Cost Classification and Behaviour

Total product/service cost can be classified in a number of different ways:
- By Element – Costs are classified in material, labour or Expenses (Overheads)
- By Function – Production or non-production cost
- By Nature – Direct or Indirect costs
- By Control – Controllable or non-Controllable
- By Behaviour – Fixed, Variable, Semi Variable, stepped Fixed Cost

Classification by Element:

Main Cost Elements are material, labour & Expenses.

Material costs include cost of obtaining materials and receiving them in the organization. Cost of bringing materials to the organizations is called as carriage inwards.

Labour consists of costs incurred in form of wages & salaries together with related employment costs.

Expenses (Overheads) are related costs such as utilities, heating, rent, rates etc.

Note:
Within all these classifications, there are number of subdivisions, for example with Material classifications, subdivisions might include:
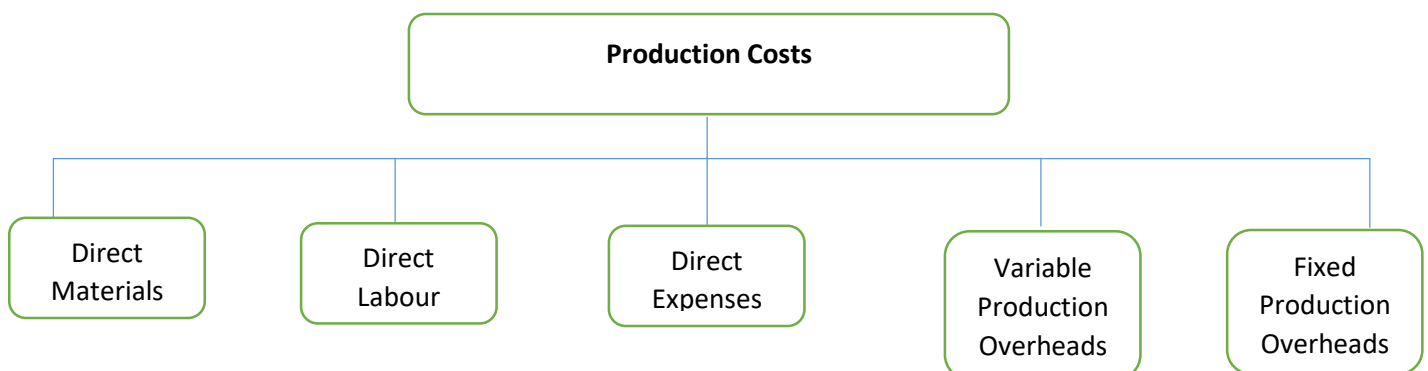
- Raw material that is basic raw material to manufacture a product e.r. wood to make chair.
- Components i.e. complete parts are assembled to make a complete unit e.g. components are assembled to make a car.
- Consumables i.e. cleaning material etc.
- Maintenance Material include spare parts for machines, lubricating oils etc.

The list of subdivisions is not exhaustive and there may be even further subdivisions of each of these groups. For example, raw material can be further divided according to types of raw material e.g. wood, iron, foam etc.

Classification by Function:

➢ **Production Costs**

Production costs are costs incurred when raw materials are converted into finished goods.

Production Costs				
Direct Materials	Direct Labour	Direct Expenses	Variable Production Overheads	Fixed Production Overheads

Examples of Production Costs:

Direct Materials - Materials that go directly into making a product e.g. *cloth in manufacturing shirts*.

Direct Labour – Cost of labour directly engaged in making product e.g. *wages of workers making shirts.*
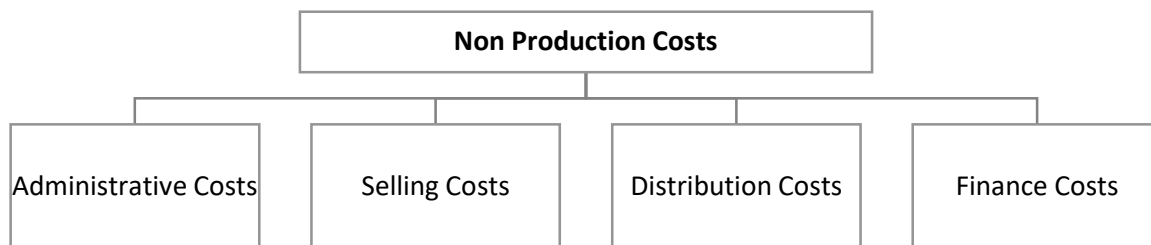
Direct Expenses – Cost of expenses directly involved in making a product e.g. *freight charges paid to bring special material used in making shirts*.

Variable Production Overheads – overheads that vary directly in proportion to quantity of product manufactured e.g. *fuel used to run machines*.

Fixed Production Overheads – overheads that do not vary directly in proportion to quantity of product manufactured and are fixed whatever the quantity of product manufactured e.g. *Rent of factory*.

➢ **Non Production Costs:**

These are costs that are not directly associated with production process in manufacturing organization.

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                    ┌──────────────────────────┐
                    │   Non Production Costs    │
                    └──────────────────────────┘
     ┌──────────────────┬──────────┴───────┬──────────────────┐
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│Administrative│  │Selling Costs │  │ Distribution │  │Finance Costs │
│    Costs     │  │              │  │    Costs     │  │              │
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Administrative Costs – Costs incurred in running general administration departments of an organization e.g. Accounts department, HR department etc.

Selling Costs – Cost associated with taking orders from customers who wish to buy an organization's product & also includes marketing costs.

Distribution Costs – Costs involved in distributing organization's products to customers e.g. delivery costs.

Finance Costs – Costs incurred in order to finance the organization e.g. interest on loan from bank.

Classification by Nature:

Here costs are classified with regard to their nature. They are grouped according to the reason for which they have been incurred. Broadest classification of this type divides costs into direct costs and indirect costs.

➢ **Direct Costs:**

A direct cost is one that can be clearly identified with the cost object we are trying to cost. For example, a furniture maker is determining cost of a wooden table. The manufacture of table involves use of timber, screws and metal drawer handles. These items are classified as direct materials and their cost is direct cost. Similarly, wages paid to machine operator, assembler and finisher involved in making table actually would be classified as direct labor.

The designer of table may be entitled for royalty of his design for each table manufactured and this would be classified as direct expense.

The total of direct costs is also called Prime Cost.

➢ **Indirect Cost:**

Other costs incurred would be classified as indirect costs. They cannot be directly attributed to a particular cost unit, although it is clear that they have been clear in production of the table. These costs are often referred to as overheads.

Examples of indirect production costs are:

Costs Incurred	Cost Classification
Lubricating oils & cleaning materials	indirect material
Salaries of supervisory labour	indirect labour
Factory rent & power	indirect expense

It is important to note that a particular cost sometimes may be a direct cost or sometimes indirect cost. It depends upon cost object we are trying to cost.

For example, *salary of machining department supervisor* is direct cost of that department because it can be specifically identified with the department. However, it can be indirect cost of each of cost units processed in machining department because it can not be directly identified with any particular cost unit.

Classification by Nature:

➢ **Controllable costs**

These are those over which the company has full authority. They can be altered in short term. Examples of controllable costs are *advertising, bonuses, direct materials, donations, dues and subscriptions, employee compensation, office supplies, and training*.

➢ **Non Controllable costs**

These costs are those that a company cannot change, such as rent and insurance. A manager, at lower level does not have power or authority to influence. However, some costs can be controlled at higher level.

Classification by behavior:
Costs may be classified according to the way they behave. Cost behavior is the way in which input costs vary with different level of activity.

Cost behavior tends to classify costs as one of the following:
- Variable Costs
- Fixed Costs
- Stepped Fixed Costs
- Semi Variable Costs

➢ **Variable Costs**

A variable cost is a cost which tends to vary directly with the volume of output. The variable cost per unit is the same amount for each unit produced.

Graph of variable cost (1)
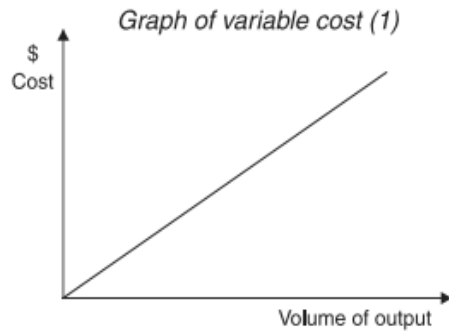
a) The most important variable cost is the cost of raw materials (where there is no discount for bulk purchasing since bulk purchase discounts reduce the cost of purchases).
b) Direct labour costs are, for very important reasons, classed as a variable cost even though basic wages are usually fixed.
c) Sales commission is variable in relation to the volume or value of sales.

➢ **Fixed Costs**

A fixed cost is a cost which tends to be unaffected by increases or decreases in the volume of output. Fixed costs are a period charge, in that they relate to a span of time; as the time span increases, so too will the fixed costs (which are sometimes referred to as period costs for this reason).

A sketch graph of fixed cost would look like this.
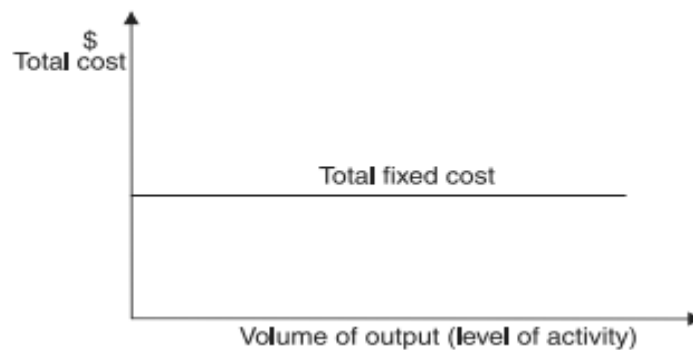
Examples of a fixed cost would be as follows:

- The salary of the managing director (per month or per annum)
- The rent of a single factory building (per month or per annum)
- Straight line depreciation of a single machine (per month or per annum)

➢ **Stepped Fixed Cost**

This is a type of fixed cost that remains fixed within certain level of activity. Once the upper limit of activity is reached, then a new level of fixed cost becomes irrelevant.

Consider the depreciation of a machine which may be fixed if production remains below 1,000 units per month. If production exceeds 1,000 units, a second machine may be required, and the cost of depreciation (on two machines) would go up a step.

A sketch graph of a step cost could look like this.

Graph of step cost
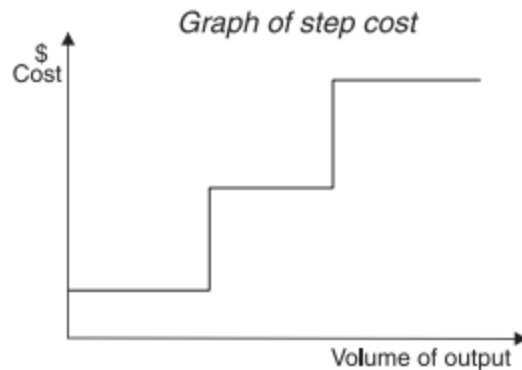
Other examples of step costs are as follows.
- Rent is a step cost in situations where accommodation requirements increase as output levels get higher.
- Basic pay of employees is nowadays usually fixed, but as output rises, more employees (direct workers, supervisors, managers and so on) are required.
- Royalties.

➤ Semi Variable Cost

It is a cost which contains both fixed and variable components and so is partly affected by changes in the level of activity.

Examples of these costs include the following:

(a) Electricity and gas bills
    (i) Fixed cost = standing charge
    (ii) Variable cost = charge per unit of electricity used

(b) Salesman's salary
    (i) Fixed cost = basic salary
    (ii) Variable cost = commission on sales made

(c) Costs of running a car
    (i) Fixed cost = road tax, insurance
    (ii) Variable costs = petrol, oil, repairs (which vary with miles travelled)

Determining the fixed and variable elements of semi-variable costs

Analyzing costs

The fixed and variable elements of semi-variable costs can be determined by the high-low method.

Cost accountants tend to separate semi-variable costs into their variable and fixed elements. They therefore generally tend to treat costs as either fixed or variable. There are several methods for identifying the fixed and variable elements of semi-variable costs. Each method is only an estimate, and each will produce different results.

The two main methods are:
- High-low method
- Least Square Regression

High-low method:

Follow the steps below to estimate the fixed and variable elements of semi-variable costs.

Step 1   Review records of costs in previous periods.

- Select the period with the **highest** activity level.
- Select the period with the **lowest** activity level.

Step 2   Determine the following.

- Total cost at high activity level
- Total cost at low activity level
- Total units at high activity level
- Total units at low activity level

Step 3   Calculate the following.

$$\frac{\text{Total cost at high activity level} - \text{total cost at low activity level}}{\text{Total units at high activity level} - \text{total units at low activity level}}$$

= variable cost per unit (v)

Step 4   Fixed costs = (total cost at high activity level) – (total units at high activity level × variable cost per unit)

= 170,000 – (90,000 × 1) = 170,000 – 90,000 = $80,000

Therefore the costs in 20X5 for output of 85,000 units are as follows.

	$
Variable costs = 85,000 × $1	85,000
Fixed costs	80,000
	165,000

Another Example of The high-low method

DG Co has recorded the following total costs during the last five years.

Year	Output volume Units	Total cost $
20X0	65,000	145,000
20X1	80,000	162,000
20X2	90,000	170,000
20X3	60,000	140,000
20X4	75,000	160,000

Required

Calculate the total cost that should be expected in 20X5 if output is 85,000 units.

Solution

Step 1
- Period with highest activity = 20X2
- Period with lowest activity = 20X3

Step 2
- Total cost at high activity level = 170,000
- Total cost at low activity level = 140,000
- Total units at high activity level = 90,000
- Total units at low activity level = 60,000

Step 3   Variable cost per unit

$$= \frac{\text{total cost at high activity level} - \text{total cost at low activity level}}{\text{total units at high activity level} - \text{total units at low activity level}}$$

$$= \frac{170,000 - 140,000}{90,000 - 60,000} = \frac{30,000}{30,000} = \$1 \text{ per unit}$$

Step 4   Fixed costs = (total cost at high activity level) – (total units at high activity level × variable cost per unit)

$$= 170,000 - (90,000 \times 1) = 170,000 - 90,000 = \$80,000$$

Therefore the costs in 20X5 for output of 85,000 units are as follows.

	$
Variable costs = 85,000 × $1	85,000
Fixed costs	80,000
	165,000

Example:

Month	Number of Burgers Sold	Total Cost ($)
Jan	122	$5,123
Feb	154	$4,356
Mar	113	$3,670
Apr	**190**	**$5,800**
May	98	$4,000
Jun	90	$3,200
Jul	123	$3,456
Aug	111	$2,145
Sept	161	$5,468
Oct	**78**	**$3,210**
Nov	118	$4,125
Dec	132	$4,100

Variable Cost Per Unit = $\frac{(\$5,800 - \$3,210)}{(190 - 78)}$ = **$23.125**

For the Highest Activity
Fixed Cost is calculated using the formula given below:

Fixed Cost   =   Highest Activity Cost – (Variable Cost Per Units * Highest Activity Units)
           Fixed Cost = $5,800 – ($23.125 * 190)
           Fixed Cost = $1,406.25

For the Lowest Activity
Fixed Cost is calculated using the formula given below:

Fixed Cost   =   Lowest Activity Cost – (Variable Cost Per Units * Lowest Activity Units)
           Fixed cost = $3,210– ($23.125 * 78)
           Fixed Cost = $1,406.25

So basically Total cost equation is given by = 23.125x + 1406.25
Where x is the number of burgers sold in a particular month.

Least squares regression method

It is a method to segregate fixed cost and variable cost components from a mixed cost figure. It is also known as linear regression analysis.

Least squares regression analysis or linear regression method is deemed to be the most accurate and reliable method to divide the company's mixed cost into its fixed and variable cost components. This is because this method takes into account all the data points plotted on a graph at all activity levels which theoretically draws a best fit line of regression.
Linear regression is basically a mathematical analysis method which considers the relationship between all the data points in a simulation. All these points are based upon **two unknown variables – one independent and one dependent**. The dependent variable will be plotted on the y-axis and the independent variable will be plotted to the x-axis on the graph of regression analysis. It estimates the relationship between these two variables by a straight line is called a simple linear regression.

Scatter Plots: The first step in regression is to plot your data on a scatter plot. The following table lists the monthly sales and advertising expenditures for all the months of the last year by a digital electronics company.

Month	Sales	Advertising
	Rs. '000	Rs. '000
January	100	5.5
February	110	5.8
March	112	6
April	115	5.9
May	117	6.2
June	116	6.3
July	118	6.5
August	120	6.6
September	121	6.4
October	120	6.5
November	117	6.7
December	123	6.8

In this case, you would plot last year's data for monthly sales and advertising expenditures as shown on the scatter plot below. (Data for independent and dependent variables must be from the same period of time.)
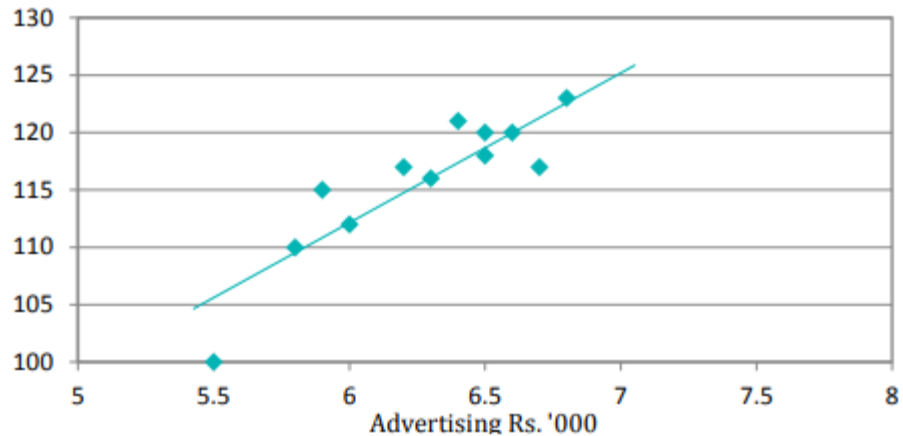
Sales Rs. '000

Advertising Rs. '000
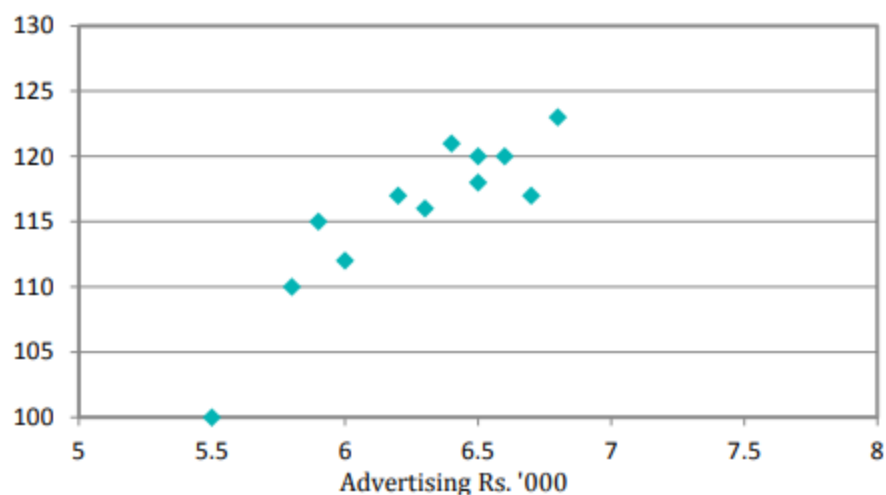
This scatter plot represents the historical relationship between an independent variable, shown on the x-axis, and a dependent variable, shown on the y-axis.

Regression Line:

The figure below is the same as the scatter plot above, with the addition of a regression line fitted to the historical data.

Sales Rs. '000

The regression line is the line with the smallest possible set of distances between itself and each data point. As you can see, the regression line touches some data points, but not others. The distances of the data points from the regression line are called error terms. The extension of the line of regression requires the assumption that the underlying process causing the relationship between the two variables is valid beyond the range of the sample data.

Regression is a powerful business tool due to its ability to predict future relationships between variables such as these.

Equation of a Regression Line:

You may recall the equation of a straight line from your review of the Linear Functions topic in the Algebra section of the course on Quantitative methods.

$$y = a + bx$$

Variables, constants, and coefficients are represented in the equation of a line as:

- x represents the independent variable
- y represents the dependent variable
- the constant a denotes the y-intercept—this will be the value of the dependent variable if the independent variable is equal to zero, this represent the component value of y that is independent of x.
- the coefficient b describes the movement in the dependent variable as a result of a given movement in the independent variable

Formula:

Given a number of pairs of data, a line of best fit (y = a + bx) can be constructed by calculating values for a and b using the following formulae:

$$a = \frac{\Sigma y}{n} - \frac{b\Sigma x}{n}$$

$$b = \frac{n\Sigma xy - \Sigma x \Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$$

Where:

x, y =   values of pairs of data.

n =   the number of pairs of values for x and y.

Σ =   A sign meaning the sum of. (The capital of the Greek letter sigma).

Note: the term b must be calculated first as it is used in calculating a.

Example:
A company has recorded the following output levels and associated costs in the past six months:

Month	Output (000 of units)	Total cost (Rs m)
January	6.8	42.3
February	8.7	48.1
March	9.2	50.7
April	7.1	42.6
May	7.5	46.5
June	8.5	48.2

In order to construct the equation of a line that is of best fit for this data, please see below

Working:	x	Y	x²	xy
January	6.8	42.3	46.24	287.64
February	8.7	48.1	75.69	418.47
March	9.2	50.7	84.64	466.44
April	7.1	42.6	50.41	302.46
May	7.5	46.5	56.25	348.75
June	8.5	48.2	72.25	409.7
	47.8	278.4	385.48	2233.46
	$= \Sigma x$	$= \Sigma y$	$= \Sigma x^2$	$= \Sigma xy$

$$b = \frac{n\Sigma xy - \Sigma x \Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$$

$$= \frac{6(2233.46) - (47.8)(278.4)}{6(385.48) - (47.8)^2}$$

$$= \frac{13400.76 - 13307.52}{2312.88 - 2284.84} = \frac{93.24}{28.04} = 3.325$$

	This is the cost in millions of rupees of making 1,000 units)
$a = \dfrac{\Sigma y}{n} - \dfrac{b\,\Sigma x}{n}$	$a = \dfrac{278.4}{6} - \dfrac{3.325(47.8)}{6}$
	$a = 46.4 - 26.49 = 19.91$
Line of best fit:	$y = a + bx$
	$y = 19.91 + 3.325x$

Example

The records of direct labor hours and total factory overheads of IMI Limited over first six months of its operations are given below:

	Direct labor Hours in 000	Total factory Overheads Rs. in 000
September 20X9	50	14,800
October 20X9	80	17,000
November 20X9	120	23,800
December 20X9	40	11,900
January 20X0	100	22,100
February 20X0	60	16,150

The management is interested in distinguishing between the fixed and variable portion of the overhead and using the least square regression method, it is required to estimate the variable cost per direct labor hour and the total fixed cost per month.

Required: Estimate both variable and fixed costs using regression analysis.

Linear regression analysis

A company has estimated the following linear regression line to describe the relationship between its output and costs:

$$y = 19.91 + 3.325x$$

(Where x is in thousands and y is millions of rupees).
What costs would be expected for output of 3,000 units and 10,000 units? Using the equation, as follows the predicted costs would be $29.885 and $ 53.16

	$y = 19.91 + 3.325x$
3,000 units	$y = 19.91 + 3.325(3) = 29.885$
10,000 units	$y = 19.91 + 3.325(10) = 53.16$