

COST VOLUME PROFIT (CPV)

- ❑ Cost-volume-profit (CVP) analysis is a way to find out how changes in variable and fixed costs affect a firm's profit.
- ❑ Companies can use CVP to see how many units they need to sell to break even (cover all costs) or reach a certain minimum profit margin.
- ❑ CVP analysis makes several assumptions, including that the sales price, fixed, and variable costs per unit are constant.

Cost Volume Profit (CVP) Analysis

- › An understanding of CVP analysis is extremely useful to management in budgeting and profit planning. It elucidates the impact of the following on the net profit:
 - Changes in selling prices
 - Changes in volume of sales
 - Changes in variable cost,
 - Changes in fixed cost.

CVP Analysis

- ▶ CVP Analysis is an important tool of Profit Planning. It provide information on following matters:

Cost

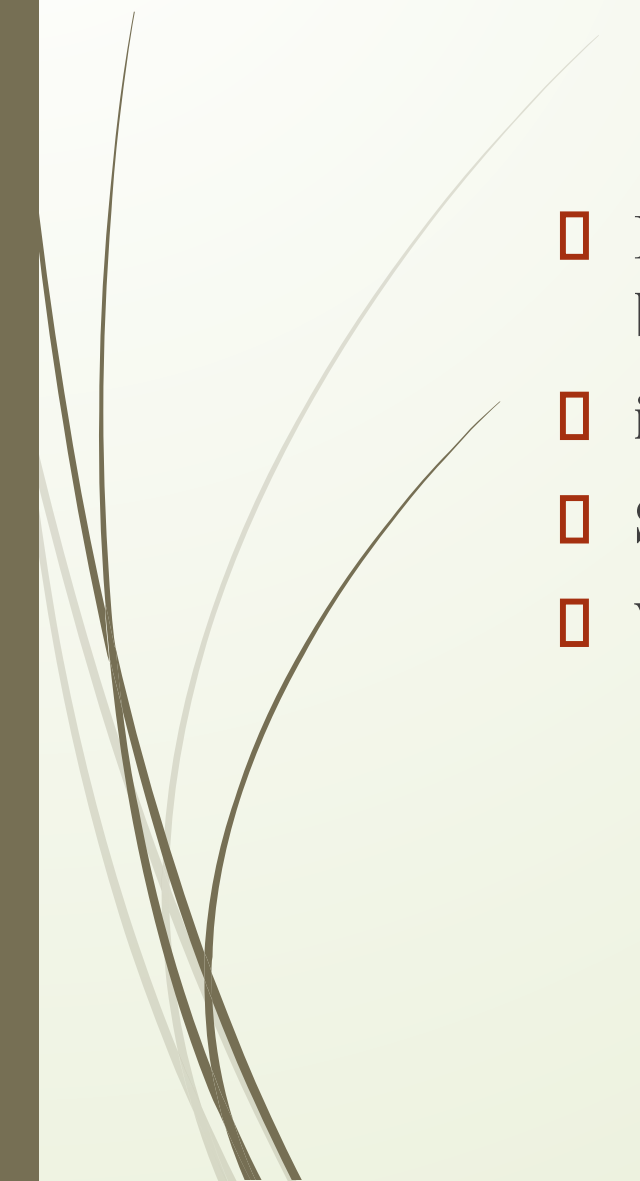
Volume

Profit

- ▶ 1.The behaviour of cost in relation to volume.
- ▶ 2.Volume of production/sales, where business will break even.
- ▶ 3. Sensitivity of profits due to variation in output.
- ▶ 4. Amount of profit for a projected sales volume.
- ▶ 5. Quantity of production and sales for a target profit level.



CPV analysis

- It can be defined as a management tool showing the relationship between various ingredient of profit planning.
 - i.e Cost (Fixed/ variable)
 - Selling price
 - Volume of activity
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Basic terms

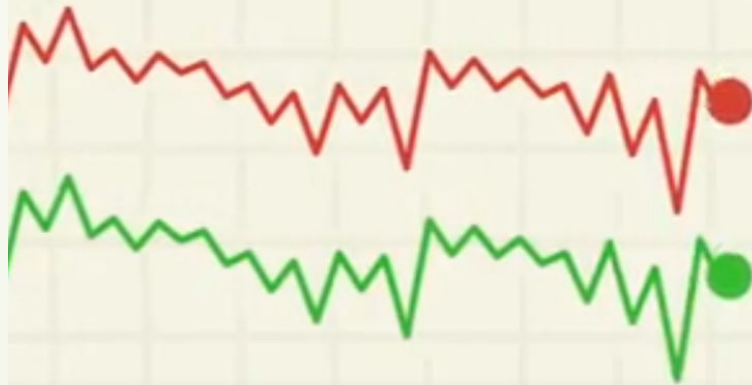
Contribution Margin/ gross margin

- **CVP analysis also manages product contribution margin. The contribution margin is the difference between total sales and total variable costs. For a business to be profitable, the contribution margin must exceed total fixed costs.**
- While contribution margins only count the variable costs, the gross profit margin includes all of the costs that a company incurs in order to make sales

$$CM = \text{Contribution margin} = \text{Sales} - \text{Variable Costs}$$

**VARIABLE
COSTS**

**PRODUCTION
VOLUME**



Contriubution

□ **Fixed Cost+ Profit/loss= contribution**

Q1 FC= 2,50,000

VC= 10 per unit ,


SP= 15 per unit

output = 75000 unit what is profit or loss ?

Sales = 75000 x 15= 11,25,000

Contribution = 11,25,000- 7,50,000 = 3,75,000

Profit = 3,75,000 – 2,50,000 = 1,25,000



❑ Neeta is a young entrepreneur who recently used GMAT success a test prep book and software package for the business school admission test. Neeta loved the book and software so that after graduating she signed a contract with GMAT success publisher to sell the learning material . She recently sold them at a college fair in new Delhi and is now thinking of selling them at a college fair in Mumbai. Neeta know she can purchase each package with the privilege of returning all unsold packages and receiving a full of a full 1200 per package . She knows that she must pay 20000 to rent a booth at the fair. She will incur no other cost. Should she rent the booth or not ?

❑ Identify the problem and uncertainties.

(i) The price

(ii) The no. of units she can sell

❑ Obtain information

❑ Make predictions about the future

❑ Make decision by choosing among alternatives

❑ Implement the Decision evaluate performance and learn

Expressing CPV relationships

□ Equation method

$[(\text{Selling price} \times \text{QTY sold}) - (\text{VC per unit} \times \text{qty sold})] - \text{FC} = \text{operating income}$

□ Contribution margin method

(1) $[(\text{SP} - \text{VC}) \times \text{QTY sold}] - \text{FC} = \text{Operating income}$

(2) $(\text{Contribution margins per unit} \times \text{qty sold}) - \text{FC} = \text{operating income}$

Break-Even Analysis

- ▶ Widely used technique to study to CVP relationship.
- ▶ **Narrow Interpretation**– A system of determination of that level of activity where total cost is equal to total selling price.
- ▶ **Broader interpretation**–That system of analysis which determines probable profit at any level of activity.

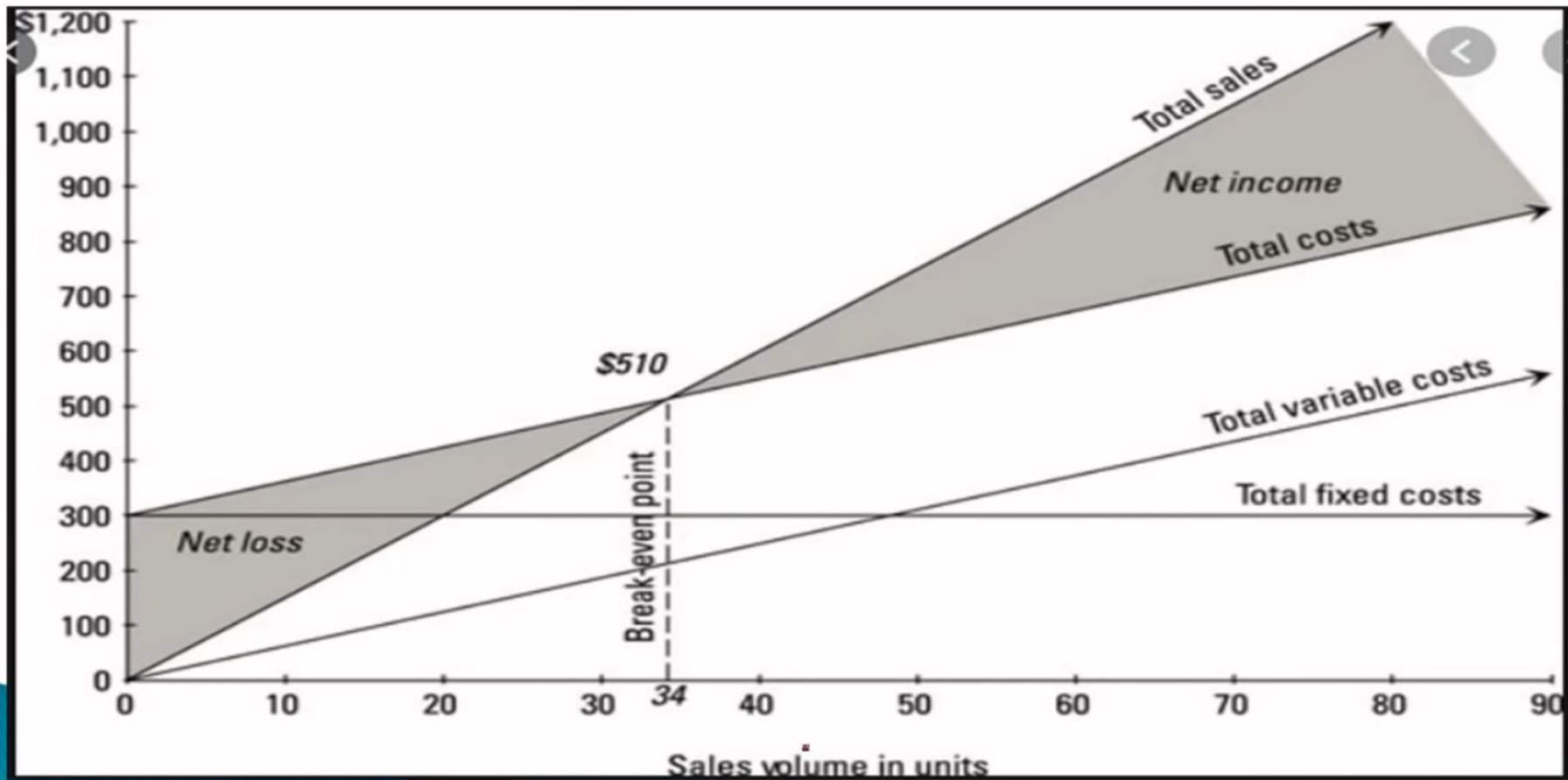
3. Break Even Point



- ▶ The point which breaks the total cost & selling price evenly to show the level of output or sales at which there shall be neither profit nor loss.
- ▶ At this point , income of business exactly equals its expenditure.

At B.E.P Total Cost=Total Sales
Income=Expenditure

- ▶ If Production > B.E.P \Rightarrow Profit Shall Accrue
- ▶ If Production < B.E.P \Rightarrow Loss Suffered by business

Graph . B.E.P





Cases	Volume	Contrib	FC	Profit
1	1000 units	48000	96000	(48000)
2	1500 units	72000	96000	(24000)
3	2000 units	96000	96000	0
4	2500 units	120,000	96000	24000

		5 packesge sold	25 packesge sold	40packesge sold
Revenue		10000(2000X5)	50000(2000X25)	80000(2000X40)
VC		6000(1200X5)	30000(1200X25)	48000(1200X40)
Contribution		4000	20000	32000
FC		20000	20000	20000
Operating income		(16000)	0	12000
Contribution per unit		4000/5 =800	20000/25=800	32000/40=800
Contribution margin% (contribution per rupee of revenue earned).		4000/10000= 40%	20000/50000=40%	32000/80000=40%

2. Profit/Volume Ratio(P/V Ratio)

- ▶ Important for studying the **profitability of operation** of a business.
- ▶ Also establishes a relationship between the contribution and the sale value.
- ▶ Also called “**Contribution/Sales Ratio**”.
- ▶ Imp. For management to find out **which product is more profitable**.

$$P/V \text{ Ratio} = \frac{\text{Contribution}}{\text{Sales}} = \frac{\text{Sales} - \text{Variable Cost}}{\text{Sales}}$$

$$\text{or } C/S = \frac{S - V}{S} \text{ or } 1 - \frac{\text{Variable Costs}}{\text{Sales}}$$

PV Ratio

› Meaning

- Also called as **Contribution to Sales Ratio, Profit Volume Ratio**
- This ratio shows the **proportion of sales** available to **cover** fixed costs and profit.
- A higher contribution to sales ratio implies that the rate of growth of contribution is faster than that of sales.

› Formula

Type	Formula
I	$\text{PV Ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100$
II	$\text{PV Ratio} = \frac{\text{Change in Contribution}}{\text{Change in Sales}} \times 100$
III	$\text{PV Ratio} = \frac{\text{Change in Profit}}{\text{Change in Sales}} \times 100$

› Also

$\text{Contribution} = \text{Sales} \times \text{PV Ratio}$
$\text{Sales} = \text{Contribution} / \text{PV Ratio}$

Volume	20,000	24,000	change
Sales @ 80 p.u.	1600K	1920K	320K
Var cost @ 60 p.u.	(1200K)	(1440K)	
cont @ 20 p.u.	400K	480K	80K
FC	300K	300K	
Profit	100K	180K	

Formula
$PV \text{ Ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100$
$PV \text{ Ratio} = \frac{\text{Change in Contribution}}{\text{Change in Sales}} \times 100$
$PV \text{ Ratio} = \frac{\text{Change in Profit}}{\text{Change in Sales}} \times 100$

- Contribution per unit / selling price per unit = $80/20 = 25\%$
- Contribution / sales = $400000/1600000 = 25\%$
- Change in contribution / change in sales = $80000/320000 = 25\%$
- Change in profit / change in sales = $80000 / 320000 = 25\%$

Desired Profit

- ▶ At B.E.P the desired profit is zero.
- ▶ In case the volume of output/sales is to be computed for a 'desired profit'. The amount of 'desired profit' should be added to fixed cost in formulae.


$$\text{Units for a desired profit} = \frac{\text{Fixed Cost} + \text{Desired Profit}}{\text{Contribution per unit}}$$

$$\text{Sales for a desired profit} = \frac{\text{Fixed Cost} + \text{Desired Profit}}{P/V \text{ Ratio}}$$

B.E.P

- At B.E.P operating income is 0
- Therefore contribution margin x breakeven no. of units = FC
- Break even no. of units = FC/ contribution margin per unit (P/V ratio)
- In last example $20000/800 = 25$ units or to find the B.E.P contribution = FC
- Now suppose neeta wants to earn 12000 RS how many units must she sell ?
- **$[(\text{Selling price} \times \text{QTY sold}) - (\text{VC per unit} \times \text{qty sold})] - \text{FC} = \text{operating income}$**
 $(2000 \times Q) - (1200 \times Q) - 20000 = 12000 \Rightarrow 40 \text{ units}$
- **Quantity of units required to be sold = $(\text{FC} + \text{target operating income}) / \text{contribution per unit}$**
- **Revenue needed to earn target operating income = $(\text{FC} + \text{target operating income}) / \text{contribution margin percentage}$**

$$12000 = (20000 + 12000) / 0.40 = 80000$$

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- Bernard window is a small company that installs windows its cost structure is as follows
 - SP per unit = 5000
 - VC per unit = 4000
 - Annual fixed cost = 15,00,000

(a) Calculate B.E.P in units and revenue

(b) The number of windows the company must install and revenue needed to earn a target operating income of 10,00,000.

Formula

$$\text{Break-even Point (of output)} = \frac{\text{Fixed Cost}}{\text{Contribution per unit}}$$

Break-even Point (of sales)

$$= \frac{\text{Fixed Cost}}{\text{Contribution per unit}} \times \text{Selling Price per unit}$$

or

$$= \frac{\text{Fixed Cost}}{\text{Total Contribution}} \times \text{Total Sales}$$

$$\text{or } = \frac{\text{Fixed Cost}}{1 - \frac{\text{Variable cost per unit}}{\text{Selling price per unit}}} = \frac{\text{Fixed Cost}}{P/V \text{ Ratio}}$$

SP	160	Cont pu	48	Cases	Volume	Contrib	FC	Profit
			=	1	1000 units	48000	96000	(48000)
VC	112	PV ratio	30%	2	1500 units	72000	96000	(24000)
				3	2000 units	96000	96000	0
FC for Month	96000 /-			4	2500 units	120,000	96000	24000

$$\text{BEP units / BEQ} = \frac{\text{Fixed cost}}{\text{Cont pu}} = \frac{96000}{48} = 2000 \text{ units}$$

$$\text{BEP value / BES} = \frac{\text{Fixed cost}}{\text{PV ratio}} = \frac{96000}{30\%} = 320,000 \text{ ₹}$$

Target net income

□ **Total net income**

= operating income

+ non operating revenues (interest, commission, dividend, rent)

– non operating cost

If we assume that non operating revenue and non operating income = 0

Then net income = Operating income – Income taxes.

Q neeta may be interested in knowing the quantity of units of GMAT success she must sell to earn a net income of 9600 assuming income tax rate 40 percent.

Target net income = (target operating income) x (1- tax rate)

Target operating income = target net income / (1- tax rate)

= 9600/(1-0.40) = 16000 therefore to earn a net income of 9600 neetas target operating income is 16000

since target operating income is 16000 then no. of units for this income =

(200xQ)-(1200-Q)-2000 = 16000 = 45 units



CVP analysis for Decision Making

□ Consider a decision about choosing the features for a product

(1) Engine size

(2) transmission system

(3) steering system for a new car

Different choices will effect the variable SP, VC , FC, operating income so CVP analysis make product decisions by estimating estimated profitability of the choices

CVP analysis for Decision Making

- Suppose neeta anticipates selling 40 units at GMAT success package at the fair. Her operating was 12000. neeta is considering advertising the product in fair brochure . The advertisement has a fixed cost of 5000. neeta thinks that advertising will increase sales 10% to 44 packages. Should neeta advertise?

	40 packages sold with no advertising	44 sold with advertising	difference
Revenue (1200)	80000	88000	8000
VC (1200)	48000	52800	4800
contribution	32000	35200	3200
FC	20000	25000	5000
Operating income	12000	10200	(1800)
Neeta should not advertise			



Decision to reduce selling price

- ❑ neeta want to reduce the selling price to 1750 she think she will sell 50 units in such a scenario CP of package will be 1150. should neeta reduce the selling price.
- ❑ Contribution margin from lowering the price (1750) for 50 units = 30000
- ❑ Contribution margin for 40 units @ 2000 = 32000
- ❑ Change in contribution = (2000)
- ❑ Therefore neeta should not reduce selling price

Determining target prices

- Neeta can ask “at what price can I sell 50 units (purchased @1150) and continue to earn an operating income of 12000.

Target operating income	12000
+ FC	20000
Target contribution margin	32000
Divided by no. of units sold	$32000/50 = 640$
Target contribution margin per unit	640
+VC	1150
Target selling price	1790



Sensitivity analysis and Margin of safety

- ❑ Sensitivity analysis is a “what if” technique managers use to examine how an outcome will change if the original predicted data are not achieved or if an underlying assumption changes. The analysis answers questions such as What will operating income be if the quantity of units sold decreases by 55 from the original prediction?
- ❑ What will operating income be if variable cost increases by 10%?
- ❑ This helps visualize the possible outcome that might occur before the company commits to funding a project
- ❑ managers then do sensitivity analysis to test how sensitive their conclusions are
- ❑ Margin of safety is one aspect of sensitivity analysis



Margin of safety

- Q if budgeted revenue is above break even and drop, how far can they fall below budget before the breakeven point is reached?
- Sales might decrease as a result of factors such as poorly executed marketing program or a competitor introducing a better product
- $\text{Margin of safety} = \text{Budgeted revenues} - \text{breakeven revenues}$
- In case of neeta's example revenue at 40 units is 80000 and revenue at breakeven unit (25) is 50000
- $\text{margin of safety} = 80000 - 50000$
- $\text{Margin of safety percentage} = \text{Margin of safety in Rs} / \text{actual revenue}$
- $30000 / 80000 = 37.5\%$
- If Sale will drop by 37.5% then B.E.P is reach and after that there is a loss

4. Margin Of Safety

- ▶ Total Sales minus the sales at Break-even point .

$$\text{M.S.} = \text{T.S.} - \text{B.E.S}$$

$$\text{Margin of Safety} = \text{Total Sales} - \text{Break-even Sales.}$$

Margin of safety can also be computed according to the following formula:

$$\text{Margin of Safety} = \frac{\text{Net Profit}}{\text{P/V Ratio}}$$

MOS– Significance


If the margin of safety is large, it is a sign of soundness of the business since even with a substantial reduction in sales, profit shall be earned by the business. If the margin is small, reduction in sales, even to a small extent may affect the profit position very adversely and larger reduction of sales value may even result in losses. Thus, margin of safety serves as an indicator to the strength of the business.

	Total	Break even	Margin of safety
Sales (10,000 X 400)	40,00,000	2800,000 (7000 X 400)	12,00,000 (3000 X 400)
var. cost (10,000 X 320)	32,00,000	2240,000 (7000 X 320)	960,000 (3000 X 320)
Contribution	8,00,000	560,000	240,000
Fixed cost	560,000	560,000	0
Profit	240,000	0	240,000

$$\text{Mos Sales} \times \text{PV ratio} = \text{Profit}$$

A company earned a profit of ₹ 30,000 during the year. If the marginal cost and selling price of the product are ₹ 8 and ₹ 10 per unit respectively, FIND OUT the amount of margin of safety. VC SP

$$PV = \frac{2}{10} \times 100 = 20\% \quad \frac{30,000}{20\%} = 150,000$$



A Ltd. Maintains margin of safety of 37.5% with an overall contribution to sales ratio of 40%. Its fixed costs amount to ₹ 5 lakhs.

CALCULATE the following:

- i. Break-even sales*
- ii. Total sales*
- iii. Total variable cost*
- iv. Current profit*
- v. New 'margin of safety' if the sales volume is increased by 7 ½ %.*

A Ltd. Maintains margin of safety of 37.5% with an overall contribution to sales ratio of 40%. Its fixed costs amount to ₹5 lakhs.

CALCULATE the following:

- i. Break-even sales $FC / PV \text{ ratio} = 500,000 / 40\% = 1,250,000$
- ii. Total sales $\frac{1,250,000}{62.5} \times 100 = 20,00,000$
- iii. Total variable cost $20L \times 60\% = 12L$
- iv. Current profit $(20L \times 40\%) = 8L \quad 8L - 5L = 3L$
- v. New 'margin of safety' if the sales volume is increased by $7\frac{1}{2}\%$.
 $\text{New Sales} = 20L + 7.5\% = 21,50,000$ / $BES = 1,250,000$
 $MOS = 900,000 \checkmark$

Illustration 1 – Page 14.14

ILLUSTRATION 1

MNP Ltd sold 2,75,000 units of its product at ₹ 37.50 per unit. Variable costs are ₹ 17.50 per unit (manufacturing costs of ₹ 14 and selling cost ₹ 3.50 per unit). Fixed costs are incurred uniformly throughout the year and amounting to ₹ 35,00,000 (including depreciation of ₹ 15,00,000). There are no beginning or ending inventories.

Required:

COMPUTE breakeven sales level quantity and cash breakeven sales level quantity.

$$\frac{35L}{20 p4} = 175000 \text{ units}$$

$$\frac{20L}{20} = 100,000 \text{ units}$$

ILLUSTRATION 2

You are given the following particulars

- i. Fixed cost ₹ 1,50,000*
- ii. Variable cost ₹ 15 per unit*
- iii. Selling price is ₹ 30 per unit*

CALCULATE:

- (a) Break-even point*
- (b) Sales to earn a profit of ₹ 20,000*

ILLUSTRATION 2

You are given the following particulars

- i. Fixed cost ₹ 1,50,000
- ii. Variable cost ₹ 15 per unit
- iii. Selling price is ₹ 30 per unit

$$\text{Cost pu} = 15 \quad \text{PV ratio} = 50\%$$

CALCULATE:

$$\text{BEQ} = 150\text{k} / 15 = 10,000$$

(a) Break-even point $\text{BES} = 150\text{k} / 50\% = 300\text{k}$

(b) Sales to earn a profit of ₹ 20,000

$$\frac{(150,000 + 20,000)}{15} = 11334$$