16

Marginal (Variable) Costing

CONCEPT OF MARGINAL COST, MARGINAL COSTING

Marginal cost, in cost accounting, means variable production costs, i.e. the costs which tend to vary in direct proportion to the changes in the production level. If an extra unit of output is produced, the costs which could be incurred for producing this extra unit, will only be marginal (variable) costs since fixed costs remain constant.

Marginal costing is a costing techinque in which only variable manufacturing costs are considered and used while valuing inventories and determining cost of goods sold. That is, only variable manufacturing costs are considered product costs and are allocated to products manufactured. These costs include direct materials, direct labour and variable factory overhead. Fixed factory (manufacturing) overheads are not considered product costs and are not used to value inventories and determine the cost of goods sold and are excluded from the cost of product. Fixed manufacturing costs are treated as period costs in marginal costing, i.e. costs which are a function of a time rather than of production. In marginal costing, fixed manufacturing overheads are written off to the profit and loss account in the period in which are incurred.

ABSORPTION COSTING

Absorption costing, also known as full costing, is a costing technique in which all manufacturing costs, variable and fixed, are considered as costs of production and are used in determining the cost of goods manufactured and inventories. All manufacturing costs are fully absorbed into finished goods.

DIFFERENCE BETWEEN MARGINAL COSTING AND ABSORPTION COSTING

Marginal costing and absorption costing differ from each other in the following respects:

1. *Cost element in product cost* Marginal costing and absorption costing differ only in the treatment of fixed factory (manufacturing) overheads in the accounting records and financial statement. In both the costing techniques it is agreed that selling and administrative expenses,

whether variable or fixed, are period costs and these costs are not treated as product costs with the result that selling and administrative expenses are not included in the costs of inventories, and costs of goods sold. Similarly, it is also agreed that variable manufacturing costs are products costs, i.e., costs to be charged to the product. The disagreement between the two, is only in regard to the treatment of fixed manufacturing costs.

2. *Inventory values* Marginal costing and absorption costing do influence inventory values differently. The value of inventories under marginal costing is relatively at a lower figure as inventories are determined in terms of only variable production costs. In absorption costing, the value of inventories is comparatively at a higher figure because it considers fixed factory overhead also besides the variable production costs.
3. *Difference in net income* The treatment of fixed factory overhead brings differences in the net income figures in the two costing techniques. The magnitude of any difference in net income is a function of fixed manufacturing costs per unit and the change in inventory levels.

The question of difference in net income has been further explained in the following pages while discussing income statement under absorption costing and marginal costing.

INCOME STATEMENTS UNDER ABSORPTION COSTING AND MARGINAL COSTING

Income Statement under Absorption Costing

Under absorption costing all costs are divided into three categories: manufacturing, selling, and administrative costs. In the income statement, all manufacturing costs (variable and fixed) are subtracted from the sales revenue to get a gross margin/gross profit on sales: and selling and administrative expenses (fixed and variable) are deducted from gross margin to arrive at the net income.

It should be clearly understood that fixed manufacturing overhead are charged to units produced on the basis of per unit fixed manufacturing overhead rate obtained by dividing the standard fixed manufacturing overhead by normal output level as follows:

$$\frac{\text{Standard fixed manufacturing overhead}}{\text{Normal output (Capacity)}}$$

If production is above or below the normal or standard output, adjustments are made for volume (capacity) variances. If the volume (capacity) variance is favourable, i.e., over-absorption (actual production being higher than normal capacity production), the amount of over-absorption is deducted from the total cost of goods manufactured and sold. If the volume (capacity) variance is unfavourable, i.e., under-absorption (actual production being lesser than normal capacity production), the amount of under-absorption is added to the cost of goods manufactured and sold. A proforma of income statement prepared under absorption costing is given in Fig. 16.1.

Income Statement under Marginal Costing

Under marginal costing, only variable costs of production (direct material, direct labour and variable manufacturing) are subtracted from sales revenue to determine a balance which is known by different names, such as marginal contribution, marginal income (profit), marginal revenue, marginal balance, profit pick-up, etc. All fixed costs, and variable selling, distribution and administrative costs are deducted from this balance to arrive at the net income. Since fixed manufacturing costs are not charged to

Income Statement (Absorption Costing)

		Amount Rs
	Sales	
Less:	Manufacturing costs:	
	(1) Variable production costs:	
	Direct material cost	
	Direct labour cost	
	Variable manufacturing overhead	
	(2) Fixed factory (manufacturing) overhead	
	Cost of goods manufactured	
Add:	Beginning inventory	
	Cost of goods available for sale	
Less:	Closing inventory	
	Cost of goods sold	
	Over- or under-applied factory (manufacturing) overhead (Over-absorption to be deducted and under-absorption to be added)	
	Cost of goods sold at actual	
	Gross profit on sales	
Less:	Fixed selling and administrative expenses	
	Variable selling and administrative expenses	
	Net Income	

Fig. 16.1 Income Statement Proforma (Absorption Costing)

products under marginal costing, there can be no volume (capacity) variance. Marginal contribution/ marginal income under marginal costing is greater than the gross profit/gross margin under absorption costing. Figure 16.2 depicts a proforma of income statement prepared under marginal costing.

Under marginal costing, fixed manufacturing overhead are excluded and therefore inventory values are lower than inventory value computed under absorption costing. Income may be higher or lower depending upon whether inventories are built up or liquidated. That is, the income statement under absorption costing may reflect higher profit if the production is more than the normal capacity production and also lower sales has been made. This happens because above normal capacity production has over-absorbed its actual fixed manufacturing overhead.

Absorption/full costing and marginal costing influence differently gross profit, net profit, and inventory values of different month/periods. The following data and income statement prepared under both costing techniques explain this situation.

Data:

Normal capacity 20,000 units per month
Variable costs (direct materials, direct labour, variable factory overhead) per unit Rs 6.
Fixed factory overhead Rs 25,000 per month or Rs 1.25 per unit at normal capacity.
Fixed selling and administrative expenses are Rs 5,000 p.m.
Variable selling and administrative expenses are Re 1.00 per unit sold.
Sales prices per unit is Rs 10.
Actual production, sales and inventories in units are:

Income Statement (Marginal Costing)

		Amount (Rs)
	Sales	
Less:	Variable production costs:	
	Direct material costs	
	Direct labour cost	
	Variable manufacturing (factory) overhead	
	Cost of goods manufactured	
Add:	Beginning inventory	
	Cost of goods available for sale	
Less:	Closing inventory	
	Cost of goods sold	
	Marginal contribution	
Less:	Fixed manufacturing overhead	
	Variable selling and administrative expenses	
	Fixed selling and administrative expenses	
	Net Income	

Fig. 16.2 Income Statement Proforma (Marginal Costing)

	First month	*Second month*	*Third month*	*Fourth month*
Unit in beginning inventory	—	—	3,000	1,000
Units produced	17,500	21,000	19,000	20,000
Units sold	17,500	18,000	21,000	16,500
Units in closing inventory	—	3,000	1,000	4,500

Solution

Income Statement (Absorption Costing)

	First month	*Second month*	*Third month*	*Fourth month*
Sales	Rs 1,75,000	1,80,000	2,10,000	1,65,000
Variable cost per unit Rs 6	1,05,000	1,26,000	1,14,000	1,20,000
Fixed factory overhead @ Rs 1.25	21,875	26,250	23,750	25,000
Cost of goods manufactured	1,26,875	1,52,250	1,37,750	1,45,000
Add: Beginning inventory	—	—	21,750	7,250
Cost of goods available for sales	1,26,875	1,52,520	1,59,500	1,52,250
Less: Ending inventory	—	21,750	7,250	32,625
Cost of goods sold	1,26,875	1,30,500	1,52,250	1,19,625
Over- or under-applied				

(Contd.)

	First month	*Second month*	*Third month*	*Fourth month*
factory overhead	3,125	(1,250)	1,250	—
Cost of goods sold at actual	1,30,000	1,29,250	1,53,500	1,19,625
Gross profit on sales	45,000	50,750	56,500	45,375
Selling and administrative expenses (fixed and variable)	22,500	23,000	26,000	21,500
Net income for the month	22,500	27,750	30,500	23,875

Note: In absorption costing income statement, fixed factory expenses are included in the unit cost and also in the inventory values.

(i) Ending inventory: Second month $\frac{3,000}{21,000} \times 1,52,250 = \text{Rs } 21,750$

Third month $\frac{1,000}{22,000} \times 1,50,500 = \text{Rs } 7,250$

Fourth month $\frac{4,500}{21,000} \times 1,52,250 = \text{Rs } 32,625$

(ii) In first month, Rs 3,125 is under-absorbed factory overhead due to production less than normal capacity and should be added to the cost of goods sold.

(iii) In the second month, Rs 1,250 is over-absorbed due to higher production and has, therefore been subtracted.

(iv) In the third month, Rs 1,250 is under-absorbed and has been added back to cost of goods sold.

(v) In the fourth month, production is at normal capacity and there is no under- or over-absorption.

Income Statement (Marginal Costing)

	First month	*Second month*	*Third month*	*Fourth month*
Sales (Rs)	1,75,000	1,80,000	2,10,000	1,65,000
Variable production cost:				
Variable manufacturing costs Rs 6 per unit	1,05,000	1,26,000	1,14,000	1,20,000
Cost of goods manufactured	1,05,000	1,26,000	1,14,000	1,20,000
Add: Beginning inventory	—	—	18,000	6,000
Cost of goods available for sale	1,05,000	1,26,000	1,32,000	1,26,000
Less: Closing inventory	—	18,000	6,000	27,000
Cost of goods sold	1,05,000	1,08,000	1,26,000	99,000
Contribution	70,000	72,000	84,000	66,000

(*Contd.*)

	First month	*Second month*	*Third month*	*Fourth month*
Less: Fixed factory overhead	25,000	25,000	25,000	25,000
Fixed selling and administrative expenses	5,000	5,000	5,000	5,000
Variable selling and administrative expenses	17,500	18,000	21,000	16,500
Total fixed costs and non-manufacturing variable costs	47,500	48,000	51,000	46,500
Net income for the month	22,500	24,000	33,000	19,500

Note: Under marginal costing, fixed factory (manufacturing) overhead costs are not included in the product unit costs and costs of inventories.

(i) Valuation of closing inventory

Second month	= 3,000 × Rs 6	= Rs	18,000
Third month	= 1,000 × Rs 6	= Rs	6,000
Fourth month	= 4,500 × Rs 6	= Rs	27,000

(ii) The question of under- or over-absorption of factory overhead does not arise under marginal costing.

A comparison of the income statements leads to the following conclusions:

1. Under variable costing, the closing inventory is costed at a smaller figure because only variable costs are charged to the product.
2. Both costing methods report the same amount of profit in periods in which production and sales are equal and there is no inventory change (first month). This is because the amount of fixed factory overhead costs charged to the period was the same in each case. Under marginal costing Rs 25,000 was deducted from sales as period costs. Under absorption costing Rs 25,000 was charged to the sales in two parts; (a) Rs 21,875 as part of the cost of sales (17,500 units × Rs 1.25); and (b) Rs 3,125 as unfavourable volume (capacity) variance.
3. When inventory of manufactured goods fluctuates from period to period, net income will differ somewhat under the two methods because absorption costing requires that part of the period costs be included in inventory, whereas marginal costing excludes period costs. Therefore:
   (i) When production exceeds sales (the inventory is increased), the net income reported under absorption costing is higher than reported under variable costing. This follows because under absorption costing, a portion of the fixed costs budgeted for the period is shifted to the following period in the closing inventories whereas under marginal costing the total fixed costs are charged against income. This is clear from comparing the net income of the second and fourth month.
   (ii) When sale exceeds production (the inventories are decreased), marginal costing shows a higher profit because only current period costs are being charged aganist current revenues, whereas under absorption costing the period costs previously included in inventory are now being charged against current revenues. This situation is illustrated by the income of the third month.

4. Under marginal costing profits always move in the same direction as sales volume. They cannot, of course, increase of decrease in direct proportion because unit fixed costs do not remain constant. Profit reported under absorption costing behave irregularly and sometimes in the opposite direction from sales. For example, sales of the fourth month is higher than the net income for the first month.
5. The above income statements are prepared on the assumption that selling prices remained constant and that there were no changes in either the manufacturing costs or the selling and administrative expenses. Further, it has been assumed that overheads costs are absorbed at predetermined rates based on normal capacity.
6. The aggregate net income (of different months or periods taken together) will be the same under both costing methods provided production and sales, in total, are equal. In the above example, total production are 77,500 units and total sales are 73,000 units. Since production and sales are unequal, the combined net income is not the same.

Reconciliation of Net Income

The differences in the net income between absorption costing and marginal costing are due to: (i) amount of fixed factory overhead charged to inventory, (ii) Over or under-absorbed fixed factory overhead having been deferred in absorption costing. The entire difference in net income can be explained by the amount of fixed factory overhead that is included in the beginning and closing inventories.

Reconciliation of Differences between Absorption and Marginal Costing Income

	Second month (Rs)	*Third month* (Rs)	*Fourth month* (Rs)
Marginal costing income	24,000	33,000	19,500
Absorption costing income	27,750	30,500	23,875
Difference to be explained	(3,750)	2,500	(4,375)
1. Differences in the value of opening and closing inventories:			
(a) Second month:			
Opening zero	0	—	—
Closing 18,000–21,750	(3,750)		
(b) Third month:			
Opening 18,000–21,750	—	3,750	
Closing 6,000 –7,250	—	(1,250)	—
(c) Fourth month:			
Opening 6,000–7,250	—	—	(1,250)
Closing 27,000–32,625	—	—	(5,625)
	(3,750)	2,500	(4,375)

Inventory Values

Differences between the net incomes reported under absorption costing and marginal costing are also reflected in inventory values. As stated earlier, inventories under absorption costing absorb a part of the fixed manufacturing costs of a period, whereas inventories under marginal costing include only the variable manufacturing costs. Closing inventories calculated from the data given above would be as follows:

	Closing Inventories			
	First month	*Second month*	*Third month*	*Fourth month*
Absorption costing @ Rs 7.25 per unit	—	21,750	7,250	32,625
Margin costing @ Rs 6.00 per unit	—	18,000	6,000	27,000

The following summarises the differences between marginal costing and absorption costing with regard to effect on net income:

1. If production = sales; absorption profit = marginal costing profit.
2. If production > sales; absorption profit > marginal costing profit.
3. If production < sales; absorption profit < marginal costing profit.
4. If production fluctuates and sales are constant; absorption profit fluctuates and marginal costing profit is constant.
5. If production is constant and sales fluctuates; both profits vary in the direction of sales.

APPLICATIONS (ADVANTAGES) OF MARGINAL COSTING

The marginal costing has great potentialities for management in different managerial tasks and decision-making processes. Marginal costing is particularly useful to management in (i) profit planning, (ii) product pricing decisions, (iii) cost control, (iv) managerial decision-making, and (v) the impact of fixed costs.

Profit Planning

Profit planning, generally known as budget or plan of operations, may be defined as the planning of future operations to attain a defined profit goal. Under marginal costing, the cost data needed for profit planning and decision-making are readily available from the accounting records and statements. It facilitates the analysis of cost-volume-profit relationships by separating fixed and variable costs on the income statement. Marginal costing helps management in planning and evaluating the profit resulting from a change in volume, in the sales-mix, in make or buy situations, in the selection of the most profitable products, customers, territories, and other segments of the entire business.

Product Pricing Decisions

Marginal costing provides more useful information to management for pricing than absorption costing. Marginal costing serves as the basis of product pricing in many cases. Under marginal costing, management has the data to determine when it is advisable to accept orders if other than normal conditions exist. In some cases, a sales order can be accepted even if it contributes partly to fixed costs. However, the full cost and not only the variable cost should be the basis of product pricing in the long-run. The full cost is the cost which includes variable manufacturing cost and fixed manufacturing cost incurred in the production process.

Cost Control

Marginal costing provides continuing opportunities to review period costs in relation to the level of sales and net income. Separation of variable and period costs supports the use of standards, budgets, and responsibility reporting to aid management in controlling costs. Marginal costing helps in preparing reports for all departments or responsibility centres based on standard costs, flexible budgets, and a division of all costs into their fixed and variable components. All managers can examine and interpret their reports with respect to the cost variances originating in their respective areas of responsibility. Reports prepared on the marginal costing basis and accompanied by additional information become valuable planning and control tools.

Impact of Fixed Costs

Marginal costing evaluates the impact of fixed costs on profits because the total amount of fixed costs for the period appears in the income statement. It is argued that managerial decisions can be easily made if fixed expenses are separated and are not mixed in controlling operating costs.

Managerial Decision Making

The identification and classification of costs as either fixed or variable provide a framework for the accumulation and analysis of costs. This also provides a basis for the study of contemplated changes in production levels or proposed actions concerning new markets, plant expansion or contraction, or special promotional activities. The marginal income figure is useful figure to management because it can be readily projected to measure increments in net income which accompany increments in sales.

LIMITATIONS OF MARGINAL COSTING

The limitations of marginal costing are listed below:

1. The marginal costing method requires that all costs should be divided into fixed and variable components. It cannot be true under all circumstances. Examples of factors that might affect this assumption include quantity discounts on materials, and labour efficiency variances.
2. Complete product cost does not depend only on variable costs. Fixed costs should be considered in determining the product cost and for long-range pricing and other long-run policy decisions.
3. Income figure obtained under marginal costing have to be used carefully if management decides to expand business or drop a product line. Management has to consider other factors also before deciding to drop a product line such as customer goodwill.

COST BEHAVIOUR

Cost behaviour can be defined as the manner in which costs changes due to changes in volume or activity. In relation to cost behaviour analysis, fixed and variable cost classifications are basically found. A proper analysis of cost behaviour patterns is the basis of all profit planning and cost control. The separation of costs into fixed, variable and semi-variable is necessary in order to determine, analyse, control, measure or evaluate the following:

1. Departmental expenses allowed at various levels of production.
2. Operating efficiency of a department.

3. Use of variable costing method.
4. Utilisation of facilities.
5. Break-even point.
6. Relative profitability of territories, departments and customers.
7. Company profit position.
8. Cost-profit-volume analysis.
9. Marginal or differential cost for various decision making purposes.
10. Effect of proposed capital expenditures.
11. Effect of alternative courses of action.

METHODS OF DETERMINING COST BEHAVIOUR

Several methods are used for segregating semi-variable costs into fixed and variable. There are four major techniques that are found in practice and they may be listed as follows:

1. Higher and low points method
2. Scattergraph method
3. Least squares regression method
4. Accounting or analytical approach.

High and Low Points Method

This approach considers the difference in total cost between two different volumes, and divides the incremental cost by the volume. As the words 'high' and 'low' imply, the two levels of volume chosen are the highest and the lowest for the period under review. The result of this division is the estimated variable cost per unit. Then, the average activity level is computed together with the average cost for the periods in the data base. The fixed cost is estimated by taking the total average cost and subtracting the variable cost for the average activity level. The variable cost is computed by multiplying the average activity level by the variable cost per unit as determined above.

As a simple illustration, assume that a company incurred the following costs in two periods (high and low) in which 5,000 units and 10,000 units were produced:

	Cost incurred	
	5,000 units	10,000 units
Insurance on factory building	Rs 30,000	Rs 30,000
Indirect material	45,000	70,000

Since insurance remained constant at the two volumes, there is no variable component. Indirect materials contain both a fixed and variable components.

Separation is made as follows:

Variable components:

Indirect material cost of 10,000 units	Rs 70000
Indirect material cost of 5,000 units	Rs 45000
Cost of production of additional 5,000 units	Rs 25000
Variable cost per unit Rs 25000 ÷ 5,000 units	Rs 5

Fixed components:	5,000	units	10,000 units
Total indirect material cost	Rs 45000		Rs 70000
Variable components @ Rs 5 per unit	25000		50000
Fixed costs for period	Rs 20000		Rs 20000

Scattergraph Method

In this method, various costs are plotted on a vertical line, the y-axis, and measurement figures (activity levels such as direct labour hours, units of output, percentage of capacity or direct labour cost) are plotted along a horizontal line, the x-axis. A stright line is fitted to this scatter of points by visual approximation. The slope of the line is used to estimate the variable costs and the intercept of the line with the vertical axis is considered as the estimated fixed cost.

Least Squares Regression Method

The method of least squares uses the equation for a straight line:

$Y = a + bx$, with a as the fixed element, and b the degree of variability. For many accounting applications, regression provides an accurate estimate of fixed and variable costs.

Accounting or Analytical Approach

This approach to cost behaviour analysis is a close scrutiny of the chart of accounts and a classification of costs into their fixed and variable components according to their basic characteristics determined by the accountant using good judgement, knowledge, and experience. This approach is simple and inexpensive but in its simplicity lies its inherent weakness. The results obtained are not accurate and may happen to be mere guesses.

Example 16.1

The following are the maintenance costs incurred in a machine shop for six months with corresponding machine hours:

Month	*Machine hours*	*Maintenance costs*
January	2,000	30000
February	2,200	32000
March	1,700	27000
April	2,400	34000
May	1,800	28000
June	1,900	29000
Total:	12,000	1,80,000

Analyse the Maintenance Cost which is semi-variable into fixed and variable element.

Solution

Computation of Variable Cost and Fixed Cost has been done according to Range Method.

	Machine hours	*Maintenance costs*
Highest point, April	2,400	34,000
Lowest point, March	1,700	27,000
	700	7000

$$\text{Variable cost per machine hour} = \frac{\text{Change in maintenance costs}}{\text{Change in hours}}$$

$$= 7000/700 = \text{Rs } 10$$

Total variable cost for 2,400 machine hours will be 2,400 × Rs 10 = Rs 24,000
Hence, fixed cost is (Rs 34,000 – Rs 24,000) = Rs 10,000

Analysis of Maintenance Cost into Fixed and Variable Element

	Machine hours	*Maintenance cost (Rs)*	*Fixed cost (Rs)*	*Variable cost (Rs)*
January	2,000	30000	10000	20000
February	2,200	32000	10000	22000
March	1,700	27000	10000	17000
April	2,400	34000	10000	24000
May	1,800	28000	10000	18000
June	1,900	29000	10000	19000

COST-VOLUME PROFIT (CVP) ANALYSIS

Profits of business firms are the result of many factors such as: (i) selling prices, (ii) volume of sales (iii) unit variable costs (iv) total fixed costs, (v) combinations in which the various product lines are sold, etc. To do an affective job in planning, management must have analyses which allow reasonably correct predictions of how profits will be affected by a change in any one of these factors. A cost volume profit (CVP) analysis is useful to management in knowing how profit is influenced by sales volume, sales price, variable expenses and fixed expenses.

Broadly, CVP analysis uses the techniques of (i) Break-even analysis and (ii) Profit-volume (P/V) analysis.

Break-even Analysis

A break-even analysis indicates at what level cost and revenue are in equilibrium. It is a simple and easily understandable method of presenting to management the effect of changes in volume on profits. Detailed analysis of break-even data will reveal to management the effect of alternative decisions which reduce or increase costs and which increase sales volume and income. It is a device which portrays the effects of any type of future planning by evaluating alternative courses of action.

Break-even Point

The break-even point can be defined as the point or sales level at which profit are zero and there is no loss. That is, break-even point is that point at which total costs are equal to total sales revenue. At the break-even point profit being zero, contribution (sales-variable cost) is equal to the fixed cost. If the

actual volume of sales is higher than the break-even volume, there will be a profit. Beyond the break-even point, all the marginal contribution represents income.

Assume that a company manufactures and sells a single product as follows:

Selling price per unit	= Rs 20
Variable cost per unit	= Rs 10
Total fixed cost	= Rs 1,00,000

The break-even sales to cover fixed costs will be 10,000 units,

Selling price per unit	= Rs 20
Variable cost per unit	= Rs 10
Contribution	= Rs 10

$$\text{Break-even volume} = \frac{\text{Rs 1,00,000 fixed cost}}{\text{Rs 10 contribution margin}}$$

$$= 10{,}000 \text{ units.}$$

If the company can sell more than 10,000 units, it will earn profits because fixed costs remain constant. If less than 10,000 units are sold, a loss will be incurred. The profits will be equal to the number of units sold in excess of 10000 units multiplied by the unit contribution margin. For example, if 25000 units are sold the company will be operating at 15,000 units above its break-even point and will earn a profit of Rs 1,50,000 (15,000 units × Rs 10 contribution margin).

Break-even Formula

The break-even point can be obtained directly by a mathematical formula. The basic formula to find out the break-even point is:

$$\text{Break-even sales (units)} = \frac{\text{Fixed cost}}{\text{Contribution margin per unit}}$$

$$\text{Break-even sales (volume)} = \frac{\text{Fixed cost}}{\text{C/S ratio (also known as P/V ratio *)}}$$

$$\text{Break-even sales volume} = \frac{\text{Total fixed expenses}}{1 - \text{Total variable expenses / Total sales volume}}$$

$$\text{Cash break-even point (units)} = \frac{\text{Cash fixed cost}}{\text{Cash contribution per unit}}$$

* C/S ratio is popularly known as P/V ratio because after fixed costs are fully recovered, i.e. after break-even point all contributions (sales-variable costs) become profit. However, before break-even point all contributions will not become profit since fixed costs are yet to be recovered.

Break-even Chart

Total revenues and total costs at different sales volume can be estimated and plotted on a break-even chart. This chart is constructed as follows:

1. A horizontal base line, the *x*-axis, is drawn and spaced into equal distances representing either plant capacity, sales volume or number of units.

2. A vertical line, the *y*-axis is drawn on the left side of the chart and also spaced into equal parts. This line indicates sales revenue and also costs.
3. A line parallel to the horizontal line (*x*-axis) is drawn for fixed costs.
4. A total cost line is drawn starting at the *y*-axis fixed cost point and moving to the right. This total cost line represents the total of all items of cost, fixed and variable.
5. The sales line is drawn starting at the zero point on the vertical axis and ending at the top on the right side.
6. The total cost line intersects the sales line at a point which is known as the break-even point.
7. The area to the left of the break-even point between the total cost line and the sales line is the loss area; the profit area lies to the right of the break-even point above the total cost line.

The data from the previous example are presented on the break-even chart (see Fig. 16.3).

From Fig. 16.3 it can be observed that the break-even point occurs when sales are 10,000 units at Rs 2,00,000.

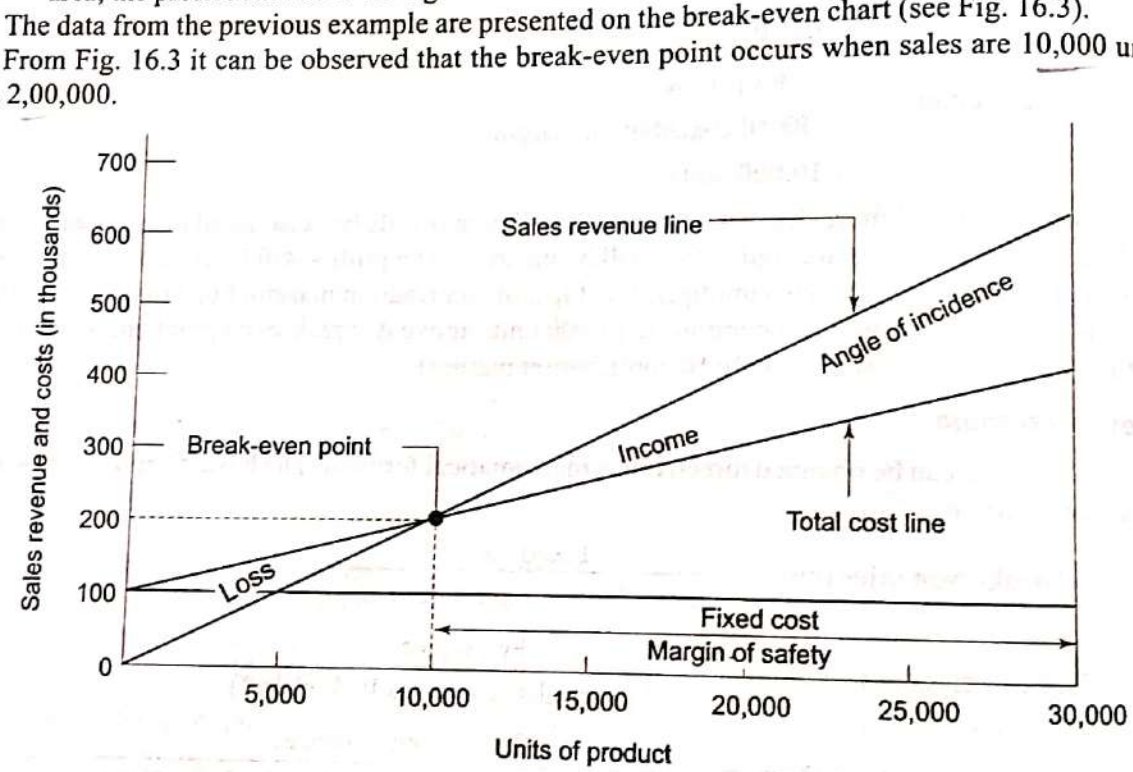

Fig. 16.3 Break-even Chart

Cash Break-Even Point

If a firm has a minimum of available cash or the opportunity cost of holding excess cash is high, management may want to know the volume of sales that will cover all cash expenses, during a period. This is known as the cash break-even point.

Not all fixed operating costs involve cash payments. For example, depreciation expense is a non-cash charge. To find the cash break even point, the non-cash charges must be subtracted from total fixed operating costs. Therefore, the cash break-even point is lower than the usual break-even point. The formula is:

$$BEP = \frac{FC - d}{P - V}$$

where P = selling price per unit
V = unit variable cost
FC = Fixed operating costs
d = depreciation expenses

Thus, cash break even point indicates break even sales to cover only the fixed costs involving cash payments and to break even.

This is illustrated below:

Let Sales 20,000 units at Rs 10 per unit
Variable costs, Rs 4 per unit
Fixed cost Rs 5000 including depreciation, Rs 10,000
Preference divided to be paid Rs 20,000
Taxed to be paid Rs 25,000
Assume that there are no lags in payment.

Break-even point (in units) will be 6667 units as displayed in Figure 16.4 below.

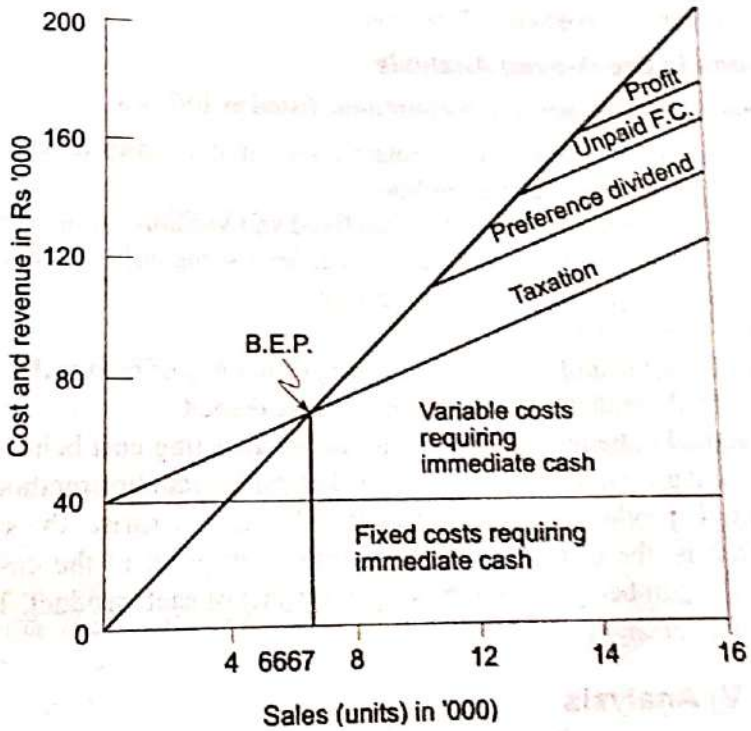

Fig 16.4 Break-even Chart

Margin of Safety

This is the difference between sales and the break-even point. If the distance is relatively short, it indicates that a small drop in production or sales will reduce profits considerably. If the distance is long, it means that the business can still make profits even after a serious drop in production. It is important that there should be a reasonable margin of safety, otherwise a reduced level of production may prove dangerous. The margin of safety can be found by using the following formula:

$$\text{Margin of safety} = \text{Profit} \div \text{P/V ratio}$$

or $$\text{Margin of safety} = \frac{\text{Profit} \times \text{Sales}}{\text{Sales} - \text{Variable cost}}.$$

Angle of Incidence

This is the angle at which the sales line cuts the total cost line. Management's aim will be to have as large an angle of incidence as possible because a large angle of incidence shows a high rate of profit. A narrow angle would show that even fixed overheads are absorbed and profit accrues at a relatively low rate of return, indicating that variable costs form a large part of cost of sales.

Sales Formula

Often, it is necessary to know what level of sales is required to achieve a desired level of profit. The desired sales can be expressed in various ways:

$$\text{Sales} = \text{Fixed cost} + \text{Variable cost} + \text{Profit}$$

or

$$\text{Sales} = (\text{Profit} + \text{Fixed cost})/\text{P/V ratio}$$

Basic Assumptions in Break-even Analysis

Break-even analysis is based on several assumptions, listed as follows:

1. Selling prices and pricing policy will remain constant at all sales levels. If this is not ture, sales revenue cannot be plotted as a straight line.
2. All costs and expenses can be separated into fixed and variable components.
3. The total of the fixed costs is constant at all sales levels; the unit variable costs remain the same. If this is not true, straight lines cannot be drawn.
4. Production and sales quantities are equal.
5. Managerial policies, technological methods, and efficiency of men and machines will not change and cost control will neither be strengthened nor weakened.
6. Volume is assumed to be the only important factor affecting cost behaviour. Other influencing factors such as unit prices, sales-mix, labour strikes, and production methodology remain constant.
7. In case of multiple products being manufactured by the enterprise, the sales-mix should remain unchanged. That is, the calculation of the break-even point in the case of multiple products predetermines the number of units to be sold in respect of each product. This multiproduct sales-mix should remain unchanged.

Profit/Volume (P/V) Analysis

A P/V graph is sometimes used in place of or along with a break-even chart. Profits and losses are given on a vertical scale; and units of products, sales revenue or percentage of activity are given on a horizontal line. The horizontal line is drawn on the graph to separate profits from losses. The profits and losses at various sales levels are plotted and connected by the profit line. The break-even point is measured at the point where the profit line intersects the horizontal line. The P/V graph may be preferred to the break-even chart because profit and losses at any point can be read directly from the vertical scale; but the P/V graph does not clearly show how costs vary with activity.

Data used earlier to prepare the break-even chart are also used in preparing the P/V graph *(see Fig. 16.5).*

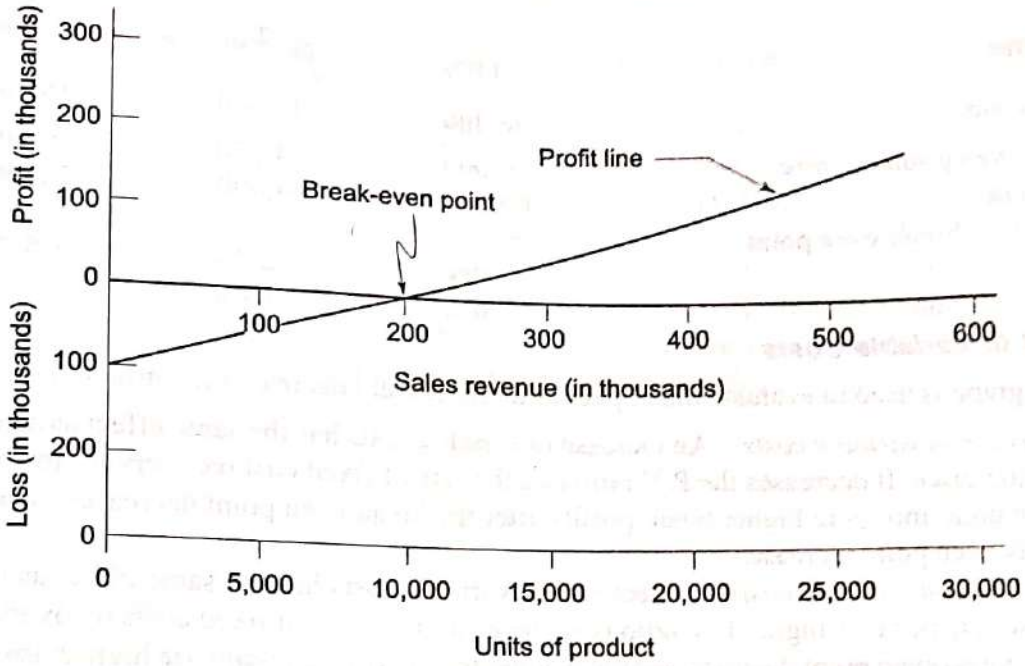

Fig. 16.5 Profit Volume (P/V) Graph

Role of CVP Analysis

A cost-volume profit analysis can be used to measure the effect of factor changes and management decision alternatives on profits. These factors include possible changes in selling prices, changes in variable or fixed cost, expansion or contraction of sales volume, or other changes in operating methods or policies. Cost-volume profit analysis is also useful for problems of product pricing, sales-mix, adding or deleting product lines, and accepting special orders.

Changes in Selling Prices

The CVP graph is frequently used to illustrate the potential profit effects of contemplated price changes. Effects on the profit pattern are as follows:

1. *Increase in selling price* If the selling price is increased, it increases the P/V ratio, and the rate of fixed costs recovery is increased. The break-even point (break-even volume) declines, profit beyond the break-even point increases, losses below the break-even point decreases.
2. *Decrease in selling price* If the selling price decreases, it decreases the P/V ratio and the rate of fixed cost recovery declines. The break-even point increases.

Assume, for example, that a company produces a product with a selling price of Rs 10 per unit and a variable cost of Rs 4 per unit. Fixed costs are Rs 36,000 per year. The effect of a 20% increase and 20% decrease in the present selling price is given below:

	Selling price		
	Present	*20% Increase*	*20% Decrease*
Selling price per unit	Rs 10.00	Rs 12.00	Rs 8.00
Variable cost per unit	4.00	4.00	4.00
Marginal contribution per unit	6.00	8.00	4.00

P/V ratio	60%	$66\frac{2}{3}$ %	50%
Fixed costs	36,000	36,000	36,000
Break-even point in units	6,000	4,500	9,000
In volume	60,000	54,000	72,000
Changes in break-even point	–	–	–
In units	0%	– 25%	+ 50%
In sales volume	0%	– 10%	+ 20%

Changes in Variable Costs

The CVP graph is used to evaluate the impact of increases and decreases in variable costs per unit.

1. *Increase in variable costs* An increase in variable costs has the same effect as a decrease in the selling price. It decreases the P/V ratio and the rate of fixed cost recovery is slower. The break-even point moves to higher level; profits after the break even point decreases; losses before the break even point increases.
2. *Decrease in variable costs* A decrease in variable costs has the same effect as an increase in the selling price. A higher P/V ratio is achieved and the rate of fixed costs recovery is increased. The break-even point declines, profits beyond the break-even point are higher; losses before the break-even point are lower.

To illustrate the effect of change in variable costs, assume a company is selling a product for Rs 40 a unit and has a variable cost of Rs 20 per unit. Fixed costs total Rs 48,000 per year. The effects of a 20% increase and a 20% decrease in variable cost are given in the following table:

	Present variable cost (Rs)	*20% Increase (Rs)*	*20% Decrease (Rs)*
Unit selling price	40.00	40.00	40.00
Variable cost per unit	20.00	24.00	16.00
Marginal contribution	20	16.00	24.00
P/V ratio	50%	40%	60%
Fixed costs	48,000	48,000	48,000
Break-even point:			
Sales volume	96,000	1,20,000	80,000
Units	2,400	3,000	2,000

Changes in Fixed Cost

Increases and decreases in the fixed cost do not have any impact on the P/V ratio but they change the break-even point. With the same P/V ratio, the rate of the fixed costs recovery remains the same.

1. *Increase in fixed costs* If fixed costs are increased, the break-even point (break-even-volume) is higher. Profits above the break-even point are lower by the amount of the increase in fixed costs; below the break-even point losses increase by the amount of increase.
2. *Decrease in fixed costs* If fixed costs are decreased, it lowers the break-even point. The profits are greater by the amount of the decrease, and losses are smaller by the amount of the decrease in fixed costs.

Assume that a company has a P/V ratio of 40% and present fixed costs of Rs 50,000. The effects of change in the fixed costs by Rs 10,000 are as follows:

	Present fixed cost	*Increase by*	*Decrease by*
Fixed costs		Rs 10,000	Rs 10,000
P/V ratio	Rs 50,000	Rs 60,000	Rs 40,000
Break-even point	40%	40%	40%
Decrease	1,25,000	1,50,000	1,00,000
	0	+25,000	– 25,000

From the above example, it is clear that the P/V ratio is the same in each situation and break-even point can be determined by dividing the amount of the change by the P/V ratio:

$$\frac{\text{Change in fixed costs}}{\text{P/V ratio}}$$

$$= \frac{\text{Rs } 10{,}000}{40\,\%} = \text{Rs } 25{,}000$$

Desired or Target Profit

Sometimes, management faces two decisions: (i) to increase sales volume through reduction in selling prices, and (ii) to increase selling prices in case the P/V ratio is low, with the expectation that a higher profit will be earned. These decisions should be taken carefully after studying the profit pattern and other factors, otherwise the results can be harmful particularly for those companies whose P/V ratios are already low. Also, if reduction in selling prices does not increase the sales volume, the price reduction will result only in lower profits.

The increase in sales volume required to overcome the effect of a price reduction is relatively greater when the rate of the contribution margin per unit is relatively greater as compared to when the rate of the contribution margin per unit is relatively low. If a product makes only a small contribution, then a reduction in selling price makes it all the more difficult to recover the fixed costs and to earn profits.

Similarly, a business firm may think of increasing the selling price if the P/V ratio is low. However, increase in selling price may reduce the sales volume.

Multi-product Situations

When there are multiple products with different contribution margins, the mix of the product has a direct effect on the fixed costs recovery and total profits of the firm. Different products have different P/V ratios because of different selling prices and variable costs. The total profits depend to some extent upon the proportions in which the products are sold.

For example, assume that a company with fixed costs of Rs 25,000 per year manufactures two products A and B with P/V ratios as follows:

	Product A	*Product B*
Unit selling price	Rs 10	Rs 20
Variable costs	4	16
Marginal contribution	6	4
P/V ratio	60%	20%

With comparatively low variable costs, product A has a relatively high P/V ratio; each unit of product A sold contributes Rs 6 to fixed costs recovery and profit. Product B, with comparatively high variable costs, has a low P/V ratio; each unit sold contributes only Rs 4 to fixed costs recovery and profit. Other things being equal, the sale of product A is more profitable than that of product B, despite the fact that the selling price of product B is twice that of product A. It is correct to say that profits will decline as the sales mix shifts from product A to product B. This also implies, however, that new analyses of profit volume relationship must be made as the product-mix changes.

LIMITATIONS OF CVP ANALYSIS

CVP analysis is a useful planning and control device, usually in the form of a chart, showing how revenue, costs, and profit fluctuate with volume. The CPV technique is useful to management in areas of budgeting, cost control and decision making. In spite of CVP being a useful technique, it suffers from some limitations. Firstly, because of the many assumptions, CVP is only an approximation at best. If prices, unit costs, sales-mix, operating efficiency, or other relevant factors change, then the overall CVP analysis and relationships also must be modified. Because of these assumptions, cost data are of limited significance.

In a multi-product situation, different products typically yield different contribution margins and are produced in various volumes with differing costs. As a result neither the revenue curve nor the cost curve is necessarily straight and the break-even point is difficult to find.

Therefore, while preparing or interpreting cost-volume profit analysis, all assumptions and limitations should be carefully considered. A series of CVP analysis based on different sets of assumptions and circumstances may be prepared to reflect situations prevailing in different business enterprises. When circumstances change, CVP analysis should also be revised to reflect the changing situations. It is also necessary to have up-to-date analysis so that it can act as a useful device in profit forecast, budgeting, cost control and managerial decision-making.

Example 16.2

Prepare Income Statements under Absorption costing and under Marginal costing from the following information relating to the year 1997–98:

Opening Stock	= 1,000 units valued at Rs 70,000 including variable cost of Rs 50 per unit.
Fixed Cost	= Rs 1,20,000
Variable Cost	= Rs 60 per unit
Production	= 10,000 units
Sales	= 7,000 units @ Rs 100 per unit.

Stock is valued on the basis of FIFO.

Solution *(B. Com. Hons Delhi 1998)*

Income Statement
(Absorption Costing)

		(Rs)	(Rs)
	Sales		7,00,000
Less:	Cost of goods sold:		
	Opening stock (1,000 units × Rs 70)	70,000	

	Variable cost (10,000 units × Rs 60)	6,00,000	
	Fixed cost	1,20,000	
		7,90,000	
Less:	Closing stock (4000 units) 4,000 units × Rs 72 =	2,88,000	502000
	Net Income		1,98,000

Income statement (Marginal Costing)

		Rs	(Rs)
	Sales		7,00,000
Less:	Cost of goods sold:		
	Opening stock (1,000 units × Rs 50)	50,000	
	Variable cost (10,000 units × Rs 60)	6,00,000	
		6,50,000	
Less:	Closing stock (4000 units × Rs 60)	2,40,000	4,10,000
	Contribution margin		2,90,000
Less:	Fixed Cost		1,20,000
	Net Income		1,70,000

Difference in Net Income = Rs 198000 – 1,70,000
= Rs 28,000

This difference in net income is due to difference in inventony values:

	Absorption Costing (Rs)	*Marginal Costing (Rs)*
Opening stock	Rs 70,000	Rs 50,000
Closing stock	Rs 2,88,000	2,40,000
Difference	2,18,000	1,90,000

Net difference = 2,18,000 – 1,90,000
= Rs 28,000

Note: 1. It has been assumed that fixed cost is fixed production cost.
2. It has been assumed that variable cost (Rs 60 per unit) is variable production cost.

Example 16.3

Your company has a production capacity of 12,500 units and normal capacity utilisation is 80%. Opening inventory of finished goods on 1-1-1999 was 1,000 units. During the year ending 31-12-1999, it produced 11,000 units while it sold only 10,000 units.

Standard variable cost per unit is Rs 6.50 and standard fixed factory cost per unit Rs 1.50. Total fixed selling and administration overhead amounted to Rs 10,000. The company sells its product at Rs 10 per unit.

Prepare Income Statements under Absorption Costing and Marginal Costing. Explain the reasons for difference in profit, if any.

(B. Com. Hons Delhi, 2000)

Solution

Income Statement for the year ended 31st Dec., 1999 (Under Absorption Costing Method)

		Rs	Rs
Sales:	10,000 Units @ Rs 10 per unit		1,00,000
Less:	Marginal Cost:		
	Variable Production Costs: 11,000 units @ Rs 6.50 per unit	71,500	
	Fixed factory cost @ Rs 1.50 per unit 11000 × 1.50 =	16,500	
		88,000	
Add:	Opening stock: 1000 units @ Rs 8 per unit (i.e. Rs 6.50 + Rs 1.50)	8,000	
	Costs at goods available for sales	96,000	
Less:	Closing stock: 2000 units valued at current cost. $\frac{96,000 \times 2,000}{12,000}$	16,000	80,000
	Gross Profit		20,000
Less:	Fixed selling and administrative overhead.		10,000
	Net Profit		10,000

Income Statement for the year ended 31st December, 1999 (Under Marginal Costing Method)

		Rs	Rs
Sales:	10,000 Units @ Rs 10 per unit		1,00,000
Less:	Marginal Cost:		
	Variable production cost: 11,000 units @ Rs 6.50 per unit	71,500	
	Variable cost of opening stock of finished stock (1000 units @ Rs 6.50 per unit)	6,500	
	Cost of goods available for sales	78,000	
Less:	Closing stock of finished stock: 2000 units @ Rs. 6.50 per unit	13,000	
	Contribution	65,000	65,000
Less:	Fixed selling and administrative overhead		35,000
	Fixed factory cost @ Rs 1.50 per unit	10,000	
	Net Profit	16,500	26,500
			8,500

Reason for difference The difference in profits, Rs 1,500 (i.e. Rs 10,000 – Rs 8,500), as arrived at under absorption and marginal costing methods is due to the element of fixed cost included in the valuation of opening and closing stock under the absorption costing method.

Example 16.4

'LMN' limited sells its product at Rs 3 per unit. The company uses a First-in, First-out actual costing system. A new fixed manufacturing overhead allocation rate is computed each year by dividing the actual fixed manufacturing overhead cost by the actual production costs. The following simplified data are related to its first two years of operation:

Unit Data	*Year I*	*Year II*
Sales	1,000	1,200
Production	1,400	1,000
Cost	Rs	Rs
Variable manufacturing	700	500
Fixed manufacturing	700	700
Variable marketing and administration	1,000	1,200
Fixed marketing and administration	400	400

Required:

(i) Prepare income statements based on:
  (a) absorption costing and (b) variable costing for each year.

(ii) Give reasons for the differences in the answer.

(B. Com. Hons, Delhi, 2001)

Solution

(i) Income Statement (Absorption Costing)

	Year I (Rs)	*Year II* (Rs)
Sales	3000	3600
Less: Cost of goods sold:		
Opening stock	Nil	400
Variable manufacturing	700	500
Fixed manufacturing	700	700
Cost of goods available for sales	1,400	1,600
Less: Closing inventory $\frac{400}{1,400} \times$ Rs 1,400	400	240*
Cost of goods sold	1,000	1,360
Gross Profit	2000	2240
Less: Variable marketing & Administration	(1,000)	(1,200)
Fixed marketing and Administration	(400)	(400)
Net Income	600	640

Closing stock	15,00,000	3,00,000
Difference	15,00,000	12,00,000
Net difference (effect)	6,00,000	4,50,000

Example 16.9

The ratio of variable cost to sales is 70%. The break-even point occurs at 60% of the capacity sales. Find the capacity sales when fixed costs are Rs 90,000. Also compute profit at 75% of the capacity sales.

(CA Inter Nov. 1997)

Solution

Basic Calculations

$$\frac{\text{Variable Cost}}{\text{Sales}} = 70\%$$

Hence $\frac{\text{Contribution}}{\text{Sales}} = 30\%$ or P/V Ratio = 30%

Computation of Capacity Sales

Break-even Point $= \frac{\text{Fixed cost}}{\text{P/V ratio}} = \frac{\text{Rs } 90{,}000}{30\%} = \text{Rs } 3{,}00{,}000$ (i)

Break-even Point (as given) = 60% of capacity sales

Hence Capacity Sales $= \frac{\text{Rs } 3{,}00{,}000}{60\%} = \text{Rs } 5{,}00{,}000$

Computation of Profit at 75% of the Capacity Sales

	Rs
75% of Capacity sales (75% × Rs 5,00,000)	3,75,000
Less: Variable Cost (70% × Rs 3,75,000)	2,62,500
Contribution	1,12,500
Less: Fixed Cost	90,000
Profit	22,500

Example 16.10

Profit/Volume Ratio of a company is 50%, while its margin of safety is 40%. If sales volume of the company is Rs 50 lakhs, find out its break-even point and net profit.

(B.Com. Hons Delhi 1999)

Solution

$$\text{Margin of safety} = \frac{\text{Excess Sales over Break-even Sales}}{\text{Actual Sales}}$$

$$40\% = \frac{x}{50 \text{ lakhs}}$$

or $x = 20$ lakhs

Hence (i) Break-even Sales = 50 lakhs – 20 lakhs = 30 lakhs
Variable Cost of Break-even Sales = Rs 15 lakhs.
Hence Fixed Costs = Rs 15 lakhs.
(ii) Net Profit = Contribution – Fixed Cost
= 50 lakhs × 50/100 – 15 lakhs
= 25 lakhs – 15 lakhs = Rs 10 lakhs.

Example 16.11

X Ltd. has earned contribution of Rs 2,00,000 and net profit of Rs 1,50,000 on sales Rs 8,00,000. What is its margin of safety?

(C.A. Inter May 1997)

Solution

$$\text{P/V Ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100$$

$$= \frac{\text{Rs } 2,00,000}{\text{Rs } 8,00,000} \times 100 = 25\%$$

$$\text{Margin of Safety} = \frac{\text{Profit}}{\text{PV ratio}} = \frac{\text{Rs } 1,50,000}{25\%}$$

= Rs 6,00,000

Example 16.12

If margin of safety is Rs 2,40,000 (40% of sales) and P/V ratio is 30% of AB Ltd. Calculate its (1) Break-even Sales and (2) Amount of profit on sales of Rs 9,00,000.

(CA Inter May 1997)

Solution

Basic Calculation

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

= Margin of Safety × P/V Ratio

= Rs 2,40,000 × 30% = Rs 72,000

(ii) Total Sales $= \frac{\text{Margin of Safety}}{40\%}$

$= \frac{\text{Rs } 2,40,000}{40\%} = \text{Rs } 6,00,000$

(iii) Contribution = Sales × P/V Ratio

= Rs 6,00,000 × 30% = Rs 1,80,000

(iv) Fixed Cost = Contribution – Profit

= Rs 1,80,000 – Rs 72,000

= Rs 1,08,000

Computation of Break-even Sales

$$= \frac{\text{Fixed Cost}}{\text{P/V Ratio}} = \frac{\text{Rs } 1{,}08{,}000}{30\%} = \text{Rs } 3{,}60{,}000$$

Computation of Profit on Sales of Rs 9,00,000

= Sales × P/V Ratio – Fixed Cost

= Rs 9,00,000 × 30% – Rs 1,08,000

= Rs 2,70,000 – Rs 1,08,000 = Rs 1,62,000

Example 16.13

(i) Ascertain profit, when sales = Rs 2,00,000
Fixed Cost = Rs 40,000
BEP = Rs 1,60,000

(ii) Ascertain sales, when fixed cost = Rs 20,000
Profit = Rs 10,000
BEP = Rs 40,000

(CA Inter May 1999)

Solution

(i) P/V ratio $= \frac{\text{Fixed Cost} \times 100}{\text{B.E.P.}} = \frac{\text{Rs } 40{,}000 \times 100}{\text{Rs } 1{,}60{,}000} = 25\%$

Contribution = Sales × P/V Ratio = F.C. + Profit

= Rs 2,00,000 × 25% = Rs 50,000 = Rs 40,000 + Profit

or Rs 50,000 = Rs 40,000 + Profit

or Profit = Rs 10,000

(ii) Contribution = F.C. + Profit = Rs 20,000 + Rs 10,000

= Rs 30,000

P/V ratio $= \frac{\text{Rs } 20{,}000}{\text{Rs } 40{,}000} \times 100 = 50\%$

Also, P/V ratio $= \frac{\text{Contribution}}{\text{Sales}} \times 100$

or Sales $= \frac{C}{\text{P/V ratio}} \times 100 = \frac{\text{Rs } 30{,}000}{50\%} = \text{Rs } 60{,}000$

Example 16.14

The profit volume ratio of X Ltd. is 50% and the margin of safety is 40%. You are required to calculate the net profit if the sales volume is Rs 1,00,000. *(CA Inter Nov. 1998)*

Solution

Margin of Safety $= \frac{\text{Excess Sales Over Break-even Sales}}{\text{Actual Sales}}$

	40/100	= X/1,00,000
or	100X	= 40,00,000
or	X	= Rs 40,000
Break-even Sales		= Rs 1,00,000 – Rs 40,000 = Rs 60,000
Profit Volume Ratio		= 50%
Variable Cost		= 50%
Hence, Variable Cost is Rs 60,000 – 60,000 × 50/100		= Rs 30,000
Fixed Cost = Rs 60,000 – Rs 30,000		= Rs 30,000
Contribution on Sales of Rs 1,00,000		= Rs 50,000
Less: Fixed Cost		= Rs 30,000
Profit		= Rs 20,000

Example 16.15

A company sells its product at Rs 15 per unit. In a period, if it produces and sells 8,000 units, it incurs a loss of Rs 5 per unit. If the volume is raised to 20,000 units, it earns a profit of Rs 4 per unit.

Calculate break-even point in terms of rupees as well as in units.

(B. Com. Hons, Delhi 2001, CA Inter Nov 1996)

Solution

I. Sales = 8000 Units × Rs 15 per Unit = Rs 1,20,000
Loss = 8000 Units × Rs 5 per Unit = Rs 40,000

II. Sales = 20,000 Units × Rs 15 per Unit = Rs 3,00,000
Profit = 20,000 Unit × Rs 4 per Unit = Rs 80,000

	Sales	*Profit/Loss*
I.	1,20,000	(–) 40,000
II.	3,00,000	(+) 80,000

$$\text{P/V Ratio} = \frac{\text{Change in Profit}}{\text{Change in Sales}}$$

$$= \frac{1,20,000}{1,80,000} = \frac{2}{3} \text{ or } 66\frac{2}{3}\%$$

Sales at Break even point (in Rs)

Fixed Cost = S × PV Ratio – Profit

(On the basis raised volume II)

$$\text{Fixed Cost} = \text{Rs } 3,00,000 \times \frac{2}{3} - 80,000$$

Fixed Cost = Rs 2,00,000 – Rs 80,000 = Rs 1,20,000

$$\text{B. E.P.} = \frac{\text{F}}{\text{P/V Ratio}} = \frac{1,20,000 \times 3}{2} = \text{Rs } 1,80,000$$

$$\text{Sales at Break-even point (in units)} = \frac{\text{Sales in Rs}}{\text{Selling price per unit}}$$

$$= \frac{\text{Rs } 1,80,000}{15} = 12,000$$

Note: (1) Re 5 per unit loss is given is the question, in the indirect way it is a variable cost per unit.
(2) Change in Profit is computed by adding loss of Rs 40,000 in the profit of Rs 80,000 because loss of Rs 40,000 has also been covered in the second period of time or in the second option if the volume is raised to 20,000 units.

Example 16.16

A company has earned a contribution of Rs 2,00,000 and net profit of Rs 8,00,000. What is the margin of safety?

(B.Com. Hons, Delhi 2000)

Solution

Given

Contribution = Rs 2,00,000
Net Profit = Rs 1,50,000
Sales = Rs 8,00,000

$$\text{P/V ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100$$

$$= \frac{2,00,000}{8,00,000} \times 100 = 25\%$$

$$\text{Margin of safety} = \frac{\text{Profit}}{\text{P/V Ration}} = \frac{1,50,000}{25} \times 100$$

= Rs 6,00,000

Margin of safety = Rs 6,00,000

Or

We know

$$S - V = F + P$$

or $$S - V = C$$

∴ $$C = F + P$$

Putting the values = 2,00,000 = F + 1,50,000

or $$F = 2,00,000 - 1,50,000$$

= Rs 50,000

$$\text{Break-even point} = \frac{\text{Fixed cost}}{\text{P/V Ratio}}$$

$$= \frac{\text{Rs } 50,000}{25} \times 100 = \text{Rs } 2,00,000$$

Margin of safety = Actual sales – Break-even sales = Rs 8,00,000 – Rs 2,00,000

= Rs 6,00,000

Example 16.17

B & Co. has recorded the following data in the two most recent periods:

Total Cost of Production (Rs)	*Volume of Production (units)*
14,600	800
19,400	1,200

What is the best estimate of the firm's fixed costs per period?

(CA Inter Nov 1995)

Solution

	Period I	*Period 2*	*Difference*
Total Cost of Production (Rs)	14,600	19,400	4,800
Volume of Production (Units)	800	1,200	400

$$\text{Variable Cost per unit} = \frac{\text{Difference in Total Cost of Production}}{\text{Defference in Volume of Production}}$$

$$= \frac{\text{Rs } 4,800}{400 \text{ units}} = \text{Rs } 12$$

Fixed Cost = Total Cost of Production of a period – Total Variable Cost

= Rs 14,600 – 800 units × Rs 12

= Rs 14,600 – Rs 9,600 = Rs 5,000

Example 16.18

A Ltd. maintains a margin of safety of 37.5% with an overall contribution to sales ratio of 40%. Its fixed costs amount to Rs 5 lakhs. Calculate the following:

(i) Break-even Sales;

(ii) Total Sales;

(iii) Total Variable Costs;

(iv) Current Profit;

(v) New "Margin of Safety" if the sales volume is increased by $7\frac{1}{2}$%.

Solution

(I.C.W.A. Inter Dec. 1998)

(i) $\text{Break-even Sales} = \frac{\text{Fixed Cost}}{\text{P/V Ratio}}$

$= \frac{5 \text{ lakhs}}{40\%} = \text{Rs } 12.50 \text{ lakhs}$

(ii) Total Sales = Break-even Sales + Margin of Safety

Margin of Safety = Actual sales – Break-even Sales

Let Actual Sales be Rs 100

Margin of Safety is Rs 37.5

Hence, Break-even Sales will be Rs 62.5

In case Break-even Sales are 62.5; Actual Sales are Rs 100

Hence, if Break-even Sales are Rs 12.5 lakhs

Actual sales will be = $\frac{100}{62.5} \times 12.5$

= Rs 20 lakhs

(iii) Contribution = Sales – Variable Costs

Hence, Total Variable Costs = 60% of Rs 20 lakhs

= Rs 12 lakhs

(iv) Current Profit = Sales – (Variable Costs + Fixed Costs)

= Rs 20 lakhs – (Rs 12 lakhs + Rs 5 lakhs)

= Rs 20 lakhs – Rs 17 lakhs

= Rs 3 lakhs

(v) New Margin of Safety if sales volume is increased by 7.5%

New Sales Value = Rs 20 lakhs + 7.5% of 20 lakhs = Rs 21.50 lakhs

Hence, New Margin of Safety = 21.50 lakhs – B.E. Sales of Rs 12.50 lakhs = Rs 9 lakhs.

Example 16.19

A company has annual fixed costs of Rs 14,00,000. In 1996 sales amounted to Rs 60,00,000 as compared with Rs 45,00,000 in 1995 and profit in 1996 was Rs 4,20,000 higher than in 1995.

(i) At what level of sales does the company break-even?

(ii) Determine profit or loss on a forecast sales volume of Rs 80,00,000.

(iii) If there is a reduction in selling price in 1997 by 10% and the company desires to earn the same profit as in 1996, what would be the required sales volume?

(B.Com. Hons Delhi 1997)

Solution

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

$$= \frac{4,20,000}{15,00,000} \times 100 = 28\%$$

(i) Break-even Sales $= \frac{\text{Fixed Cost}}{PV \text{ Ratio}}$

$$= \frac{14,00,000}{28\%}$$

= Rs 50,00,000

(ii) Profit on sales of Rs 80,00,000

Total Contribution 80,00,000 × 28/100	= 22,40,000
Less: Fixed Cost	14,00,000
Profit	8,40,000

(iii) If Present Selling Price is		Rs 100
Variable Cost is (100 – 28)		Rs 72
New Selling Price (100 – 10)		Rs 90
New Contribution		Rs 18
New PV Ratio	$\frac{18}{90} \times 100 =$	20%
Profit in 1996:		
Contribution 60,00,000 × 28/100 =		16,80,000
Less: Fixed Cost		14,00,000
Profit		2,80,000

$$\text{Sales for Desired Profit of Rs 2,80,000} = \frac{\text{Fixed Cost + Desired Profit}}{\text{New } PV \text{ Ratio}}$$

$$= \frac{14,00,000 + 2,80000}{20\%}$$

$$= \frac{16,80000}{20\%} = \text{Rs } 84,00,000$$

Example 16.20

A Company manufactures radios, which are sold at Rs 1,600 per unit. The total cost is composed of 30% for direct materials, 40% for direct wages and 30% for overheads. An increase in material price by 30% and in wage rates by 10% is expected in the forthcoming year, as a result of which the profit at current selling price may decrease by 40% of the present profit per unit. You are required to prepare a statement showing current and future profit at present Selling Price.

How much Selling Price should be increased to maintain the present rate of profit?

(CA Inter May 2001)

Solution

Let X be the cost, Y be the profit and Rs 1,600 selling price per unit of radio manufactured by a company. Hence

$$X + Y = \text{Rs } 1,600 \qquad \text{(i)}$$

Statement of present and future cost of a radio

Particulars	*Present cost (Rs)* (a)	*Increase in cost (Rs)* (b)	*Anticipated future cost (Rs)* (c) = (a) + (b)
Direct material	0.3 X	0.09 X	0.39 X
Direct labour	0.4 X	0.04 X	0.44 X
Overheads	0.3 X	–	0.30 X
Total	X	0.13 X	1.13 X

An increase in material price and wage rates resulted into a decrease in current profit by 40 percent at present selling price; therefore we have:

$$1.13\ X + 0.6\ Y = 1,600 \quad \text{(ii)}$$

On solving (i) and (ii) we get:

$$X = \text{Rs } 1,207.55$$
$$Y = \text{Rs } 392.45$$

Current profit Rs 392.45 or 32.5% of cost
Future profit Rs 235.47

Statement of revised selling price to maintain the present rate of profit

	Rs
Direct material cost 0.39 × Rs 1,207.55	470.94
Direct labour cost (0.44 × Rs 1207.55)	531.32
Overheads 0.30 × Rs 1,207.55	362.27
Total cost	1,364.53
Profit (32.5% of total cost)	443.47
Revised selling price	1,808.00

Example 16.21

XYZ Ltd. furnishes you the following income information:

Particulars	*Year 1994*	
	First-half (Rs)	*Second-half (Rs)*
Sales	8,10,000	10,26,000
Profit earned	21,600	64,800

From the above, you are required to compute the following assuming that the fixed cost remains the same in both the periods:

(i) P/V Ratio
(ii) Fixed Costs
(iii) The amount of profit or loss where sales are Rs 6,48,000.
(iv) The amount of sales required to earn a profit of Rs 1,08,000.

(B. Com. Hons Delhi 1996)

Solution

(i) *Computation of PV Ratio*

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

$$= \frac{43,200}{2,16,000} \times 100 = 20\%$$

(ii) *Computation of Fixed Cost*

Fixed Cost = Contribution – Profit

(For 1st half) = 8,10,000 × 20% – 21,600

= 1,62,000 – 21,600

= Rs 1,40,400

(iii) Contribution = 20% × Rs 6,48,000 = Rs 12,9,600

Loss = Rs 1,29,600 – 1,40,400 = Rs 10,800

(iv) *Computation of sales to earn a profit of Rs 1,08,000.*

$$\frac{\text{Fixed Cost + Desired Profit}}{PV \text{ Ratio}}$$

$$= \frac{1,40,400 + \text{Rs } 108,000}{20\%} = \text{Rs } 12,42,000$$

Example 16.22

The following costs and sales of a manufacturing company for the first half and second half of 1998-99 are given:

	First-half Rs	*Second-half* Rs
Sales	24,00,000	30,00,000
Total Costs	21,80,000	26,00,000

You are asked to determine:

(i) Contribution/Sales Ratio of the firm.
(ii) Annual Fixed Costs.
(iii) Break-even Point.
(iv) Margin of Safety as Percentage of Sales:

Solution *(I.C.W.A. Inter June 1999)*

(a) Computation of Contributions/Sales Ratio

Particulars	*First Half Rs*	*Second Half Rs*	*Change Rs*
Sales	24,00,000	30,00,000	6,00,000
Total Cost	21,80,000	26,00,000	4,20,000
Profit	2,20,000	4,00,000	1,80,000

$$\text{Contribution/Sales Ratio} = \frac{\text{Change in Profit}}{\text{Change in Sales}}$$

$$= \frac{1,80,000}{6,00,000}$$

$$= 0.3 \text{ or } 30\%$$

(b) *Computation of Fixed Cost for 1998-99*

Total Sales for the year	= Rs 54,00,000
Total Costs	= Rs 47,80,000
PV Ratio is	= 30%
Total Variable Costs	= 70% of Rs 54,00,000
	= Rs 37,80,000
Fixed Costs	= Total Costs – Variable Costs
	= Rs 47,80,000 – Rs 37,80,000
	= Rs 10,00,000

(c) *Break-even Point*

$$= \frac{\text{Fixed Costs}}{PV \text{ Ratio}}$$

$$= \frac{\text{Rs } 10,00,000}{30\%}$$

$$= \text{Rs } 33,33,333$$

(d) *Margin of Safety as a percentage of Sales*

Margin of Safety (MS)	= Sales – Break-even Sales
	= Rs 54,00,000 – Rs 33,33,333
	= Rs 20,66,667
Margin of Sofety as % of Sales	$= \frac{20,66,667}{54,00,000} \times 100 = 38.3\%$

Example 16.23

Raj Ltd. manufactures three products X, Y and Z. The unit selling prices of these products are Rs 100. Rs 160 and Rs 75 respectively. The corresponding unit variable costs are Rs 50, Rs 80 and Rs 30. The proportions (quantity-wise) in which these products are manufactured and sold are 20%, 30% and 50% respectively. The total fixed costs are Rs 14,80,000.

Calculate overall break-even quantity and the product-wise break up of such quantity.

(C.A. Inter May 1999)

Solution

Overall Break-Even Quantity

Products	*X*	*Y*	*Z*
Selling Price per unit (Rs)	100	160	75
Less: Variable Cost per unit (Rs)	50	80	30
Contribution per unit (Rs)	50	80	45
Share in Total Sales	20%	30%	50%
Proportionate Contribution per unit	10	24	22.50

Composite Contribution per unit = 56.5

$$\text{Composite Break-even Point} = \frac{\text{Total Fixed Cost}}{\text{Composite Contribution per unit}}$$

$$= \frac{\text{Rs } 14,80,000}{\text{Rs } 56.5} = 26,195 \text{ units.}$$

Product-wise break-up of overall break-even quantity:
Product X: 26,195 units × 20/100 = 5,239 units
Product Y: 26,195 units × 30/100 = 7,858 units
Product Z: 26,195 units × 50/100 = 13,098 units

Example 16.24

A single product company sells its products at Rs 60 per unit. In 1996, the company operated at a margin of safety of 40%. The fixed costs amounted to Rs 3,60,000 and the variable cost ratio to sales was 80%.

In 1997, it is estimated that the variable cost will go up by 10% and the fixed costs will increase by 5%.

Find the selling price required to be fixed in 1997 to earn the same P/V ratio as in 1996.

Assuming the same selling price of Rs 60 per unit in 1997, find the number of units required to be produced and sold to earn the same profit as in 1996.

(CA Inter May 1998)

Solution

Basic Calculations

1. P/V Ratio in 1996

$$\text{P/V Ratio} = \frac{\text{Selling Price per unit} - \text{Variable Cost per unit}}{\text{Selling Price per unit}} \times 100$$

$$= \frac{\text{Rs } 60 - \text{Rs } 48}{\text{Rs } 60} \times 100 = \frac{\text{Rs } 12}{\text{Rs } 60} \times 100 = 20\%$$

2. *Number of units sold (in 1996)*

$$\text{Break-even Point} = \frac{\text{Fixed cost}}{\text{Contribution per unit}} = \frac{\text{Rs } 3,60,000}{\text{Rs } 12} = 30,000 \text{ units}$$

The margin of safety is 40%. Hence break-even point is at 60% of units sold.

$$\text{or} \quad \text{No. of units sold} = \frac{\text{Break-even point}}{60\%} = \frac{30,000 \text{ units}}{60} \times 100 = 50,000 \text{ units}$$

3. Profit earned in 1996

Profit = Units sold in 1996 × Contribution per unit – Fixed costs
= 50,000 units × Rs 12 – Rs 3,60,000
= Rs 6,00,000 – Rs 3,60,000 = Rs 2,40,000

Fixation of Selling Price in 1997

Variable Cost per unit in 1997 = Rs 48 + Rs 4.80 = Rs 52.80
Fixed cost in 1997 = Rs 3,60,000 + Rs 18,000 = Rs 3,78,000
P/V Ratio in 1996 = 20%
Since P/V ratio is 20%, Hence, Variable cost is 80%

$$\text{Hence, the required selling price} = \frac{\text{Rs } 52.80}{80\%} = \text{Rs } 66$$

Number of units to be produced and sold in 1997 to earn the same profit as in 1996

Profit in 1996 = Rs 2,40,000
Fixed cost in 1997 = Rs 3,78,000
Desired contribution in 1997 (Rs 2,40,000 + Rs 3,78,000) = Rs 6,18,000
Contribution per unit in 1997 = Selling price per unit – Variable cost per unit
= Rs 60 – Rs 52.80 = Rs 7.20

$$\text{Number of units to be produced and sold in 1997} = \frac{\text{Fixed cost in 1997}}{\text{Contribution per unit in 1997}}$$

$$= \frac{\text{Rs } 6,18,000}{\text{Rs } 7.20} = 85,833 \text{ units.}$$

Example 16.25

A company producing a single product sells it at Rs 50 per unit. Unit variable cost is Rs 35 and fixed cost amounts to Rs 12 lakhs per annum. With this data you are required to calculate the following, treating each independent of the other:

(a) P/V Ratio and Break-even Sales
(b) New Break-even Sales if variable cost increases by Rs 3 per unit, without increase in selling price.
(c) Increase in sales required if profits are to be increased by Rs 24 lakhs.
(d) Percentage increase/decrease in sales volume units to off-set
  (i) an increase of Rs 3 in the variable cost per unit.
  (ii) a 10% increase in selling price without affecting existing profits quantum.
(e) Quantum of advertisement expenditure permissible to increase sales by Rs 1.2 lakhs, without affecting existing profits quantum.

(CA Inter June 1995)

Solution

$$\text{(a) PV Ratio} = \frac{\text{Contribution per unit}}{\text{Selling Price per unit}}$$

$$= \frac{50-35}{50} = 30\%$$

$$\text{Break Even Sales} = \frac{\text{Fixed Cost}}{\text{P. V. Ratio}}$$

$$= \frac{12.00}{30\%} = \text{Rs } 40 \text{ lakhs}$$

$$\text{(b) Revised PV Ratio} = \frac{\text{Existing Contribution per unit}}{\text{Selling price per unit}}$$

$$= \frac{15-3}{50} = \frac{12}{50} = 24\%$$

$$\text{Revised Break Even Sales} = \frac{12}{24\%} = \text{Rs } 50 \text{ lakhs}$$

$$\text{(c) Increase in Sales Required} = \frac{\text{Increase in Contribution}}{\text{PV Ratio}}$$

$$= \frac{24}{30\%} = \text{Rs } 8 \text{ lakhs}$$

$$\text{(d) (i) Percentage in Sales Volume (units)} = \frac{\text{Reduction in Contribution}}{\text{New Contribution per unit}}$$

$$= \frac{3}{12} \times 100$$

$$= 25\%$$

(ii) Percentage Decrease in Sales Volume (units)

$$= \frac{\text{Increase in Contribution per unit}}{\text{New Contribution per unit}}$$

$$= \frac{5\ (i.e. 10\% \text{ of Rs } 50)}{20\ i.e.\ (55-35)}$$

$$= 25\%$$

(e) The contribution by sales arising out of advertisement expenses should be equal to amount of Rs 1.2 lakhs the sale increase to avoid profit or loss. Hence, 30% of 1.2 lakhs or Rs 36,000 should be the maximum permissible advertisement expenditure for being incurred to get an increase of sale of Rs 1.2 lakhs without affecting existing profits.

Example 16.26

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:

(Rs in 1000)

Particulars	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) Fixed Costs.

(ii) Break-even Sales

(CA Inter Nov. 1996)

Solution

Computation of Profit Volume Ratio

	Sales			Profit			P/V Ratio
	Actual	Over/ (Under) Budget	Budgeted Sales	Actual	Over/ (Under) Budget	Budgeted Profit	(Diff. between Profit) (Diff. between Sales)
North	1,100	(400)	1,500	135	(180)	315	45% (180/400 × 100)
East	1,450	150	1,300	210	90	120	(60%) (90/150 × 100)
South	1,200	(200)	1,400	330	(110)	440	55% (110/200 × 100)

(i) Computation of Fixed Costs

(Rs '000)

Particulars	Actual sales	P/V Ratio	Contribution	Actual Profit	Fixed Cost
	(1)	(2)	(3) = (1) × (2)	(4)	(5) = (3) – (4)
North	1,100	45	495	135	360
East	1,450	60	870	210	660
South	1,200	55	660	330	330
Total	3,750	54	2,025	675	1,350

(ii) Computation of Break-Even Sales

(Rs '000)

Particulars	Fixed Cost	P/V Ratio	Break-even Sales
	(a)	(b)	(a)/(b)
North	360	45	800
East	660	60	1,100
South	330	55	600
			2,500

Break-even Sales (company as whole): $\frac{\text{Fixed Cost}}{\text{Composite P/V Ratio}} = \frac{1350}{54} = 2{,}500$ (in Rs '000).

Example 16.27

A company wants to buy a new machine to replace one which is having frequent breakdown. It received offers for two models M1 and M2. Further details regarding these models are given below:

	M1	*M2*
Installed capacity (units)	10,000	10,000
Fixed overhead per annum (Rs)	2,40,000	1,00,000
Estimated profit at the above capacity (Rs)	1,60,000	1,00,000

The product manufactured using this type of machine (M1 or M2) is sold at Rs 100 per unit. You are required to determine:

(a) Break even level of sales for each model.
(b) The level of sales at which both the models will earn the same profit.
(c) The model suitable for different levels of demand for the product.

(I.C.W.A. Inter Dec. 1997)

Solution

(a) *Basic Calculations*

Statement showing Comparative Parameters of two Machines

Type of Machines	*Model M1*	*Model M2*
1. Installed Capacity (units)	10,000	10,000
2. Fixed Overhead per annum (Rs)	2,40,000	1,00,000
3. Selling Price of the Product (Rs)	100	100
4. Estimated Profit at the above Capacity (Rs)	1,60,000	1,00,000
5. Total Sales Value (Rs)	10,00,000	10,00,000
6. Total Contribution (Rs) (2) + (4)	4,00,000	2,00,000
7. Variable Cost	6,00,000	8,00,000
8. Variable Cost per unit	Rs 60	Rs 80
9. P/V Ratio = Contribution/Sales	0.40	0.20

Computation of Break-even Sales

	Model M1	*Model M2*
Break-even Sales	$\frac{\text{Fixed Cost}}{\text{PV Ratio}}$	$\frac{\text{Fixed Cost}}{\text{PV Ratio}}$
	$= \frac{\text{Rs } 2{,}40{,}000}{.40}$	$\frac{\text{Rs } 1{,}00{,}000}{.20}$
BEP in units	= Rs 6,00,000	Rs 5,00,000
	= 6,000 units	5,000 units

17

Alternative Choices Decisions

DECISION MAKING

Decision making is the process of evaluating two or more alternatives leading to a final choice, popularly known as Alternative Choices Decisions. Decision making is closely associated with planning for the future and is directed towards a specific objective or goal.

DIFFERENTIAL ANALYSIS

Differential analysis may be defined as the use of relevant costs and relevant revenues in making decisions. Relevant costs and benefits are very important in evaluating alternatives, in ascertaining the effect of various alternatives on profit and selecting the alternative with the greatest benefit. The relevant costs and revenues are the differences between the alternatives under consideration. The amount of such differenes are called differentials and the accounting analysis concerned with the effect of alternatives on revenues and costs is called differential analysis. Relevant revenues and relevant costs are also known as differential revenues and differential costs. Differential revenue is the amount of increase or decrease in revenue expected from a particular course of action as compared with an alternative. Differential analysis provides a decision rule to managers in decision making which is: the alternative that gives the greatest incremental profit should be selected. Incremental profit is the difference between the relevant revenues and relevant costs of each alternative.

In case, decision affects both revenue and costs, management must estimate the changes in each to estimate the change in profit. In many decisions, only costs will change. In this case, the most beneficial (profitable) decision will be the one with the lowest cost because the lowest cost alternative will give the highest profit, provided all other factors and situations remain constant.

RELEVANT COSTS

Whatever alternatives are evaluated, the decision-maker has to decide which costs are relevant. Relevant costs are those that are pertinent, and bear upon the decision to be made. Relevant costs are the costs that will change as a result of the decision. Relevant costs are also known as decision-making costs. The relevant costs vary with the type of decision. However, the following are the common characteristics of relevant costs:

1. Relevant costs are expected future costs
2. They differ between different decision alternatives.

Expected future costs imply that the costs are expected to occur during the time period covered by the decision. For example, new product will need the incurrence of direct material, direct labour and other costs. Relevant costs also differ between decision alternatives. For example, a graduate may choose between advanced education and immediate employment. The costs that are relevant in this decision and which differ between the two decisions are the costs of books, fees, etc., because these costs will not be incurred if the graduate takes up employment. However, irrelevant costs are costs of accommodation, clothes, etc. which will have to be incurred under both the decisions.

Relevant costs are also known as differential costs. Differential cost is the difference in the total costs between alternative choices. It is the difference in total costs between two volumes. When a decision results in an increased cost, the differential cost may be referred to as an incremental cost. The incremental cost includes the change in fixed component as well as the variable component. Assume that a company has physical facilities to manufacture 20,000 units of a product; production beyond that point would require the installation of additional equipment, that is, fixed costs as well as variable costs will have to be incurred if management desires to produce more than 20,000 units.

TYPES OF CHOICES DECISIONS

Most management decisions may be referred to as alternative choice decisions. Alternative choice decisions cover situations with two or more alternative courses of action from whch the manager (decision-maker) must select the best alternative. A decision involving more than two alternatives is called a multiple alternative choice decision. Some examples of alternative choice decisions are: make or buy, own or lease, retain or replace, repair or renovate, now or later, change versus status quo, slower or faster, export versus local sales, shutdown or continue, expand or contract, change the produce-mix, take or refuse orders, place special orders, select sales territories, replace present equipment with new machinery, sell at split-up point or process further, etc.

Some of the above alternative choices decisions and the information relevant to the decisions are discussed below.

MAKE OR BUY

Make or buy decisions arise when a company with unused production capacity consider the following alternatives:

(a) To buy certain raw materials or subassemblies from outside suppliers.
(b) To use available capacity to produce the items within the company.

A make or buy decision is basically one of determining which alternative is economically most desirable and most effectively utilises the firm's resources. These decisions can effect the firm's production methods and capacities, available working capital, cost of borrowing funds, and competitive position. Costs that will be incurred under both alternatives are not relevant to the analysis. The firm should make an analysis of the cost, quality and quantity considerations of the individual make or buy decisions. Differential cost analysis is especially useful if the company has idle capacity and idle workers that can be used to make the tools or parts. Other potential use of available capacity should also be considered; and qualitative factors must be evaluated in the decision process. These considerations include price

stability from suppliers, reliability of delivery and quality of the material or component involved. Qualitative factors are not included in differential cost analyses, but they should be used to test the reasonableness of any decision based purely on quantitative cost studies.

For example, assume that a company can make a part that it has been purchasing at a unit cost of Rs 30. The company has been operating at 75% of normal capacities and in the foreseeable future no use for the excess capacity is contemplated except for the possible production of the part. Fixed manufacturing cost amounts to Rs 17,00,000 a year whether the plant operates at 75% or 100% of capacity. The cost to manufacture 50,000 units of the part that will be needed has been estimated as follows:

	Units cost	*Total cost*
Direct materials	12.5	6,25,000
Direct labour	8.0	4,00,000
Variable manufacturing overhead	5.0	2,50,000
Total incremental cost	25.5	12,75,000
Cost to purchase part	30.0	15,00,000
Net advantage in parts production	4.5	2,25,000

In the above analysis the fixed manufacturing overhead has not been considered because it has to be incurred under both alternatives. Logically, the costs that will be increased or decreased as a result of making the part should be considered. In some cases, both the variable and fixed costs will be affected.

Add or Drop Products

The decision to eliminate an unprofitable product is a special case of product profitability evaluation. To evaluate the financial consequences of eliminating a product, it is necessary to concentrate on the differential or incremental profit effect of the decision. An important factor in the decision to add or drop a product is whether it will increase or decrease the future income of the business. Appropriate cost and profit measures must be developed for each alternative.

Assume a company is considering dropping product *B* from its line because accounting statements show that product *B* is being sold at a loss.

Income Statement

	Product A	*Product B*	*Product C*	*Total*
Sales revenue	50,000	7,500	12,500	70,000
Cost of sales:				
Direct material	7,500	1,000	1,500	10,000
Direct labour	15,000	2,000	2,500	19,500
Indirect manufacturing cost (50% of direct labour)	7,500	1,000	1,250	9,750
	30,000	4,000	5,250	39,250
Gross margin on sales	20,000	3,500	7,250	30,750

Selling and administrative expenses (allocation on arbitrary basis)	12,500	4,500	4,000	21,000
Net income (loss)	7,500	(1,000)	3,250	9,750

Additional Information

(i) Factory overhead costs are made up of fixed costs of Rs 5,850 and variable costs of Rs 3,900. Variable costs by products are; product A Rs 3,000, product B, Rs 400, and product C Rs 500.
(ii) Fixed costs and expenses will not be changed if product B is eliminated.
(iii) Variable selling and administrative expenses to the extent of Rs 11,000 can be traced to the product as follows: A, Rs 7,500; B, Rs 1,500; C, Rs 2,000.
(iv) Fixed selling and administrative expenses are Rs 10,000.

The decision to drop product B cannot be reasonably made from the above data prepared under a conventional income statement. This information together with the following statement may be helpful to management.

	Product A Rs	*Product B* Rs	*Product C* Rs	*Total* Rs
Sales revenue	50,000	7,500	12,500	70,000
Less: Variable product Costs:				
Direct material	7,500	1,000	1,500	10,000
Direct labour	15,000	2,000	2,500	19,500
Factory overhead	3,000	400	500	3,900
Selling and administrative expenses	7,500	1,500	2,000	11,000
	33,000	4,900	6,500	44,400
Contribution margin	17,000	2,600	6,000	25,600
Less: Fixed costs:				
Factory overhead				5,850
Selling and administrative expenses				10,000
Total fixed costs				15,850
Net income				9,750

This statement shows that product B exceeds its variable costs by Rs 2,600. If the sale of product B were discontinued, this marginal contribution would be lost and the net income of the firm would be reduced by Rs 2,600. That is, net income will be Rs 7,150 (Rs 9,750 – Rs 2,600). In this illustration it has been assumed that sales of products A and C will not be increased after product B is dropped. Further, it has been assumed that dropping product B will not change the fixed costs and expense. If these assumptions are not true, new analysis must be made. Assume, for example, that after dropping product B, the sales of product A increase by 10%. The total profit of the firm will not increase by this sales increase. Product A makes only a marginal contribution of 34%.

Sales revenue	Rs 50,000	100%
Variable costs	33,000	66%
Marginal contribution	17,000	34%

On additional sales of Rs 5,000, the marginal contribution would be Rs 1,700;

Sales revenue	Rs 5,000
Variable costs (66%)	3,300
Marignal contribution (34%)	1,700

This contribution is less than Rs 2,600 now being realised on the sales of product B. It would take additional sales of product A of approximately Rs 7,647 to equal the marginal contribution of Rs 2,600 now being made by product B:

$$\frac{\text{Marginal contribution of product B}}{\text{Marginal contribution of product A}} = \frac{2,600}{34\%} = \text{Rs } 7,647$$

It is possible that dropping product B may result in reduction in some of the fixed costs. Product B now contribute Rs 2,600 towards recovery of fixed costs and expenses. Only if the fixed costs and expenses can be reduced by more than this amount will it be advisable to drop product B.

Sell or Process Further

The decision whether a product should be sold at the split-off point or processed further is faced by many manufacturers. The choice between selling a product at split-off or processing it further is a short-run operating decision. Additional processing adds value to a product and increases its selling price above the amount for which it could be sold at split-off. The decision to process further depends upon whether the increase in total revenues exceeds the additional costs incurred for processing beyond split-off. Generally speaking, there are two general conditions under which a sell or process further decision could occur.

1. The company is evaluating the possibility of processing beyond split-off and must incur certain equipment costs and other fixed costs if additional processing is to occur.
2. The company already processes a product beyond split-off and has invested in the equipment and required personnel.

The first situation is really a capital budgeting problem and here it is not sufficient to determine whether incremental revenues exceed incremental costs. Since new investments in machinery and building are involved, the rate of return on this investment must also be considered.

In the second situation, the relevent costs are only those costs which relate to the additional processing of each product beyond the split-off point. The joint costs are relevant to the further processing decisions. Certain fixed costs such as supervisory salaries are related to additional processing. If these costs are eliminated by selling products at split-off, they are incremental and should be included in the decision analysis. If salaried personnel are assigned other duties in the company when additional processing is discontinued, the salary costs are not incremental since they are incurred under either decision alternative. If the equipment used for additional processing sits idle or can be used in other processes, it should be ignored in the decision analysis. Depreciation expense is never relevant in short-run operating decisions, since depreciation is an allocation of costs incurred in a past period.

In deciding upon which course of action to follow, the company compares the contribution margin from the sale of the partially processed product with the contribution margin from the sale of the completely processed product. The revenue to be derived from the sale of the partially processed product is the opportunity cost attached to the decision of further processing. Assume, for example, a partially processed product can be sold for Rs 90 per unit which is manufactured at a cost of Rs 60. Further

processing can be done at an additional cost of Rs 30 per unit and the final product can be sold at Rs 150 per unit. The firm can produce 10,000 units. The analysis is shown below:

	Sell	*Process and Sell*
	Rs 900000	Rs 1500000
Sales revenue (10,000 units)	600000	900000
Less: Manufacturing costs	30,0000	60,0000

Net advantage in further processing Rs 6,00,000 – 3,00,000 = Rs 30,0000

Thus, there is a net advantage of Rs 30,000 in processing the product further. The market value of the partially processed product (Rs 9,00,000) is considered to be the opportunity cost of further processing.

The figure of net advantage of Rs 3,00,000 can be arrived at in the following manner also:

		Rs 15,00,000
Revenue from sale of final product (10,000 × 15)		
Less: Additional processing cost (10,000 × 3)	3,00,000	
Revenue from sale of intermediate product	9,00,000	12,00,000
Net advantage in further processing		3,00,000

Operate or Shutdown

Differential cost analysis is also used when a business is confronted with the possibility of a temporary shutdown. This type of analysis has to determine whether in the short-run a firm is better off operating than not operating. As long as the products sold recover their variable costs and make a contribution towards the recovery of fixed costs, it may be preferable to operate and not to shutdown. Also management should consider the investment in the training of its employees which would be lost in the event of a temporary shutdown. Recruiting and training new workers would add to present costs. Another factor is the loss of established markets. Also, a temporary shutdown does not eliminate all costs. Depreciation, taxes, interest, and insurance costs are incurred during shutdown also. The other points (benefits) which should be considered are the following: avoiding operating losses, savings in maintenance and repair costs, savings in indirect labour costs, savings in fixed costs.

A company operating below 50% of its capacity expects that the volume of sales will drop below the present level of 10,000 units per month. Management is concerned that a further drop in sales volume will create a loss and has under consideration a recommendation that operations be suspended, until better market conditions prevail and also a better selling price. The present operating income statement is as follows:

Sales revenue (10,000 units @ Rs 3.00)		Rs 30,000
Less: Variable costs @ Rs 2.00 per unit	20,000	
Fixed costs	10,000	30,000
Net Income		0

The following income statements have been prepared for sales at different capacities:

	Units Produced					
	Shutdown	2,000	4,000	6,000	8,000	10,000
Sales revenue @ Rs 3	0	6,000	12,000	18,000	24,000	30,000
Variable costs @ Rs 2	0	4,000	8,000	12,000	16,000	20,000
Contribution	0	2,000	4,000	6,000	8,000	10,000
Fixed costs	4,000	10,000	10,000	10,000	10,000	10,000
Loss	4,000	8,000	6,000	4,000	2,000	0

It would appear that shutdown is desirable when the sales volume drops below 6,000 units per month, the point at which operating losses exceed the shutdown cost. This volume of 6,000 units could be arrived at without an income statement as follows:

Fixed costs if plant operates	Rs 10,000
Fixed costs if plant shutsdown	4,000
Additional cost to be recovered when operating	6,000

Each unit of product sold contributes Re 1.00 to fixed costs recovery:

Selling price per unit	Rs 3.00
Variable cost per unit	Rs 2.00
Contribution	Rs 1.00

Sale of 6,000 units is necessary to recover Rs 6,000 of fixed costs.

$$\frac{\text{Rs } 6{,}000}{\text{Re } 1.00} = 6{,}000 \text{ units}$$

If the selling price is cut to Rs 2.80, the contribution margin will be Re 0.80 per unit.
Required sale to recover an additional Rs 6,000 of fixed costs.

$$\frac{\text{Rs } 6{,}000}{\text{Re } 0.80} = 7{,}500 \text{ units}$$

That is, sales of 7,500 units would be necessary to recover an additional Rs 6,000 of fixed costs.

Special Orders

The question of special orders or one time orders arises when a company has excess or idle production capacity and management considers the possibility of selling additional products at less than normal selling prices, provided that such a special order will not affect the regular sales of the same product.

The basic problem is to determine an acceptable price for the special order units. Cost analysis using the contribution approach is a useful technique to determine the short-run profit effects of special order transactions. In deciding the pricing of special orders where normal operations are not disturbed and where unused production capacity exists, it is not advisable to attach fixed costs to products. Price determination should take into account the recovery of incremental (variable) costs caused by accepting the special order. If the normal fixed costs are included in the price of the special order, the price may be too high and the business firm could lose the entire order and the contribution margin to be earned on the special order. Only the relevant (variable) costs should be used in the decision analysis to arrive at an appropriate price. Fixed costs are relevant only if incurred to facilitate the special order.

The following example illustrates the special order decisions.

A manufacturing company produces 20,000 units by operating at 60% of the capacity and sells at a price of 30 per unit. The budgeted figures for the year 2003 are as follows:

	Production (20,000 units)
	Rs 85,000
Raw material @ Rs 4.25	1,15,000
Direct labour @ Rs 5.75	1,55,000
Variable factory overhead @ 7.75	
Fixed factory overhead	1,25,000
Variable selling costs 2.75% of selling price	72,500
Fixed selling and administrative costs	

The company receives a special order for 10,000 units from a firm. The company desires to earn a profit of Re 1.00 per unit and no selling expenses are to be incurred for the special order. The minimum price on the special order and income statements are as follows:

Pricing of Special Order

	(10,000 units) (Rs)
Variable costs to be incurred:	
Raw materials	4.25
Direct labour	5.75
Variable overhead	7.75
Variable cost per unit	17.75
(no selling expenses)	1.00
Desired profit	18.75
Minimum price	

Increase in sales = 10,000 units × Rs 18.75 = Rs 1,87,500

Income Statement

	Without special order (Rs)	*Special order (Rs)*	*With special order (Rs)*
Sales	6,00,000	1,87,500	7,87,500
Less: Variable costs:			
Raw materials	85,000	42,500	1,27,500
Direct labour	1,15,000	57,500	1,72,500
Variable factory overhead	1,55,000	77,500	2,32,500
Variable selling costs (2.75% of selling price)	16,500	–	16,500
Total variable costs	3,71,500	1,77,500	5,49,000
Less: Fixed costs:			
Fixed factory overhead	1,25,000	–	1,25,000
Fixed selling and administrative cost	72,500	–	72,500
Total fixed costs	1,97,500	–	1,97,500
Total costs	5,69,000	1,77,500	7,46,500
Net income before taxes	31,000	10,000	41,000

From the above analysis it is clear that the acceptance of the special order will increase the profit by Rs 10,000. Also the bid price (Rs 18.75) is significantly less than the normal price of Rs 30. However, before arriving at a proper decision, management should consider some qualitative factors other than just the immediate impact on income. An important point is the effect on regular customers. If regular customers are paying more for the products, they may demand price reduction or quit buying from the firm and seek another source of supply. Another consideration is the possibility of special order customers being the regular customers.

Replace or Retain

The decision to replace or retain plant and equipment is also an important decision and should be taken very carefully. The differential costs which are important in retain or replace decisions are the following: change in fixed overhead costs, loss on sale of old equipment, capital investment and related costs such as rate of return and interest. Management should also consider differential benefits likely to be derived such as higher production and increased sales, realisable value of old machine, savings in operating costs, tax advantages, if any. Suppose a company has purchased a plant for Rs 1,00,000 five years ago which has a life of 10 years with no salvage value. The present book value is Rs 50,000. Management is considering the replacement of this plant with a new plant costing Rs 80,000 having a life of five years with no scrap value at the end of its life. The costs of operating present plant and the proposed palnt are as follows:

	Present plant (Rs)	*Proposed plant* (Rs)
Variable costs:		
Labour, supplies, power, etc.	80,000	48,000
Fixed costs:	10,000	12,000
Insurance, taxes, etc.	10,000	16,000
Depreciation	1,00,000	76,000

It appears that the proposed plant would result into cost savings of Rs 24,000 (Rs 1,00,000 – 76,000). However, the book value of the present equipment is a sunk cost and not relevant in the decision. The following table helps in making a better analysis of the data:

	Present plant Rs	*Proposed plant* Rs
Variable costs:		
Labour, supplies, power, etc.	80,000	48,000
Fixed costs:		
Insurance, taxes, etc.	10,000	12,000
Depreciation	0	16,000
	90,000	76,000

The purchase of the new plant results in a saving of Rs 14,000 (Rs 90,000 – 76,000). Management has to consider whether this benefit is enough to justify the investment of Rs 80,000 in new machinery.

LIMITATIONS OF DIFFERENTIAL COST ANALYSIS

Differential cost analysis helps in evaluating decision alternatives. Relevant costs are the cost factors that differ between alternatives. The primary objective is to select the least costly alternative. However,

cost computations and profit estimates are one means of tackling such problems. Many projects and proposals are rejected simply because the costs involved are too high or relative income potential was lower than that of an alternative. Yet, the project may have been beneficial to the company in that it would have allowed the company to balance its risk, or to offer a complete product line which would have attracted new customers to all the company's products. Perhaps this is the very reason why the cost accountant needs to be extremely careful in the translation of the data with which he works.

Managers must study carefully the data to be used in decision-making. Other qualitative factors besides cost should be given proper attention. The pressure of competition, the maintenance of sources of supply and of certain marketing outlets, and the maintenance of the existing personnel organisation and morale may often be the real determinants of business decisions. The quantitative information alone does not provide a solution to all business problems. Sometimes, other factors are more important than cost factors.

Example 17.1 (Differential Cost Analysis)

P Ltd., is at present operating at 80% capacity level, the production being 15,000 units per annum. The company operates a flexible budgetary control system. The following relevant cost data are obtained from the company's budget at different capacity utilisation levels:

	Capacity utilisation level	
	80%	*100%*
Sales	Rs 20,00,000	Rs 25,00,000
Variable overheads	Rs 2,25,000	Rs 2,50,000
Semi-variable Overheads	Rs 1,05,000	Rs 1,11,000
Fixed overheads	Rs 4,00,000	Rs 4,70,000
Output (in Units)	15,000	18,750

Material and labour cost per unit are constant under present conditions. The management expects a profit margin of 10% on sales.

You are required to compute the differential cost of producing the additional 3,750 units by increasing the capacity utilization level to 100 per cent and the minimum price per unit at 10% profit on cost.

(B. Com. Hons. Delhi 2001)

Solution

		Rs
Sales at 80% capacity		20,00,000
Less: Profit 10% $\left(\frac{20,00,000 \times 10}{100}\right)$		2,00,000
Cost of goods sold:		18,00,000
Less: Expenses	Rs	
Variable overheads	2,25,000	
Semi-variable overheads	1,05,000	
Fixed overheads	4,00,000	7,30,000
Cost of material and labour at 80% capacity		10,70,000

Therefore, material and labour cost at 100% capacity

$$\frac{10,70,000 \times 100}{80} = \text{Rs } 13,37,500$$

Differential cost analysis is as follows:

	80% Capacity 15,000 units	*100% Capacity 18,750 units*	*Differential cost*
	Rs	Rs	Rs
Material and Labour	10,70,000	13,37,500	2,67,500
Variable Expenses	2,25,000	2,50,000	25,000
Semi-variable Exp.	1,05,000	1,11,000	6,000
Fixed Expenses	4,00,000	4,70,000	70,000
Total Cost	18,00,000	21,68,500	3,68,500

(a) Differential Cost for 3750 Units = Rs 3,68,500

(b) Minimum Price = $\frac{\text{Rs } 3,68,500}{3750 \text{ units}}$ Rs 98.266

Add: 10% Profit on cost 9.826

108.092

Example 17.2 (Deciding Mode of Conveyance)

A company is considering three alternative proposals for conveyance facilities for its sales personnel who have to do considerable travelling, approximately 20,000 kilometres every year.

The proposals are as follows:

(i) Purchase and maintain its own fleet of cars. The average cost of car is Rs 1,00,000.

(ii) Allow the Executive use his own car and reimburse expenses at the rate of Rs 1.60 paise per kilometre and also bear insurance costs.

(iii) Hire cars from an agency at Rs 20,000 per year per car. The company will have to bear costs of petrol , taxes and tyres.

The following further details are available:

Petrol Re. 0.60 per kilometre
Repairs and maintenance Re 0.20 per kilometre
Tyre Re 0.12 per kilometre
Insurance Rs 1,200 per car per annum
Taxes Rs 800 per car per annum
Life of the car : 5 years with annual milage of 20,000 kilometres.
Resale value : Rs 20,000 at the end of the fifth year.

You are required to work out the relative costs of the three proposals and rank them.

(B. Com. Hons. Delhi, 2001)

Solution

	Alternatives (Cost per km Rs)		
	(i) (Rs)	(ii) (Rs)	(iii) (Rs)
Petrol	0.60	–	0.60
Repairs and Maintenance	0.20	–	–
Tyres	0.12	–	0.12
Insurance (1200 ÷ 20,000 km)	0.06	0.06	–
Taxes (800 ÷ 20,000 km)	0.04	–	0.04

Depreciation: $\frac{1,00,000 - 20,000}{5 \times 20,000}$	0.80	–	–
Reimbursement of Expenses	–	1.60	–
Hire Charges (20,000 ÷ 20,000)	–	–	1.00
	1.82	1.66	1.76
Cost of 20,000 kms	36,400	33,200	35,200

∴ The Proposal should be selected in order of (ii), (iii) and (i)

Example 17.3 (Differential Cost Computation)

A company has an installed production capacity of 1,00,000 units and presently it is working at 70% capacity utilisation. As production capacity utilisation increases, cost per unit decreases as follows:

Capacity utilisation	*Cost per unit*
70%	Rs 97
80%	Rs 92
90%	Rs 87
100%	Rs 82

The company has received three export orders from different sources as under:
Source A–5,000 units at Rs 55 per unit
Source B–10,000 units at Rs 52 per unit
Source C–10,000 units at Rs 51 per unit

Advise the company whether any or all the export orders should be accepted or not.

(B. Com. Hons. Delhi 2000)

Solution

Statement showing Differential Costs at Different Capacity Utilisation Levels
(Installed Capacity 1,00,000 units)

Capacity Utilisation	*Production at different levels capacity utilisation*	*Unit cost Rs*	*Total cost Rs*	*Differential cost Rs*	*Differential cost per unit Rs*
Percent	*Units*				
70	$70,000\left(1,00,000 \times \frac{70}{100}\right)$	97	67,90,000	–	–
80	$80,000\left(1,00,000 \times \frac{80}{100}\right)$	92	73,60,000	5,70,000	$57\left[\frac{5,70,000}{10,000}\right]$
90	$90,000\left(1,00,000 \times \frac{90}{100}\right)$	87	78,30,000	4,70,000	$47\left[\frac{4,70,000}{10,000}\right]$
100	1,00,000	82	82,00,000	3,70,000	$37\left[\frac{3,70,000}{10,000}\right]$

Statement showing Profit or Loss Accepting the Various Export Orders

Export order source	*Export order*	*Capacity utilisation*	*Differential costs*		*Price per unit*	*Sales revenue from the export order*	*Profit or (loss)*
			Per unit	*Total*			
	Unit	*Percent*	*Rs*	*Rs*	*Rs*	*Rs*	*Rs*
A	5,000	75	57	2,85,000	55	2,75,000	(10,000)
B	10,000	85	First 5,000 units being upto 80% @ Rs 57 Next 5,000 units Rs @ Rs 47	5,20,000	52	5,20,000	Nil
C	10,000	95	First 5,000 units being upto 90% @ Rs 47 Next 5,000 units @ Rs 7	4,20,000	51	5,10,000	90,000
Total	25,000	95%		12,25,000		13,05,000	80,000

It is clear from the above statement that it is advantageous for the company only when it accepts all the export orders. If the company accepts export orders only for one or two of three sources, it will suffer a loss. Therefore, the company should accept export orders from all the three sources to earn additional profits.

Example 17.4 (Material Procurement Decision)

A Company has the option to procure a particular material from two sources:

Source I assures that defectives will not be more than 2% of supplied quantity.

Source II does not give any assurance, but on the basis of past experience of supplies received from it, it is observed that defective percentage is 2.8%.

The material is supplied in lots of 1,000 units. Source II supplies the lot at a price, which is lower by Rs 100 as compared to Source I. The defective units of material can be rectified for use at a cost of Rs 5 per unit.

You are required to find out which of the two sources is more economical.

(CA Inter May 2001)

Solution

Comparative Statement of Procuring Material from Two Sources

	Material source I	*Material source II*
Defectives (in%)	2 *(Future estimate)*	2.8 *(Past experience)*
Units supplied *(in one lot)*	1,000	1,000
Total defective units in a lot	20 *(1,000 units × 2%)*	28 *(1,000 units × 2.8%)*
Additional price paid per lot (Rs): (A)	100	-
Rectification cost of defect (Rs) (B)	100 *(20 units × Rs 5)*	140 *(28 units × Rs 5)*
Total additional cost per (Rs): {(A) + (B)}	200	140

Decision: On comparing the total additional cost incurred per lot of 1,000 units, we observe that it is more economical, if the required material units are procured from material Source II.

Example 17.5 (Selling Price Decision)

The accounts of a company are expected to reveal a profit of Rs 14,00,000 after charging fixed costs of Rs 10,00,000 for the year ended 31st March, 2000. The selling price of the product is Rs 50 per unit and variable cost per unit is Rs 20.

Market investigations suggest the following responses to the price changes:

Alternatives	*Selling Price reduced by*	*Quantity Sold increased by*
I	5%	10%
II	7%	20%
III	10%	25%

Evaluate these alternatives and state which of the alternatives, on profitability consideration, should be adopted for the forthcoming year.

(CA Inter Nov. 2000; B. Com. (Hons) Delhi 2001)

Solution

Statement for evaluating three alternatives on profitability consideration

	Alternatives		
	I	*II*	*III*
Selling price per unit (Rs)	47.50 (Rs 50 – 5% of Rs 50)	46.50 (Rs 50 – 7% of Rs 50)	45.00 (Rs 50 – 10% of Rs 50)
Less: Variable cost per unit (Rs)	20.00	20.00	20.00
Contribution per unit (Rs)	27.50	26.50	25.00
Revised quantity of units to be sold *(Refer to Working Note 3)*	88,000	96,000	1,00,000
Total contribution (Rs)	24,20,000 (88,000 units × Rs 27.50)	25,44,000 (96,000 units × Rs 26.50)	25,00,000 (1,00,000 units × Rs 25)

Recommendation: An evaluation of the above three alternatives on profitability consideration clearly shows that alternative II is the best as it gives maximum contribution and hence profitability. Therefore this alternative should be adopted.

Working Notes:

1. *Contribution per unit*

= Rs Selling price per unit – Variable cost per unit

= Rs 50 – Rs 20 = Rs 30

2. *Expected quantity of units to be sold*

	(Rs)
Profit	14,00,000
Add: Fixed costs	10,00,000
Total contribution	24,00,000

$$\text{Quantity of units sold} = \frac{\text{Total contribution}}{\text{Contribution per unit}} = \frac{\text{Rs } 24,00,000}{\text{Rs } 30} = 80,000 \text{ units}$$

(Refer to working note 1)

3. *Revised quantity of units to be sold*

Alternatives	*Units to be sold*
I	80,000 units + 10% of 80,000 units = 88,000 units
II	80,000 units + 20% of 80,000 units = 96,000 units
III	80,000 units + 25% of 80,000 units = 1,00,000 units

Example 17.6 (Dropping a Product)

The costs per unit of three products *X*, *Y* and *Z* are given below:

Products	X	Y	Z
Direct Material (Rs)	20	16	18
Direct Labour (Rs)	12	14	12
Variable Overheads (Rs)	8	10	6
Fixed Expenses (Rs)	6	6	4
	Rs 46	46	40
Profit	18	14	12
Selling Price (Rs)	64	60	52
No. of units produced	10,000	5,000	8,000

Production arrangements are such that if one product is given up the production of the others can be raised by 50%. The directors propose that product Z should be given up because the contribution from the product is the lowest. Present suitable analysis of the data indicating whether the proposal should be accepted. *(B. Com Hons Delhi 1998)*

Solution

1. *Computation of present Profit*

	Rs
Product *X* (10,000 × 18)	1,80,000
Product *Y* (5,000 × 14)	70,000
Product *Z* (8,000 × 12)	96,000
	3,46,000

2. *Computation of Fixed Cost*

	Rs
Product X (10,000 × 6)	60,000
Product Y (5,000 × 6)	30,000
Product Z (8,000 × 4)	32,000
	1,22,000

3. Computation of Profit Under Proposed Situation (*Product Z discontinued*)

Product X (15,000 × 40)	Rs 6,00,000
Product Y (7,500 × 40)	3,00,000
	9,00,000
Add: Total Fixed Cost [as per calculation above]	1,22,000
Total Cost (1)	10,22,000
Sales:	
Product X (15,000 × 64)	9,60,000
Product Y (7,500 × 60)	4,50,000
Total Sales (2)	14,10,000
Profit = (2) – (1) = (3)	= 3,88,000

Thus, the profit under the proposed situation will increase by Rs 42,000 (i.e. 3,88,000 – 3,46,000). Hence, the proposal for discontinuance of Product Z should be accepted.

Note: It has been assumed that fixed costs of Rs 1,22,000 are for the business as a whole. They have been simply apportioned to Product X, Y, and Z and they will continue to be same even after the Product Z is discontinued.

Example 17.7 (Decision to Increase Sales)

Quality Product Limited has drawn up the following budget for the year 1998–99:

	Rs
Raw Materials	20,00,000
Labour, stores, power and other variable costs	6,00,000
Fixed Manufacturing Overheads	7,00,000
Packing and variable distribution cost	4,00,000
Fixed general overheads including selling	3,00,000
Sales Revenue @ Rs 50 per unit	40,00,000
Budgeted Profit	50,00,000
	Rs 10,00,000

The General Manager suggests to reduce selling prices by 5% and expects to achieve an additional volume of 5%. The more intensive manufacturing programme will involve additional costs of Rs 15,000 for production planning. It will also be necessary to open an additional sales office at the cost of Rs 1,00,000 per annum.

The Sales Manager, on the other hand, suggests to increase selling price by 10% which it is estimated will reduce sales volume by 10%. At the same time a saving in manufacturing overheads and general overheads of Rs 50,000 and Rs 1,00,000 per annum respectively is expected on this reduced volume.

Which of these two proposals would you accept and why? Show complete working.

(B. Com. (Hons) Delhi 1998)

Solution

Computation of Profit as per Proposal of General Manager

1. New Sales Volume (Units 1,00,000 + 5%)		1,05,000
		Rs
2. Sales Value (1,05,000 × 4,750)		49,87,500
3. Cost of Sales:		
Variable Costs = $\frac{30,00,000}{1,00,000} \times 1,05,000$		31,50,000
Fixed Cost:		
Present = 7,00,000 + 3,00,000		10,00,000
Additional Fixed Cost		1,15,000
Total Costs		42,65,000
Profit (2) – (3) = (4)		7,22,500

Computation of Profit as per Proposal of Sales Manager

1. Sales Volume (1,00,000 – 1,000)		9,00,000
		Rs
2. Sales Value (90,000 × 55)		49,50,000
3. Cost of Sales		
Variable Cost = $\frac{30,00,000}{1,00,000} \times 90,000$		27,00,000
Fixed Cost:		
Present	10,00,000	
Less: Saving in Fixed Cost	1,50,000	8,50,000
Total Cost		35,50,000
Profit = (2) – (3)		14,00,000

The profit as per the proposal of Sales Manager is much higher as compared to the proposal of the General Manager. Hence, the proposal of the Sales Manager should be accepted.

Example 17.8 (Minimum Price Decision)

An umbrella manufacturer makes an average profit of Rs 2.50 per unit on a selling price of Rs 14.30 by producing and selling 60,000 units at 60 per cent of potential capacity.

His cost of sales per unit is as follows:

Direct Materials	Rs 3.50
Direct Wages	Rs 1.25
Factory Overhead	Rs 6.25 (50% fixed)
Sales Overhead	Re 0.80 (25% variable)

During the current year, he intends to produce the same number but estimates that his fixed costs would go up by 10 per cent while the rates of direct wages and direct materials will increase by 8% and 6% respectively. However, the selling price cannot be changed.

Under this situation, he obtains an offer for a future 20% of his potential capacity.

What minimum price would you recommend for acceptance of the offer to ensure the manufacturer an overall profit of Rs 1,67,300? *(B. Com. Hons Delhi 1996)*

Solution

Statement of Marginal Cost for Current Year

		Per units
Direct Material	Rs 3.50 +.21	3.71
Direct Wages	Rs 1.25 + .10	1.35
Variable Overheads		3.125
Factory Overheads		0.20
Selling Overheads		8.385
Total Marginal Cost		5.915
Contribution per unit		14.300
Selling Price		

Statement of Profit

			Output 60,000 units
Sales (60,000 × 14.30)			Rs 8,58,000
Less: Variable Costs (60,000 × 3.385)			5,03,100
Contribution			3,54,900
Less: Fixed Costs:			
Factory Overheads 60,000 × 3.125 =		1,87,500	
Add: 10% Increase		18,750	
		2,06,250	
Sales Overheads	36,000		
Add: 10% Increase	3,600	39,600	2,45,850
Profit			1,09,050
Desired Profit			1,67,300
Profit on 60,000 units			1,09,050
Profit to be earned on 20,000 units			58,250

Statement of Minimum Selling Price for 20,000 Units

	Rs
Variable Cost (20,000 × 8.385)	1,67,700
Desired Profit	58,250
Total Sales	2,25,950

Selling Price per unit $\frac{2,25,950}{20,000}$ = Rs 11.30

Example 17.9 (Product profitability)

The following particulars are taken from the records of a company engaged in manufacturing two products, A and B, from a certain material:

Particulars	*Product A (per unit) Rs*	*Product B (per unit) Rs*
Sales	2,500	5,000
Material cost (Rs 50 per kg)	500	1,250
Direct labour (30 per hour)	750	1,500
Variable overhead	250	500
Total fixed overheads: Rs 10,00,000		

Comment on the profitability of each product when:

(i) Total sales in value is limited.
(ii) Raw materials is in short supply.
(iii) Production capacity is the limiting factor.
(iv) Total availability of raw materials is 20,000 kg and maximum sales potential of each product is 1,000 units, find the product mix to yield maximum profits.

(CA Inter Nov 1998)

Solution

Basic Calculations

Statement of Evaluation of Products A and B

Particulars	*Product A*		*Product B*	
	Rs	*Rs*	*Rs*	*Rs*
Sales		2,500		5,000
Less: Variable Costs:				
Material Cost	500		1,250	
Direct Labour	750		1,500	
Variable Overhead	250		500	
		1,500		3,250
1. Contribution per unit		1,000		1,750
2. P/V Ratio	$\frac{1,000}{2,500} \times 100$		$\frac{1,750}{5,000} \times 100$	
	= 40%		35%	
3. Material in kg per unit	$= \frac{\text{Rs } 500}{\text{Rs } 50}$		$\frac{\text{Rs } 1,250}{\text{Rs } 50}$	
	= 10 kg		25 kg	
4. Contribution per kg of Material	= Rs 100		Rs 70	
5. Labour hour per unit	$= \frac{\text{Rs } 750}{30}$		$\frac{1,500}{30}$	
	= 25 hours		= 50 hours	
6. Contribution per Labour Hour	= Rs 40		Rs 35	

(i) *Comment on the Profitability of each product when total sales in value is limited*
Product A has a higher P/V ratio than Product B and hence Product A is more profitable.

(ii) *Comment on the Profitability of each product when raw materials is in short supply*
Product A has a higher contribution per kg of raw material than Product B. Hence, Product A is more profitable.

(iii) *Comment on the Profitability of each product when production capacity is the limiting factor*
Product A has a higher contribution per labour hour than Product B. Hence, Product A is more profitable.

(iv) *When raw material and sales quantity both are limiting factors*

Statement of Product Mix to Yield Maximum Profits
(When total availability of raw material is 20,000 kg)

Products	*Units to be made*	*Raw material consumed (kg)*	*Contribution per unit (Rs)*	*Total Contribution (Rs)*	*Fixed Cost (Rs)*	*Cost (Rs)*	*Profit (Rs)*
(I)	*(II)*	*(III)*	*(IV)*	*(V)*	*= (II) × (IV)*	*(VI)*	*(VII) = (V) − (VI)*
A	1,000	10,000 (1,000 units × 10 kg.)	1,000		10,00,000		
B	400	10,000 (400 units × 25 kg.)	1,750	7,00,000			
	20,000			17,00,000	10,00,000	7,00,000	

Example 17.10 (Replacement of a Product)

A multi product company has the following costs and output data for the last year.

	Product		
	X	*Y*	*Z*
Sales mix	40%	35%	25%
Selling price	Rs 20	Rs 25	Rs 30
Variable cost per unit	10	15	18
Total fixed cost			1,50,000
Total sales			5,00,000

The company proposes to replace product Z by product S. Estimated cost and output data are:

Sales mix	50%	30%	20%
Selling price	20	25	28
Variable cost per unit	10	15	14
Total fixed costs			1,50,000
Total sales			5,00,000

Analyse the proposed change and suggest what decision the company should take.

(ICWA, Inter)

Solution

(I) Computation of Present Profit and BEP

Particula	*Products*			
	X	*Y*	*Z*	
Selling price	Rs 20	Rs 25	Rs 30	
Variable cost	10	15	18	
Contribution	10	10	12	
P/V ratio	50%	40%	40%	
Sales mix	40%	35%	25%	100%
Contribution per rupee of sales: (P/V ratio × Sales mix)	20%	14%	10%	44%
Sales				Rs 5,00,000
Total contribution Rs (5,00,000 × 44/100)				2,20,000
Fixed costs				1,50,000
Profit				Rs 70,000
Break-even point (Rs 1,50,000 × 100/44)				Rs 3,40,909

(2) Computation of Proposed Profit and BEP

Particula	*Products*			*Total*
	X	*Y*	*Z*	
Selling price	Rs 20	Rs 25	Rs 28	
Variable cost	10	15	14	
Contribution	10	10	14	
P/V Ratio	50%	40%	50%	
Sales mix	50%	30%	20%	100%
Contribution per rupee of sales (P/V ratio × Sales mix)	25%	12%	10%	47%
Sales				Rs 5,00,000
Total contribution 5,00,000 × 47/100				2,35,000
Fixed cost				1,50,000
Profit				Rs 85,000
Break-even point (1,50,000 × 100/47)				3,19,149

A comparison of the present situation and the proposed situation shows that if product Z is replaced by product S, profit would increase by Rs 15,000 and break-even point will reduce by Rs 21,760. The change is beneficial and, therefore, product Z may be dropped, provided all other relevant factors remain constant.

Example 17.11 (Decision about New Market)

A company annually manufactures 10,000 units of a product at a cost of 4 per unit and there is home market for consuming the entire volume of production at the sale price of 4.25 per unit. In the year 2002, there is a fall in the demand for home market which can consume 10,000 units only at a sale price of Rs 3.72 per unit. The analysis of cost per Rs 10,000 units is:

	Rs 15,000
Materials	11,000
Wages	8,000
Fixed overheads	6,000
Variable overheads	

The foreign market is explored and it is found that this market can consume 20,000 units of the product if offered at sale price of 3.55 per unit. It is also discovered that for additional 10,000 units of the product (over initial 10,000 units) the fixed overheads will increase by 10 per cent. Is it worthwhile to try to capture the foreign market?

Solution

Statement showing the Advisability of Selling Goods in Foreign Market

	Year 2001	*Year 2002*		
	Home market	*Home market*	*Foreign market*	*Total*
	10,000	*10,000*	*20,000*	*30,000 units*
	(1) Rs	*(2) Rs*	*(3) Rs*	*(4) Rs*
Materials	15,000	15,000	30,000	45,000
Wages	11,000	11,000	22,000	33,000
Overheads:				
Fixed	8,000	8,000	1,600	9,600
Variable	6,000	6,000	12,000	18,000
Total cost	40,000	40,000	65,600	1,05,600
Profit (loss)	2,500	(2,800)	5,400	2,600
Sales	42,500	37,200	71,000	1,08,200

From the above it is clear that it is advisable to sell goods in the foregin market. It will compensate not only for the loss on account of sale in the domestic market but will also result in an overall profit of Rs 2,600.

Example 17.12 (Export Offer)

Due to industrial depression, a plant is running, at present, at 50% of its capacity. The following details are available.

	Cost of production per unit
Direct material	Rs 2
Direct labour	1
Variable overhead	3
Fixed overhead	2
	8

Production per month	20,000 units
Total cost of production	Rs 1,60,000
Sale price	1,40,000
Loss	20,000

An exporter offers to buy 5,000 units per month at the rate of Rs 6.50 per unit and the company hesitates to accept the offer for fear of increasing its already large operating losses.

Advise whether the company should accept or decline this offer.

Solution

Statement of Profit

	Existing situation	*Proposed situation*		
	20,000 Units	20,000 Units	5,000 Units	Total 25,000 Units
A. Sales Rs	1,40,000	1,40,000	32,500	1,72,500
B. Variable costs: (Rs)				
Direct material	40,000	40,000	10,000	50,000
Direct labour	20,000	20,000	5,000	25,000
Variable overheads	60,000	60,000	15,000	75,000
Total variable cost	1,20,000	1,20,000	30,000	1,50,000
C. Contribution (A) – (B) (Rs)	20,000	20,000	2,500	22,500
D. Fixed costs (Rs)	40,000	40,000	–	40,000
Profit (loss) Rs	(20,000)	(20,000)	2,500	(17,500)

The company should accept the offer since the amount of loss will stand reduced from 20,000 to Rs 17,500.

Example 17.13 (Decision about Mechanisation)

Management of a manufacturing unit is considering extensive modernisation of the factory through progressive mechanisation which would result in improved productivity and reduced strength. Through negotiations with the union, it was agreed that for every 1% increase in productivity, workers would be paid 0.5% incentive wages. It was also agreed that through voluntary retirement the staff strength would be reduced to 300 from the present level of 400. The following further comparative data are available before and after the proposed mechanisation:

	Before mechanisation	*After mechanisation*
No. of articles produced per month	50,000	48,000
Fringe benefits	50% of wages	
Wages paid per month	Rs 4,00,000	
Sales per month (value)	Rs 24,00,000	
P/V ratio	25%	

Based on the above data, you are required to work out the annual financial implication of the proposal. *(ICWA Inter)*