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# UNIT 20 PROFITABILITY ANALYSIS

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## 20.0 OBJECTIVES

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After going through this Unit, you should be able to:

- explain the conceptual framework of cost volume profit analysis,
- discuss the utility of break even point,
- describe the uses of profit volume ratio,
- calculate the **CVP** for a **multi** product firm, and
- point out the utility of break even analysis.

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## 20.1 INTRODUCTION

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A business enterprise sets up its **goals/objectives** and directs its efforts towards the **fulfilment** of them. The primary or central objective of different enterprises may be as:

- 1) A business enterprise seeks profits that will provide a socially acceptable rate of return on investment.
- 2) A Government enterprise attempts to provide services to the citizens at an acceptable cost.
- 3) A non-profit organisation works toward the satisfaction of a general or specific need to society.

The economic considerations are of secondary importance to the non-profit entity and this may be true in certain circumstances for both the business type entity and the non-profit entity. However, in most of the cases, the economic factors cannot be entirely ignored as long as resources are scarce in relation to human desire and needs. Profit is a signal for the allocation of resources and a yardstick for judging managerial efficiency. The management of a **firm** has to decide upon the quantum of profits and strive to achieve the target. In this Unit, you will learn the concept of cost volume profit analysis. In this **connection** break even point, break even chart and profit volume ratio will be discussed in detail.

In Profit Planning the management of a firm seeks to answer the following questions:

- At what level of activity, should the firm be able to **sustain**? (how much capacity to have?)
- What activity level should the firm actively sustain? (How much capacity to use?)
- a What products **and/or** services, and how much of each, should the **firm** offer? and
- What price should the firm charge?

In seeking answers to these questions, the management requires forecasting of revenues and costs. Revenues depend upon sales and the costs depend upon the elements which make it. **Therefore**, understanding the behaviour of costs and revenues is very much necessary for profitability analysis.

Let us now discuss the cost volume profit analysis in detail. There are two approaches for profitability analysis viz., **Cost-Volume Profit Analysis (CVP)** and **Proforma Income Statements**. **Cost-Volume Profit Analysis provides information on relationship among costs, volume, prices and profits**. These help in developing alternative operational strategies for the target profit. The **Proforma** Income Statement approach furnishes a more refined and detailed breakdown of costs and, therefore, provides a better basis for establishing control.

The Cost Volume Profit analysis is an attempt to measure the effect of changes in volume, cost, price and product-mix on profits. **In fact**, these variables are inter-related and each one of them is affected by a number of internal and external factors. For example costs may vary due to the choice of the project, scale of operation, extent of automation and new technology and management and workers **efficiency**. Externally costs are affected by the market forces. Although a number of factors influence costs and profits, the largest **single** variable affecting them in the short run is the **volume** of output. Hence, the C V relationship is a vital instrument for the manager who takes short run decisions **like**: what are the most profitable and what are the least profitable products or services? How does a **selling** price affect profits? How does volume or product-mix affect products or services cost and profit? What will be the break even point if volume and costs change? How **an increase** in wages or other operating expenses will affect profit?

The manager may take the help of CVP to answer these questions. In simple terms usually CVP helps in deciding:

- i) At what sales volume would **the firm** break even?
- ii) How sensitive is profit to variations in output, selling price, **fixed** costs, and variable costs?
- iii) How much should the firm produce **and** sell in order to reach a target profit **level**?

In **analysing** the profitability through Cost-Volume Profit analysis, it becomes essential to understand the relationship between sales, fixed costs, variable costs **and** the profit.

The costs may be classified **into** three categories based on the behaviour of cost relative to volume changes:

- **Fixed Cost**
- **Variable Cost**
- **Semivariable Cost**

Let us discuss them in detail.

### 202.1 Fixed Cost

Fixed Costs are those costs which do not change with variation in the level of output. Rent of factory building, property taxes, **insurance**, depreciation on plant and machinery are the examples of fixed cost. These costs arise as a result of capacity creation and are invariant with respect to variation of activity. They tend to change only with time. When **fixed** cost is

expressed in terms of per unit, it changes with level of activity. The **fixed** costs are shown in figure-1:

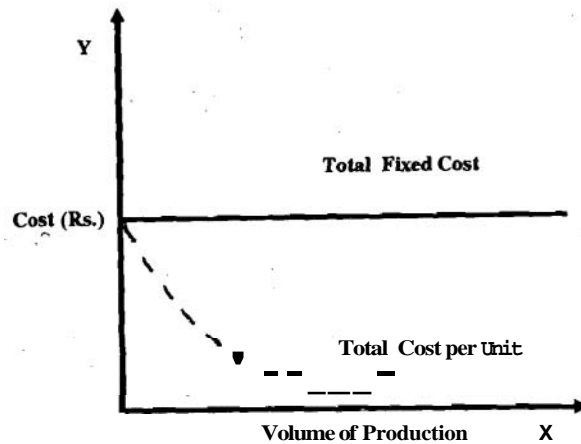


Fig. 1.

From the graph, it can be seen that:

- i) The total **fixed** cost line does not touch X axis at all because **fixed cost** can never be zero, as these refer to cost incurred for capacity creation.
- ii) Even if production is not there, the fixed cost **will** remain there because it has already been incurred.
- iii) Fixed cost when **calculated** on per unit basis, we find that it goes down with the increase in production.

### 20.2.2 Variable Cost

Variable costs in the normal production range usually change in direct proportion to the level of activity. When levels of output increase or decrease these costs also accordingly increase or decrease. However, if we find the variable cost per unit basis, it remains same. Variable cost generally consists of direct materials, direct labour (wages), power, royalties, commission to salesmen etc. This is shown in figure-2:

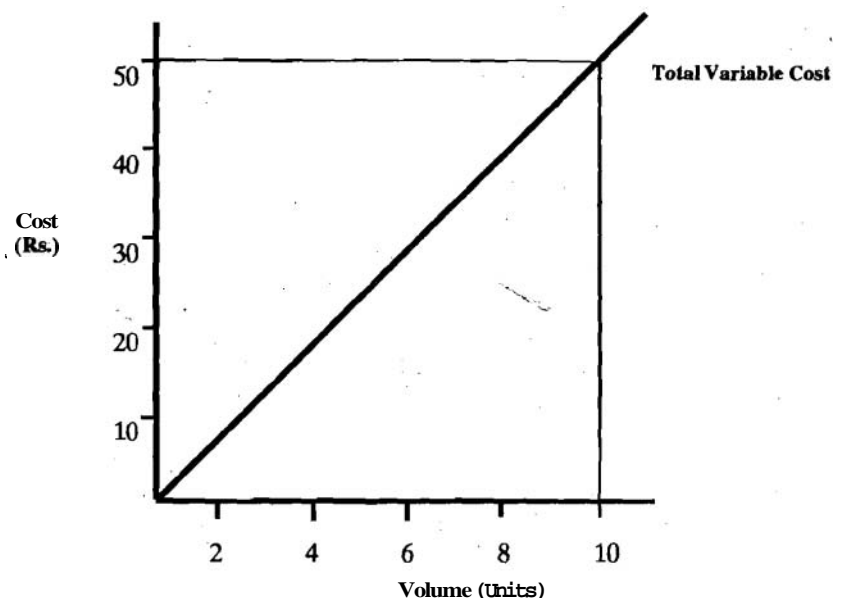


Fig. 2.

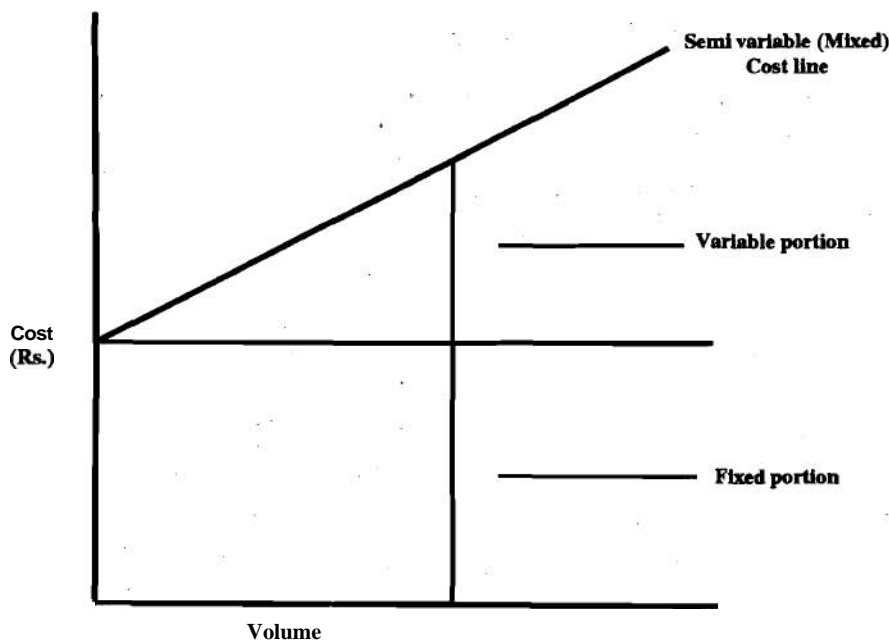
The main characteristics of variable costs are :

- i) Total variable cost varies in direct proportion to volume of output.
- ii) Variable cost per unit remains constant.
- iii) Variable costs are easy to identify and can be accurately allocated as cost objects.
- iv) Variable cost is **nil** when production is **nil**.

### 20.23 Semivariable Cost

**Semivariable** Costs are the costs which are **partly fixed and partly variable i.e.**, they have a **fixed** part which does not vary without put changes and also variable part which changes. The common example of this type of cost is rentals of telephone which has a **minimum** rent and rent free calls. After the free calls are exhausted the changes are levied according to number of calls done. The other example of semivariable costs are the overhead costs, cost of selling a product, indirect labour and material costs.

In **figure-3** the behaviour of semivariable cost is represented.



**Fig. 3.**

### 20.24 Assumptions of Cost Volume Profit Analysis

The simplicity of **CVP** analysis lies in number of assumptions which should be clearly understood before attempting to analyse the profitability. The **following** assumptions are made:

- 1) It is assumed that behaviour of total cost and revenues is always determined with reasonable accuracy..
- 2) All costs **can** be divided into fixed and variable costs.
- 3) Unit selling price is constant.
- 4) Total fixed cost remain constant.
- 5) Variable costs change at a linear rate.
- 6) It is assumed that the firm continues to sell a single product, **or** the given sales **mix** will be unchanged as volume changes over the relevant range.

- 7) Stocks are kept either constant or at zero level. Therefore, it is **assumed** that production equals sales.
- 8) **The** time horizon is short and time value of money is not **significant**.
- 9) The manufacturing facilities considered for analysis do not change during the **time** period.
- 10) **Prices** of the factor of productin do not change.

**Check Your Progress-1**

1) What **do** you mean by Cost Volume Profit Analysis?

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2) Distinguish between Fixed cost and Variable cost.

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3) What is Semi-variable cost?

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## 203 BREAK EVEN POINT

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A break even point (BEP) is that level of output where total cost equals total revenues. At this level of output the firm neither earns profit nor suffers any loss. This is a point where total **contribution** is just equal to **fixed** cost and no profit is earned. No firm would **like** to keep output level at **this** point only since each firm would like to have an acceptable profit. However, beyond this point of output, the firm earns a profit.

The relation between revenue and cost data is expressed as:

	per Unit (Rs.)	Total (Rs.)
Sales	_____	_____
Less variable cost	_____	_____
Contribution	_____	_____
Less fixed cost	_____	_____
Profit	_____	_____

We know that

$$\begin{aligned} \text{Sale} &= \text{Total Cost} + \text{Profit} \\ &= \text{Variable} + \text{Fixed Cost} + \text{Profit} \end{aligned}$$

At the break even point, profits **will** be **nil**, so

$$\text{Sale} = \text{Variable Cost} + \text{Fixed Cost}$$

In the algebraic form this relation can be expressed:

- If  $F$  = Total fixed cost  
 $Q$  = Quantity Produced and Sold  
 $V$  = Unit Variable Cost  
 $P$  = **Selling Price** per unit.

$$\begin{aligned} \text{Total Variable Cost} &= Q \times V \\ \text{Total Revenue} &= Q \times P \\ Q \times P &= QV + F + \text{Profit} \\ \text{or Profit} &= Q(P - V) - F \end{aligned}$$

At break even point as there is no profit

$$\begin{aligned} Q(P - V) - F &= 0 \\ \text{or } Q &= \frac{F}{P - V} \end{aligned}$$

This expression is used in **finding** out the break even quantity that should be produced and sold to cover up the fixed cost.

Another important aspect is the contribution. Contribution is defined as difference between the selling price and variable cost. The theory of contribution describes the relationship between variable cost and selling price. In short, you should remember that :

- i) The difference between selling price and variable cost per unit is the contribution.
- ii) If nothing is produced the loss involved **will** be the total fixed costs.
- iii) Variable cost per unit remains the same for different levels of output.

Contribution may be worked on per unit basis.

$$\text{Contribution per unit} = \text{Selling Price per Unit} - \text{Variable per unit}$$

**Example :**

Let us consider an example to understand how to calculate the breaks even quantity.

A factory produces 15000 units. Sale price of each unit is Rs.15/-. The **fixed** cost of firm is Rs.50,000/-. The variable cost per unit is Rs.10/-. To **find** out the break even quantity.

The break even Quantity (Q) is calculated as:

$$Q = \frac{50,000}{15 - 10} = 10,000 \text{ units}$$

If the firm produces 10,000 units only by incurring a fixed cost of Rs.50,000, then at this level of output, there **will be** no profit to the firm. Since the firm has to earn profit, it should produce more than break even quantity.

In this case as firm is producing 15000 units, so the profit can be worked out:

$$\begin{aligned} \text{Profit} &= 15000 \times 15 - 15000 \times 10 - 50,000 \\ &= 25,000 \text{ (Rs.)} \end{aligned}$$

## 20.4 BREAK EVEN CHART

The break even point can also be determined using break even chart. A break even chart shows the relationship between costs, volume and profit graphically. In this graph, the total cost line and revenue line are plotted against the different levels of production. The point at which total cost line and revenue line cuts each other, is called break even point.

Graphically, is is shown in Figure-4:

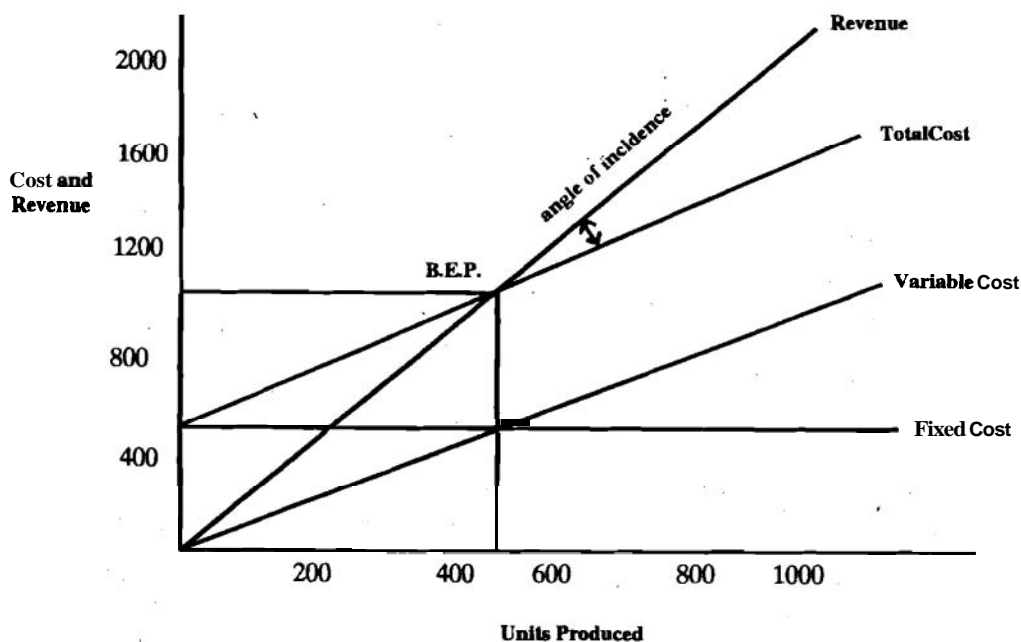


Fig. 4.

Using the previous example, we can **determine** the break even point through the break even chart method. At various levels of production, the cost and revenues can be worked out:

Output (Units)	Variable Cost @ 10	Fixed Cost	Total Cost	Sales @ 15 per unit
0	0	50,000	50,000	nil
5,000	50,000	50,000	1,00,000	75,000
10,000	1,00,000	50,000	1,50,000	1,50,000
15,000	1,50,000	50,000	2,00,000	2,25,000

Now plotting this data we get a graph as shown in figure-5:

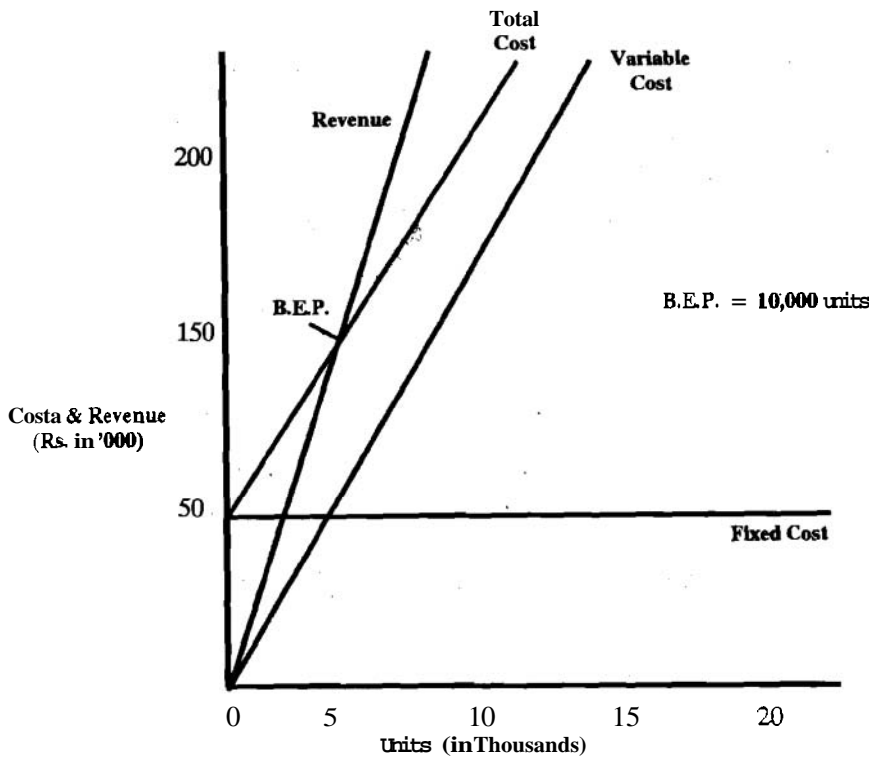


Fig. 5.

From this graph we find out ~~the~~ break even quantity = 10000 and profit for 15,000 units = Rs.25,000.

**Angle of Incidence :** In the break even graph, the angle formed by the intersection of sales line and total cost line at the BEP is known as angle of incidence. As seen from figure-5 above, with the value of increasing angle of incidence, the break even point will be lower and with lower angle of incidence, the higher will be the break even point.

Also the area to left of break even point represents the uncovered **fixed** cost, while to the right it shows the profit area.

## 20.5 PROFIT VOLUME RATIO

When the unit contribution margin is expressed in terms of percentage, it is called **profit/volume** ratio or **P/V** ratio. This ratio shows the relationship between contribution and volume of sales.

$$\frac{P}{V} = \frac{\text{Contribution}}{\text{Sale}} \times 1000$$

$$= \frac{\text{Sale} - \text{Variable Cost}}{\text{Sale}} \times 100$$

$$= \frac{1 - \text{Variable Cost}}{\text{Sale}} \times 100$$

P/V ratio serves as a guide to profitability of a business. **On** the basis of this ratio, management **decides** to choose the most profit selling area, **l i e** of product and method of sale. In specific term **P/V** ratio can be used:

- i) For the determination of variable costs for **any volume** of sales.
- ii) With the help of P/V ratio comparisons can be made for line of product, sales area, methods of sale, individual factories and separate companies.



In order to ascertain the actual profitability position, the management should also **find** out the **Margin of Safety**, which is dealt in the next Section.

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## 20.6 MARGIN OF SAFETY

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**The excess of actual sale over the breakeven sale is called Margin of Safety.** Margin of Safety can be expressed in absolute terms or in relative form. In absolute terms, the margin of safety is expressed as:

**Margin of Safety = Actual Volume of Sale – Break even point sales.**

In the above example (Sec. 20.4), the Margin of Safety is:

$$\begin{aligned} &= (15000 - 10000) \times 15 \\ &= \text{Rs. } 75000 \end{aligned}$$

The size of the Margin of Safety is an extremely valuable guide to the strength of a business. If large, **this** means that there can be a substantial falling off in sales and yet a **profit** can still be made. On the other hand, if the margin is small any loss of sales may be a serious problem. In other words, the margin of safety indicates the extent to which sales may fall before the firm suffers a loss. You should note that the higher margin of safety is better for the firm.

**A** firm can also use Profit-Volume analysis to find out the volume of sale required for earning a given amount of profit.

$$\begin{array}{l} \text{Sales Volume} \\ \text{(to earn desired} \\ \text{amount of Profit)} \end{array} = \frac{\text{Fixed Cost} + \text{Desired Profit}}{\text{P/V or Contribution ratio}}$$

The profit in this formula means profit before interest and tax.

The profit of a firm may change due to change in any or combination of the following causes:

- 1) Selling Price
- 2) Volume
- 3) Variable Cost
- 4) Fixed Cost

As the **selling** price changes, the revenue of firm will be affected and so the break even point or profitability is affected. The price may change due to change in cost of production, due to competition, etc.

From the break even quantity expression, it **can** be easily seen that as the prices increase keeping the variable cost same, the contribution would change and hence the break even point would change.

If the volume of output changes without any change in selling price or cost, the break even point would not change and hence profit will increase with increase in volume and vice versa.

Change in variable cost will cause change in contribution and hence break even point will be affected. The profit of the firm will be affected too. Here, we may have a case when variable costs increase without a change in selling price which is based on the competition in market.

**A** change in **fixed** cost will not affect the contribution, but break even point is changed and hence the profit will also change. When the fixed cost is **increased**, the break even point will rise, so for a given volume of output, the profit will change. Change in fixed cost may be due to external factors like increase in rent, or property tax or internal one as changes in salaries.

## 20.7 COST VOLUME PROFIT ANALYSIS FOR A MULTI PRODUCT FIRM

In the profitability analysis so far we have discussed break even analysis for a single product firm. However, in real business situation a firm may be producing a number of products. The relative proportion of sales of each product is called the sales **mix** or product **mix**. In the break even analysis of a multiproduct firm, if the **fixed** cost distribution for different products is known, then break even point for them can be calculated independently. However, in practical life the **fixed** cost for the firm is known as a whole rather than **fixed** cost pertaining to each product. To work out the break even point in such cases, we work out the combined break even point for the firm.

The overall break even quantity of a multiproduct firm can be calculated **using** the following formula:

$$Q = \frac{F}{\sum W_i CM_i}$$

Where,

Q = Combined break even quantity

F = Total fixed cost

W<sub>i</sub> = Proportion of product in the sales **mix**

CM<sub>i</sub> = Contribution margin of product

To understand use of this expression, let us consider the case of M/s. ABC Limited. The **firm** manufactures three products X, Y and Z. The selling price, variable cost and the sales **mix** are shown in the following table.

Product	Sales Mix	Selling Price (Rs./Unit)	Variable Cost (Rs./Unit)
X	20%	15	5
Y	30%	20	10
Z	50%	30	10

The total fixed cost of firm is Rs.15,00,000.

The weighted contribution margin in this case shall be:

$$\begin{aligned} & W_1 CM_1 + W_2 CM_2 + W_3 CM_3 \\ = & .2 \times 10 + .3 \times 10 + .5 \times 20 \\ = & \text{Rs.15} \end{aligned}$$

The combined break even quantity =

$$\frac{15,00,000}{15} = 1,00,000 \text{ units}$$

The quantity (break even) of each product can now be worked out as:

Product

$$X = 0.2 \times 1,00,000 = 20,000 \text{ units}$$

$$Y = 0.3 \times 1,00,000 = 30,000 \text{ units}$$

$$Z = 0.5 \times 1,00,000 = 50,000 \text{ units}$$

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## 20.8 UTILITY OF BREAK EVEN ANALYSIS

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Break even analysis is considered a very important method of short term profit **analysis**. This helps in **analysing** the profit at various levels of output. This analysis can be used in **fixing** a price or reviewing prices. Suppose the firm decides to lower the selling prices, then it would also like to know the changes in volume of sale required to match the profit earlier obtained. The financial manager may use this analysis in **planning** the make up of **capitalisation** of company. We may find out the operating **risk** of company. Once the break even point is known, the changes in volume of output **determine** the stability of profit. This also helps the management to determine the **ability** to service debt. **Acquiring** the fixed assets and its implication on profit of company can be analysed **using** break even analysis.

However, there are certain drawbacks in break even analysis which should be given due considerations:

- 1) Break even analysis being a short run analysis may not be useful for **firms** which frequently change their product **mix**, method of production or where material and labour cost **changes** rapidly.
- 2) This **analysis** also do not consider the uncertainty and risk factor, in estimating the cost, volume of output and hence the profit. This analysis uses the past records of cost, volume and prices which are considered to be stable. However, in today's context the same may not be true.

**Check Your Progress-2**

- 1) ~~What~~ is break even point?

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- 2) What do you mean by **contribution**?

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- 3) What is profit-volume ratio?

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## 20.9 LET US SUM UP

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In the profitability analysis, the **cost** volume profit analysis plays an important role. **This** analysis is based on relationship of profit to volume of output, costs and price. CVP model helps in **answering** what and if questions related to changing price, variable cost or fixed cost on the profit.

The cost volume profit analysis provide profitability analysis in short run **i.e.**, during which the fixed factors of production represented by the capital assets like plant, machinery, land, building etc. remain the same. During the short run, the costs, revenue and profits of a firm are basically functions of level of an activity. However, in practical case, we find that some factors like changing general prices, seasonal fluctuations, government or management policies also bring about changes in costs, revenues and profits of a **firm**. So, it is necessary to keep this into consideration while using the **CVP** analysis.

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## 20.10 KEYWORDS

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- CVP Analysis** : It is a method which helps in studying the behaviour of profit in relation to cost and volume.
- Fixed Costs** : Fixed costs are the costs which do not vary with change in volume of output.
- Variable Costs** : The costs which vary in direct proportion to the volume of production.
- Break even Point** : Break even point is the level of sales (volume) at which total costs and total revenues are equal.
- Break even Chart** : This is a graphical method of presenting the relationship between costs/revenues and volume of production.
- Angle of Incidence** : The angle of incidence denotes the angle formed between the revenue line and the total cost line at the break even point.
- Margin of Safety** : The excess of actual or budgeted sales over the break even sales is **known** as margin of safety.
- Contribution** : It refers to the difference between selling price and variable cost.
- $$\text{Contribution} = \text{Selling Price} - \text{Variable Cost}$$

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## 20.11 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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### Check Your Progress-1

- 1) See Sec. 20.2.
- 2) Base your answer on Sub-sec. 20.2.1 and 20.2.2.
- 3) Read the Sub-sec. 20.2.3.

### Check Your Progress-2

- 1) See Sec. 20.3.
- 2) The **difference** between **selling** price and variable cost. Read the second aspect of Sec. 20.3.
- 3) Read Sec. 20.5.