COST ESTIMATION AND REGRESSION ANALYSIS

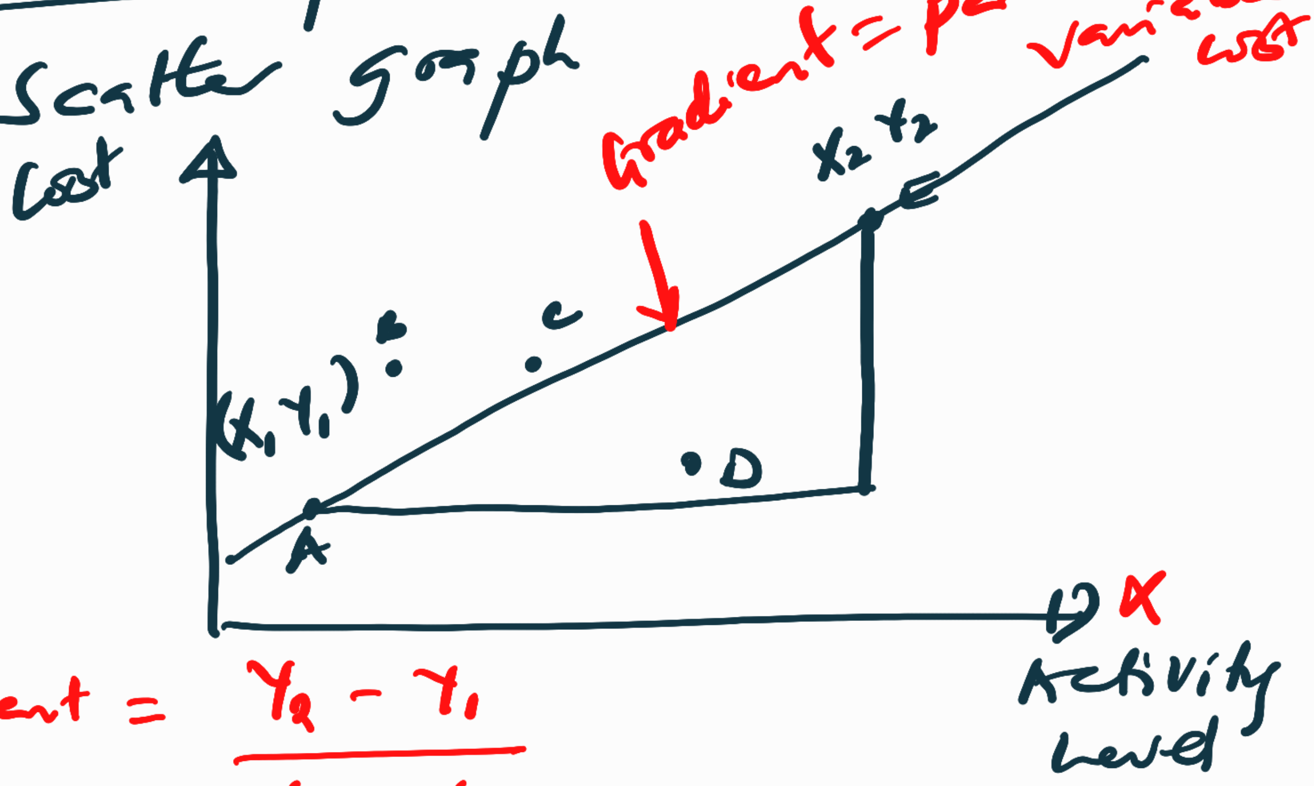
Cost $\longrightarrow$ Exchange value for a good or a service

Approaches to cost estimation

1. Engineering Approach.
2. Inspection of Accounts
3. Trend Analysis/ Historical data Analysis.

Methods of cost estimation

1. Scatter graph



$$\text{Gradient (b)} = \frac{Y_2 - Y_1}{X_2 - X_1}$$

$$TC = TFC + TVC$$

$$TC = TFC + [bx.]$$

$$TC = a + bx.$$

$$\boxed{Y = a + bx}$$ — Total cost function

2. High - Low Method

* Highest Activity level with associated costs

* Lowest Activity Level with associated costs.

$$\text{Unit variable cost (b)} = \frac{\text{Costs at highest activity level} - \text{Costs at Lowest activity level}}{\text{Output/units at Highest Level} - \text{output/units at lowest level.}}$$

Example

Period	output Bundles	Costs Ushs. " Millions
Jan	35,000	23,000
Feb	37,500	25,000
Mar	38,000	26,000
Apri	34,000	22,000

May	58,000	34,000
June	55,000	33,000
July	29,000	20,000
Aug	33,000	21,000
Sept	36,000	24,000
Oct.	59,000	38,000
Nov	56,000	35,000
Dec	50,000	29,000

Establish the cost when 75,000 are produced. using the High-Low mtd

Solution

- Highest Activity Level — 59,000 units
  Associated cost — Sh. 38,000
- Lowest activity Level — 29,000 units
  Associated cost — shs. 20,000 m

$$\text{Unit Variable cost (b)} = \frac{38,000 - 20,000}{59,000 - 29,000}$$

= 0·6 million per unit.

$TC = TFC + TVC$

$TFC = TC - TVC$

$= TC - [bX]$

$= 20{,}000 - [0.6 \times 29{,}000]$

$TFC\,(a) = 2600$ millions

$Y = a + bX.$

$$\boxed{Y = 2600 + 0.6X}$$

Total cost when output is 75,000 units

$\Rightarrow Y = 2600 + (0.6 \times 75{,}000)$

$= \underline{\underline{\text{shs. } 47{,}600 \text{ millions}}}$

<u>Least - Squares Method (Regression Analysis)</u>

Using Regression line $Y = a + bX.$

where Y = Dependent variable (cost)

a = Constant of variation

b = Co-efficient of Variation

X = Independent Variable
(Activity Level)

$$b = \frac{n\Sigma XY - \Sigma X \Sigma Y}{n\Sigma x^2 - (\Sigma X)^2}$$ = Unit variable cost.

$$a = \frac{\Sigma Y - b\Sigma X}{n}$$ $\bar{Y} = 26,000$

Output X	Cost Y	$Y - \bar{Y}$	$(Y-\bar{Y})^2$
35,000	23,000	-3000	
37,500	25,000	-1000	
38,000	26,000	0	
34,000	22,000	-4,000	
58,000	34,000		
55,000	33,000		
29,000	20,000		
33,000	21,000		
36,000	24,000		
59,000	38,000		
56,000	35,000		
50,000	29,000		
$\Sigma X = 520,500$	$\Sigma Y = 330,000$	$\Sigma XY =$ 15,054,500,000	$\Sigma x^2 =$ 23,963,250,000

$$b = \frac{n\sum XY - \sum X \sum Y}{n\sum X^2 - (\sum X)^2}$$

$$= \frac{[12 \times 15{,}054{,}500{,}000] - [520{,}500 \times 330{,}000]}{[12 \times 23{,}963{,}250{,}000] - [520{,}500 \times 520{,}500]}$$

$$= 0.534 \text{ millions}$$

$$a = \frac{\sum Y - b\sum X}{n} = \frac{330{,}000 - (0.534 \times 520{,}500)}{12}$$

$$= 4\,338 \text{ million}$$

Cost function $\Rightarrow$ $Y = 4338 + 0.534X$ (Million)

when 75,000 units are produced

$$Y = 4338 + 0.534 \times 75{,}000$$

$$= \underline{\underline{44{,}388 \text{ Million}}}$$

Test of Reliability

1. Coefficient of determination.

2) Coefficient of Correlation (r)

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

when $r = 1$ there is a perfect positive linear correlation (Straight line)

$r = -1$ negative linear correlation

$r = 0$ No relationship

r from previous example $= 0.981$

b) Coefficient of determination r^2

2. Standard error of estimate

$$S_E = \sqrt{\frac{\sum (Y-\bar{Y})^2}{N}}$$

where Y – original value of Y

$\bar{Y}$ = Assumed mean of Y

3. Standard Error of Co-efficient

$$S_{Ec} = \sqrt{\frac{1-r^2}{n-2}}$$

Revision Questions

Qn. 1 (a) (i) Dec 2020

Qn. 4 (a) Oct 2021

Qn. 1 (a)(iii) June 2022

Qn. 4 (a) Oct. 2021

Coefficient of determination (r^2)

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

$$= \frac{(6 \times 1028.7) - (33.1 \times 181.1)}{\sqrt{\left[\left[(6 \times 190.65) - (33.1 \times 33.1)\right]\left[(6 \times 5603.11) - (181.1 \times 181.1)\right]\right]}}$$

$$r = 0.893$$

$$r^2 = 0.8$$

There is a strong positive relationship between advertisement and sales revenue. Advertisement is responsible for 80% of sales of SCS, hence Mr. Kayiwali

Should continue to invest in advertisement

Standard Error of Estimate (SEE)

$$S_{EE} = \sqrt{\frac{\sum (Y-\bar{Y})^2}{N}}$$

$Y = a + bX$

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

$$= \frac{(6 \times 1028.7) - (33.1 \times 181.1)}{(6 \times 190.65) - (33.1 \times 33.1)}$$

$= 3.682$

$$a = \frac{\sum Y - b\sum X}{n} = \frac{181.1 - (3.682 \times 33.1)}{6}$$

$= \underline{\underline{9.871}}$

$Y = a + bX.$

$Y = 9.871 + 3.682X$ — cost fn

Pd	Y	X	$\bar{Y}$	$(Y-\bar{Y})$	$(Y-\bar{Y})^2$
Jan	27.1	4.2	25.34		
Feb	25.0	3.9	24.23		
Mar	29.7	5.7	30.86		
April	28.8	5.9	31.60		
May	30.4	6.1	32.33		
June	40	7.3	36.75		
					$\Sigma(Y-\bar{Y})^2 = 27.811$

$$S_{EE} = \sqrt{\frac{\Sigma(Y-\bar{Y})^2}{N-2}} = \sqrt{\frac{27.811}{6-2}}$$

$$= 2.637$$