

# **Cost and Management Accounting- II**

**4<sup>th</sup> Semester**

**Unit-4**

**Marginal Costing and CVP Analysis**

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# Marginal Costing and CVP Analysis

**Formulae:**  $\text{Contribution} = \text{Sales} - \text{Variable Cost}$

$$\text{Contribution} = \text{Fixed Cost} + \text{Profit}$$

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

$$\text{Contribution Per Unit} = \text{Selling Price Per Unit} - \text{Variable Cost Per Unit}$$

$$\text{PV Ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100$$

$$\text{Break - Even Point (in Unit)} = \frac{\text{Fixed Cost}}{\text{Contribution Per Unit}}$$

$$\text{Break - Even Point (Sales Revenue)} = \frac{\text{Fixed Cost}}{\text{Contribution Per Unit}} \times \text{Selling Price Per Unit}$$

$$\text{Break - Even Point (Sales Revenue)} = \frac{\text{Fixed Cost}}{\text{PV Ratio}}$$

$$\text{Sales in Unit for Target Profit} = \frac{\text{Fixed Cost} + \text{Target Profit}}{\text{Contribution Per Unit}}$$

$$\text{Sales Revenue for Target Profit} = \frac{\text{Fixed Cost} + \text{Target Profit}}{\text{Contribution Per Unit}} \times \text{Selling Price Per Unit}$$

$$\text{Margin of Safety (in Units)} = \frac{\text{Profit}}{\text{Contribution Per Unit}}$$

$$\text{Margin of Safety (in Units)} = \text{Total sales Units} - \text{Break Even Sales Units}$$

$$\text{Margin of Safety (Sales Revenue)} = \text{Total Sales Revenue} - \text{Break Even Sales Revenue}$$

$$\text{Margin of Safety Percentage} = \frac{\text{Margin of Safety Sales Revenue}}{\text{Total Sales Revenue}} \times 100$$

$$\text{Fixed Cost} = \text{Contribution} - \text{Profit}$$

$$\text{Fixed Cost} = (\text{Sales} \times \text{PV Ratio}) - \text{Profit}$$

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

$$\text{Profit} = \text{Contribution} - \text{Fixed Cost}$$

$$\text{Profit} = \text{sales} - (\text{Variable Cost} + \text{Fixed Cost})$$

$$\text{Profit} = (\text{Sales} \times \text{PV Ratio}) - \text{Fixed Cost}$$

$$\text{Sales Revenue for Target Profit} = \frac{\text{Fixed Cost} + \text{Target Profit}}{\text{PV Ratio}}$$

$$\text{Margin of Safety (Sales Revenue)} = \frac{\text{Profit}}{\text{PV Ratio}}$$

1. From the following information you're required to calculate:

- (a) Sales to break-even in unit
- (b) Sales to break-even in sales revenue
- (c) Sales to earn a profit of Rs. 60000.

Additional information:

(i) Sales (10000 units) Rs. 160000; (ii) Variables cost Rs. 96000; (iii) Fixed cost Rs. 480000

#### Solution

##### Contribution Method

Selling Price per Unit (₹ 1,60,000 / 10,000)	₹ 16.00
Less: Variable Cost per Unit (₹ 96,000 / 10,000)	<u>9.60</u>
Contribution per Unit	<u>6.40</u>

$$\begin{aligned}\text{(a) Sales to Break — even (in Unit)} &= \frac{\text{Fixed Cost}}{\text{Contribution per Unit}} \\ &= \frac{48,000}{6.40} = 7,500 \text{ units}\end{aligned}$$

$$\begin{aligned}\text{(b) Sales to Break — even (in Sales Revenue)} &= \frac{\text{Fixed Cost}}{\text{Contribution per Unit}} \times \text{Selling Price per Unit} \\ &= \frac{48,000}{6.40} \times 16 = ₹ 1,20,000\end{aligned}$$

*Alternatively,*

$$\text{C/S Ratio (P/V Ratio)} = \frac{\text{Contribution per Unit}}{\text{Selling Price per Unit}} \times 100 = \frac{6.40}{16} \times 100 = 40\%$$

$$\text{Sales to Break — even (in Sales Revenue)} = \frac{\text{Fixed Cost}}{\text{C/S Ratio (P/V Ratio)}} = \frac{48,000}{40\%} = ₹ 1,20,000$$

**(c) Sales to earn a Profit of ₹ 60,000**

$$\begin{aligned}\text{Sales Units for Target Profit} &= \frac{\text{Fixed Cost} + \text{Target Profit}}{\text{Contribution per Unit}} \\ &= \frac{48,000 + 60,000}{6.40} = 16,875 \text{ Units}\end{aligned}$$

$$\begin{aligned}\text{Sales Revenue for Target Profit} &= \frac{\text{Fixed Cost} + \text{Target Profit}}{\text{Contribution per Unit}} \times \text{Selling Price per Unit} \\ &= \frac{48,000 + 60,000}{6.40} \times ₹ 16 = ₹ 2,70,000\end{aligned}$$

2. From the following information, calculate :

(a) Profit Volume Ratio;

(b) Break-even Point

Year	Sales (₹)	Profit (₹)
2004	4,80,000	32,000
2005	5,60,000	52,000

[C.U.B.Com. (Hons.) – 2006]

**Solution**

$$\begin{aligned} \text{(a) P/V Ratio} &= \frac{\text{Change in Profit}}{\text{Change in Sales}} \times 100 \\ &= \frac{52,000 - 32,000}{5,60,000 - 4,80,000} \times 100 = \frac{20,000}{80,000} \times 100 = 25\% \end{aligned}$$

(b) Taking figures of 2004, Contribution = Sales  $\times$  P/V Ratio = ₹ 4,80,000  $\times$  25% = ₹ 1,20,000.

Fixed Cost = Contribution – Profit = ₹ 1,20,000 – ₹ 32,000 = ₹ 88,000.

*Alternatively*, figures of 2005 can also be taken.

$$\text{Break-even Point (Sales Revenue)} = \frac{88,000}{25\%} = ₹ 3,52,000$$

3. From the following details find out break-even sales and fixed cost and required sales to earn a profit of ₹ 3,00,000 :

Sales – ₹ 9,00,000; Margin of safety – 40%; P/V Ratio – 2/3

[C.U.B.Com. (Hons.) – 2008]

**Solution**

$$\begin{aligned} \text{Break-even Sales} &= \text{Total Sales} - \text{Margin of Safety} \\ &= ₹ 9,00,000 - (40\% \text{ of } ₹ 9,00,000) \\ &= ₹ 9,00,000 - ₹ 3,60,000 = ₹ 5,40,000 \end{aligned}$$

*We know,*

$$\begin{aligned} \text{Break - even Point (Sales Revenue)} &= \frac{\text{Fixed Cost}}{\text{P/V Ratio}} \\ \text{or Fixed Cost} &= \text{Break-even Point (Sales Revenue)} \times \text{P/V Ratio} \\ &= ₹ 5,40,000 \times \frac{2}{3} = ₹ 3,60,000. \end{aligned}$$

Sales required to earn a profit of ₹ 3,00,000 :

$$\begin{aligned} \text{Required Sales} &= \frac{\text{Fixed Cost} + \text{Target Profit}}{\text{P/V Ratio}} \\ &= \frac{3,60,000 + 3,00,000}{\frac{2}{3}} = \frac{6,60,000}{\frac{2}{3}} \times \frac{3}{3} = ₹ 9,90,000 \end{aligned}$$



4. A company earned a profit of ₹ 30,000 during the year 2017-18. If the marginal cost and selling price of a product are ₹ 8 and ₹ 10 per unit respectively, find out the amount of "Margin of Safety".

**Solution**

$$P/V \text{ Ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100 = \frac{\text{Selling Price} - \text{Marginal Cost}}{\text{Selling Price}} \times 100 = \frac{10 - 8}{10} \times 100 = 20\%$$

$$\text{Margin of Safety} = \frac{\text{Profit}}{P/V \text{ Ratio}} \times 100 = \frac{30,000}{20} \times 100 = ₹ 1,50,000$$

5. A company sells its product at ₹ 15 per unit. In a period, if it produces and sells 8,000 units, it incurs a loss of ₹ 5 per unit. If the volume is raised to 20,000 units, it earns a profit of ₹ 4 per unit. Calculate break-even point both in terms of rupees as well as in units. *[C.U.B.Com. (Hons.) - Adapted]*

**Solution**

$$\begin{aligned} \text{Average cost at 8,000 units volume} &= \text{Selling price per unit} + \text{Loss component per unit} \\ &= ₹ 15 + ₹ 5 = ₹ 20 \end{aligned}$$

$$\text{Total cost at 8,000 units volume} = 8,000 \times ₹ 20 = ₹ 1,60,000$$

$$\begin{aligned} \text{Average cost at 20,000 units volume} &= \text{Selling price per unit} - \text{Profit component per unit} \\ &= ₹ 15 - ₹ 4 = ₹ 11 \end{aligned}$$

$$\text{Total cost at 20,000 units volume} = 20,000 \times ₹ 11 = ₹ 2,20,000$$

$$\begin{aligned} \text{Variable Cost per Unit} &= \frac{\text{Change in the Total Cost}}{\text{Change in the Volume of Production}} \\ &= \frac{2,20,000 - 1,60,000}{20,000 - 8,000} = \frac{60,000}{12,000} = ₹ 5 \text{ per unit} \end{aligned}$$

$$\text{Total Fixed Cost} = \text{Total Cost} - \text{Variable Cost} = ₹ 1,60,000 - (8,000 \times ₹ 5) = ₹ 1,20,000$$

$$P/V \text{ Ratio} = \frac{S - V}{S} = \frac{15 - 5}{15} \times 100 = 66\frac{2}{3}\% \text{ or } 2/3$$

Where,

S = Selling price per unit

V = Variable cost per unit

$$(i) \text{ Break-even Point (₹)} = \frac{\text{Fixed Cost}}{P/V \text{ Ratio}} = (1,20,000 \times 3) / 2 = ₹ 1,80,000$$

$$(ii) \text{ Break - even Point (Units)} = \frac{\text{Fixed Cost}}{\text{Contribution per Unit}} = \frac{1,20,000}{15 - 5} = 12,000 \text{ Units}$$

6. A company has three factories situated in North, East and South with its Head office in Mumbai. The management has received the following summary report on the operations of each factory for a period (all figures are in '000 ₹).

	Sales		Profit	
	Actual	Over / (Under) Budget	Actual	Over / (Under) Budget
North	1,100	(400)	135	(180)
East	1,450	150	210	90
South	1,200	(200)	330	(110)

Calculate for each factory and for the company as a whole for the period :

(i) The Fixed Costs; (ii) Break-even Sales.

[C.U.B. Com. (Hons.) – Adapted]

**Solution**

**Working Notes :**

**(1) Calculation of Budgeted Sales**

Particulars	North (₹ '000)	East (₹ '000)	South (₹ '000)
Actual Sales	1,100	1,450	1,200
Add: Under budget	400	-	200
Less: Over budget	-	(150)	-
<b>Budgeted Sales</b>	<b>1,500</b>	<b>1,300</b>	<b>1,400</b>

**(2) Calculation of Budgeted Profit**

Particulars	North (₹ '000)	East (₹ '000)	South (₹ '000)
Actual Profit	135	210	330
Add: Under budget	180	-	110
Less: Over budget	-	(90)	-
<b>Budgeted Profit</b>	<b>315</b>	<b>120</b>	<b>440</b>

### (3) Calculation of P/V Ratio

$$P/V \text{ Ratio} = \frac{\text{Change in Profit}}{\text{Change in Sales}} \times 100 = \frac{\text{Budgeted Profit} - \text{Actual Profit}}{\text{Budgeted Sales} - \text{Actual Sales}} \times 100$$

$$\text{North : } \frac{315 - 135}{1500 - 1100} \times 100 = \frac{180}{400} \times 100 = 45\%$$

$$\text{East : } \frac{120 - 210}{1300 - 1450} \times 100 = \frac{90}{150} \times 100 = 60\%$$

$$\text{South : } = \frac{440 - 330}{1400 - 1200} \times 100 = \frac{110}{200} \times 100 = 55\%$$

#### (i) Calculation of Fixed Cost

[₹ '000]

Regions	Actual Sales (1)	P/V Ratio (2)	Contribution (3) = (1 x 2)	Actual Profit (4)	Fixed Cost (5) = (3 - 4)
North	1,100	45%	495	135	360
East	1,450	60%	870	210	660
South	1,200	55%	660	330	330
	3,750	*54%	2,025	675	1,350

\*2,025 / 3,750 x 100

#### (ii) Calculation of Break-even Sales

Regions	Fixed Cost (₹ '000)	P/V Ratio	Break-even Point Sales (₹ '000)
North	360	45%	360 / 45 x 100 = 800
East	660	60%	660 / 60 x 100 = 1,100
South	330	55%	330 / 55 x 100 = 600

$$\text{Break - even Sales (Company as a whole)} = \frac{\text{Total Fixed Cost}}{\text{P/V Ratio}} = \frac{1350}{54} \times 100 = 2500 \text{ (in ₹ '000)}$$



7. Information for two successive years are given below :

Year	Units (₹)	Selling Price (₹)	Average Cost
2014	12,000	50	30
2015	15,000	50	28

Calculate :

(i) P/V ratio and fixed cost; (ii) Break-even Sales; (iii) Sales to earn a profit of ₹ 2,10,000; (iv) Selling price to earn a profit of ₹ 1,50,000 by selling 9,000 units; and (v) Margin of safety when profit is 30,000.

[C.U.B.Com. (Hons.) - 2016]

Solution		Calculation of Change in Sales and Profit (figures in ₹)		
		Sales	Total Cost	Profit
2014		6,00,000	3,60,000	2,40,000
2015		7,50,000	4,20,000	3,30,000
Change		1,50,000		90,000

$$(i) \text{ P/V Ratio} = \frac{\text{Change in Profit}}{\text{Change in Sales}} \times 100 = \frac{90,000}{1,50,000} \times 100 = 60\%$$

Contribution of 2014 = ₹ 6,00,000 × 60%	₹ 3,60,000
Profit of 2014	2,40,000
Fixed Cost	1,20,000

$$(ii) \text{ Break - even Sales} = \frac{\text{Fixed Cost}}{\text{P/V Ratio}} = \frac{1,20,000}{60\%} = ₹ 2,00,000$$

(iii) Required Contribution to Earn a Profit of ₹ 2,10,000	₹
Fixed Cost	1,20,000
Target Profit	2,10,000
Required Contribution	3,30,000

$$\text{Sales} = \frac{\text{Contribution}}{\text{P/V Ratio}} = \frac{3,30,000}{60\%} = ₹ 5,50,000$$

(iv) Fixed Cost	1,20,000
Required Profit	1,50,000
Required Contribution	2,70,000

$$\text{Contribution per unit} = ₹ 2,70,000 \div 9,000 = ₹ 30.$$

$$\text{Selling price} = \text{Variable cost per unit} + \text{Contribution per unit} \\ = ₹ 20 \text{ (Note 1)} + ₹ 30 = ₹ 50$$

$$(v) \text{ Margin of Safety} = \frac{\text{Profit}}{\text{P/V Ratio}} = \frac{30,000}{60\%} = ₹ 50,000$$

Working Note :

(1) Total cost of manufacturing 12,000 units	₹ 3,60,000
Less: Fixed cost	1,20,000
Total Variable Cost	2,40,000
Variable Cost per unit = ₹ 2,40,000 ÷ 12,000 = ₹ 20	



8. Dingdong Ltd. manufactures a particular product with a capacity to produce 5,000 units. The following particulars relate to the activities of the company for the year 2015 and 2016 :

	2015 (₹)	2016 (₹)
Sales @ ₹ 50 per unit	75,000	1,50,000
Material	15,000	30,000
Labour	30,000	60,000
Production Overhead	16,500	27,000
Administrative Overhead	10,000	10,000
Selling Overhead	8,500	13,000
Total Costs	80,000	1,40,000

**Calculate :**

- BEP Sales (in volume and value)
- Budgeted Net Profit if 75% of the capacity is utilized in 2017.
- Number of units to be sold to earn a net profit of ₹ 25,000 and
- The amount of sales to be made to achieve a target profit of 10% on Sales in 2018.

*IC.U.B.Com. (Hons.) – 2017*

**Solution**

**1. Number of Units Produced**

2015 : ₹ 75,000 ÷ ₹ 50 = 1,500 units

2016 : ₹ 1,50,000 ÷ ₹ 50 = 3,000 units

**2. Number of units to be produced in 2017 = 5,000 × 75% = 3,750 units**

**3. Calculation of Variable Cost per Unit**

Particulars	₹
Materials (₹ 15,000 ÷ 1,500)	10.00
Labour (₹ 30,000 ÷ 1,500)	20.00
Production Overhead $\left[ \frac{27,000 - 16,500}{3,000 - 1,500} \right]$	7.00
Selling Overhead $\left[ \frac{13,000 - 8,500}{3,000 - 1,500} \right]$	3.00
<b>Variable Cost per Unit</b>	<b>40.00</b>

**4. Calculation of Fixed Cost**

Particulars	₹
Administration Overhead	10,000
Production Overhead [16,500 – (1,500 × 7)]	6,000
Selling Overhead [8,500 – (1,500 × 3)]	4,000
<b>Total Fixed Cost</b>	<b>20,000</b>

Contribution per Unit = ₹ 50 – ₹ 40 = ₹ 10

$$P/V \text{ Ratio} = \frac{\text{Contribution per Unit}}{\text{Selling Price per Unit}} \times 100 = \frac{10}{50} \times 100 = 20\%$$

$$(a) \text{ Break — even Point (Units)} = \frac{\text{Fixed Cost}}{\text{Contribution per Unit}} = \frac{20,000}{10} = 2,000 \text{ Units}$$

$$\begin{aligned} \text{Break — even Point (Sales Value)} &= \frac{\text{Fixed Cost}}{\text{Contribution per Unit}} \times \text{Selling Price per Unit} \\ &= \frac{20,000}{10} \times 50 = ₹ 1,00,000 \end{aligned}$$

**(b) Net Profit if 75% capacity is utilised in 2017**

Number of Units to be produced in 2017 (Note 3) = 3,750

Total contribution (3,750 units × ₹ 10) 37,500

Less: Fixed cost 20,000

Net Profit of 2017 (Expected) 17,500

**(c) Number of Units to be Sold to earn a Profit of ₹ 25,000**

Fixed cost 20,000

Target profit 25,000

Required Contribution 45,000

$$\text{Number of Units to be Sold} = \frac{\text{Total Contribution}}{\text{Contribution per Unit}} = \frac{45,000}{10} = 4,500 \text{ units}$$

**(d) Amount of Sales to be made to achieve a target profit of 10% on Sales in 2018**

Let Sales = x

Therefore, Profit = 10% of x = 0.1x

$$\text{Sales Value} = \frac{\text{Total Fixed Cost} + \text{Target Profit}}{\text{P/V Ratio}}$$

$$x = \frac{20,000 + 0.1x}{20\%}$$

$$\text{or, } 0.2x = ₹ 20,000 + 0.1x$$

$$\text{or, } 0.1x = ₹ 20,000$$

$$\text{or, } x = ₹ 2,00,000$$

Therefore, total sales = ₹ 2,00,000

**Check :**

Contribution from Sale of ₹ 2,00,000 = 20% of ₹ 2,00,000 ₹ 40,000

Less: Fixed Cost 20,000

**Profit** 20,000

$$\text{Percentage of Profit on Sales} = \frac{\text{Profit}}{\text{Sales}} \times 100 = \frac{20,000}{2,00,000} \times 100 = 10\%$$

9. X Ltd. has the following revenue and cost characteristics of its only product :

Selling price per unit	₹ 60
Variable cost per unit	₹ 36
Fixed cost	₹ 6,00,000

**Calculate the following :**

- BEP in units and in rupees.
- Sales (units) required to earn a profit of ₹ 1,20,000.
- Margin of Safety and Profit when actual sales are 42,000 units.
- If 20% profit on sales is required, what level of sales is to be attained and what is the amount of profit ?
- Selling price required to earn a profit after tax of ₹ 1,05,000 (tax rate being 30%) by selling 25,000 units.

[C.U.B.Com. (Hons.) – 2018]

**Solution**

	₹
Selling Price per unit	60
Less: Variable cost per unit	<u>36</u>
Contribution per unit	<u>24</u>

$$P/V \text{ Ratio} = \frac{\text{Contribution per Unit}}{\text{Selling Price per Unit}} \times 100 = \frac{24}{60} \times 100 = 40\%$$

$$(a) \text{ Break - even Point (Units)} = \frac{\text{Fixed Cost}}{\text{Contribution per Unit}} = \frac{6,00,000}{24} = 25,000 \text{ units}$$

$$\begin{aligned} \text{Break - even Point (in rupees)} &= \frac{\text{Fixed Cost}}{\text{Contribution per Unit}} \times \text{Unit Selling Price} \\ &= \frac{6,00,000}{24} \times 60 = ₹ 15,00,000 \end{aligned}$$



(b) Sales (Units) required to earn a profit of ₹ 1,20,000

	₹
Fixed cost	6,00,000
Target profit	<u>1,20,000</u>
<b>Required Contribution</b>	<u>7,20,000</u>
Sales (Units) = $\frac{\text{Required Contribution}}{\text{Contribution per Unit}}$	$= \frac{7,20,000}{24} = 30,000 \text{ units}$

(c) Margin of Safety and Profit when actual sales is 42,000 units

(1) Calculation of Margin of Safety	₹
Actual Sales Value (42,000 × ₹ 60)	25,20,000
Less: BEP (Sales)	<u>15,00,000</u>
<b>Margin of Safety</b>	<u>10,20,000</u>
(2) Calculation of Profit	₹
Total Contribution (42,000 units × ₹ 24)	10,08,000
Less: Fixed cost (given)	<u>6,00,000</u>
<b>Profit</b>	<u>4,08,000</u>

(d) If 20% profit on sales is required, what level of sales is to be attained and what is the amount of profit ?

Let sales =  $x$

Therefore, profit = 20% of  $x = 0.2x$

Sales Value =  $\frac{\text{Total Fixed Cost} + \text{Target Profit}}{\text{P/V Ratio}}$

$$x = \frac{6,00,000 + 0.2x}{40\%}$$

$$\text{or, } 0.4x = ₹ 6,00,000 + 0.2x$$

$$\text{or, } 0.2x = ₹ 6,00,000$$

$$\text{or, } x = ₹ 30,00,000$$

Therefore, Sales = ₹ 30,00,000

Profit = ₹ 30,00,000 × 20% = ₹ 6,00,000

**Check :**

	₹
Contribution from Sales of ₹ 30,00,000 = 40% of ₹ 30,00,000	12,00,000
Less: Fixed cost (given)	<u>6,00,000</u>
<b>Profit</b>	<u>6,00,000</u>

$$\text{Percentage of Profit on Sales} = \frac{\text{Profit}}{\text{Sales}} \times 100 = \frac{6,00,000}{30,00,000} \times 100 = 20\%$$



(e) **Selling price required to earn a profit after tax of ₹ 1,05,000 (tax rate being 30%) by selling 25,000 units**

Profit after tax of 30% = ₹ 1,05,000

Therefore, profit before tax  $(1,05,000 \div 70\%) = ₹ 1,50,000$

**Required contribution :**

Fixed cost

Target profit before tax

**Contribution**

Contribution per unit  $(7,50,000 \div 25,000) = ₹ 30$

Selling price per unit = Variable cost per unit + Contribution per unit = ₹ 36 + ₹ 30 = ₹ 66

**Check :**

Total Sales  $(25,000 \times ₹ 66)$

Less: Total Variable Cost  $(25,000 \times 36)$

**Contribution**

Less: Fixed Cost

Profit before tax

Less: Tax @ 30%

**Profit after tax**

₹
6,00,000
1,50,000
<u>7,50,000</u>
₹
16,50,000
<u>9,00,000</u>
7,50,000
<u>6,00,000</u>
1,50,000
<u>45,000</u>
<u>1,05,000</u>

**THANK YOU FOR WATCHING MY  
PRESENTATION**