

Chap - 4

## **Cost-Volume-Profit (CVP) Analysis**

*(Go through the reference books for details)*

### ❖ **Cost-volume-profit (CVP) Analysis** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 234)

Cost-volume-profit (CVP) analysis is one of most powerful tools that helps management to make their decision. It helps them understand the interrelationship between cost, volume and profit in an organization by focusing on interactions among the following five elements:

1. Prices of products
2. Volume or level of activity
3. Per unit variable cost
4. Total fixed costs
5. Mixed of product sold

As CVP analysis helps managers understand the interrelationships among cost, volume, and profit, it is a vital tool in many business decisions. These decisions include, for example, what products to manufacture or sell, what pricing policy to follow, what marketing strategy to employ, and what type of productive facilities to acquire.

### ❖ **Contribution Margin** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 235)

Contribution margin is the amount remaining from sales revenue after variable expenses have been deducted. Thus, it is the amount available to cover fixed expenses and then to provide profits for the period. It is used first to cover the fixed expenses and then whatever remains goes toward profits. If the contribution margin is not sufficient to cover the fixed expenses, then a loss occurs for the period.

	<b>Activity Level 500 Units</b>	<b>Activity Level 600 Units</b>	<b>Activity Level 700 Units</b>
Sales @ Tk. 10 per unit	Tk. 5000	Tk. 6000	Tk. 7000
Less, Variable Expenses @ Tk. 8 per unit	Tk. 4000	Tk. 4800	Tk. 5600
<b>Contribution Margin @ Tk. 2 per unit</b>	<b>Tk. 1000</b>	<b>Tk. 1200</b>	<b>Tk. 1400</b>
Less, Fixed Expenses	Tk. 1200	Tk. 1200	Tk. 1200
<b>Net Operating Income (Loss)</b>	<b>Tk. (200)</b>	<b>Tk. 0</b>	<b>Tk. 200</b>

In the above example, at activity level 500 units, contribution margin is Tk. 1000, which is less than the fixed expenses Tk. 1200. So, operating loss at this level Tk. 200 ( Tk. 1200- 1000). At activity level 600 units, the contribution margin and fixed expenses are equal i. e., Tk. 1200 = Tk. 1200 and it is break-even level of activity where there is no profit or loss. And at activity level 700 units, the contribution margin is more than the fixed expenses by Tk. 200, which indicate the operating income for the period.

❖ **Contribution Margin Ratio** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 240)

When the contribution margin is expressed as a percentage of total sales is known as contribution margin ratio. It indicates that how contribution margin will be affected by a change in total sales. CM ratio is calculated as follows:

$$\text{CM ratio} = \frac{\text{Contribution Margin}}{\text{Total Sales}} = \frac{1200}{6000} = 20\%$$

or

$$\text{CM ratio} = \frac{\text{Unit Contribution Margin}}{\text{Unit Selling Price}} = \frac{2}{10} = 20\%$$

Here, contribution margin is 20% of total sales. If sales increase then contribution margin will increase by 20% of the sales increased.

❖ **Break-Even Point** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 244)

Break-even point is that level of activity where there is no profit or loss. At this level, total revenue equals to total expenses and company's profit is zero, i.e., Total Sales Revenue = Total Variable Costs + Total Fixed Costs. If the company exceed break-even level, then the company earns profit and if the activity level is under the break-even point, company suffers a loss. There are two methods for calculating break-even point, which are as follows:

**A. The Equation Method:** The equation method centers on the contribution approach to the income statement equation to calculate the break-even point. The format of this income statement can be expressed in equation form as follows:

$$\text{Profit} = (\text{Sales} - \text{Variable Expenses}) - \text{Fixed Expenses}$$

Rearranging this equation slightly yields the following equation, which is widely used in CVP analysis:

$$\text{Sales} = \text{Variable Expenses} + \text{Fixed Expenses} + \text{Profits}$$

**Example**

Let, Selling price per unit = Tk. 10, Variable Expense per unit = Tk. 8, Total Fixed Expenses = Tk. 1200, Break-even Quantity of sales (Q) =? What would be the break-even sales in amount (Taka)?

$$\text{Sales} = \text{Variable Expenses} + \text{Fixed Expenses} + \text{Profits}$$

$$\Rightarrow \text{Tk. } 10Q = \text{Tk. } 8Q + \text{Tk. } 1200 + \text{Tk. } 0$$

$$\Rightarrow \text{Tk. } 10Q - \text{Tk. } 8Q = \text{Tk. } 1200$$

$$\Rightarrow \text{Tk. } 2Q = \text{Tk. } 1200$$

$$\Rightarrow Q = 600$$

Therefore, Break-even point in units = 600 Units or

$$\text{Break-even point in amount} = \text{Tk. } 10 \times 600 \text{ Units} = \text{Tk. } 6000$$

**B. The Contribution Margin Method:** The contribution margin method is actually just a shortcut version of the equation method. To calculate the break-even sales, divide fixed costs by the unit contribution margin:

$$\text{Break-even point in units} = \frac{\text{Fixed Expenses}}{\text{Unit Contribution Margin}} = \frac{1200}{2} = 600 \text{ Units}$$

or

$$\text{Break-even point in Taka} = \frac{\text{Fixed Expenses}}{\text{Contribution Margin Ratio}} = \frac{1200}{0.2} = \text{Tk. } 6000$$

❖ **Target Profit Analysis** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 246)

Target profit is that amount of profit that the company wants to earn for this period. CVP formulas can be used to determine the sales volume needed to achieve a target profit. The expected sales volume or expected level of activity can be calculated through cost-volume-profit formula. There are two methods for this purpose:

**A. The Equation Method**

$$\text{Sales} = \text{Variable Expenses} + \text{Fixed Expenses} + \text{Profits}$$

**Example**

Let, Selling price per unit = Tk. 10, Variable Expense per unit = Tk. 8, Total Fixed Expenses = Tk. 1200, Expected Profit = Tk. 200. What will be the expected Quantity of sales (X) =? What will be the expected sales in amount (Taka)?

$$\text{Sales} = \text{Variable Expenses} + \text{Fixed Expenses} + \text{Profits}$$

$$\Rightarrow \text{Tk. } 10X = \text{Tk. } 8X + \text{Tk. } 1200 + \text{Tk. } 200$$

$$\Rightarrow \text{Tk. } 10X - \text{Tk. } 8X = \text{Tk. } 1400$$

$$\Rightarrow \text{Tk. } 2X = \text{Tk. } 1400$$

$$\Rightarrow X = 700$$

Therefore,

Expected sales in units to achieve the target profit = 700 Units or  
 Expected sales in amount to achieve the target profit = Tk. 10 x 700 Units = Tk. 7000

**B. The Contribution Margin Method**

$$\text{Expected sales in units} = \frac{\text{Fixed Expenses} + \text{Profit}}{\text{Unit Contribution Margin}} = \frac{1200+200}{2} = 700 \text{ Units}$$

or

$$\text{Expected sales in Taka} = \frac{\text{Fixed Expenses} + \text{Profit}}{\text{Contribution Margin Ratio}} = \frac{1200+200}{0.2} = \text{Tk. } 7000$$

❖ **The Margin of Safety** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 248)

The margin of safety is the excess of budgeted (or actual) sales over the break-even volume of sales. The higher the margin of safety, the lower the risk of not breaking even. The formula is:

$$\text{Margin of Safety} = \text{Total Budgeted (or actual) sales} - \text{Break-even Sales}$$

$$\text{Margin of Safety Percentage} = \frac{\text{Margin of Safety in amount}}{\text{Total Budgeted (or actual) Sales}}$$

**Example** (From previous example)

Sales 700 units @ Tk. 10	Tk. 7000
Break-even sales 600 units @ 10	<u>Tk. 6000</u>
Margin of Safety in Taka	Tk. 1000
Margin of Safety as a percentage of sales	<u>14.29%</u>

This margin of safety means that at the current level of sales and with the company's current prices and cost structure, a reduction in sales of Tk. 1000 or 14.29%, would result in just breaking even

❖ **Operating Leverage** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 251)

Operating leverage is a measure of how sensitive net operating income is to percentage changes in sales. Operating leverage acts as a multiplier. If operating leverage is high, a small percentage increase in sales can produce a much larger percentage increase in net operating income.

$$\text{Degree of Operating Leverage} = \frac{\text{Contribution Margin}}{\text{Net Operating Income}}$$

The degree of operating leverage is a measure, at a given level of sales, of how a percentage change in sales volume will affect profits.

**Example**

	Activity Level 700 Units(100%)	Activity Level 770 Units(110%)	Activity Level 840 Units(120%)
Sales @ Tk. 10 per unit	Tk. 7000	Tk. 7700	Tk. 8400
Less, Variable Expenses @ Tk. 8 per unit	Tk. 5600	Tk. 6160	Tk. 6720
<b>Contribution Margin @ Tk. 2 per unit</b>	<b>Tk. 1400</b>	<b>Tk. 1540</b>	<b>Tk. 1680</b>
Less, Fixed Expenses	Tk. 1200	Tk. 1200	Tk. 1200
<b>Net Operating Income (Loss)</b>	<b>Tk. 200</b>	<b>Tk. 340</b>	<b>Tk. 480</b>

$$\text{Degree of Operating Leverage} = \frac{\text{Contribution Margin}}{\text{Net Operating Income}} = \frac{1400}{200} = 7$$

In the above example, degree of operating leverage at activity level 700 units is 7. If sales increase by 10%, then we can expect the net operating income to increase by seven times i.e., 10% x 7 = 70% (Tk. 200 x 170% = Tk. 340). If sales increase by 20%, then we can expect the net operating income to increase by seven times i.e., 20% x 7 = 140% (Tk. 200 x 240% = Tk. 480).

❖ **Assumptions of CVP Analysis** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 256)

A number of assumptions underlie CVP analysis:

1. Selling price is constant. The price of a product or service will not change as volume changes.
2. Costs are linear and can be accurately divided into variable and fixed elements.
3. In multi-product companies, the sales mix is constant
4. In manufacturing companies, inventories do not change. The number of units produced equals the number of units sold.

❖ **Preparing the CVP Graph** (Managerial Accounting, Garrison, 10<sup>th</sup> edition, p. 238)

## ❖ Problem 1

A Company manufactures and sells a telephone answering machine. The company's contribution format income statement for the most recent year is given below:

	Taka
Sales (2000 units @ Tk. 60 per unit)	120000
Less, Variable Expenses @ Tk. 45 per unit	90000
<b>Contribution Margin @ Tk. 15 per unit</b>	<b>30000</b>
Less, Fixed Expenses	24000
<b>Net Operating Income</b>	<b>6000</b>

### Required

1. Compute the company's Contribution Margin Ratio and Variable Expense Ratio
2. Compute the company's break-even point in both units and amount using (i) equation method and (ii) contribution margin method
3. Assume that sales increase by Tk. 40000 next year. If cost behavior patterns remain unchanged by how much will the company's net operating income increase? (Use contribution margin ratio)
4. If the company's target profit is Tk. 9000, how many units will have to be sold and what will be targeted sales in amount [Use (i) equation method and (ii) contribution margin method]
5. Refer to the original data, compute the company's margin of safety in both amount and percentage form
6. (a) Compute the company's degree of operating leverage at the present level of sales  
(b) If sales increase by 10% what percentage would you expect net operating income to increase?  
(c) Prepare a comparative income statement showing 10% increase in sales with the original data.

## ❖ Problem 2

Porter Company's most recent income statement is shown below:

	Taka
Sales (30000 units @ Tk. 5 per unit)	150000
Less, Variable Expenses @ Tk. 3 per unit	90000
<b>Contribution Margin @ Tk. 2 per unit</b>	<b>60000</b>
Less, Fixed Expenses	50000
<b>Net Operating Income</b>	<b>10000</b>

### Required

1. Compute the company's Contribution Margin Ratio and Variable Expense Ratio
2. Compute the company's break-even point in both units and amount
3. Assume that sales increase by Tk. 50000 next year. If cost behavior patterns remain unchanged by how much will the company's net operating income increase? (Use contribution margin ratio)
4. If the company's target profit is Tk. 15000, how many units will have to be sold and what will be targeted sales in amount
5. Refer to the original data, compute the company's margin of safety
6. (a) Compute the company's degree of operating leverage at the present level of sales  
(b) If sales increase by 10% what would you expect net operating income for next year?

### ❖ Problem 3

The information relating the previous year of ABC Company are; selling price per unit Tk. 90, variable expenses per unit Tk. 63 and fixed expenses for this period of the company Tk. 135000.

#### Required

1. Compute the company's break-even point in both units and amount
2. If the company's target profit is Tk. 90000, what will be targeted sales for the next year
3. If the company's actual sales 5500 units, compute the company's margin of safety

### ❖ Problem 4

Superior Door Company sells doors to homebuilders. The doors are sold for Tk. 60 each. Variable costs are Tk. 42 per door, and fixed costs total Tk. 45000 per year. The company is currently selling 3000 doors per year.

#### Required

1. Compute the company's Contribution Margin and CM Ratio
2. Compute the company's break-even point
3. Refer to the original data, compute the company's margin of safety
4. How many units will have to be sold to earn profit Tk. 12000
5. (a) Compute the company's degree of operating leverage at the present level of sales  
(b) If sales increase by 15% what percentage would you expect net operating income to increase?  
(c) Prepare a comparative income statement showing 15% increase in sales with the original data.

### ❖ Problem 5

Saha & Company sells a single product. The company's sales and expenses for a recent month follow:

	Total Taka	Per Unit Taka
Sales	600000	40
Less, Variable Expenses	420000	28
<b>Contribution Margin</b>	<b>180000</b>	<b>12</b>
Less, Fixed Expenses	150000	
<b>Net Operating Income</b>	<b>30000</b>	

#### Required

1. Compute the company's CM Ratio and Variable Expenses Ratio.
2. What is the monthly break-even point in unit sold and sales amount?
3. Refer to the original data, compute the company's margin of safety
4. How many units will have to be sold to earn profit Tk. 40000
5. (a) Compute the company's degree of operating leverage at the present level of sales  
(b) If sales increase by 5% what percentage would you expect net operating income to increase?  
(c) Prepare a comparative income statement showing 5% increase in sales with the original data.

### ❖ Problem 6

A Company's income statement for the recent month is given below:

	Taka
Sales 1350 units	27000
Less, Variable Expenses	18900
<b>Contribution Margin</b>	<b>8100</b>
Less, Fixed Expenses	9000
<b>Net Operating Income (Loss)</b>	<b>(900)</b>

#### Required

1. Compute the company's CM Ratio and Variable Expenses Ratio
2. What is the monthly break-even point in unit sold and sales amount using (i) equation method, (ii) contribution margin method and (iii) CVP Graph method
3. How many units will have to be sold to earn profit Tk. 1000 and what will be the total sales?

### ❖ Problem 7

Three companies are each producing and selling annually 10000 units of a similar product at a unit sales price of Tk. 10. The companies have fixed and variable costs as follows:

Company	Fixed Cost Tk.	Variable Cost Per Unit Tk.
A	20000	6
B	40000	4
C	60000	2

#### Required

1. Compute Contribution Margin, CM Ratio and Variable Expenses Ratio of each company
2. What is the break-even point in unit sold and sales amount
3. How many units will have to be sold to increase profit by 10% and what will be the total sales?
4. Refer to the original data, compute the company's margin of safety
5. (a) Compute the company's degree of operating leverage at the present level of sales  
(b) If sales increase by 5% what percentage would you expect net operating income to increase?
6. Which is the best among three companies and why?