

Management Accountancy

Unit 2

Cost Management and Reporting

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Contents

- Concept and classification of costs
- Cost behavior and cost estimation
- Segregation of semi-variable (mixed) cost:
 - High-Low method
 - Least Square Method (Regression method)
 - Correlation coefficient
 - Coefficient of determination
 - Standard error of estimates
 - Standard error of regression coefficient
 - Confidence interval
 - Student “t” test

Learning Objectives

- Explain the meaning of cost
- Classify the cost in different approaches
- Segregate the mixed costs into variable and fixed cost by using high-low method and regression equation method

Cost Concept

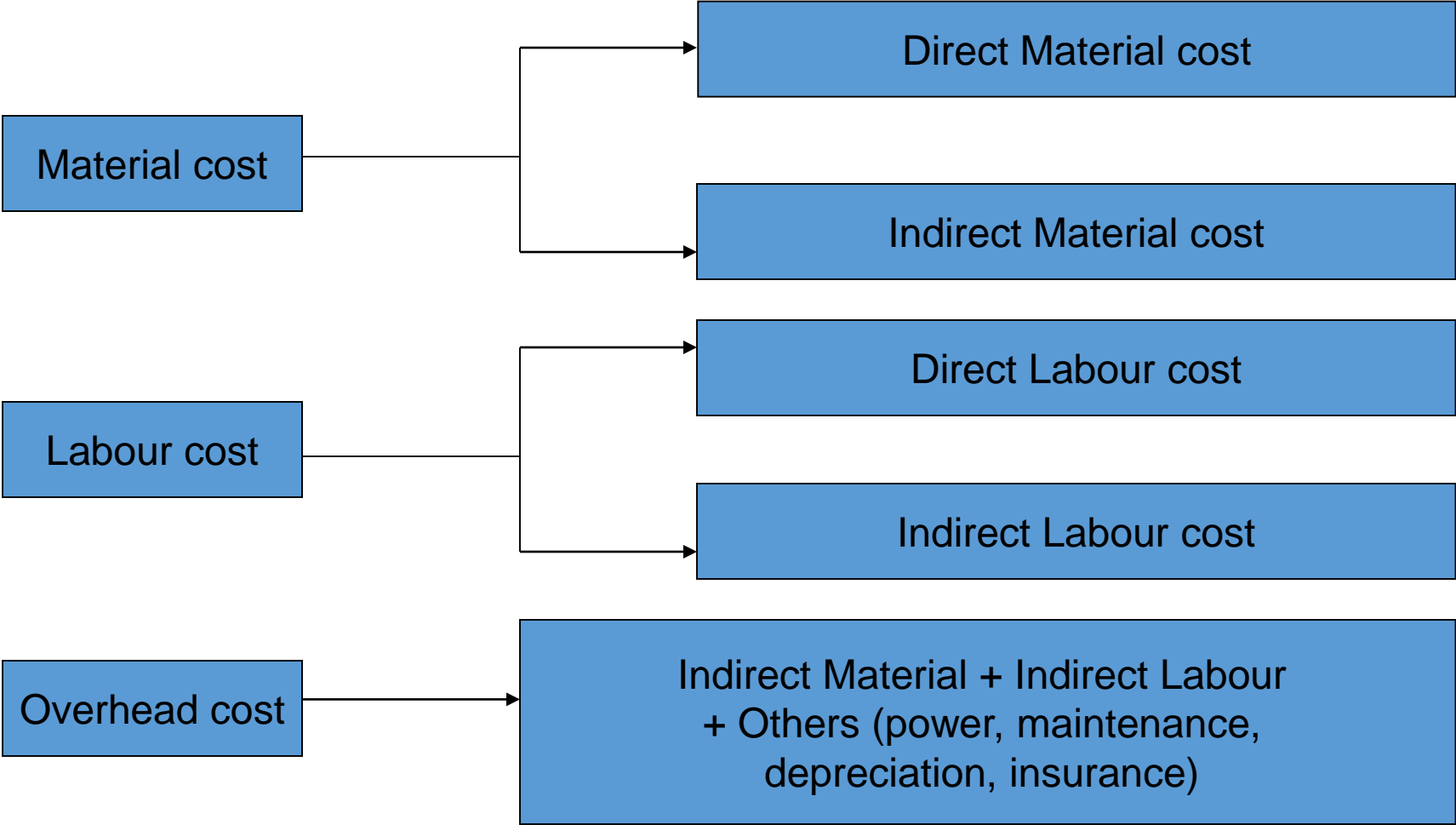
- All expenditure involved in the process of production of goods or services is termed as cost
- Cost is the price paid for producing the goods or obtaining the services measured in terms of monetary value
- A resource sacrificed or foregone to achieve a specific objective
- Cost is a measurement, in monetary terms, of the amount of resources used for some purpose.
 - The definition includes *three important ideas*:
 - Cost measures the *use of resources*
 - Cost measurements are expressed in *monetary terms*
 - Cost measurement always relates to *a purpose*

Cost Objects

- The product, project, organizational unit, or other activity for which costs are measured
- A cost center is a cost object for which costs of one or more related functions or activities are accumulated
- For example (in hospital): the hospital as a whole, the X-ray department, the emergency room, the personnel office, treatment of a type of disease

Classification of Cost

According to Nature/Element



Material and Labour of Costs

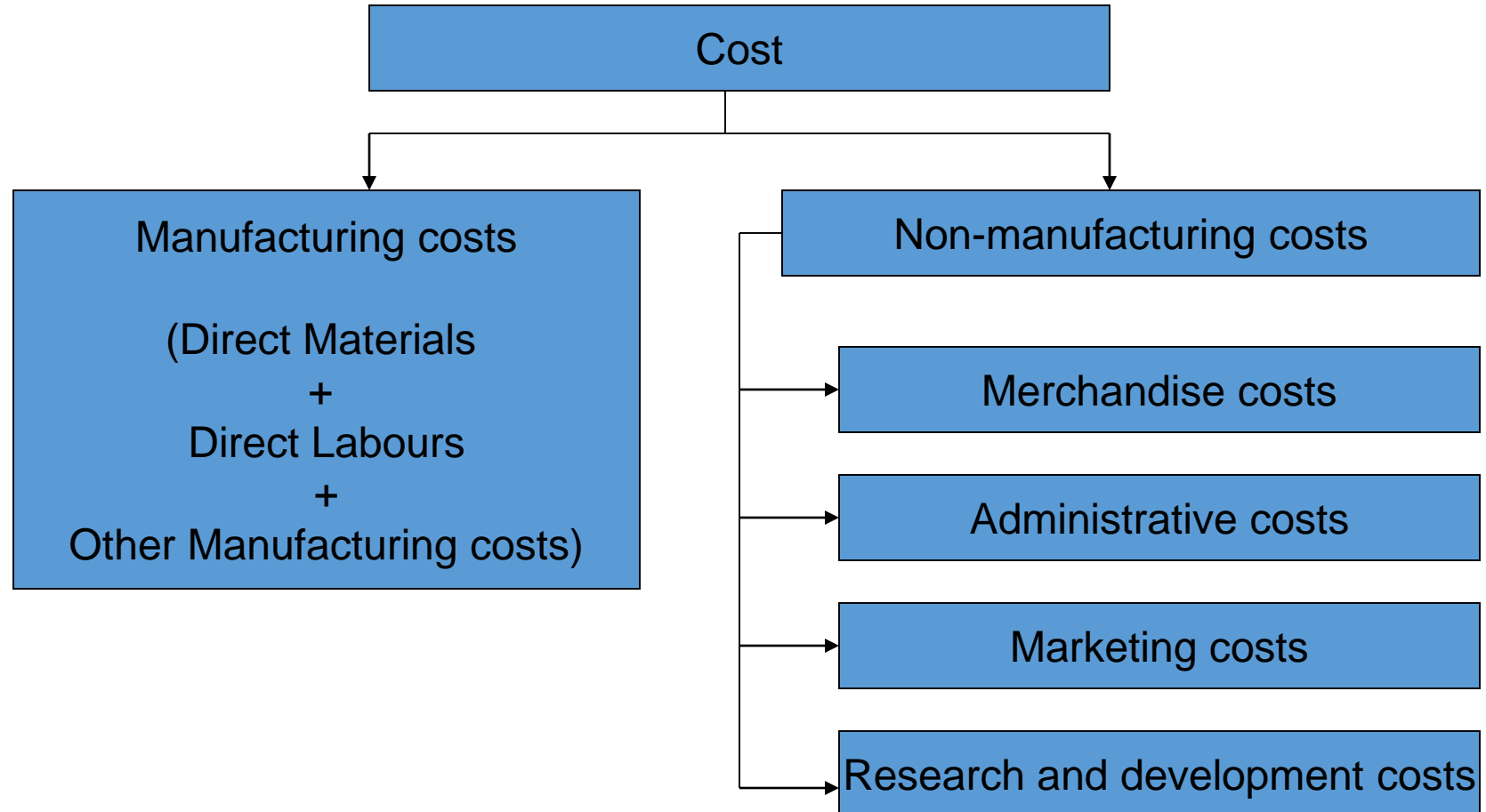
- **Direct material** - Quantities of material identified with a cost object (i.e., raw material)
 - The *quantity* of material used
 - The *price per unit* of quantity
- **Direct labor**
 - Measuring the quantity of labour time expended
 - The price per unit of labour
 - Direct worker paid a piece rate, number of pieces completed
 - Example, earnings of workers who assemble parts into finished goods
- **Indirect material** – Materials used in the production process but not directly traced to individual products (i.e., supplies)
 - Example, spices in a restaurant, lubricating oil for factory machinery
- **Indirect labour** – the earnings of employees who do not work directly on a single product but whose efforts are related to the overall process of production
 - Example, supervisors and stockroom personnel

Classification of Cost

According to Function

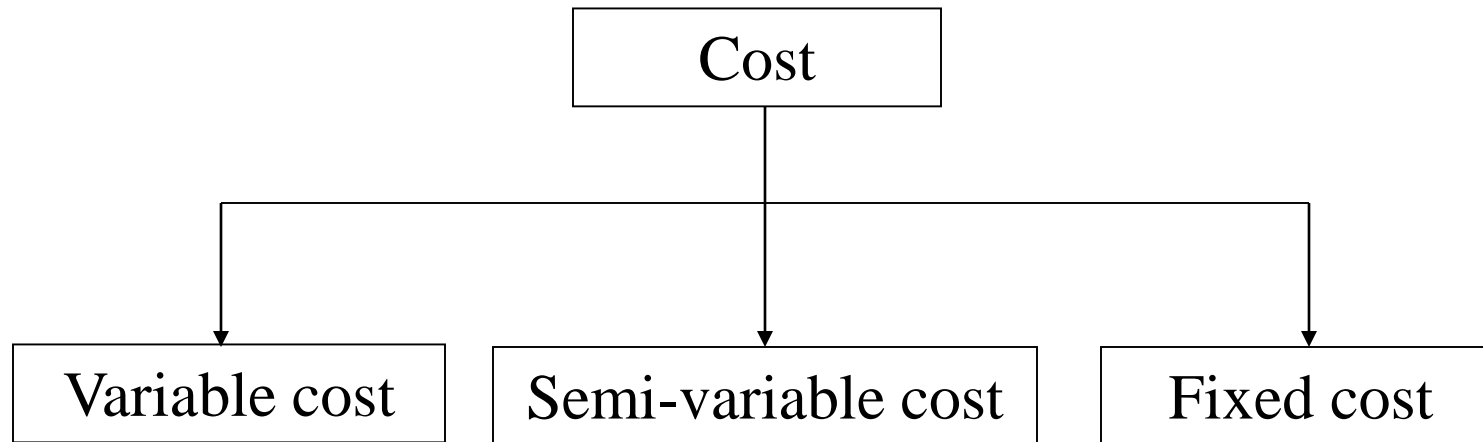
- Manufacturing/ Production cost
- Office/ Administration cost
- Selling and Distribution cost
- Research and Development cost

Classification of Cost



Classification of Cost

According to behavior



Cost Behavior

Years	2017	2018	2019	2020	2021
Outputs (units)	10	20	30	40	50
VC (\$) @ \$ 5 per unit	50	100	150	200	250
FC (\$)	150	150	150	150	150
Total cost (\$) (Semi-VC)	200	250	300	350	400

$$\text{Total Cost} = \text{Total Fixed Cost} + (\text{Unit Variable Cost} \times \text{Outputs})$$

Classification of Cost

Variable cost (VC)

- VC in total vary with activity levels proportionately
- Total VC and level of activities are positively correlated
- VC is constant if expressed on a per unit basis
- *For example: Direct material, direct labor and variable overhead, sales commission*

Semi-variable cost (Mixed cost)

- Partly fixed and partly variable cost (VC+FC)
- *For example: Maintenance costs*

Fixed Cost (FC)

- Remain constant in total
- FC in per unit vary with activities
- Unit FC and activities are negatively correlated
- *For example: Rent, salaries, insurance*

Difference between VC and FC

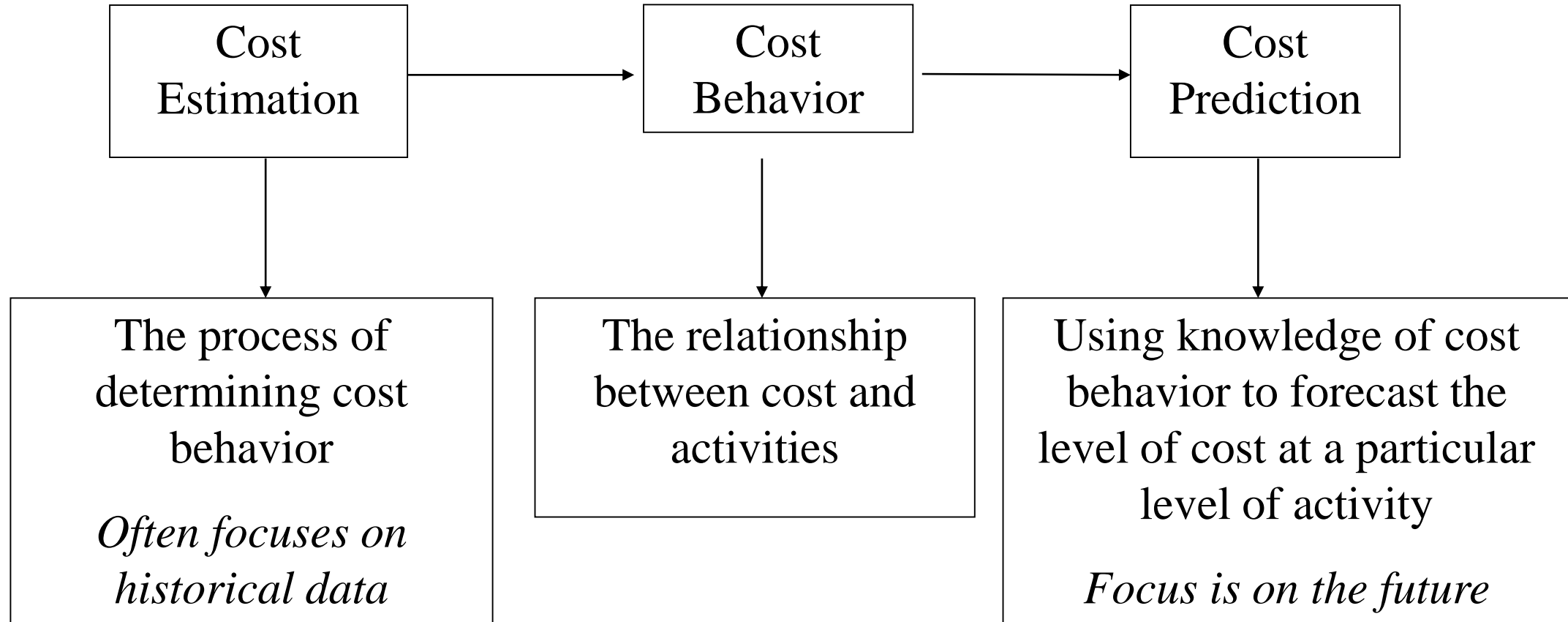
S.N.	Basis	Variable Cost	Fixed Cost
1	Total Cost	Total VC is vary with output proportionately	Total FC is constant for all level of activities (outputs)
		There is positive relationship between Total VC and outputs	There is no relationship between Total VC and outputs
2	Per Unit Cost	VC per unit is constant for all level of activities (outputs)	FC per unit is vary with outputs inversely (negatively)
		There is no relationship between VC per unit and outputs	There is negative relationship between FC per unit and outputs
3	Examples	Direct materials, Direct wages, Direct expenses	Rent, Salaries, Insurance premium etc.

Identify Cost Behavior



Cost items	1,000 units	2,000 units
Materials	\$ 2,000	\$ 4,000
Rent	\$ 3,000	\$ 3,000
Labour	\$ 3,000	\$ 6,000
Repair	\$ 2,000	\$ 3,000
Supervision	\$ 3,000	\$ 5,000
Miscellaneous	\$ 1,500	\$ 1,500

Cost Estimation

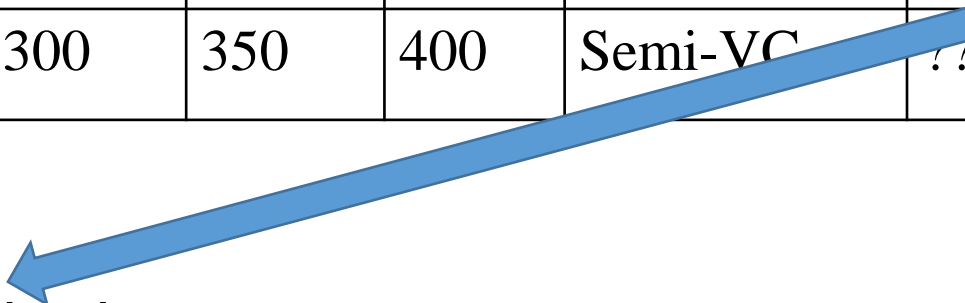


Source: Hilton and Platt (2014)

Years	2017	2018	2019	2020	2021	Cost Behaviour	Predicted cost
Units	10	20	30	40	50		51
Cost (\$)	50	100	150	200	250	VC	$51 \times 5 = 255$
Cost (\$)	150	150	150	150	150	FC	150
Cost (\$)	200	250	300	350	400	Semi-VC	????

Cost Estimation

1. High-Low Method
2. Least Square Method



Segregation of Semi-Variable Costs

Years	Outputs (Units)	Cost (\$)
2017	10	200
2018	20	250
2019	30	300
2020	40	350
2021	50	400

Method 1: High-Low Method

$$\text{VC Per Unit} = \frac{\text{Highest cost at highest outputs} - \text{Lowest cost at Lowest outputs}}{\text{Highest outputs} - \text{Lowest outputs}}$$

$$\text{VC Per Unit} = \frac{\$ 400 - \$ 200}{50 \text{ units} - 10 \text{ units}} = \$ 5 \text{ per unit}$$

Total Cost = FC + (VC per unit X Outputs)

	10 units	50 units
Total Cost	\$ 200	\$400
Less: VC @ \$ 5/unit	50	250
Fixed Cost	150	150

Segregation of Semi-Variable Costs

Method 2: Least Square Method

Total Cost = FC + (VC per unit X Outputs)

$$y = a + bx$$

y = Estimated Total Cost

a = Constant = Estimated Fixed Cost

b = Slope of Regression Equation
= Estimate Unit Variable Cost

x = Expected Outputs

$$\text{Unit Variable Cost, } b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$$

$$\text{Fixed Cost, } a = \frac{\sum y}{n} - b \frac{\sum x}{n}$$

Where, n = Number of Observations.

Segregation of Semi-Variable Costs

Years	Outputs (x)	Costs (y)	xy	x ²
2017	10	200	2,000	100
2018	20	250	5,000	400
2019	30	300	9,000	900
2020	40	350	14,000	1,600
2021	50	400	20,000	2,500
	Σx = 150	Σy = 1500	Σxy = 50,000	Σx ² = 5,500

$$b = \frac{n \sum xy - \sum x \cdot \sum y}{n \sum x^2 - (\sum x)^2}$$
$$= \frac{(5 \times 50,000) - (150 \times 1500)}{(5 \times 5,500) - (150 \times 150)} = \$5$$
$$a = \frac{\sum y - b(\sum x)}{n}$$
$$= \frac{1,500 - (5 \times 150)}{5} = \$150$$

Segregation of Semi-Variable Costs

- Question: The following data for maintenance cost is provided by a machining department of a company

Year	Machine Hours	Maintenance Cost (\$)
19 × 0	110	235
19 × 1	100	215
19 × 2	140	260
19 × 3	130	255
19 × 4	120	235

Required:

- (a) Segregation of maintenance cost by using least square method
- (b) Forecast the total maintenance cost for 19X5, if the machine hours is 150 hours

- (c) Measure goodness of fit of regression equation
 - i. Correlation coefficient (r)
 - ii. Coefficient of determination (r^2)
 - iii. Standard error of regression (S_e)
 - iv. Confidence interval for predicting cost at 95% confidence level
- (d) Assessing the confidence of regression equation
 - i. Standard error of regression coefficient. (S_b)
 - ii. Confidence interval at 95% confidence level
 - iii. Student t-value and comments.

(a) Segregation of Semi-Variable Costs

Year	Machine Hours x	Maintenance Cost (Rs.) y	x ²	xy	y ²
19 × 0	110	235	12,100	25,850	55,225
19 × 1	100	215	10,000	21,500	46,225
19 × 2	140	260	19,600	36,400	67,600
19 × 3	130	255	16,900	33,150	65,025
19 × 4	120	235	14,400	28,200	55,225
	Σx = 600	Σy = 1,200	Σx ² = 73,000	Σxy = 1,45,100	Σy ² = 2,89,300

$$b = \frac{n\Sigma xy - \Sigma x\Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$$
$$= \frac{(5 \times 1,45,100) - (600 \times 1,200)}{(5 \times 73,000) - (600 \times 600)} = \frac{5,500}{5,000} = \$ 1.10 \text{ per machine hour.}$$

$$a = \frac{\Sigma y}{n} - b \frac{\Sigma x}{n}$$
$$= \frac{1,200}{5} - \left(1.10 \times \frac{600}{5} \right) = 240 - (1.10 \times 120) = \$ 108.$$

(b) Forecast the Total Maintenance Costs

Now, the regression equation is become, $y = 108 + 1.10x$

If Machine Hours (x) = 150 hours,

Then, total maintenance cost (y) = $108 + (1.10 \times 150) = \$ 273$

(c) Goodness of Fit of Regression Equation

(i) Correlation Coefficient (r)

$$\begin{aligned} r &= \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2]} \sqrt{[n\Sigma y^2 - (\Sigma y)^2]}} \\ &= \frac{(5 \times 1,45,100) - (600 \times 1,200)}{\sqrt{[(5 \times 73,000) - (600 \times 600)]} \sqrt{[(5 \times 2,89,300) - (1,200 \times 1,200)]}} \\ &= \frac{5,500}{\sqrt{5,000} \sqrt{6,500}} \\ &= + 0.96476. \end{aligned}$$

The result shows highly positive correlation between the given variables machine hours and maintenance cost. The closer the relationship between the given two variables, the greater confidence placed in the estimation.

- r lies in between $-1 \leq r \leq +1$
- $r = +1$, perfectly positive correlated
- $r = -1$, perfectly negative correlated
- $r = 0$, uncorrelated

(c) Goodness of Fit of Regression Equation

(ii) Coefficient of Determination (r^2)

$$r^2 = r \times r = 0.96476 \times 0.96476 = 0.9307$$

Above result indicates the contribution of total variation of machine hours is 93.07% only and remaining 6.93% is error parts or contribution made by others unseen variables. The unseen variables may be the age of machine, raw material quality, and operator's experience etc. All stated unseen variables are the cause and it is effective to maintenance cost. So that, change of maintenance cost due to machine hours and other factors is 93.07% and 6.93% respectively.

- $0 \leq r^2 \leq +1$
- If $r^2 = +1$, the independent variable x has perfectly explained variations in dependent variable y

(c) Goodness of Fit of Regression Equation

(iii) Standard Error of Regression (S_e)

$$S_e = \sqrt{\frac{\sum y^2 - a\sum y - b\sum xy}{n - 2}} = \$ 5.477$$

The result indicates, the regression equation $y = 108 + 1.10x$ has error portion amounting \$ 5.477.

(c) Goodness of Fit of Regression Equation

(iv) Confidence interval for predicting cost at 95% confidence level

Estimated value (\hat{y}) $\pm S_e \times t\text{-value}$

$$273 \pm (5.477 \times 3.182)$$

$$273 \pm 17.43$$

$$\text{\$ } 255.57 \text{ to } \text{\$ } 290.43$$

The results indicates that the true predicted values lies between \$ 255.57 and \$ 290.43 with 95% confidence level. There is 5% chances to have the actual predicted value beyond the above range.

(d) Assessing the Confidence of Regression Equation

(i) Standard Error of Regression Coefficient (S_b)

x	$(x - \bar{x})$	$(x - \bar{x})^2$
110	-10	100
100	-20	400
140	+20	400
130	+10	100
120	0	0
$\Sigma x = 600$		$\Sigma (x - \bar{x})^2 = 1,000$

$$\bar{x} = \frac{\Sigma x}{n} = \frac{600}{5} = 120$$

$$S_b = \frac{S_e}{\sqrt{\Sigma (x - \bar{x})^2}} = \frac{5.477}{\sqrt{1,000}} = 0.17$$

The result indicates, estimated coefficient of regression, unit variable cost (b) = \$ 1.10 per hour has standard error of \$ 0.17 per hour.

(d) Assessing the Confidence of Regression Equation

(ii) Constructing the Confidence Limits

Estimated value $(b) \pm S_b \times t\text{-value}$

$$1.10 \pm (0.17 \times 3.182)$$

$$1.10 \pm 0.54$$

\$ 0.56 per hour to \$ 1.64 per hour

The confidence interval or true value “b” in future lies in between \$ 0.56 per hour and \$ 1.64 per hour.

(d) Assessing the Confidence of Regression Equation

(ii) Student “t” Test

The standard error of regression coefficient (S_b), and the t-statistic are closely related. The S_b gives an estimate of the range where the true coefficient will actually fall. It gives the real evidence of correlation at the given confidence level. Therefore, the higher the t value, greater the confidence in the coefficient as a predictor.

$$t = r \frac{\sqrt{n-2}}{\sqrt{1-r^2}} = 0.96476 \frac{\sqrt{5-2}}{\sqrt{1-0.9307}} = 6.348$$

The table value of t at 3 degree of freedom with 95% confidence level is 3.182. The calculate t-value with 6.348 is greater than the table value. It indicates, there is evidence of real correlation at 95% confidence level.

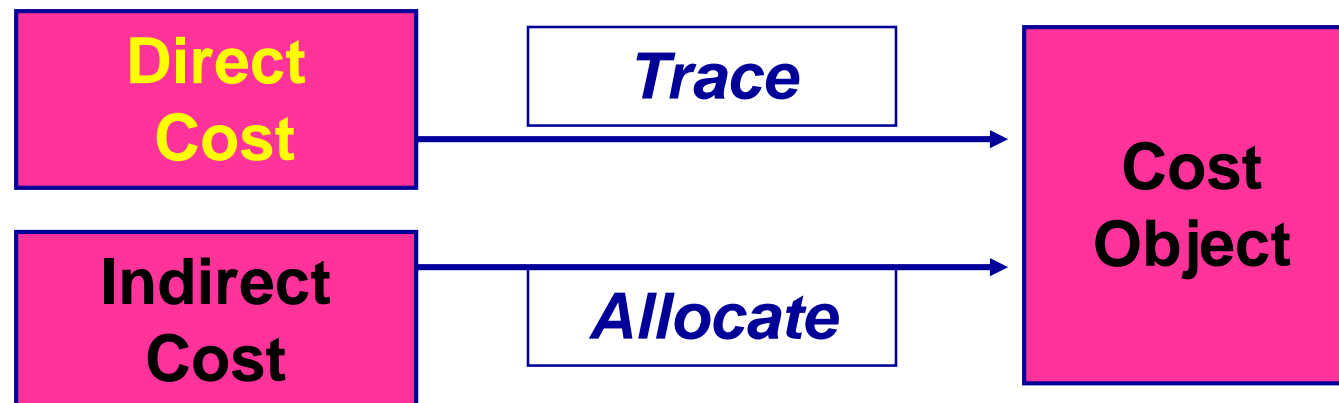
Classification of Cost

Direct cost

- A cost that can be traced to a particular department is called a **direct cost** of the department
 - *Example: Manufacturing wages and raw materials which are used in the production process*

Indirect cost

- A cost that is not traceable to a particular department is called an **indirect cost** of the department
 - *Example: Overheads which do not form part of the product, Manager salary*



Classifications of Cost

Controllable costs

- Costs that can be influenced by the action of a responsible member of a particular cost center is ***controllable costs***.
- *Example: Raw materials quantity can control by production manager, food quantity used in restaurant can control by restaurant manager*

Uncontrollable costs

- Costs that a manager can not influence significantly are classified as ***uncontrollable costs*** of that manager
- *Example: Rent, salary cannot be controlled by manager*

Opportunity Cost

- The potential benefit that is given up when one alternative is selected over another alternative.
- Opportunity costs are not recorded/reported because they do not occur. The cost is the benefit that you gave up.
- *Example: The opportunity cost of going to college is the amount of money you would have made if you were working.*

Sunk Cost

- Cost that is already paid for and cannot be changed by a decision made now or in the future.
- *Example: Tuition for this semester that you have already paid and will not get back for any reason.*

Differential costs

- A ***differential cost*** is the amount by which the cost differs under two alternative actions
- Any cost that is present under one alternative in a decision-making situation but is absent in whole or in part under another alternative
- Differential costs are also known as ***incremental costs***
- This term is synonymous with ***avoidable cost*** and ***relevant cost***

Avoidable cost

- Any cost that can be eliminated (in whole or in part) as a result of choosing one alternative over another in a decision–making situation
- This term is synonymous with ***relevant cost*** and ***differential cost***

Relevant Cost

- Future cost and different from each alternative
- A cost that is applicable to a particular decision in the sense that it will have a bearing on which alternative the manager selected
- Only those cost, which may be expected to differ between alternatives are relevant
- This term is synonymous with ***avoidable cost*** and ***differential cost***

Example: Relevant and Irrelevant Costs

CAR

-Petrol

-Tax

-Insurance

OR

Taxi

-Taxi charges

- The cost of petrol will be relevant cost, since this cost will vary depending on which transport is chosen
- The cost of tax and insurance will be irrelevant

Marginal Costs and Average Costs

- A special case of the differential cost concept is the ***marginal cost***, which is the extra cost incurred when one additional unit is produced
- ***Average cost per unit*** is the total cost, for whatever quantity is manufactured, divided by the number of units manufactured
- Marginal costs and average costs arise in a variety of economic situations

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