Multiple regression equation:

5 Marks

Multiple Regression: 1 dependent & 2 or more independent variable

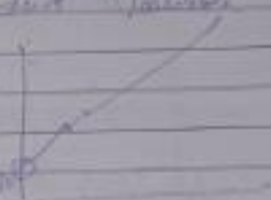
Example: Annual sale depend upon 2 or more factors profit cost & total sale etc are independent variable, dependent on annual data.

$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \epsilon$

Random error

y: predicted value of dependent variable

β_0 = y intercept (value of y when all other parameters are set to zero)



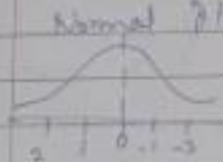
$\beta_1, \beta_2, \dots \beta_n$ slope coefficients

$\beta_1 x_1$ = Regression Coefficient β_1, of the independent variable x_1

ϵ = Random error (how much variation there in our estimate of y)

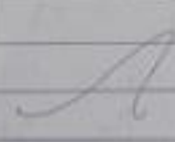
Que Difference b/w simple linear & multiple linear regression?

Normal distribution: Mean = Mode = Median



bell shape curve (Symmetrical graph)

1. Skewness 2. Kurtosis



→ Unsymmetrical graph / Skewed graph

+ve
-ve

Formula

$$a = \bar{Y} - b_1 \bar{X}_1 - b_2 \bar{X}_2$$

$$b_1 = \frac{(\sum x_2^2)(\sum x_1 y) - (\sum x_1 x_2)(\sum x_2 y)}{(\sum x_1^2)(\sum x_2^2) - (\sum x_1 x_2)^2}$$

$$b_2 = \frac{(\sum x_1^2)(\sum x_2 y) - (\sum x_1 x_2)(\sum x_1 y)}{(\sum x_1^2)(\sum x_2^2) - (\sum x_1 x_2)^2}$$

$$\Sigma x_1^2 = \Sigma X_1 X_1 - \frac{(\Sigma X_1)(\Sigma X_1)}{N}$$

$$\Sigma x_2^2 = \Sigma X_2 X_2 - \frac{(\Sigma X_2)(\Sigma X_2)}{N}$$

$$\sum x_1 y = \sum X_1 Y - \frac{(\sum X_1)(\sum Y)}{N}$$

$$\sum x_2 y = \sum X_2 Y - \frac{(\sum X_2)(\sum Y)}{N}$$

$$\sum x_1 x_2 = \sum X_1 X_2 - \frac{(\sum X_1)(\sum X_2)}{N}$$

$\Sigma X_1 = 20$ $\Sigma X_2 = 24$ $\Sigma X_1X_1 = 90$ ΣX_2X_2 148 $\Sigma X_1 Y =$

$\Sigma X_2 Y = 45.6$ $X_1X_2 = 99$

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#	Y	X_1	X_2	X_1X_1	X_2X_2	X_1X_2	X_1Y	X_2Y
	-3.7	3	8	9	64	24	-11.1	-29.6
	3.5	4	5	16	25	20	14	17.5
	2.5	5	7	25	49	35	12.5	17.5
	11.5	6	3	36	9	18	69	~~69~~ 34.5
	5.7	2	1	4	1	2	11.4	5.7
X	?	3	2					
	19.5	20	24	90	148	99	95.8	45.6

$$y = b_0 + b_1x_1 + b_1x_2$$

$$b_0 = \bar{y} - b_1\bar{x}_1 - b_2\bar{x}_2$$

$$b_1 = \frac{(\Sigma x_2^2)(\Sigma x_1 y) - (\Sigma x_1 x_2)(\Sigma x_2 y)}{(\Sigma x_1^2)(\Sigma x_2^2) - (\Sigma x_1 x_2)^2}$$

$$b_2 = \frac{(\Sigma x_1^2)(\Sigma x_2 y) - (\Sigma x_1 x_2)(\Sigma x_1 y)}{(\Sigma x_1^2)(\Sigma x_2^2) - (\Sigma x_1 x_2)^2}$$

$$\Sigma x_1^2 = \Sigma X_1 X_1 - \frac{(\Sigma X_1)(\Sigma X_1)}{N}$$

$$\Sigma x_2^2 = \Sigma X_2 X_2 - \frac{(\Sigma X_2)(\Sigma X_2)}{N}$$

$$\Sigma x_1 y = \Sigma X_1 Y - \frac{(\Sigma X_1)(\Sigma Y)}{N}$$

$$\Sigma x_2 y = \Sigma X_2 Y - \frac{(\Sigma X_2)(\Sigma Y)}{N}$$

$$\Sigma x_1 x_2 = \Sigma X_1 X_2 - \frac{(\Sigma X_1)(\Sigma X_2)}{N}$$

$\bar{x}_1 = 5 \qquad \bar{x}_2 = 4.8 \qquad \bar{y} = 19.5$

$\cancel{b_1} = \Sigma x_1^2 = 90 - \dfrac{(20)(20)}{5}$

$= 90 - \dfrac{400}{5}$

$= 90 - 80 = 10$

$\Sigma x_2^2 = 148 - \dfrac{(24)(24)}{5}$

$= 148 - \dfrac{504}{5}$

$= 148 - 100.8$

$= 47.2$

$\Sigma x_1 y = 95.8 - \dfrac{(20)(19.5)}{5}$

$= 95.8 - \dfrac{390}{5}$

$= 95.8 - 78$

$= 17.8$

$\Sigma x_2 y = 45.6 - \dfrac{(24)(19.5)}{5}$

$= 45.6 - \dfrac{468}{5} = 45.6 - 93.6$

$= -48$

$$= -48$$

$$\Sigma x_1 x_2 = 99 - \frac{(20)(24)}{5}$$

$$= 99 - 96$$

$$= 3$$

$$b_1 = \frac{(47.2)(17.8) - (3)(-48)}{(10)(47.2) - (3)^2}$$

$$= \frac{840.16 + 144}{472 - 9} = 2.125$$

$$b_2 = \frac{(10)(-48) - 3(17.8)}{(10)(47.2) - (3)^2}$$

$$= \frac{-480 - 53.4}{472 - 9} = \frac{-533.4}{463}$$

$$= -1.152$$

$$b_0 = (3.9) - (2.125)(4) - (-1.152)(4.8)$$

$$= 3.9 - 8.5 + 5.52$$

$$= 0.92$$

$$y = b_0 + b_1 x_1 + b_2 x_2$$

$$= (0.92) + (2.125)(3) + (-1.152)(2)$$

$$= 0.92 + 6.375 - 2.304$$

$$= 4.991$$