Management Accountancy

Unit 2
Cost Management and Reporting

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

After the completion of this unit, you should be able to:

- Understand concept of cost
- Classify the cost in different approaches
- Segregate the semi-variable cost into variable and fixed cost by applying high-low and least square methods

2.1 Cost concept and classification

The term 'Cost' is not easy to define. In general, all expenditures involved in the process of production of goods or services are termed as cost. However, the concept of cost is defined by different academic accountants, economist and financial analyst in their own ways.

In Nepali Brihat Sabdakosh (Nepali Dictionary), published by Royal Nepal Academy, the meaning of cost is given as "an amount of expenses needed to produce or purchase a commodity."

Likewise, the meaning of cost is given in Webester New World Dictionary as :

(a) The amount of money or the like asked or paid for a thing.
(b) The amount spent in producing or manufacturing commodity.
(c) The amount paid for something by a dealer, contractor etc.
(d) The amount of money, time, effort etc. required to achieve an end

Costs have been classified in different ways in accordance with their common characteristics. Classification of cost is the process where costs are grouped under their similar nature. Following are the important ways of classifications :

- According to nature or element
  -Direct material cost
  -Direct labour cost
  -Overhead cost

- According to functions
  -Manufacturing cost
  -Office and adminstrative cost
  -Selling and distribution cost
  -Research and development cost

- Accourding to behaviour
  -Variable cost
  -Semivariable cost
  -Fixed cost

2.2 Cost behavior and cost estimation

The costs can be classified on the basis of variability of cost in the volume of production. There are certain expenses which remain constant and do not vary with increase or decrease in production volume. However, certain expenses do vary directly and proportionately with output. In terms of variability of changes in cost behaviour in relation to changes in output or volume, cost can be classified into fixed, variable and semi-variable or mixed 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)

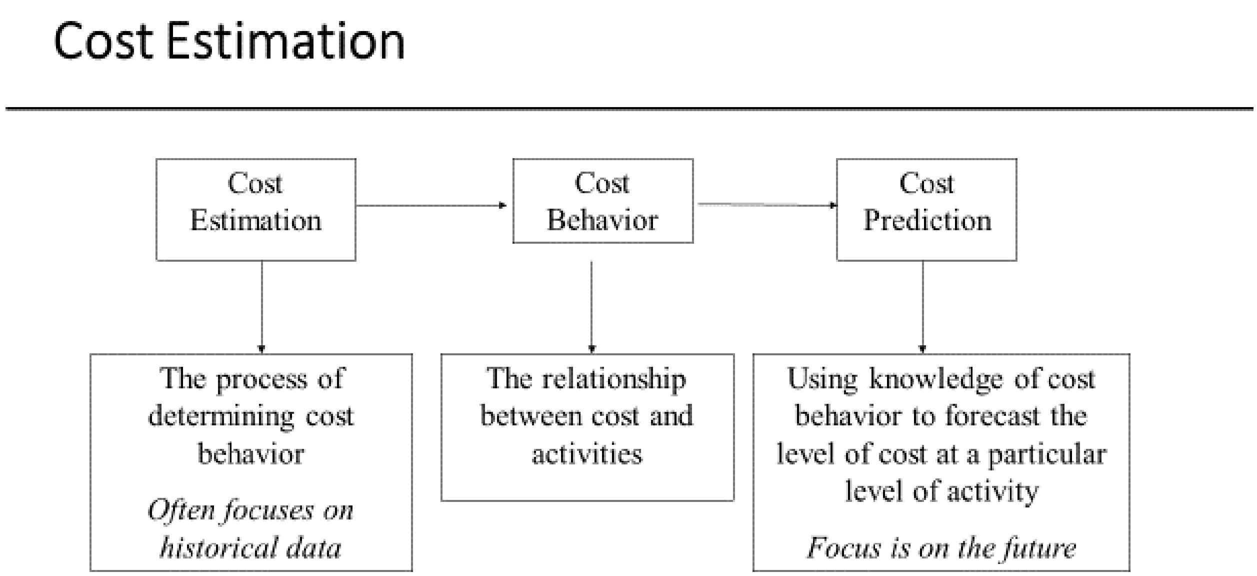
- Partly fixed and partly variable cost (VC+FC)
- *For example: Maintenance costs*

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*

Different between variable cost and fixed cost

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.



Source: Source: Hilton and Platt (2014)

Illustration 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: Segregation of maintenance cost using least square method and forecast the total maintenance cost for 19x5, if the machine hours is 150 hours.

SOLUTION:

Year	Machine Hours x	Maintenance Cost ($) 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

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

$$= \frac{(5 \times 1{,}45{,}100) - (600 \times 1{,}200)}{(5 \times 73{,}000) - (600 \times 600)}$$

$$= \frac{5{,}500}{5{,}000}$$

= \$1.10 per machine hour.

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

$$= \frac{1{,}200}{5} - \left(1.10 \times \frac{600}{5}\right)$$

= 240 – (1.10 × 120) = \$108.

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

If Machine Hours (x) = 150 hours, then total maintenance cost (y) = 108 + (1.10 × 150) = Rs. 273.00.

Goodness of Fit of a Regression Equation

Measurement of the calculate regression equation's accuracy is required for cost prediction purpose. How good the least square regression line "best fit" is in the given set of data. That can be obtained from:

(i) Correlation coefficient (r)
(ii) Coefficient of determination (r^2)
(ii) Standard error of regression (s_e)

(i) Correlation Coefficient (r)

The purpose of regression analysis is to identify a relationship for a given set of data. Correlation is a technique used to measure the strength of the relationship between the variables. Correlation indicates how well a regression line "fit" the given set of data. The better the correlation, the closer the data points are to the regression line and hence the more confidence to predictor using the regression line for estimation.

A correlation coefficient (r) lies in between $-1 \leq r \leq +1$. If r = +1, then two variables x and y are perfectly positive correlated, they move in the same direction. If r = 0, then x and y are uncorrelated, they show no tendency to follow each other. If r = -1, then x and y vary inversely. They are perfectly negative correlated, they move in the opposite direction of each other. The value of r can be obtained as follows:

$$r = \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2]}\sqrt{[n\Sigma y^2 - (\Sigma y)^2]}}$$

As on previous illustration, we obtain the value of r as under:

$$r = \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2]}\sqrt{[n\Sigma y^2 - (\Sigma y)^2]}}$$

$$= \frac{(5 \times 1{,}45{,}100) - (600 \times 1{,}200)}{\sqrt{[(5 \times 73{,}000) - (600 \times 600)]}\sqrt{[(5 \times 2{,}89{,}300) - (1{,}200 \times 1{,}200)]}}$$

$$= \frac{5{,}500}{\sqrt{5{,}000}\sqrt{6{,}500}}$$

$$= +\ 0.96476.$$

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.

(ii) Coefficient of Determination (r^2)

Coefficient of determination is calculated to find out how good the line of best fit really. It also measures the extent to which movements in y are associated with movements in x.

Square of the correlation coefficient is called the coefficient of determination and denoted by r^2. The coefficient of determination (r^2), measures the percentage of variation in y (dependent variable) explained by x (independent variable). In other words, the coefficient of determination (r^2) gives the percentage of variation in the dependent variable, which can be explained by concurrent variance in the independent variable. The coefficient of determination (r^2) can vary as follows $0 \leq r^2 \leq +1$. If $r^2 = +1$, the independent variable x has perfectly explained variations in dependent variable y.

As per previous illustration,

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

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.

Alternatively, the coefficient of determination (r^2) indicates the proportion of variation of y that is explained by the independent variables x (already state above). It is more convenient to express the coefficient of determination (r^2) as one minus the proportion of total variation that is not explained by the independent variable.

$$r^2 = \frac{\text{Explained Variation}}{\text{Total Variation}} = 1 - \frac{\text{Unexplained Variation}}{\text{Total Variation}} = 1 - \frac{\Sigma (y - \hat{y})^2}{\Sigma (y - \bar{y})^2}$$

Where,

$\Sigma (y - \hat{y})^2$ = Unexplained variation, difference between the actual value of y and the predicted value of y.

$\Sigma (y - \bar{y})^2$ = Explained variation, difference between individual y value and their mean.

When we obtain $r^2 = 1$, it indicates the predicted value exactly equal to actual cost, that is, independent variable x has perfectly explained variation in actual cost y.

(iii) Standard Error of Regression (S_e)

The standard error of estimation (S_e) is defined as the standard deviation of the regression estimation. It measures the variability or scatter of the observed values around the regression line. In effect, it indicates the reliability of the estimating equation. How good is this fit? How close are the values of $\hat{y}$ to the observe values of y? It means that if the points in the scatter diagram closely spaced around the regression line, then the estimated value $\hat{y}$ will be close to observed value of y and hence this estimate can be considered as highly reliable. It is computed as:

$$S_e = \sqrt{\frac{\Sigma (y - \hat{y})^2}{n - 2}}$$

The denominator is n-2 (degree of freedom) because we lose 2 degrees of freedom (for the values a and b) in estimating the regression line.

As continuation of previous illustration, we can calculate S_e as under:

$$S_e = \sqrt{\frac{\Sigma (y - \hat{y})^2}{n - 2}} = \sqrt{\frac{90}{5 - 2}} = \text{Rs. } 5.477$$

The result indicates, the regression equation y = 108 + 1.10x has error portion amounting Rs. 5.477. There are several other possible formulas but one more useful is given below

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

Constructing the Confidence Limits

Standard error (S_e) is used to obtain the range estimate on confident interval of the population parameter. It is given by

Estimated value ($\hat{y}$) ± S_e × t-value

As continuation of previous illustration, predictor wants the prediction to be 95% confidence, then the confidence interval or true value y in future lies in between: (if x = 150 hours)

Estimated value ($\hat{y}$) ± S_e × t-value

273 ± (5.477 × 3.182)

273 ± 17.43

Rs. 255.57 to 290.43

Assessing the Confidence of Regression Equation

Assess of the calculate regression equation's accuracy is required for cost prediction purpose because of the value of "a" and "b" themselves estimates. That can be obtained from:

(i) Standard error of regression coefficient
(ii) Student t - value

(i) Standard Error of Regression Coefficient (S_b)

Standard error of regression coefficient (S_b) measures the variability of sample regression coefficient around the true population regression coefficient. It is computed as:

$$S_b = \frac{S_e}{\sqrt{\Sigma (x - \overline{x})^2}}$$

As continuation of previous illustration, we can calculate S_b as under:

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

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

Now,

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

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

Constructing the Confidence Limits

For the different confident level, the confident interval would be established as given below:

Estimated value (b) ± S_b × t-value

As continuation of previous illustration, predictor wants the prediction to be 95% confidence, then the confidence interval or true value "b" in future lies in between:

Estimated value (b) ± S_b × t-value

1.10 ± (0.17 × 3.182)

1.10 ± 0.54

Re. 0.56 per hour to Rs. 1.64 per hour

(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. It can be obtained as

$$t = r\frac{\sqrt{n-2}}{\sqrt{1-r^2}}$$ with (n-2) degree of freedom.

As continuation of previous illustration, we can calculate t-value as under:

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

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.

2.3 Direct and Indirect Costs

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

2.4 Controllable and Uncontroable costs

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 con not influence significantly are classified as **uncontrollable costs** of that manager. Example: Rent, salary cannot be controlled by manager

2.5 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.

2.6 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.

2.7 Differential Cost

A **differential cost** is the amount by which the cost differs under two alternative action. 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.**

2.8 Avoidable or Relevant 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.

2.9 Unavoidable or Irrelevant Cost

Any cost that cannot be eliminated (in whole or in part) as a result of choosing one alternative over another in a decision–making situation.

2.10 Marginal cost and Average Cost

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.

References

Anthony, R.N., Hawkins, D.F. & Merchant, K.A. (2012). *Accounting: Text and cases*. The McGraw-Hill Companies

Atkinson, A. A., Kaplan, R. S., Matsumura, E. M., Young, S. M., & Kumar, G. A. (2104). *Management accounting: Information for decision-making and strategy execution*. Pearson Education

Colin, D. (1995). *Management and cost accounting*. ELBS, London

Dangol, R. M. & Dangol, J. (2019). *Management accountancy*. Taleju Prakashan, Kathmandu

Hilton. R. W. & Platt, D. E. (2014). *Managerial accounting: Creating value in a global business environment*. McGraw-Hill Education

Horngren, C. T., Datar, G. F., Rajan, M. V., & Lttner, C. (2011). *Cost accounting: A managerial emphasis.* Pearson Education

Horngren, C. T., Sundem, G. L., & Stratton, W. O. (1999). *Introduction to management accounting.* Prentice Hall India