



Marginal Costing Technique

Break-even Analysis

Meaning of Break-even Analysis: Break-even analysis is made up of two words: (1). Break-even, and (2). Analysis. For any business, break-even point means that position of production and sales when the business has neither profit nor loss. When this position is estimated and put before the management for decisions etc., the process is known as Break-even analysis.

Parts of Break-even analysis: For Break-even analysis, the position is analyzed on the basis of following points:

1. Contribution;
2. Profit Volume Ratio;
3. Break-even Point; and
4. Margin of Safety.

Contribution

Formulae for contribution: Contribution is calculated using the formula:

Contribution = Sales - Variable Costs

or $C = S - V$

Example: In illustration 1, where total of variable overheads paid was Rs.34,400, if amount of sales is Rs.51,600, contribution will be as follows:

$$C = S - V$$

$$\text{or } C = \text{Rs. } (51,600 - 34,400) = \text{Rs. } 17,200.$$

Significance of contribution: Contribution shows the amount available in the business for charging fixed expenses and then for net profit. Thus, contribution includes two items: (1). Fixed expenses; and (2). Net profit. In other words we can say, contribution is the sum of fixed expenses and net profit. As a formulae we can express it as follows:

Contribution = Fixed Costs + Net Profit

or $C = F + P$

Illustration:

In illustration 1 fixed cost is Rs. (3,600 + 4,000 + 3,000) = Rs.10,600 and sales is Rs.51,600, what will be the contribution?

Solution:

$$S - V = C \text{ or } \text{Rs. } 51,600 - \text{Rs. } 34,400 = \text{Rs. } 17,200$$

$$C = F + P \text{ or } \text{Rs. } 17,200 = \text{Rs. } 10,600 + \text{Rs. } 6,600 \text{ (Bal. fig)}$$

Thus, it is clear that on subtracting fixed costs from contribution we get net profit. The above figures can be presented in the form of a statement as follows:



Statement of Cost and Profit

	Rs.
Sales	51,600
Less: Variable Cost	34,400
Contribution	17,200
Less: Fixed Cost	10,600
Net Profit	6,600

Marginal Cost Equation

Two equations have been given above for contribution:

(1). $S - V = C$, and (2). $C = F + P$

Both these equations can be put together as:

$$S - V = F + P = C$$

Illustration:

From the following particulars, find out total contribution and contribution per unit:

Sales: 1,000 units @ Rs.10 per unit; Direct Material Rs.3,000; Direct Labor

Rs.2,000; Variable factory Overhead 100% of Direct Labor; and Variable Administrative and Selling Overhead 50% of Direct Labor.

Solution:

Statement showing Total Contribution and contribution per unit

Units=1000

Particulars	Total (Rs.)	Per Unit (Rs.)
Direct Material	3,000	3.00
Direct Labor	2,000	2.00
Prime Cost	5,000	5.00
Variable Factory Overhead	2,000	2.00
Factory Marginal Cost	7,000	7.00
Variable Administrative and Selling Overhead	1,000	1.00
Total Marginal Cost	8,000	8.00
Sales	10,000	10.00
Contribution	2,000	2.00

Profit/Volume Ratio

Meaning of Profit/Volume Ratio: Profit-Volume Ratio means the ratio of 'Profit' and 'Volume'. Profit here means the contribution, and volume means the amount of sales. In correct sense profit/volume ratio should be named as contribution/sales ratio.

Formulae for Profit-Volume Ratio:

$$P/V \text{ Ratio} = \text{Contribution/Sales or } C/S$$

If expressed in percentage:

$$P/V \text{ Ratio} = [C/S * 100]$$



As contribution is obtained by subtracting variable cost from sales,
P/V Ratio (In %) = $\frac{\text{Sales} - \text{Variable Cost}}{\text{Sales}} \times 100$

Illustration:

From the following information, calculate P/V Ratio according to all the four formulas.

Sales Rs.20,000; Variable Cost Rs.12,000; and Fixed Cost Rs.5,000

Solution:

First of all contribution and profit will be calculated using marginal cost equation:

$$S - V = F + P = C$$

$$P = S - V - F = \text{Rs. } (20,000 - 12,000 - 5,000) = \text{Rs. } 3,000$$

$$\text{and } C = S - V = \text{Rs. } 20,000 - \text{Rs. } 12,000 = \text{Rs. } 8,000$$

P/V Ratio in percent form using various formulae,

$$\begin{aligned} \text{Formulae (1). P/V Ratio} &= [C/S \times 100] \\ &= [8,000/20,000 \times 100] = 40\% \end{aligned}$$

$$\begin{aligned} \text{Formulae (2). P/V Ratio} &= S - V/S \times 100 \\ &= 20,000 - 12,000/20,000 \times 100 = 40\% \end{aligned}$$

$$\begin{aligned} \text{Formulae (3). P/V Ratio} &= F + P/S \times 100 \\ &= 5,000 + 3,000/20,000 \times 100 = 40\% \end{aligned}$$

$$\begin{aligned} \text{Formulae (4). P/V Ratio} &= [1 - \text{Variable Cost}/\text{Sales}] \times 100 \\ &= [1 - 12,000/20,000] \times 100 = 40\% \end{aligned}$$

Illustration:

Given:

Sales Rs.5,00,000, P/V Ratio 50%, F.C. Rs.1,00,000

Calculate:

- (1) Variable Cost
- (2) Profit
- (3) Contribution

Solution:

$$\begin{aligned} \text{(1) Variable Cost} &= \text{Sales} - (\text{P/V Ratio} \times \text{Sales}) \\ &= \text{Rs. } 5,00,000 - (50\% \times \text{Rs. } 5,00,000) \\ &= \text{Rs. } 5,00,000 - \text{Rs. } 2,50,000 \\ &= \text{Rs. } 2,50,000 \end{aligned}$$

$$\begin{aligned} \text{(2) Profit} &= (\text{P/V Ratio} \times \text{Sales}) - F \\ &= (50\% \times \text{Rs. } 5,00,000) - \text{Rs. } 1,00,000 \\ &= \text{Rs. } 2,50,000 - \text{Rs. } 1,00,000 \\ &= \text{Rs. } 1,50,000 \end{aligned}$$

$$\begin{aligned} \text{(3) Contribution} &= S \times \text{P/V Ratio} \\ &= \text{Rs. } 5,00,000 \times 50\% \\ &= \text{Rs. } 2,50,000 \end{aligned}$$

Illustration:

To produce 10,000 units of a product and sell it at a price of Rs.10 each, the following two alternative processes are available:



Particulars	Machine Process Rs.	Manual Process Rs.
Direct Material	20,000	20,000
Direct Labor	2,000	10,000
Depreciation of Machine	5,000	
Repairs to Machine	10,000	
Power	3,000	
Fixed Costs	5,000	20,000
Total Cost	45,000	50,000

Calculate the following and suggest which alternative is better.

(1) Contribution; (2) P/V Ratio; (3) Net Profit

Solution:

Statement of Contribution, P/V Ratio and Net Profit

Particulars	Machine Process Rs.	Manual Process Rs.
Sales	1,00,000	1,00,000
Less: Variable Costs	40,000	30,000
(1) Contribution	60,000	70,000
(2) P/V Ratio	60%	70%
Fixed Costs	5,000	20,000
(3) Net Profits	55,000	50,000

Break-even Point (BEP)

Meaning of Break-even Point:

According to E.L. Kohler, the volume point at which revenues and costs are equal is the Break-even point. In another sense, Kohler has said, "It is that point in the cost of a variable factor of production at which one or more alternatives are equally economical. "The break-even point is the sales volume at which there is neither profit nor loss, cost being equal to revenue."

Formulae for Break-even Point: Break- even point can be found in two ways: (a) BEP in value, and (b) BEP in units.

(a). Break-even Point in value:

It is calculated by the formulae:

Break-even Point = Fixed Cost / P/V Ratio

or $BEP = F / P/V \text{ Ratio}$

If Profit-Volume ratio is not given, the formulae will be as follows:

$BEP = F / (1 - V/S)$

Break-even Point in units:

It is calculated by the formulae

$BEP = F / C$ (Contribution per unit)

or $BEP = F / (S \text{ per unit} - V \text{ per unit})$

Illustration:

Calculate BEP in value and BEP in units from the following data:

S = 10,000 units @ Rs.10 each; V = Rs.60,000;



$$F = \text{Rs.}10,000$$

Solution:

$$C = \text{Rs.}1,00,000 - \text{Rs.}60,000 = \text{Rs.}40,000$$

$$C \text{ per unit} = \text{Rs.}10 - \text{Rs.}6 = \text{Rs.}4 \text{ (i.e. Rs.}40,000/10,000)$$

$$P/V \text{ Ratio} = 40,000/1,00,000 \times 100 = 40\%$$

$$\begin{aligned} \text{BEP (in value)} &= F / P/V \text{ Ratio} \\ &= \text{Rs.}10,000 / 40/100 = \text{Rs.}25,000 \end{aligned}$$

$$\begin{aligned} \text{BEP (in units)} &= F / \text{Contribution per unit} \\ &= 10,000 / 4 = 2,500 \text{ units.} \end{aligned}$$

Illustration:

The following data are provided:

Product	Selling price per unit Rs.	Variable Cost per unit Rs.	Percent of Rupees Sales Volume
X	4	3	20
Y	5	4	40
Z	8	6	40

Capacity: Total Sales Rs.15,00,000; Fixed cost: Rs.2,30,000.

Calculate the following:

- (a) BEP in rupees; and
- (b) Profit or Loss at 80% Capacity.

Solution:

Statement of Cost

Particulars	X	Y	Z	Total
(1) Sales (Rs.)	20	40	40	100
(2) Selling Price per Unit (Rs.)	4	5	8	
(3) No. of units sold (1)/(2)	5	8	5	
(4) Variable Cost per unit (Rs)	3	4	6	
(5) Total Variable Cost i.e. (3)*(4) (Rs)	15	32	30	77
(6) Contribution (1) - (5)	5	8	10	23

(a) BEP in rupees:

$$P/V \text{ Ratio} = 23\%$$

$$F = \text{Rs.}2,30,000$$

$$\begin{aligned} \text{Therefore, BEP} &= 2,30,000 / 23/100 = 2,30,000 \times 100/23 \\ &= \text{Rs.}10,00,000 \end{aligned}$$

(b) Profit or Loss on 80% Capacity:

$$\text{Sales on 80\% capacity} = \text{Rs.}15,00,000 \times 80/100$$

$$= \text{Rs.}12,00,000$$

$$\text{and sales at BEP} = \text{Rs.}10,00,000$$



Therefore, Additional Sales on 80% Capacity
= Rs. (12,00,000 - 10,00,000) = Rs.2,00,000
23% profit on sales of Rs.2,00,000 = Rs.46,000

Illustration:

A factory manufacturing sewing machines has the capacity to produce 500 machines per annum. The marginal cost of each machine is Rs.200 and each machine is sold at Rs.250. Fixed overheads are Rs.12,000 per annum. Calculate BEP for output and BEP for sales using five different formulae and show what profit will result if output is 90% of capacity.

Solution:

Contribution (C) per machine = Selling price (S.P.) - Variable Cost (V)
= Rs.250 - Rs.200 = Rs.50

B.E.P. (for Production) = F / Contribution per unit
= 12,000 / 50 = 240 machines

B.E.P. (for sales): using different formulae:

(1) F/P/V Ratio or 12,000/20/100

or 12,000 * 100/20 = Rs.60,000

Here P/V Ratio = 25,000/1,25,000*100 = 20%

(2) Fixed Cost / (1 - Variable Cost per Unit/Selling price per Unit)
= 12,000 / (1 - 200/250) = 12,000 / 50/250 = Rs.60,000

(3) Fixed Cost / (Contribution per unit/Selling price per unit)
= 12,000 / 50/250 = 12,000*250/50 = Rs.60,000

(4) Fixed Cost * Total Sales/Total Contribution
= 12,000 * (500*250)/(500*50) = 12,000*1,25,000/25,000
= Rs.60,000

(5) FS * 1/C = 12,000 * 1,25,000 * 1/25,000
= Rs.60,000

Profit at 90% capacity:

Output at 90% Capacity = 90% of 500 = 450 machines

Sales Value = 450 * 250 = Rs.1,12,500

Less: Variable Cost = 450 * 200 = Rs.90,000

Total Contribution Rs.22,500

Less: Fixed cost Rs.12,000

Profit at 90% Capacity Rs.10,500

Margin of Safety (M/S)

Meaning of Margin of Safety:

The more the actual sales above the break-even point, the more safe is the position of the company. Therefore, the excess of actual sales over the break-even sales is called Margin of Safety.

Formulae for Margin of Safety:

M/S = Sales (S) - BEP Sales

or M/S Profit (P) / (P/V) Ratio



In Percent: Margin of Safety can be expressed as Margin of Safety Ratio in percent form. The formulae for the same is:

$$\begin{aligned} \text{M/S Ratio} &= (\text{Margin of Safety}/\text{Sales}) \times 100 \\ \text{or} &= \text{Actual Sales} - \text{BEP Sales} / \text{Sales} \times 100/1 \end{aligned}$$

Significance of Margin of Safety:

Margin of Safety is very important for a business. In its absence or if this margin is narrow, the business will always be under a fear of insecurity. Following points are very important in this respect:

- (1). A big margin of Safety indicates that the break-even point is far below, so if the amount of sales decreases a little, the company will still be in profit and there is no risk to its safety.
- (2). If the margin of safety is very small, it indicates that the company is in difficult position.

Illustration:

Given:

Sales Rs.1,00,000; Variable cost Rs.75,000; Fixed cost Rs.20,000.

Ascertain the following:

- (1) B.E.P., (2) Margin of Safety; (3) M/S Ratio.

Solution:

$$\begin{aligned} \text{Contribution (C)} &= \text{Rs.1,00,000} - \text{Rs.75,000} \\ &= \text{Rs.25,000} \end{aligned}$$

$$\text{P/V Ratio} = 25,000/1,00,000 \times 100/1 = 25\%$$

$$\text{BEP} = 20,000/25/100 = 20,000 \times 100/25 = \text{Rs.80,000}$$

$$\begin{aligned} \text{Margin of Safety} &= \text{Rs.1,00,000} - \text{Rs.80,000} \\ &= \text{Rs.20,000} \end{aligned}$$

$$\text{M/S Ratio} = 20,000/1,00,000 \times 100/1 = 20\%$$

Illustration:

The following information is given for the year 2004:

	First 6 months	Last 6 months
	Rs.	Rs.
Sales	2,70,000	3,00,000s
Less: Total Cost	2,40,000	2,58,000
Profit	30,000	42,000

Calculate the following:

- (1) Profit-Volume Ratio;
- (2) Fixed Cost;
- (3) Break-even Point (in value);
- (4) Margin of Safety; and
- (5) Margin of Safety Ratio
- (6) Sales required to earn a profit of Rs.25,000 after tax, assume tax rate being 50%; and
- (7) Profit earned when sales are Rs.5,00,000.

Solution:



(1) **P/V Ratio** = Increase in profit/Increase in sales*100 = 12,000/30,000*100 = 40%

(2) **Fixed Cost:**

Contribution (C) on Rs.2,70,000 @ 40% = Rs.1,08,000

Fixed Cost for the first six months = C - P

$$= \text{Rs.}1,08,000 - 30,000 = \text{Rs.}78,000$$

Total Fixed Cost (F) for the year = Rs.78,000*2 = Rs.1,56,000

(3) **BEP** = F/P/V Ratio = Rs.1,56,000/40/100

$$= \text{Rs.}1,56,000 * 100 / 40 = \text{Rs.}3,90,000$$

(4) **M/S** = Actual Sales - BEP Sales

$$= \text{Rs.} (2,70,000 + 3,00,000 - 3,90,000)$$

$$= \text{Rs.}1,80,000$$

(5) **M/S Ratio** = M/S/S*100 = 1,80,000/5,70,000*100 = 31.58%

(6) **Required Sales (in Rs.)** = F + Desired Profit/1-Tax Rate/P/V Ratio

$$= (1,56,000 + 25,000/1-50\%)/40*100$$

$$= (1,56,000 + 25,000/0.50)/40*100$$

$$= 1,56,000 + 50,000/40*100 = \text{Rs.}5,15,000$$

(7) If Sales are Rs.5,00,000:

Contribution = 5,00,000*40% = Rs.2,00,000

Fixed cost = Rs.1,56,000

Therefore, Profit will be = Rs.2,00,000 - Rs.1,56,000 = Rs.44,000.

Profit-Volume Graph: Profit-Volume graph is also known as Profit graph. It is a simple form of Break-even chart. It is necessary to find out the break-even point using arithmetical formulae, before drawing the graph.

Drawing a Profit-Volume Chart: Amount of sales is shown on the horizontal line (X-axis). BEP, which has already been calculated using formulae, is marked on this axis. Vertical line (Y-axis) is drawn through the zero point (origin). The portion above the X-axis shows the region of profit, and below the X-axis is the region of loss. Point of fixed cost is marked on the Y-axis below the X-axis as it is a loss. Now, a line is drawn joining this fixed cost point on Y-axis and BEP on X-axis. This line is extended up to a point a bit beyond the current amount of sales. Thus, the graph is prepared.

Illustration:

Draw a profit-graph from the following figures:

Output 10,000 Units; Sales Rs.25,000; Variable Cost Rs.15,000; Fixed Costs Rs.5,000.

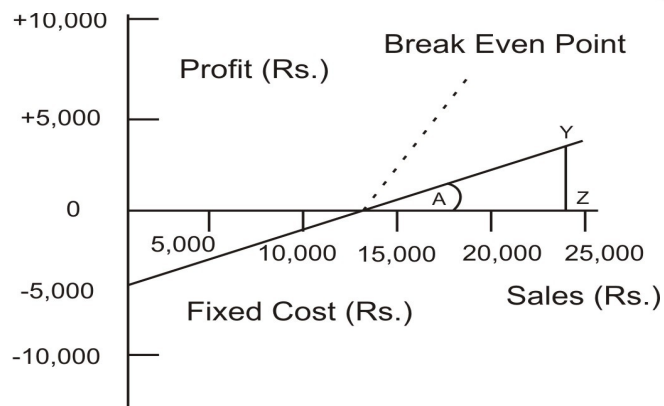
Solution:

Before drawing the graph, find out the BEP as follows:

$$\text{BEP} = F/S - V/S$$

$$= 5,000/25,000 - 15,000/25,000 = 5,000*25,000/10,000 = \text{Rs.}12,500$$

Now the graph will take the following shape.



Profit Graph

Analysis of Profit-Volume graph: BEP calculated by the formulae is Rs.12,500. It is marked at the point X on the line OZ (X-axis). The point of fixed cost (-5,000) on Y-axis is joined to this point and the line is extended up to Y. Thus, XYZ is the profit-region. YZ (Rs.5,000) shows the profit. A is the angle of incidence, and XZ (25,000 - 12,500) = Rs.12,500 is the margin of safety. The line XY can be extended to any limit and from this line profit from any amount of sale can be read on the graph.