

Multi Linear Regression.

It is an Extension of Simple Linear Regression. it models the relation between a dependent Variable (Y) and two (or) more Independent Variable ($x_1, x_2, x_3, \dots, x_n$).

the relation is expressed by the following equation:

Formulae for Multi Linear Regression:

$$Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + \dots + b_n x_n$$

Example for Multi Linear Regression

Size (Carat) x_1	Bedrooms x_2	Price (in crores)
1	3	2
2	4	5
3	7	9

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

we shd find

b_0
 b_1
 b_2

\hat{b}

$\begin{bmatrix} 11 & 2 & 5 \\ 18 & 4 & 5 \\ 14 & 7 & 9 \end{bmatrix}$

$T_x \cdot (X^T X)^{-1}$

$$\hat{b} = ((X^T X)^{-1} X^T) Y$$

It is an estimation of Simple Linear Regression. We have the relation between a dependent variable (Y) and

$$Y = b_0 + b_1 X_1 + b_2 X_2$$

$$Y = \begin{bmatrix} 2 \\ 5 \\ 9 \end{bmatrix}$$

$$X = \begin{bmatrix} 1 & 3 & 7 \\ 1 & 2 & 4 \\ 1 & 4 & 7 \end{bmatrix}$$

$$\hat{b} = \begin{bmatrix} b_0 \\ b_1 \\ b_2 \end{bmatrix} ((X^T X)^{-1} X^T) Y$$

$$X^T = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 3 & 4 & 7 \end{bmatrix}$$

$$X^T \cdot X = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 3 & 4 & 7 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 3 \\ 1 & 2 & 4 \\ 1 & 3 & 7 \end{bmatrix} = \begin{bmatrix} 3 & 6 & 14 \\ 6 & 14 & 32 \\ 14 & 32 & 74 \end{bmatrix}$$

$$(X^T X)^{-1} = \begin{bmatrix} 3 & 6 & 14 \\ 6 & 14 & 32 \\ 14 & 32 & 74 \end{bmatrix}$$

$$(X^T X)^{-1} X^T = \begin{bmatrix} 3 & 6 & 14 \\ 6 & 14 & 32 \\ 14 & 32 & 74 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 3 & 4 & 7 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & -1 \\ -1.5 & 2 & -0.5 \\ 0.5 & -1 & 0.5 \end{bmatrix}$$

Example of Multiple Regression

$$(X^T X)^{-1} X^T Y$$

$$\begin{bmatrix} 1 & -1 \\ 1.5 & -0.5 \\ 0.5 & 0.5 \end{bmatrix} \begin{bmatrix} 2 \\ 5 \\ 9 \end{bmatrix}$$

$$\hat{b} = \begin{bmatrix} -2 \\ 2.5 \\ 0.5 \end{bmatrix} \begin{matrix} b_0 \\ b_1 \\ b_2 \end{matrix}$$

Input:- x_1 x_2
1.5 3

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

$$Y = -2 + 2.5 \times 1.5 + 0.5 \times 3$$

$$Y = -2 + 2.5 \times 1.5 + 0.5 \times 3$$

$$Y = \underline{\hspace{2cm}} \text{ Ans.}$$

$$\begin{bmatrix} 1 & 1 \\ 1.5 & 1 \\ 0.5 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 2 \\ 5 \\ 9 \end{bmatrix}$$