is good for business.
- It indicates that there can be substantial falling of sale and yet profit can still be made.
- If the margin of safety is small, it indicates the weak position of business.
- The small margin of safety shows that even a small reduction in sale or production will adversely affect the profit position of business.

If safety margin is unsatisfactory, the following steps can be taken.

- By increasing the sales and production volume
- By increasing the selling price
- By decreasing the fixed cost
- By reducing the variable cost
- By changing the sales or product mix ratio

Margin of Safety (MoS)

Question

Sales units		10,000
Sales Revenue	@ Rs. 10	1,00,000
Less: Variable Cost	@ Rs. 8	80,000
Contribution Margin	@ Rs. 2	20,000
Less: Fixed Cost		10,000
Profit before tax		10,000

MoS = Actual sales – BEP sales

MoS (Units) = Actual sales units – BEP sales units = 10,000 – 5,000 units = 5,000 units

MoS (Rs.) = Actual sales Rs – BEP Rs. = Rs. 100,000 – Rs. 50,000 = Rs. 50,000

MoS (Rs.) = MoS (units) X SP = 5,000 units X Rs. 10 = Rs. 50,000

$$\text{MoS (units)} = \frac{\text{MoS (Amount)}}{\text{SP}} = \frac{\text{Rs.50,000}}{10} = 5,000 \text{ units}$$

$$\text{MoS (Units)} = \frac{\text{Profit}}{\text{CMPU}} = \frac{\text{Rs.10,000}}{10-8} = 5,000 \text{ units}$$

$$\text{MoS (Rs.)} = \frac{\text{Profit}}{\text{P/V Ratio}} = \frac{\text{Rs.10,000}}{0.20} = \text{Rs. 50,000}$$

Margin of Safety (MoS) Ratio

Question

Sales units		10,000
Sales Revenue	@ Rs. 10	1,00,000
Less: Variable Cost	@ Rs. 8	80,000
Contribution Margin	@ Rs. 2	20,000
Less: Fixed Cost		10,000
Profit before tax		10,000

$$\text{MoS Ratio} = \frac{\text{MoS}}{\text{Actual Sales}} \times 100$$

$$\text{MoS Ratio} = \frac{5,000 \text{ units}}{10,000 \text{ units}} = 0.50 = 50\%$$

$$\text{MoS Ratio} = \frac{\text{Rs.}50,000}{\text{Rs.}100,000} = 0.50 = 50\%$$

Sales Units/Amount

Question

Sales units		10,000
Sales Revenue	@ Rs. 10	1,00,000
Less: Variable Cost	@ Rs. 8	80,000
Contribution Margin	@ Rs. 2	20,000
Less: Fixed Cost		10,000
Profit before tax		10,000

Required:

Sales units and amount to earn Rs. 20,000 before tax

$$\text{Sales units} = \frac{\text{FC} + \text{DP}}{\text{CMPU}} = \frac{10,000 + 20,000}{10 - 8} = 15,000 \text{ units,}$$

$$\text{Sales (Rs.)} = \frac{\text{FC} + \text{DP}}{\text{P/V Ratio}} = \frac{10,000 + 20,000}{0.20} = \text{Rs. } 150,000$$

Sales Units/Amount

Question

Sales units		10,000
Sales Revenue	@ Rs. 10	1,00,000
Less: Variable Cost	@ Rs. 8	80,000
Contribution Margin	@ Rs. 2	20,000
Less: Fixed Cost		10,000
Profit before tax		10,000

Required:

Sales units and amount to earn Rs. 12,000 after tax (Tax rate = 40%)

$$\text{Sales units} = \frac{\text{FC} + \text{DPAT} / (1 - \text{Tax rate})}{\text{CMPU}} = \frac{10,000 + 12,000 / (1 - 0.40)}{10 - 8} = \frac{10,000 + 20,000}{10 - 8} = 15,000 \text{ units}$$

$$\text{Sales (Rs.)} = \frac{\text{FC} + \text{DPAT} / (1 - \text{Tax rate})}{\text{P/V Ratio}} = \frac{10,000 + 12,000 / (1 - 0.40)}{0.20} = \frac{10,000 + 20,000}{0.20} = \text{Rs. } 150,000$$

Sales Units

Question

Sales units		10,000
Sales Revenue	@ Rs. 10	1,00,000
Less: Variable Cost	@ Rs. 8	80,000
Contribution Margin	@ Rs. 2	20,000
Less: Fixed Cost		10,000
Profit before tax		10,000

Required:

Sales units to earn 4% of sales revenue

Equation approach

Sales units = x

S/R = 10x

DP = 4% of 10x = 0.40x

S/R = FC + VC + Profit

(Sales units X SP) = FC + (Sales units X UVC) + Profit

10x = 10,000 + 8x + 0.40x

10x - 8x - 0.40x = 10,000

x = 10,000 / (10 - 8 - 0.40) = 6,250 units

CM approach

Sales units = x

S/R = 10x

DP = 4% of 10x = 0.40x

Sales units = $\frac{FC+DP}{CMPU}$

$$x = \frac{10,000 + 0.40x}{10 - 8}$$

$$x = \frac{10,000}{10 - 8 - 0.40}$$

$$x = 6,250 \text{ units}$$

$$\begin{aligned} \text{Req. Sale Units} &= \frac{FC}{CMPU - \text{Profit per unit}} \\ &= \frac{10,000}{10 - 8 - 0.40} \\ &= 6,250 \text{ units} \end{aligned}$$

Question

The given information of a trading concern for the past two years is as under:

Year	Sales	Net Profit/Net Loss
2020	Rs. 500,000	Loss Rs. 15,000
2021	Rs. 800,000	Profit Rs. 45,000

Required:

- PV ratio
- Amount of fixed expenses
- Break-even point in Rs
- Sales required to earn a desired profit of Rs. 75,000

$$(a) \text{ P/V Ratio} = \frac{\text{Different in Profit}}{\text{Different in Sales}} = \frac{45,000 - (-15,000)}{800,000 - 500,000} = 0.20$$

(b) Calculation of FC (2020 AD)

$$\text{Sales Revenue} = \frac{\text{FC} + \text{DP}}{\text{P/V Ratio}}$$

$$500,000 = \frac{\text{FC} + (-15,000)}{0.20}$$

$$\text{FC} = 115,000$$

(c) Break-even point in Rs.

$$\text{BEP (RS.)} = \frac{\text{FC}}{\text{P/V Ratio}} = \frac{115,000}{0.20} = \text{Rs. } 5,75,000$$

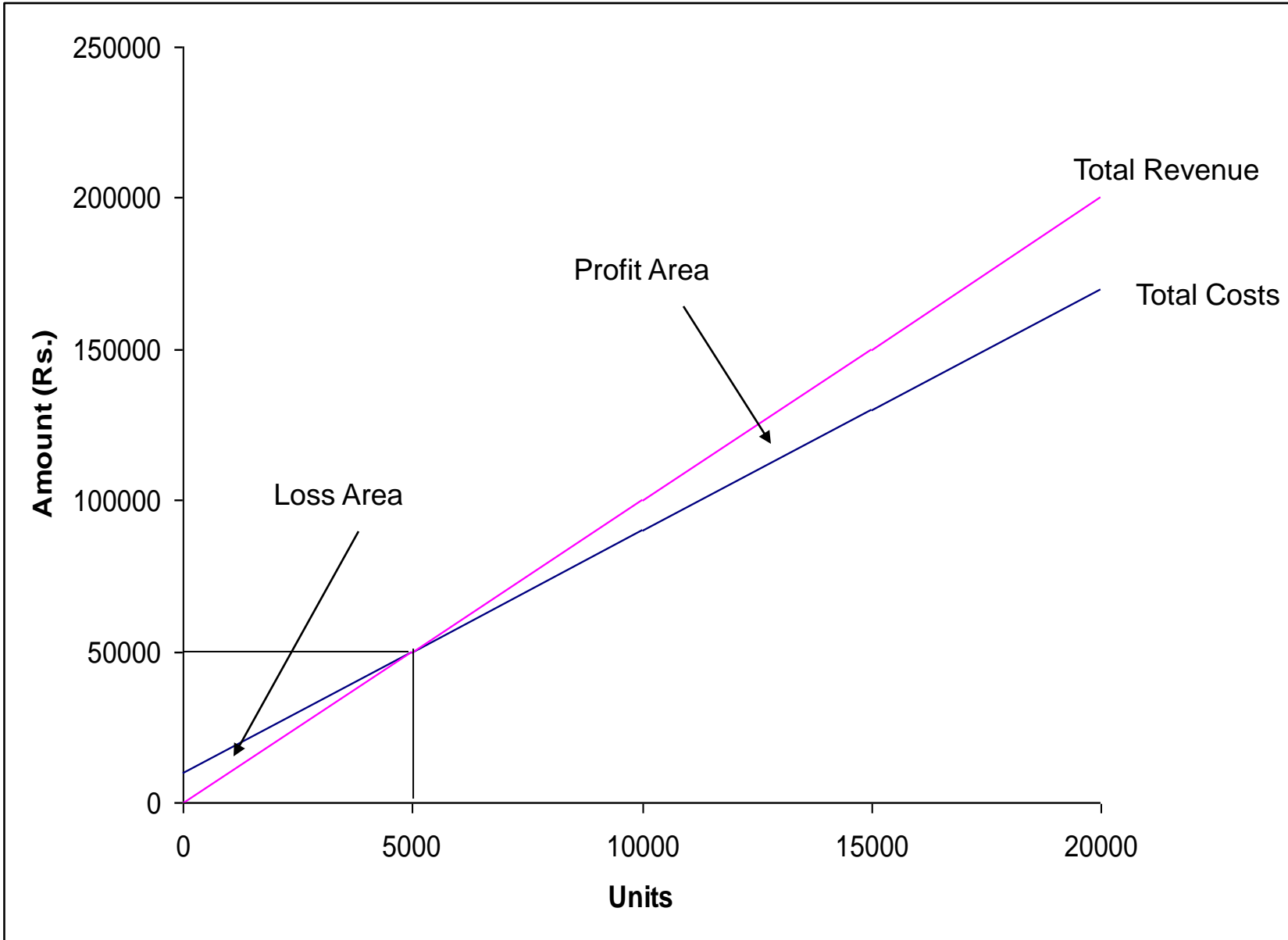
(d) Sales required to earn a desired profit of Rs. 75,000.

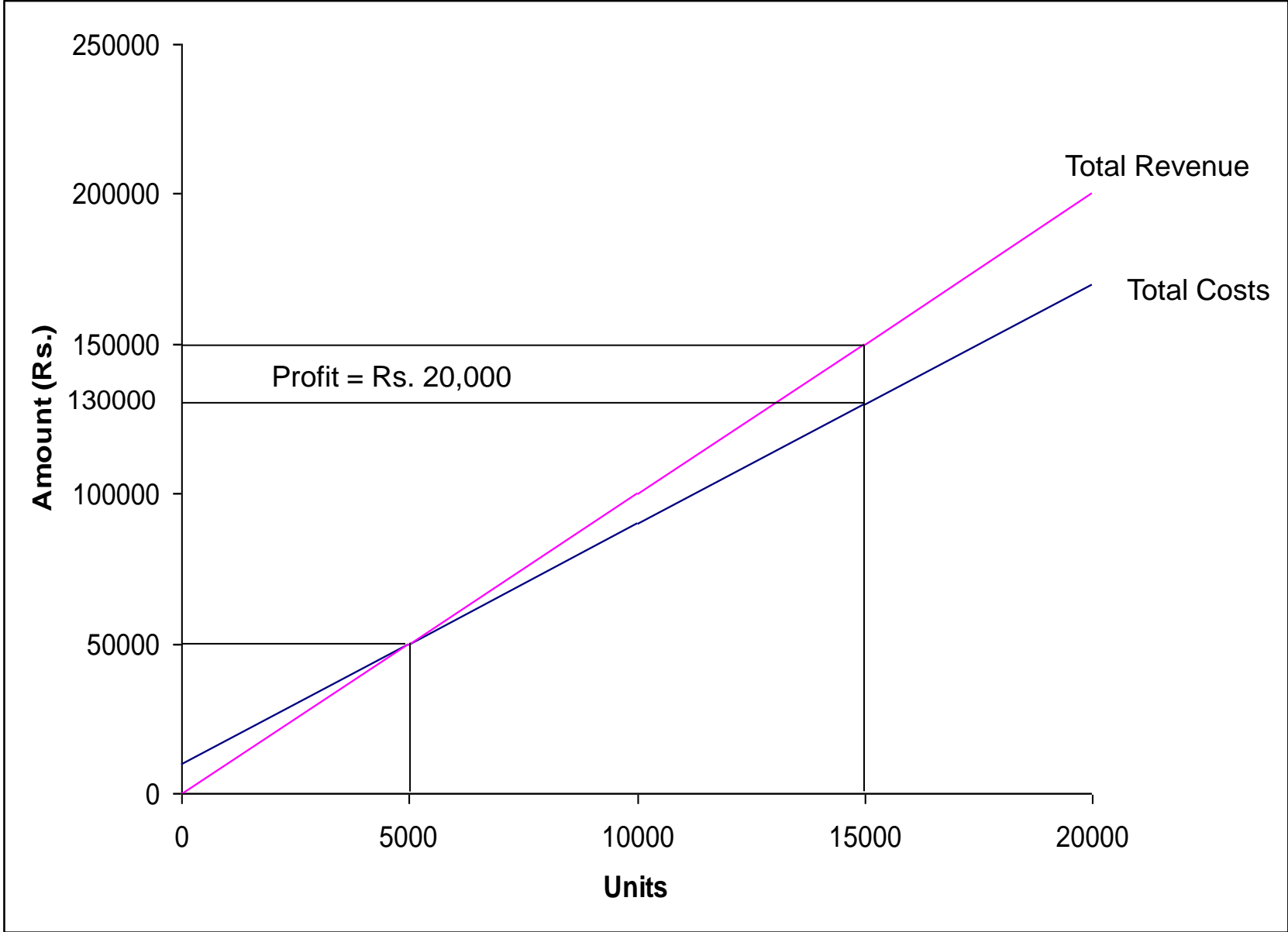
$$\text{Sales Revenue} = \frac{\text{FC} + \text{DP}}{\text{P/V Ratio}} = \frac{115,000 + 75,000}{0.20} = \text{Rs. } 950,000$$

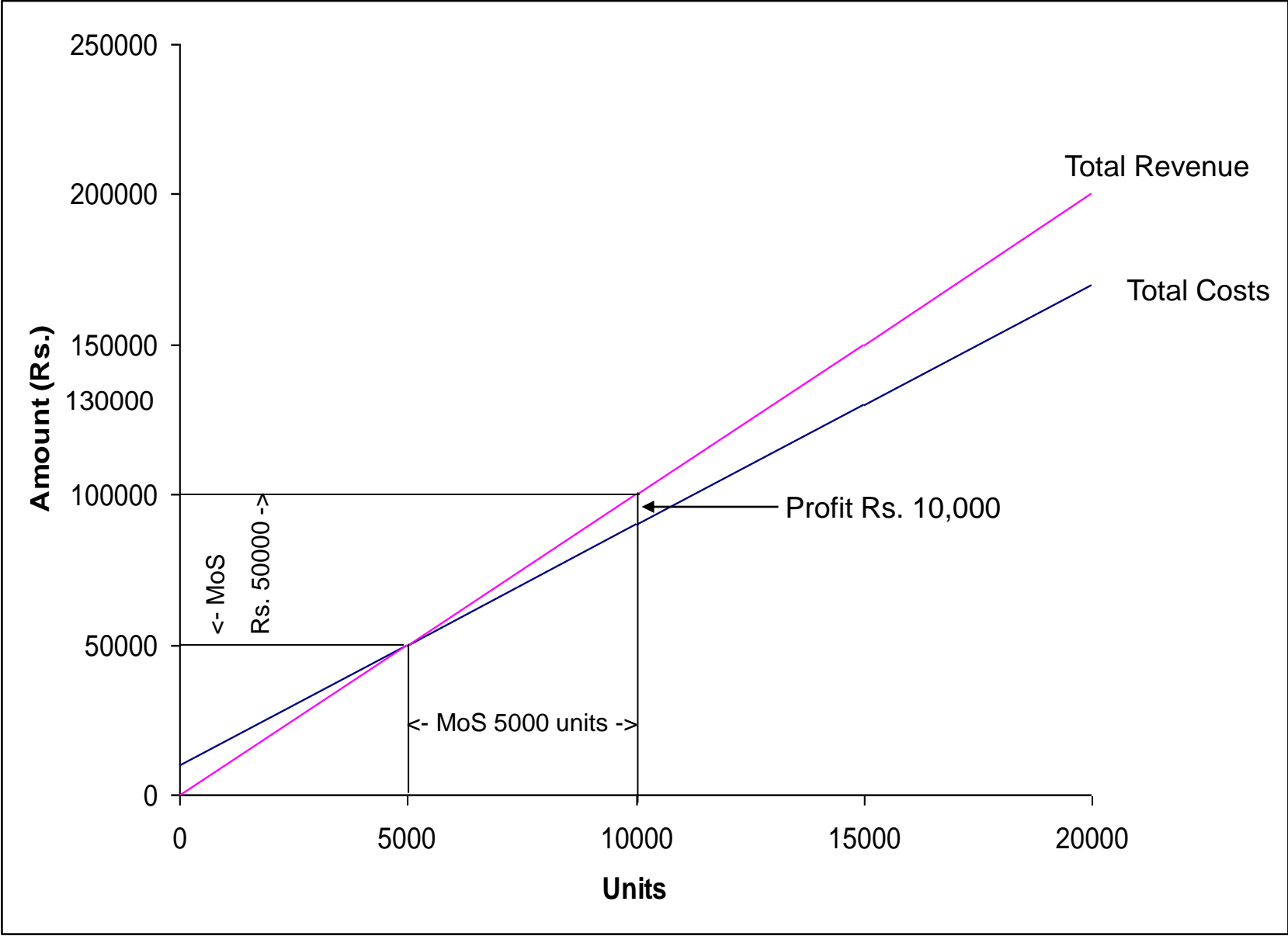
CVP Graph

- Shows the relationship between total revenues and total costs; illustrates how an organisation's profits are expected to change under different volumes of activity









CVP Analysis for Product or Sales Mix

- The terms 'product mix' and 'sales mix' are used interchangeably.
- When a firm produces or sells more than one type of commodity, it is described as product or sales mix.
- Different selling price, variable cost result in different unit contribution margin and contribution margin ratio.
- break-even points vary with the relative proportion of the commodities produced or sold.
- The assumption has to be made that sales mix remains constant.
- Key points
- Total Fixed Cost = Departmental FC + Joint FC
- Constant Sales Mix Ratio, in Units and Amount

Question

Unique multi-product company two different types of products. These two products are manufactured in two departments separately. The financial data relating to these product are presented below :

		Product X		Product Y	Total
Sales in Units		15,000		5,000	20,000
Sales Revenue (Rs.)	@10	1,50,000	@20	1,00,000	2,50,000
Less : Variable Cost	@5	75,000	@10	50,000	1,25,000
Contribution Margin	@5	75,000	@10	50,000	1,25,000
Less : Departmental Fixed Cost		25,000		25,000	50,000
		50,000		25,000	75,000
Less : Joint Fixed Cost					50,000
Net Income Before Tax					25,000

Required:

- Sales volume in units to be at Break-even Point.
- Percentage increase in the selling price of Product X to keep at in original break-even sales volume of the selling price of Product Y decreases by 15%.
- Break even sales volume in units, if standard sales is changed to 1:3 from 3:1.

Important

1. Total FC = Dept FC + Joint FC = (25000+25000) + 50000 = Rs. 100,000

2. Ratio

In units: X:Y = 15000:5000 = 3:1

In Rs. X:Y = Rs. 150,000:100,000 = 3:2

(a) Sales volume in units to be at Break-even Point

Method 1: Equation Approach

Calculation of BEP (units)

$$S/R = \text{Total FC} + \text{Total VC}$$

$$10X + 20Y = 100,000 + 5X + 10Y$$

$$10X - 5X + 20Y - 10Y = 100,000$$

$$5X + 10Y = 100,000$$

In units: X:Y = 15000:5000 = 3:1

$$X/Y = 3/1$$

$$X = 3Y \text{ or } Y = X/3$$

$$5(3Y) + 10Y = 100,000$$

$$15Y + 10Y = 100,000$$

$$Y = 4,000 \text{ units}$$

$$X = 12,000 \text{ units}$$

$$\text{Overall BEP (units)} = 12000 + 4000 = 16,000 \text{ units}$$

Calculation of BEP (Rs.)

$$\text{BEP (Rs.)} = \text{BEP (units)} * \text{SP}$$

$$\text{BEP (Rs.) for Product X} = 12,000 \text{ units} * \text{Rs. } 10 = \text{Rs. } 120,000$$

$$\text{BEP (Rs.) for Product Y} = 4,000 \text{ units} * \text{Rs. } 20 = \text{Rs. } 80,000$$

$$\text{Overall BEP (Rs.)} = \text{Rs. } 120,000 + \text{Rs. } 80,000 = \text{Rs. } 200,000$$

Break-even Point in Units

Method 2: CM Approach

$$\text{Overall BEP (Units)} = \frac{\text{Total FC}}{\text{WACMPU}} = \frac{100,000}{6.25} = 16,000 \text{ units}$$

BEP (units) for product X = 16,000 X $\frac{3}{4}$ = 12,000 units

BEP (units) for product Y = 16,000 X $\frac{1}{4}$ = 4,000 units

Working note: Calculation of WACMPU

Products	CMPU	Ratio (in units)	CMPU X Ratio
X	Rs. 5	$\frac{3}{4}$	$\frac{15}{4}$
Y	Rs. 10	$\frac{1}{4}$	$\frac{10}{4}$
		WACMPU	$\frac{25}{4} = 6.25$

OR

$$\text{WACMPU} = \frac{\text{Total CM}}{\text{Total Sales units}} = \frac{125,000}{20,000 \text{ units}} = 6.25$$

Break-even Point in Amount

$$\text{Overall BEP (Rs.)} = \frac{\text{Total FC}}{\text{WA P/V Ratio}} = \frac{100,000}{0.50} = \text{Rs. } 200,000$$

BEP (Rs.) for product X = Rs. 200,000 X 3/5 = Rs. 120,000

BEP (Rs.) for product Y = Rs. 200,000 X 2/5 = Rs. 80,000

Working note: Calculation of WACMPU

Products	CMPU	SP	P/V Ratio = CMPU/SP	Ratio (in Rs.)	P/V Ratio X Sales Ratio
X	Rs. 5	Rs. 10	5/10 = 0.50	3/5	1.5/5
Y	Rs. 10	Rs. 20	10/20 = 0.50	2/5	1/5
				WACMPU	2.5/5 = 0.50

OR

$$\text{WA P/V Ratio} = \frac{\text{Total CM}}{\text{Total Sales Revenue}} = \frac{125,000}{250,000} = 0.50$$

Verification

Income Statement

		Product X		Product Y	Total
Sales in Units		12,000		4,000	16,000
Sales Revenue (Rs.)	@10	1,20,000	@20	80,000	2,00,000
Less : Variable Cost	@5	60,000	@10	40,000	1,00,000
Contribution Margin	@5	60,000	@10	40,000	1,00,000
Less : Departmental Fixed Cost		25,000		25,000	50,000
		50,000		25,000	50,000
Less : Joint Fixed Cost					50,000
Net Income Before Tax					0

(b) Percentage increase in the selling price of Product X to keep at in original break-even sales volume of the selling price of Product Y decreases by 15%.

$$S/R = \text{Total FC} + \text{Total VC}$$

$$(12,000 \times \text{New SP of X}) + (4,000 \times 17) = 100,000 + (12,000 \times 5) + (4,000 \times 10)$$

$$\text{New SP of X} = 11$$

$$\% \text{ increase in SP of X} = (11 - 10)/10 = 10\%$$

Verification

		Product X		Product Y		Total
Sales in Units		12,000		4,000		16,000
Sales Revenue (Rs.)	@11	1,32,000	@17	68,000		2,00,000
Less : Variable Cost	@5	60,000	@10	40,000		1,00,000
Contribution Margin	@6	72,000	@7	28,000		1,00,000
Less : Total Fixed Cost						1,00,000
Net Income Before Tax						0

c) Break even sales volume in units, if standard sales is changed to 1:3 from 3:1.

$$\text{Overall BEP (Units)} = \frac{\text{Total FC}}{\text{WACMPU}} = \frac{100,000}{35/4} = 11,428 \text{ units}$$

Working note: Calculation of WACMPU

Products	CMPU	Ratio (in units)	CMPU X Ratio
X	Rs. 5	1/4	5/4
Y	Rs. 10	3/4	30/4
		WACMPU	35/4

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Thank You