

Management Accountancy

Unit 4

Cost Volume Profit (CVP) Analysis under Condition of Certainty

Structure

- Concept, Objectives, assumptions, of cost-volume-profit-analysis
- Application of cost-volume-profit for breakeven analysis and profit planning including multiple products with interpretation

After the completion of this unit, you should be able to:

- 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

4.1 Concept, Objectives, assumptions, of cost-volume-profit-analysis Concept CVP analysis

The relationship between cost volume and profit is shown by cost-volume-profit-analysis. It is an analytical tool for analysing the relationship among cost, price, profit, sales and production volume. Mainly, there are three elements in cost-volume-profit analysis. They are 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 etc.

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? etc.

4.2 Objectives of CVP analysis

Cost-Volume-Profit Analysis helps management in a number of ways. The following purposes are served by it :

- 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 factor
- 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.

Cost-volume-profit-analysis is an important tool for profit planning. It has been defined as a managerial tool showing the relationship between cost, selling price, profit and volume of activity.

CVP analysis can be applied in the following respects :

- (a) It helps in fixation of selling price.
- (b) It is helpful in cost control.
- (c) It also assists the management in understanding the behaviour of cost and helps in budgetary control.
- (d) It helps in determining the level of output where all the costs can be met.
- (e) It assists the management in profit planning.
- (f) It also assists management in performance evaluation for the purpose of management control.
- (g) 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.

4.3 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

4.4 Application of cost-volume-profit for breakeven analysis and profit planning including multiple products with interpretation

The break-even analysis is very useful in the area of managerial decision making. It is extremely a valuable technique with management. Some of the important uses of break-even analysis are summarised below :

- (i) Determination of 'no-profit no loss' sales volume.
- (ii) Calculation of sales volume to earn desire profit.
- (iii) Determination of selling price per unit for earning a desired profit.
- (iv) Calculation of sales volume to meet proposed expenditure.
- (v) Determination of margin of safety.
- (vi) Calculation of sales volume required to offset price reduction.
- (vii) Impact of change in costs on profits.
- (viii) Determination of the optimum sales mix.
- (ix) Determination of comparative profitability of each product line.
- (x) To help the management in decision making eg. make or buy a part, accept or reject a special order, Pricing of the product, Drop or continue a product line etc.
- (xi) Determination of cash requirement at different levels of activity with the help of cash break-even point.
- (xii) Ascertainment of profit potentiality of addition expansion capacity.

4.5 Margin of Safety

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. On the other hand, 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 margin of satisfactory is unsatisfactory, the following steps can be taken.

- (i) By increasing the sales and production volume.
- (ii) By increasing the selling price.
- (iii) By decreasing the fixed cost.
- (iv) By reducing the variable cost.
- (v) By changing the sales or product mix ratio.

Margin of safety is ascertained by using the following formulae :

$$\text{Margin of Safety (units)} = \frac{\text{Profit}}{\text{Contribution per Unit}}$$

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

$$\text{Margin of Safety (Units)} = \text{Actual sales units} - \text{BEP sales units}$$

$$\text{Margin of Safety (\$)} = \text{Actual sales amount} - \text{BEP sales amount}$$

$$\text{Margin of Safety (in\%)} = \frac{\text{Actual Sales} - \text{Break-even Sales}}{\text{Actual Sales}} \times 100.$$

ILLUSTRATION 1

Pokhara Metal Co. Ltd. manufactures pressure cooker, the selling price of which is \$ 500 per unit. An analysis of their accounting reveal :

Variable Cost per Unit	\$ 200
Fixed Cost for the Year	\$ 3,00,000
Sales and Production Unit	1,200 units
Normal Capacity	1,500 units

Required:

- (i) Profit Volume at Present Capacity of 1,200 units.
- (ii) Profit Volume at 90% Capacity.
- (iii) Sales Volume to Earn \$ 75,000 Profit.
- (iv) Profit Volume at Full Capacity, if Variable Cost per unit increased by \$ 25.

SOLUTION:

- (i) Profit Volume at 1,200 units :

We have, SP, Selling Price per Unit = \$ 500

UVC, Variable Cost per Unit = \$ 200

x, No. of Units Sold = 1200 units.

FC, Total Fixed Cost = \$ 3,00,000

Profit Volume = ?

$$\begin{aligned}\text{Profit} &= x (\text{SP} - \text{UVC}) - \text{FC} \\ &= 1200 (500 - 200) - 3,00,000 \\ &= 3,60,000 - 3,00,000 \\ &= 60,000\end{aligned}$$

Hence, Profit = \$ 60,000.

- (ii) Profit Volume at 90% Capacity :

Production and Sales Volume at 90% Capacity = $1,500 \times \frac{90}{100}$

= 1,350 units.

$$\begin{aligned}\text{Profit at 1,350 units} &= 1,350 (500 - 200) - 3,00,000 \\ &= 4,05,000 - 3,00,000 \\ &= 1,05,000\end{aligned}$$

Hence, Profit = \$ 1,05,000.

- (iii) Sales Volume to Earn \$ 75,000 Profit :

Let, Sales Volume = x units (suppose)

We have, Profit = $x(\text{SP} - \text{UVC}) - \text{FC}$

$$\text{or, } 75,000 = x(500 - 200) - 3,00,000$$

$$\text{or, } 75,000 = 300x - 3,00,000$$

$$\text{or, } 300x = 75,000 + 3,00,000$$

$$\therefore x = \frac{3,75,000}{300} = 1,250$$

Hence, Sales Volume to Earn \$ 75,000 profit = 1,250 units.

(iv) Profit volume at full capacity, if variable cost per unit increases by \$ 25:

$$\begin{aligned}\text{Profit} &= x(\text{SP} - \text{UVC}) - \text{FC} \\ &= 1,500(500 - 225) - 3,00,000 \\ &= 4,12,500 - 3,00,000 \\ &= 1,12,500 \\ \text{Hence, Profit} &= \$ 1,12,500.\end{aligned}$$

ILLUSTRATION 2

A company markets plastic toys. An analysis of their accounting reveals :

Fixed Costs	\$ 80,000
Variable Cost per Toy	\$ 12
Unit Selling Price	\$ 20

Required: Calculate :

- (i) Break-even Units.
- (ii) Break-even \$
- (iii) Required Sales Units for earning \$ 32,000 profit.
- (iv) Requires sales amount for earning a profit after tax of \$ 20,000, if tax rate is 50%.
- (v) Margin of safety, if sales amount is \$ 3,00,000.
- (vi) Profit if sales amount is \$ 3,50,000.
- (vii) New break-even point in units if selling price per unit increased by \$ 2.

SOLUTION:

$$\begin{aligned}\text{(i) Break-even Units} &= \frac{\text{Fixed Cost}}{\text{Unit Selling Price} - \text{Unit Variable Cost}} \\ &= \frac{80,000}{20 - 12} \\ &= 10,000 \text{ units.}\end{aligned}$$

$$\begin{aligned}\text{(ii) Break-even \$} &= \frac{\text{Fixed Cost}}{1 - \frac{\text{Unit Variable Cost}}{\text{Unit Selling Price}}} \\ &= \frac{80,000}{1 - \frac{12}{20}} \\ &= \frac{80,000}{0.4} = \$ 2,00,000.\end{aligned}$$

$$\begin{aligned}\text{(iii) Required Sales unit for earning \$ 32,000 profit} &= \frac{\text{FC} + \text{Desire Profit}}{\text{CMPU}} \\ &= \frac{80,000 + 32,000}{8} \\ &= 14,000 \text{ units.}\end{aligned}$$

Contribution Margin per Unit = Unit Selling Price – Unit Variable Cost

$$= 20 - 12 = \$ 8.$$

(iv) Required sales amount for earning a profit after tax of \$ 20,000, if tax rate is 50%

$$= \frac{FC + \frac{\text{Profit after tax}}{1 - \text{tax rate}}}{1 - \frac{\text{Unit variable cost}}{\text{Unit selling price}}}$$

$$= \frac{80,000 + \frac{20,000}{1 - 0.5}}{1 - \frac{12}{20}}$$

$$= \frac{1,20,000}{0.4}$$

$$= \$ 3,00,000.$$

(v) Margin of Safety = Actual Sales – Break-even Sales
 = 3,00,000 – 2,00,000
 = \$ 1,00,000.

(vi) Operating Profit = (Sales × P/V Ratio) – Fixed Cost
 = (3,50,000 × 0.40) – 80,000
 = \$ 60,000.

(vii) Revised Break-even Point =

$$\frac{\text{Fixed Cost}}{\text{New Selling Price} - \text{Unit Variable Cost}}$$

$$= \frac{80,000}{22 - 12}$$
 = 8,000 units.

ILLUSTRATION 3

The sales turnover and profit of a firm for two different periods are :

Period	I	II
Sales	\$ 1,40,000	\$ 1,60,000
Profit	\$ 15,000	\$ 20,000

- Required: (i) P/V Ratio.
 (ii) Fixed Cost.
 (iii) Sales required to earn a profit of \$ 40,000.
 (iv) Profit when sales are \$ 1,50,000.
 (v) Break-even Sale.
 (vi) Percentage of margin of safety to total sales for two different year\$

SOLUTION:

(i) P/V Ratio = $\frac{\text{Diff. in Profit}}{\text{Diff. in Sales}}$

$$\begin{aligned}
&= \frac{20,000 - 15,000}{1,60,000 - 1,40,000} \\
&= \frac{5,000}{20,000} \\
&= 0.25.
\end{aligned}$$

(ii) Fixed Cost = (Sales × P/V Ratio) – Profit
 Period I = (1,40,000 × 0.25) – 15,000
 = 35,000 – 15,000
 = \$ 20,000.

Period II = (1,60,000 × 0.25) – 20,000
 = \$ 20,000.

(iii) Required Sales = $\frac{FC + \text{Desire Profit}}{P/V \text{ Ratio}}$
 = $\frac{20,000 + 40,000}{0.25}$ = \$ 2,40,000.

(iv) Profit = (Sales × P/V Ratio) – FC = (1,50,000 × 0.25) – 20,000 = \$ 17,500.

(v) Break-even Sales = $\frac{\text{Fixed Ratio}}{P/V \text{ Ratio}} = \frac{20,000}{0.25} = \$ 80,000.$

(vi) % of Margin of Safety = $\frac{\text{Actual Sales} - \text{Break - Even Sales}}{\text{Actual Sales}} \times 100$

Period I = $\frac{1,40,000 - 80,000}{1,40,000} \times 100 = 42.86\%.$

Period II = $\frac{1,60,000 - 80,000}{1,60,000} \times 100 = 50\%.$

ILLUSTRATION 4

A multi-product company follows standard sales mix policy for its product. The reported income and expenditures for the last year are presented below :

Product	A	B	Total
Sales in unit	<u>30,000</u>	<u>10,000</u>	<u>40,000</u>
Sales Revenue	<u>3,00,000</u>	<u>2,00,000</u>	<u>5,00,000</u>
Less : Variable Cost	<u>1,50,000</u>	<u>1,00,000</u>	<u>2,50,000</u>
Contribution Margin	<u>1,50,000</u>	<u>1,00,000</u>	<u>2,50,000</u>
Less : Departmental Fixed Cost	<u>50,000</u>	<u>50,000</u>	<u>1,00,000</u>
Contribution available for Joint Fixed Cost	1,00,000	50,000	1,50,000
Less : Joint Fixed Cost			<u>50,000</u>
Net Income before Tax			<u>1,00,000</u>

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

- (b) Percentage increase in the selling price of product A to keep at in original break-even sales volume if the selling price of product B decreases by 15%.
- (c) Break Even Sales Volume in units, if standard sales is changed to one unit to one unit.

SOLUTION:

(a) Selling price per unit:

$$A = \frac{3,00,000}{30,000} = \$ 10.$$

$$B = \frac{2,00,000}{10,000} = \$ 20.$$

Variable Cost per unit :

$$A = \frac{1,50,000}{30,000} = \$ 5.$$

$$B = \frac{1,00,000}{10,000} = \$ 10.$$

Contribution Margin per unit :

$$A = 10 - 5 = \$ 5.$$

$$B = 20 - 10 = \$ 10.$$

Sales Mix Ratio = A:B = 30,000 : 10,000 = 3:1

Calculation of Weighted Average Contribution Margin:

Product	CMPU	Sales Mix	C × S
A	5	3/4	15/4
B	10	1/4	10/4
Weighted Average Contribution Margin			25/4

$$\begin{aligned} \therefore \text{Overall Break-even Point} &= \frac{\text{Fixed Cost}}{\text{Weighted Average Contribution Margin}} \\ &= \frac{1,00,000 + 50,000}{25/4} \\ &= 24,000 \text{ units.} \end{aligned}$$

(b) Selling Price per unit of :

Product A = \$ x (suppose)

Product B = 20 - 3 = \$ 17.

Share of Product A to BEP = 24,000 units × 3/4 = 18,000 units

Share of Product B to BEP = 24,000 units × 1/4 = 6,000 units

We have, Sales = Fixed Cost + Variable Cost + Profit

or, 18,000x + 6,000 × 17 = 1,50,000 + [(18,000 × 5) + (6,000 × 10)] + 0

or, 18,000x + 1,02,000 = 1,50,000 + 1,50,000

or, 18,000 x = 1,98,000

$$\therefore x = \frac{1,98,000}{18,000} = 11$$

Hence, Selling Price per unit = \$ 11.

Therefore, % of Increase on Selling Price = $\frac{1}{10} \times 100 = 10\%$

(c) A:B = 1:1

Calculation of Weighted Average Contribution Margin:

Product	CMPU	Sales Mix	C × S
A	5	1/2	5/2
B	10	1/2	10/2
Weighted Average Contribution Margin			15/2

$$\begin{aligned}\therefore \text{Overall Break-even Point} &= \frac{\text{Fixed Cost}}{\text{Weighted Average Contribution Margin}} \\ &= \frac{1,50,000}{15/2} \\ &= 20,000 \text{ units.}\end{aligned}$$

References

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