x_1, y_1 $\quad$ x_2, y_2

$(0, 2) \quad (-0.667, 0)$

Slope $= \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 2}{-0.667 - 0}$

$$\frac{-2}{-0.667} \approx 3$$

$y = mx + b$

$m \Rightarrow$ slope

$b \Rightarrow$ Intercept

Slope → steepness, rate of change of line of y with respect x

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

Intercept → Value of y where line crosses the y axis

when $x = 0$ what is y?

---

what will happen to slope when

1. change and keep the Intercept constant

Angle is changed

It is going rotate with the intercept point as constant

What will happen when Intercept is changing keeping the slope constant

It is going to place parallely with the same angle

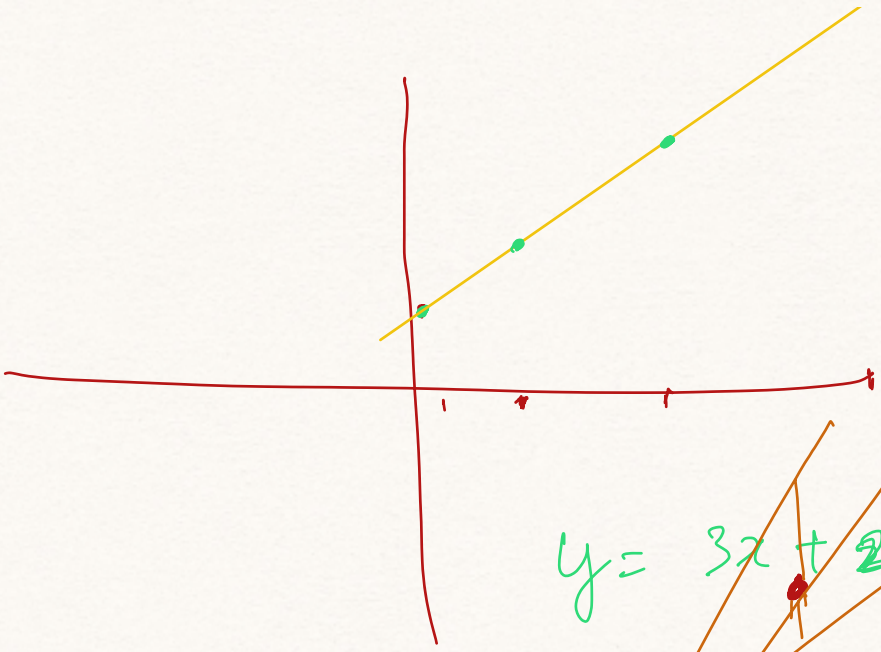
$$y = mx + b$$

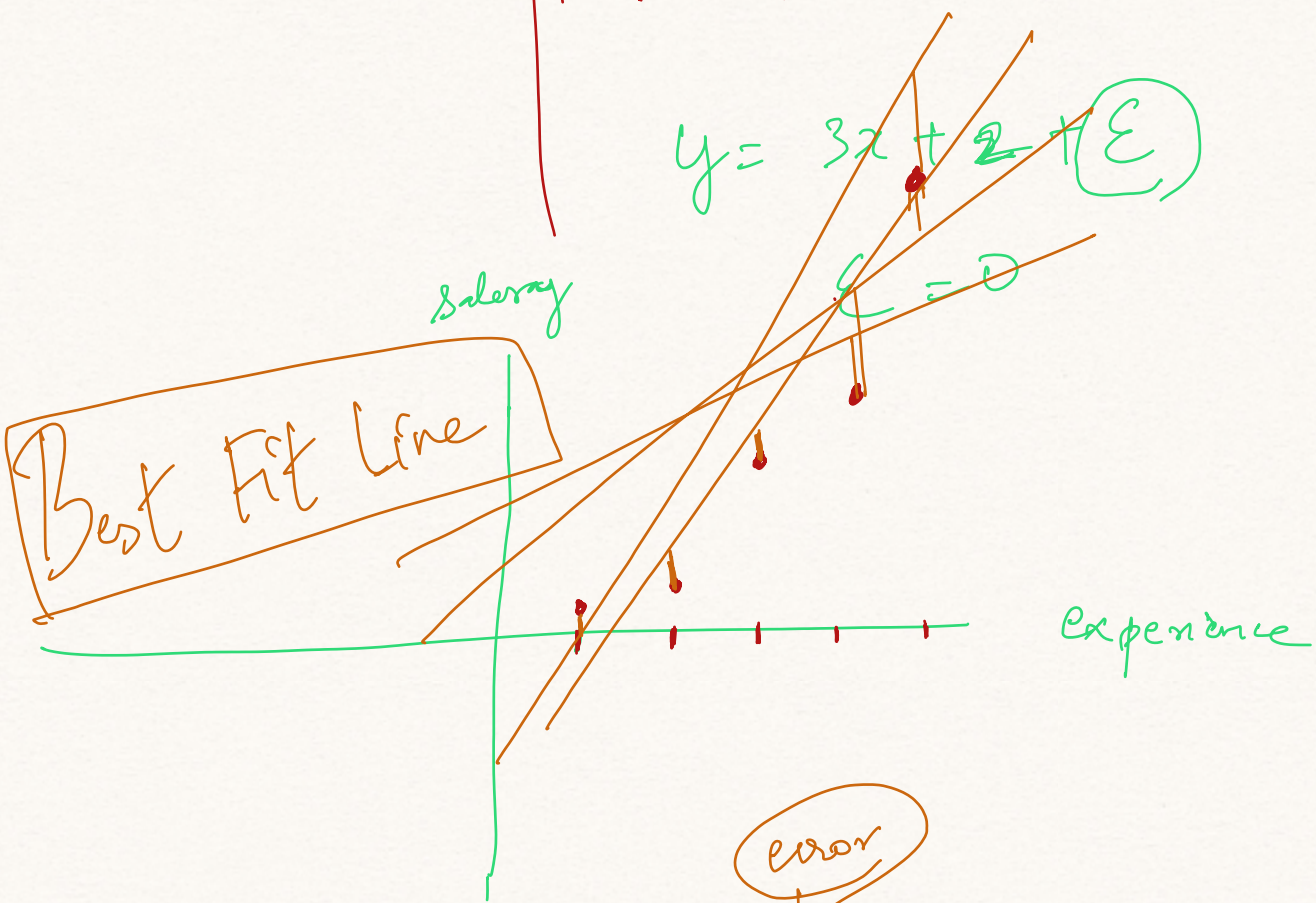
$$y = ax + b$$

$$y = mx + c$$

$$y = b_1 x + b_0$$

$$y = \theta_1 x + \theta_0$$





error

$\varepsilon \downarrow$

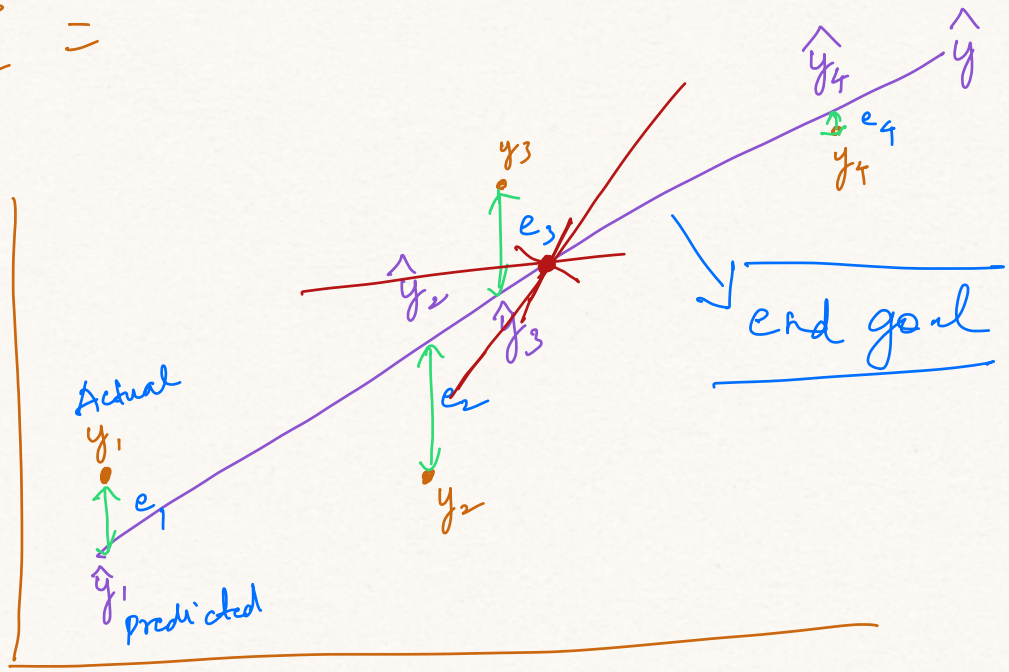
$y = \underbrace{mx + b} + \varepsilon$

linear regression

Objective to find m and b where

$\mathcal{E}$ is as minimum as possible

$\mathcal{E}$ =



$$\sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$ — may end up zero

Mean Square Error (MSE) = $\dfrac{\sum_{i=1}^{n} (y_i - \hat{y}_i)^2}{n}$

Find m and b where MSE is minimal

Slope Intercept

Rule of thumb

The best fit line will cross the Centroid

(x_1, y_1) (x_2, y_2) (x_3, y_3) (x_4, y_4)

$$\left(\frac{x_1 + x_2 + x_3 + x_4}{4}, \frac{y_1 + y_2 + y_3 + y_4}{4}\right)$$

Linear Algebra

$x + 2y = 5$

$x + 3y = 10$

$(-)$

$-y = -5$

$y = 5$

x, and y

$x + 2y = 5$

$x + 2y + 3z + 5k = 6$

$x + y - z + k = 10$

$2x + 3y + z + 2k = 15$

y - ush ...

$$x + 2(5) = 5$$

$$x + 10 = 5$$

$$\boxed{x = -5}$$

$$x + 2y = 5$$

$$2x + y = 10$$

$$\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 10 \end{bmatrix}$$

$$\boxed{X \quad \theta = y}$$

$$X^T \cdot X \theta = y X^T$$

$$\theta = \frac{1}{X^T X} \cdot y X^T$$

Linear Algebra

$$\theta = (X^T X)^{-1} y X^T$$

Normal Equation

X	Y
1	2
2	3
3	5

$$\therefore y = mx + b \times 1$$

$$X = \begin{bmatrix} 1 & x_1 \\ 1 & x_2 \\ 1 & x_3 \end{bmatrix} \quad y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$$

$$\begin{bmatrix} 1 & x_1 \\ 1 & x_2 \\ 1 & x_3 \end{bmatrix} \begin{bmatrix} b \\ m \end{bmatrix} = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} b \\ m \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix}$$

$$X \quad \theta = Y$$

multiply X^T = X transpose in both side

$$\begin{bmatrix} 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{bmatrix}^X \Rightarrow \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \end{bmatrix} X^T$$

$$(X^T \cdot X)\,\theta = y\,X^T$$

$$\theta = \frac{1}{(X^T \cdot X)} \cdot (y \cdot X^T)$$

$$\frac{1}{5} = 5^{-1}$$

$$\theta \Rightarrow (X^T \cdot X)^{-1} (X^T \cdot Y)$$

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

$$Y = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix} \quad \theta = \begin{bmatrix} b \\ m \end{bmatrix}$$

$$\left(\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 2 \\ 1 & 3 \end{bmatrix} \right)^{-1}$$

$$\left(\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \end{bmatrix} \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix} \right)$$

$3 \times 2 \quad 2 \times$

$m \times n \qquad p \times q$

$$\begin{bmatrix} 1+1+1 & 1+2+3 \\ 1+2+3 & 1+4+9 \end{bmatrix}^{-1}$$

$$\begin{bmatrix} 3 & 6 \\ 6 & 14 \end{bmatrix}^{-1}$$

$$\frac{1}{4x^2 - x}$$

$$\frac{1}{|A|}(\text{adj } A)$$

$$\frac{1}{6}\begin{bmatrix} 14 & -6 \\ -6 & 3 \end{bmatrix}$$

2x2

$$\begin{bmatrix} 2.3 & -1 \\ -1 & 0.5 \end{bmatrix}$$

x	y	$\hat{y}$	$(y-\hat{y})$	$(y-\hat{y})^2$
1	2	1.83	0.17	0.0289
2	3	3.33	−0.33	0.1089
3	5	4.83	0.17	0.0289
				0.1667

$$SSE \Rightarrow \Sigma (y-\hat{y})^2$$

$$MSE = \frac{\Sigma (y - \hat{y})^2}{n} = \frac{0.1667}{3}$$

$$MSE = 0.05$$