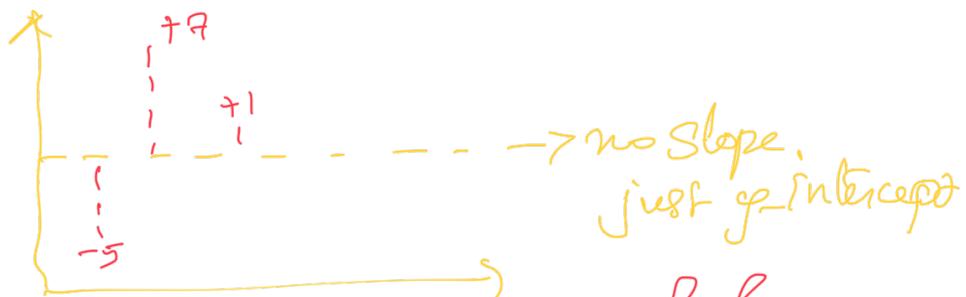


Loss/ Cost and optimisation

Recap: ① Univariate \rightarrow where the future values based mean based Best fit line



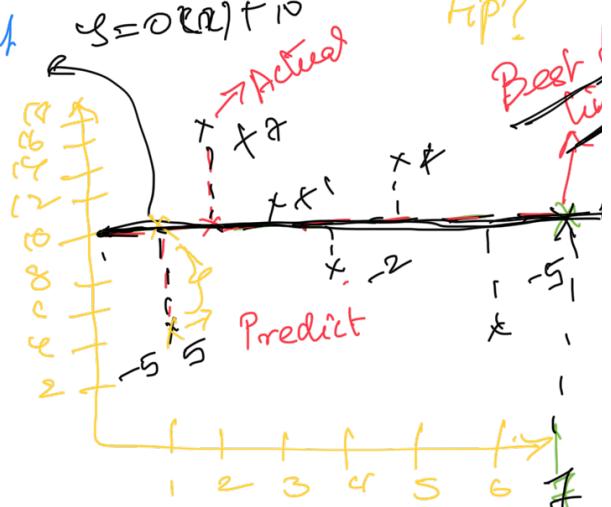
Draw back → ① Residual values are high.
 \rightarrow mere Estimate

② \rightarrow Bill amount / Tip amount
what will be the one tip?

Meal# Total Tip amount

1	=	5
2	=	12
3	=	11
4	=	8
5	=	14
6	=	5

\Rightarrow Mean 10



Sum of Residuals = Total

$$-5 + 7 + 1 + -2 + 4 + -5 = 0$$

Residual \Rightarrow Errors

SSE \rightarrow Sum of Squared Error:

$$\boxed{\text{SSE} = 120}$$

$$\text{Meal#} \quad \text{Total Bill} \quad \text{Tip} \quad (x_i - \bar{x}) \quad (y_i - \bar{y}) \quad \times \quad (x_i - \bar{x}) \quad (y_i - \bar{y}) \quad \times \quad (x_i - \bar{x})$$

$\approx 30 \approx 5 \approx 40 \approx -5 \approx 200 \approx 160$

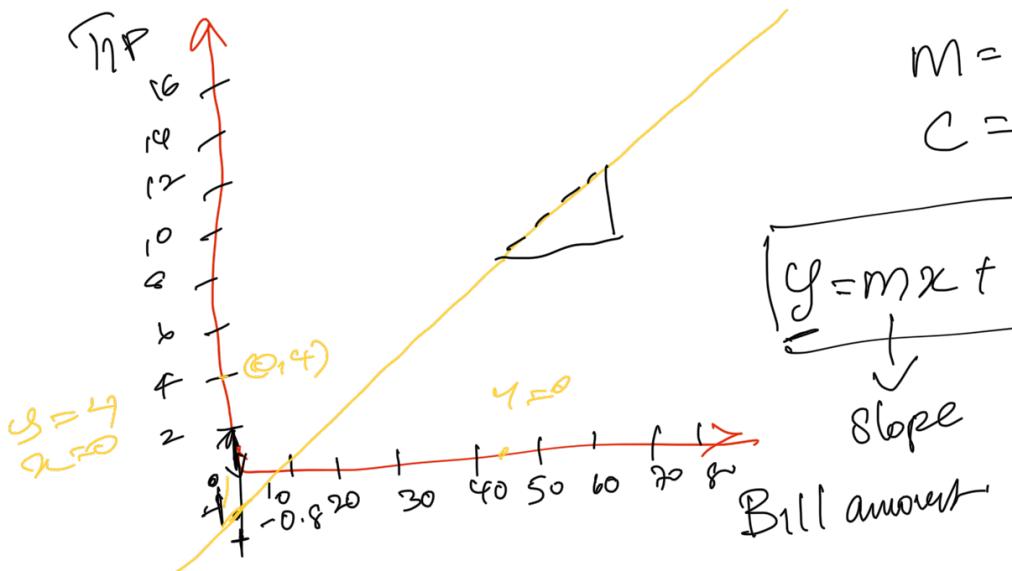
$\bar{x} = \frac{615}{4206} = 0.146$

 $\bar{y} = \frac{115}{4206} = 0.027$

 $m = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2}$

Line Equation!!
 $y = mx + c$
 $c = \bar{y} - m\bar{x} = 0.027 - 0.146(-0.027) = 0.0818$

Centroid $\Rightarrow (\bar{x}, \bar{y})$

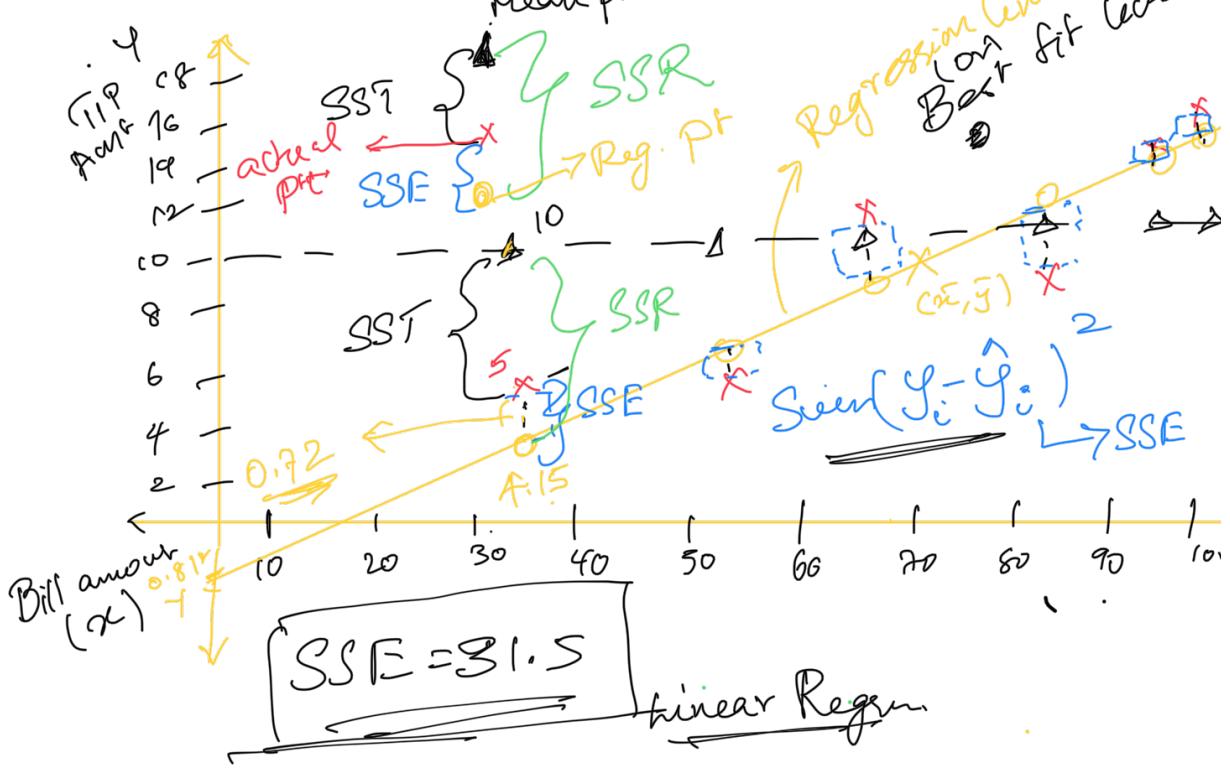


$y = 0.14x - 0.818 \rightarrow$ Goodness of fit line

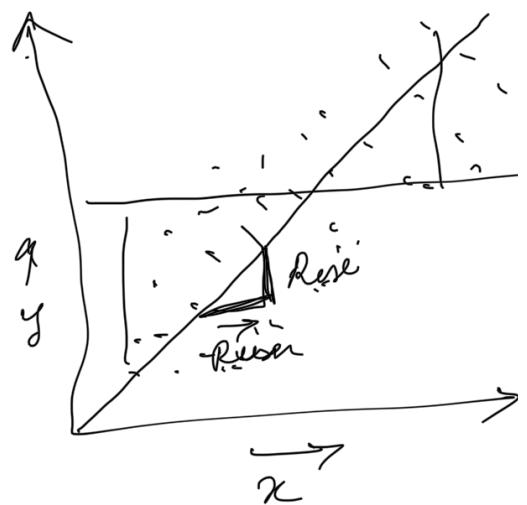
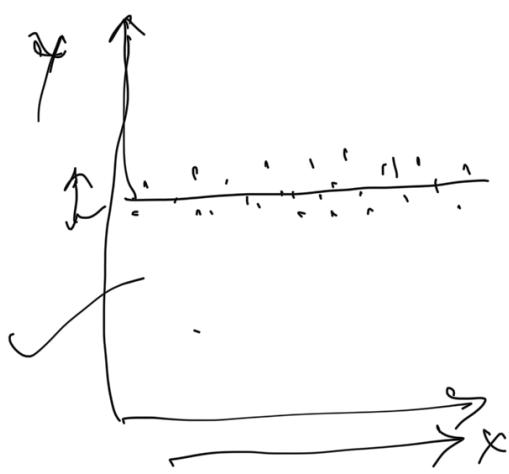
<u>X</u>	<u>TIP</u> y Prediction \hat{y}
34	$0.14(34) - 0.818 = 3.94$
108	$0.14(108) - 0.818 = 14.97$
11	$0.14(11) - 0.818 = 8.53$

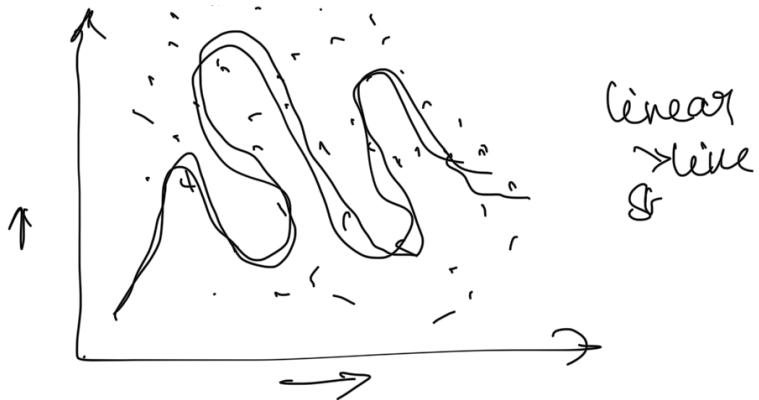
$$\begin{array}{r}
 \rightarrow 64 \\
 \rightarrow 88 \\
 \rightarrow 99 \\
 \rightarrow 51
 \end{array}
 \quad
 \begin{array}{r}
 11 \\
 8 \\
 14 \\
 5
 \end{array}
 \quad
 \begin{array}{l}
 0.14(64) = 0.818 = 12.04 \\
 0.14(88) = 0.818 = 13.65 \\
 0.14(99) = 0.818 = 6.63 \\
 0.14(51) = 0.818 = 6.63
 \end{array}
 \quad
 \text{centroid } (\bar{x}, \bar{y})$$

mean pr



Goodness of fit \rightarrow Regression line





Total Bill	Obsn	\hat{y}	$y - \hat{y}$	SSE
89	5	4.15	0.849	0.72
108	12	14.96	2.03	4.12
69	11	8.53	2.46	6.01
88	8	12.04	-4.04	16.3
99	10	13.65	0.34	0.12
51	5	6.63	-1.63	2.61

$$SSE \rightarrow 120 \rightarrow SST$$

Regression.

$$\hookrightarrow SSR = 30.07$$

SST, \rightarrow Sum of Square diff - bet. Actual & mean

SSE \rightarrow Sum of Square Errors = Difference bet actual & Predicted

SSR \rightarrow Sum of Squares due to the Regression line

Regression line

$$SSE = 31.5,$$

$$SST = 120$$

$$\rightarrow SST$$

SSR \Rightarrow Sum of Squares due to the Regression line





$$120 \rightarrow$$

Total.

$$89.925 + 30.075 \checkmark$$

reduced from Total SST by regression line

goodness of fit. $r^2 = \frac{SSR}{SST}$ → Regression line reduces Total Error.

Coefficient of Determination.

$$\begin{array}{c} SST \\ \swarrow \quad \searrow \\ SSR \qquad SSE \end{array}$$

Mean Square $r^2 = \frac{89.925}{120} = 0.75 \rightarrow 75\%$

$$\begin{array}{l} SSE = \sum (y_i - \hat{y}_i)^2 \\ MSE = \frac{SSE}{n} \end{array}$$

reduce

75% of the total sum of squares can be explained by regression eqn

remainder is error.

$r^2 = 1 \rightarrow$ Perfect regression line.

We will have to reduce the error.

$$120 \rightarrow 120 - SSB \rightarrow 120 \rightarrow MSB$$

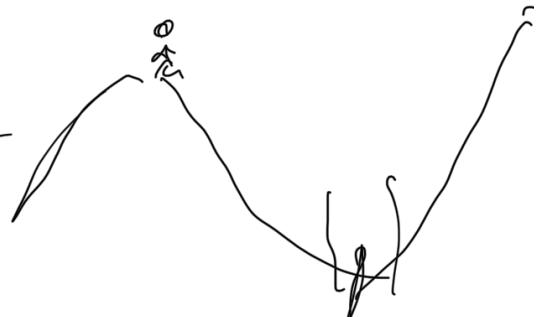
SSE

Mean Squared Error? $\frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}_i)^2$

Cost function

S-S-E

$$\sum (y_i - \hat{y}_i)^2$$



① cost fu = MSE

↓ Mean Squared Error

② alter or change the values of
 m & c → Intercept & Slope.

↓ MSE

reduction or Alteration we try to
perform Should also include MSE

Differential Calculus:

New Slope = Old Slope $- (\pm \delta)$

New Intercept = Old Intercept $- (\pm \delta)$

$$y = m_0 x + c_0$$

$$y = m_{\text{new}} x + c_{\text{new}}$$

$$\Rightarrow f(2) = (2)^2 + 2 = 4 + 2 = 6$$

Q. one fp val.

$$\frac{d f(x)}{dx} = 2x + 0$$

$$\Rightarrow \frac{d(x^n)}{dx} = nx^{n-1}$$

$\frac{d\alpha}{dx} \downarrow$ only find \dot{x} $\frac{d(\text{constant})}{dx} = 0$
 ② ~~2 variable partial diff~~ $f(x,y)$ \rightarrow Partial differentiation
 new slope \rightarrow Old slope - P.D(MSE) w.r.t Slope
 new intercept \Rightarrow old intercept - P.D(MSE) w.r.t Intercept

$$Cost f_{fu} = \sum_{i=1}^n (y_i - (mx + c))^2$$

$$\hat{y} = mx + c$$

$$(x,y) = x^2 + y^2 / 2xy$$

$$\frac{d(CF)}{dm} \Rightarrow 2 \left(\frac{y^2}{n} + m^2 x^2 \frac{2}{FC} + 2mx - 2ymx - 2yc \right)$$

$$\Rightarrow 2(0 + 2mx^2 + 0 + 2xc - 2yx - 0)$$

$$- 2 \sum_{i=1}^n (ma^2 + ac - yx) \dots$$

$$\Rightarrow \frac{2n}{n} \sum_{i=1}^n \epsilon_i (mx + c - y)$$

\checkmark Step x slope = $-\frac{2}{n} \sum_{i=1}^n x_i (\hat{y}_i - y_i)$

\checkmark Step x Intercept = $-\frac{2}{n} \sum_{i=1}^n (y_i - \hat{y}_i)$

X	Y
0.5	1.4
2.3	1.9
2.9	3.2

$m = 0.64$

$c = 0$

$y = mx + c$

$\Rightarrow 0.64(0.5) + 0$

$\Rightarrow 0.32$

$SSE = (1.4 - 0.32)^2 + (1.9 - 1.44)^2 + (3.2 - 1.856)^2$

$= 1.16 + 0.10 + 1.82 = 3.12$

\checkmark $y_3 = mx_3 + c$

$= 0.64(2.9) + 0$

$= 1.856$

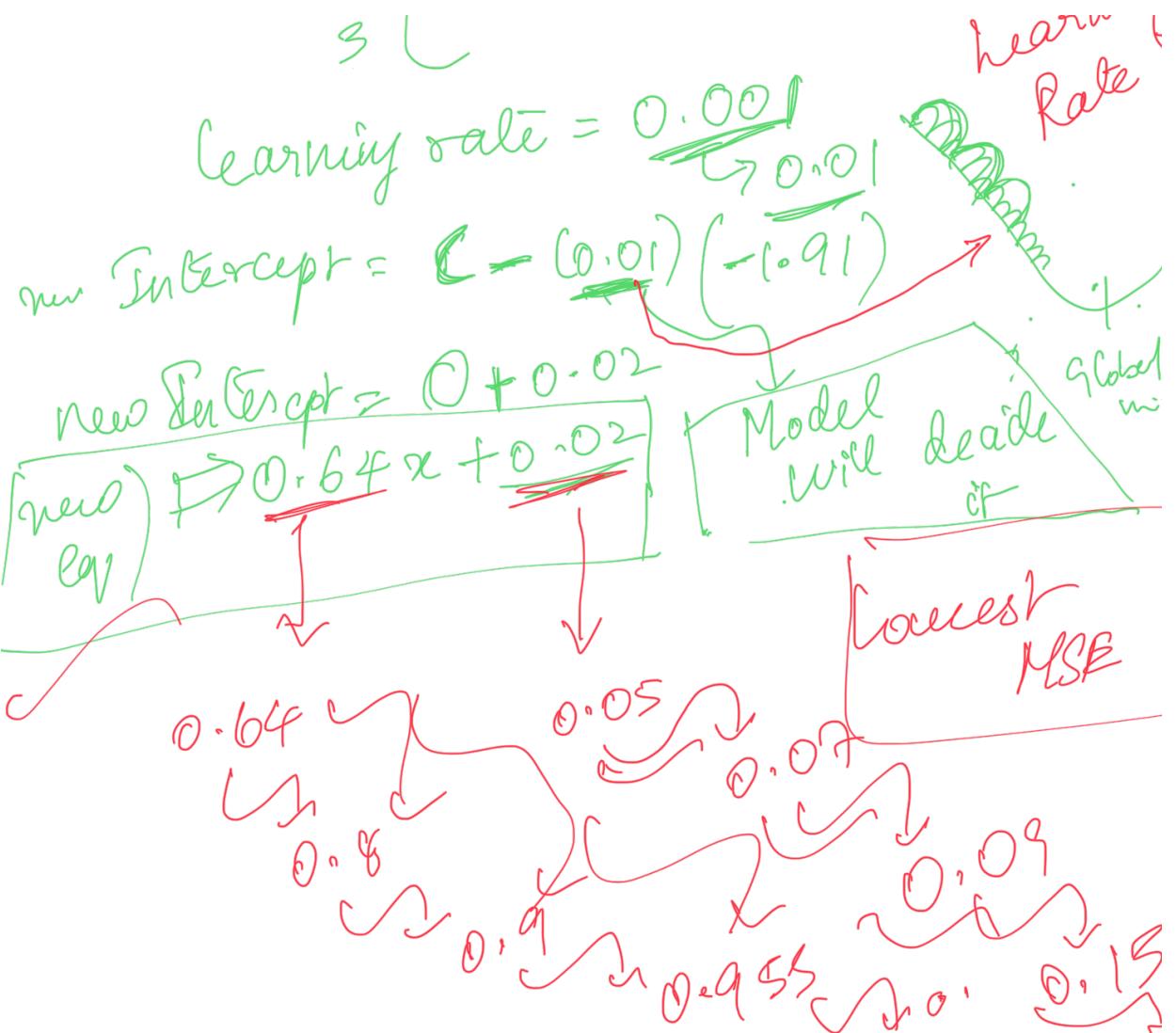
$+ (1.4 - 0.32)$

$= + 1.08$

$\left| \begin{array}{l} C(1.9 - 1.44) \\ = 0.45 \end{array} \right.$

$\left| \begin{array}{l} C(3.2 - 1.856) \\ = 1.35 \end{array} \right.$

$- 2 [1.08 + 0.45 + 1.35] = -1.91$



Write this using for code.

Pseudo code

- ① Pre define $\rightarrow m & C = 0$
- ② delta \rightarrow formula
- ③ MSE \rightarrow print
- ④ Learning rate = 0.01
- ⑤ n iteration = 1000

