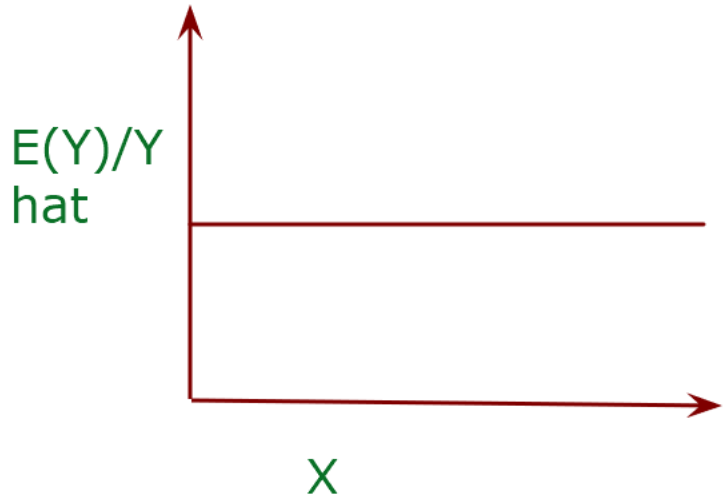
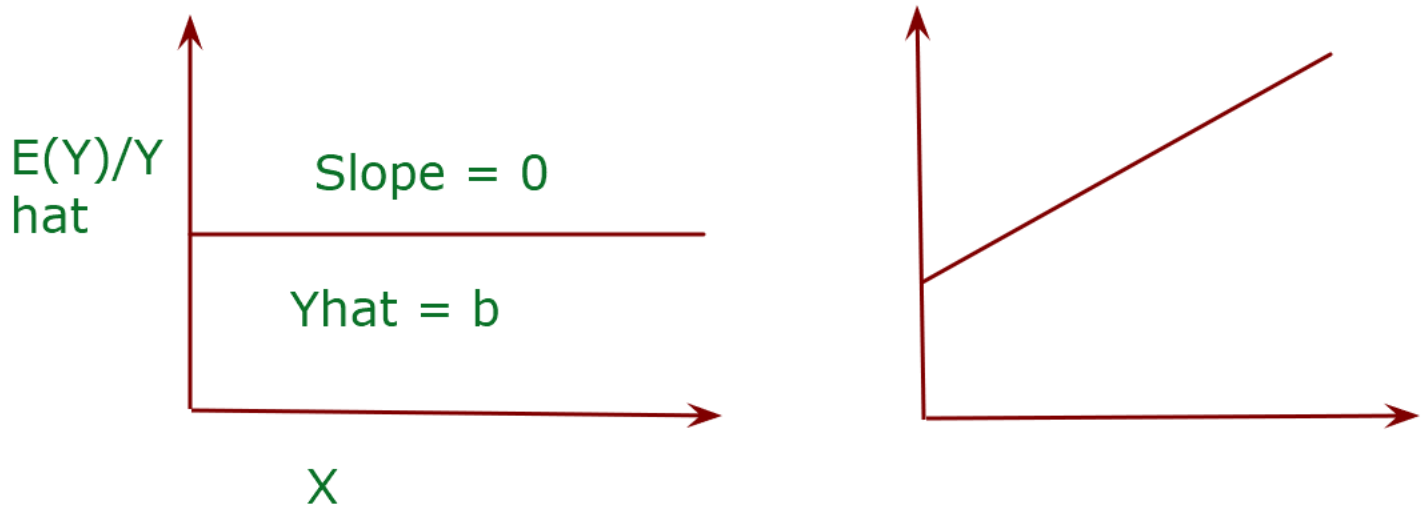
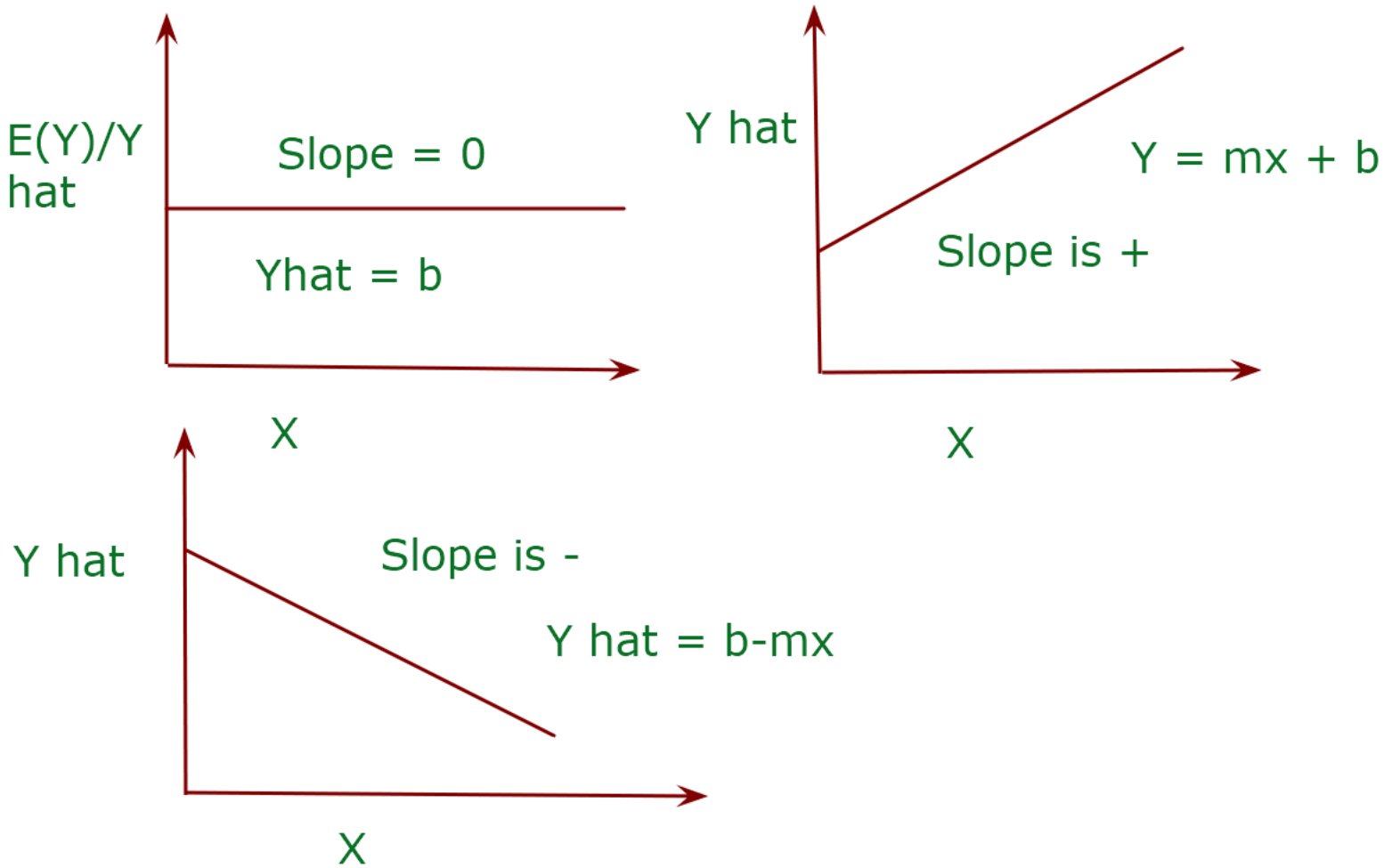
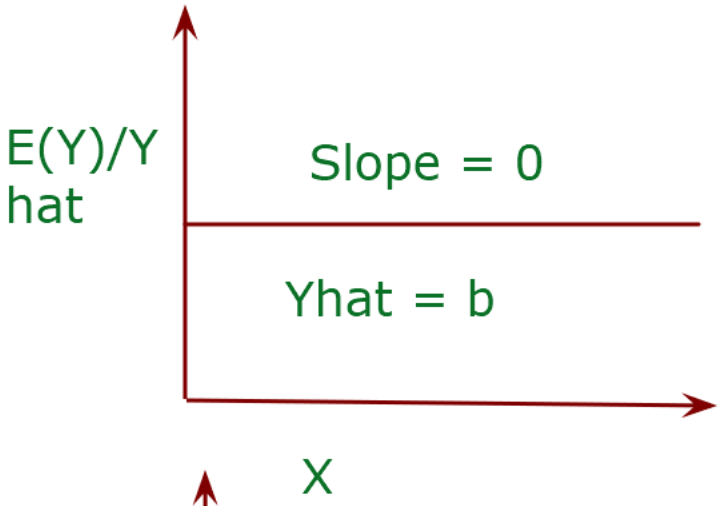
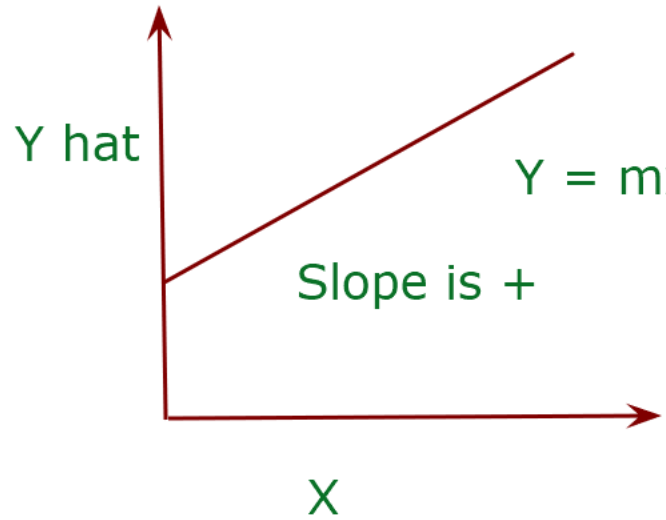
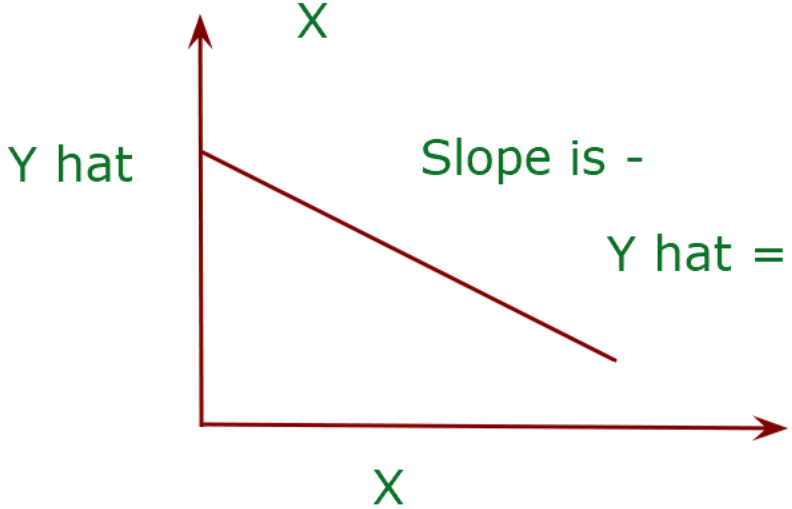

E(Y)/Y
hat
X


E(Y)/Y hat
Slope = 0
Yhat = b
X

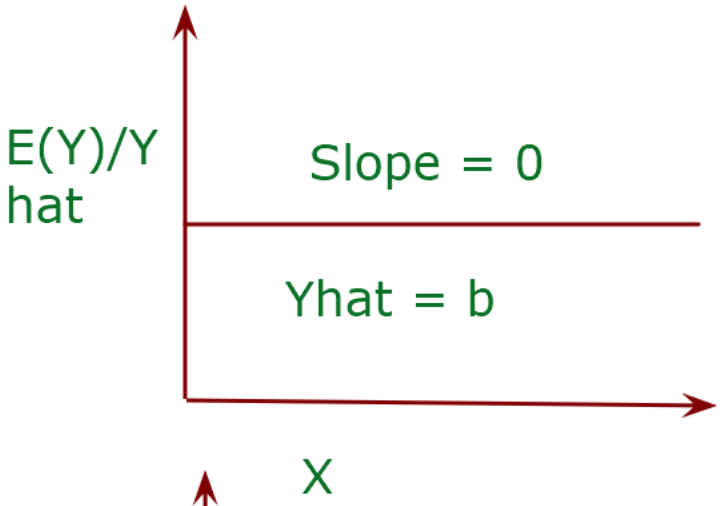

E(Y)/Y hat
Slope = 0
Yhat = b
X
Y hat
Y = mx + b
Slope is +
X
Y hat
Slope is -
Y hat = b-mx
X

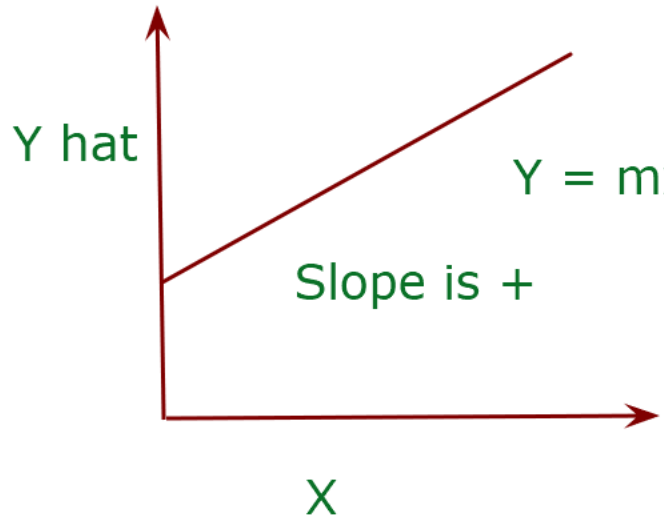


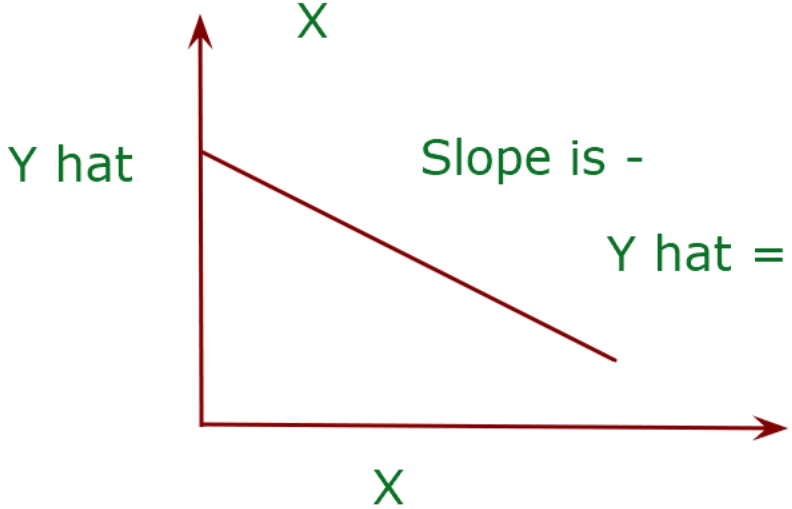




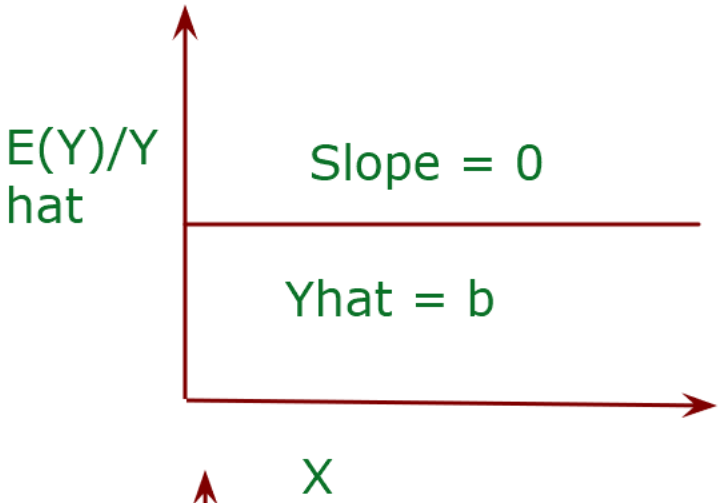
Y hat = 0.6 -6.6x
Y hat = 36 + 6.9X
Y hat = 12.6 - 0.0014x

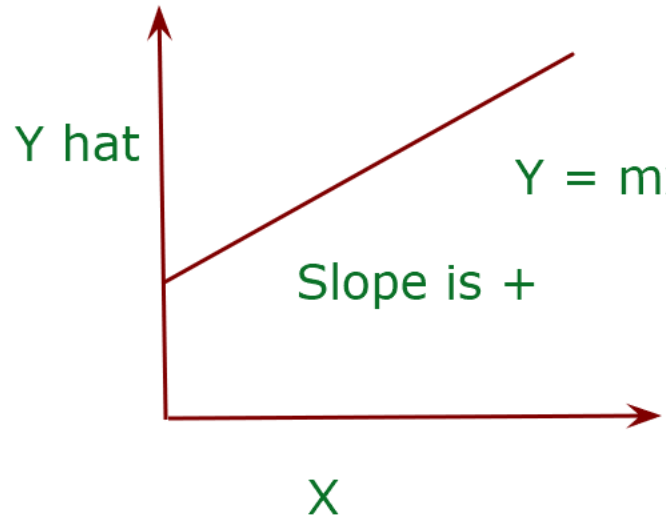


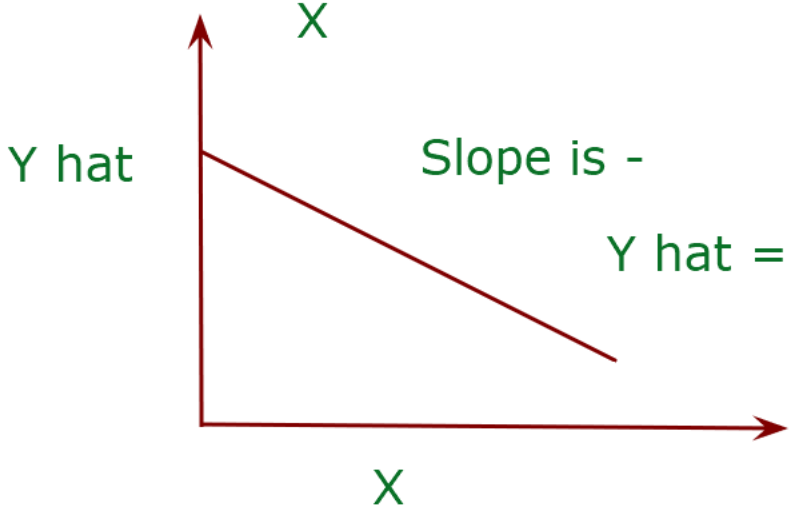




Y hat = 0.6 -6.6x (iii)
Y hat = 36 + 6.9X (ii)
Y hat = 12.6 - 0.0014x







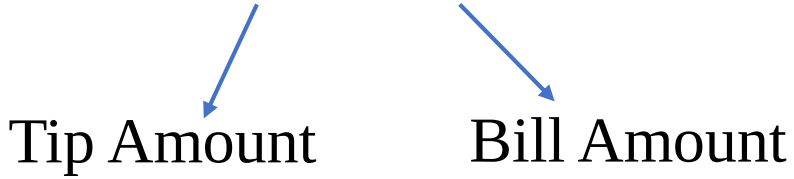
Y hat = 0.6 -6.6x (iii)
Y hat = 36 + 6.9X (ii)
Y hat = 12.6 - 0.0014x
(i)

Bill Amount for Tips

Meal (#)	Bill Amount (in Rs.)	Tip Amount (in Rs.)
1.	36	7
2.	110	19
3.	66	13
4.	90	10
5.	101	16
6.	53	7

Interesting Fact: Now you have bill amount data as well.

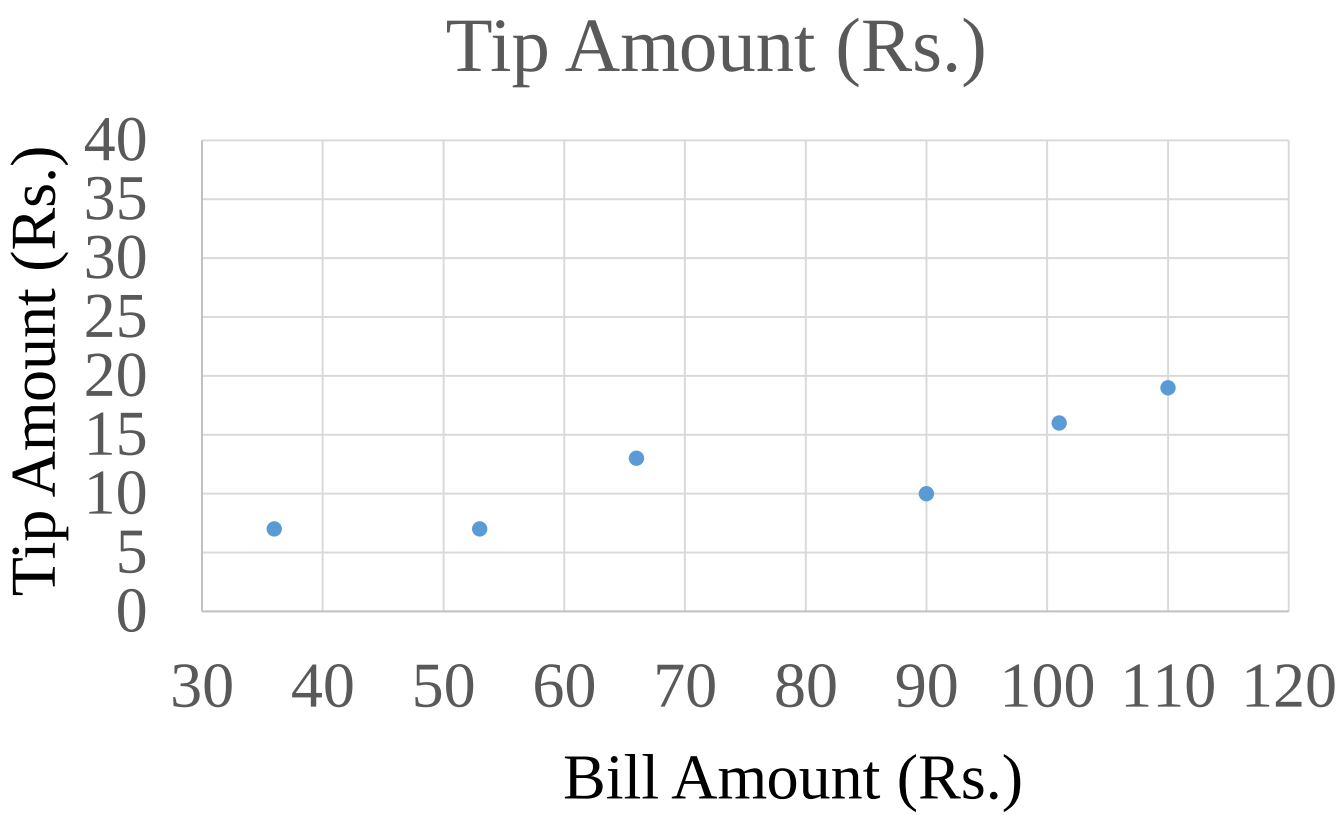
- How to predict tip amount?
- What is DV and IV variable?



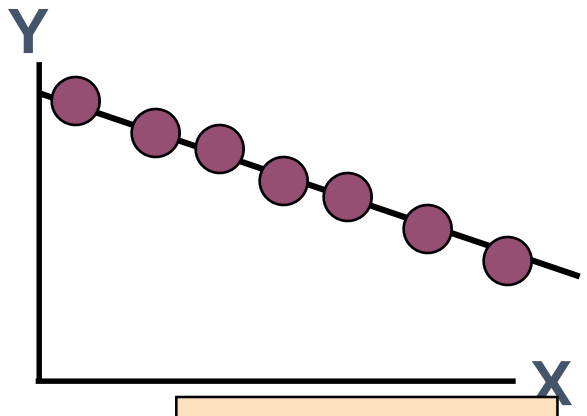
Collected Data for Service

Meal (#)	Bill Amount (in Rs.)	Tip Amount (in Rs.)
1.	36	7
2.	110	19
3.	66	13
4.	90	10
5.	101	16
6.	53	7
7.		**?**

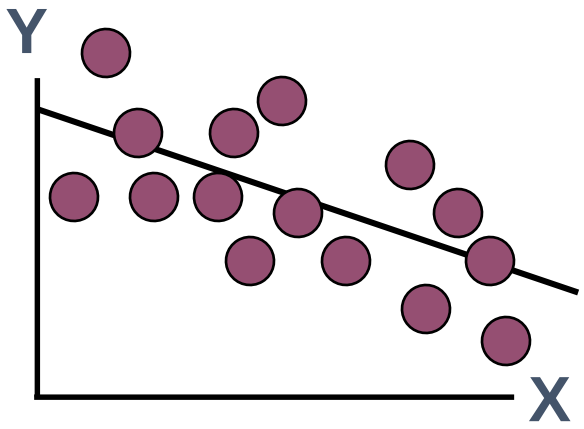
Scatter Plot: Visualize the data to observe the pattern

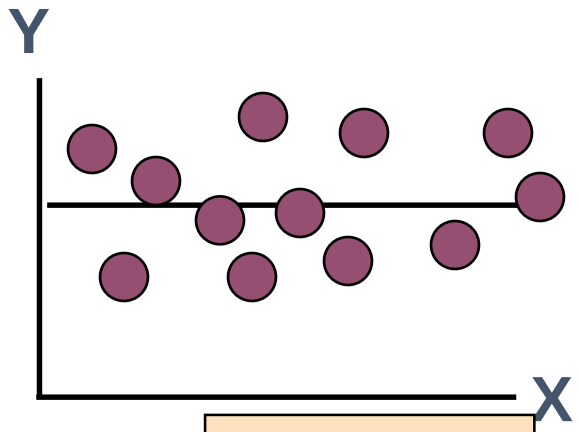


Scatter Plots of Data

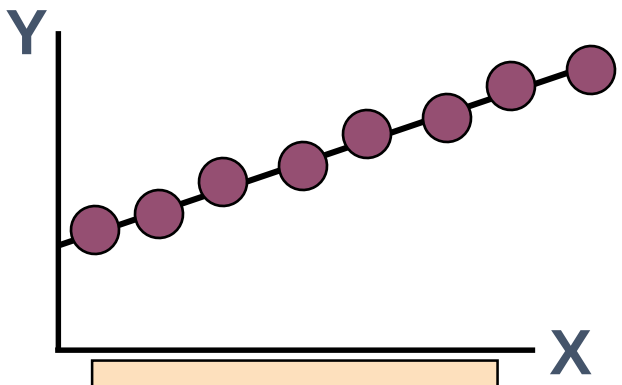


E(Y) = β0 - β1x

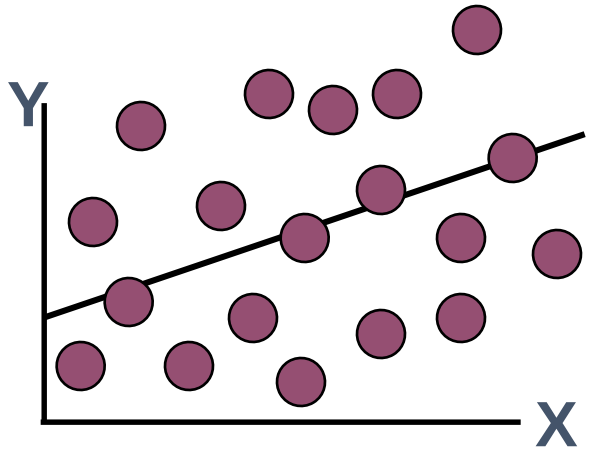


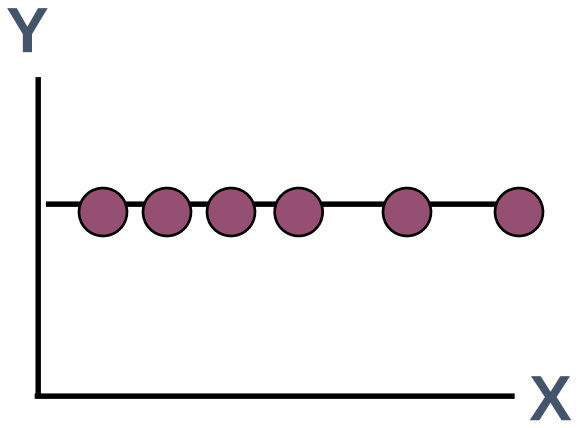


E(Y) = β0 + 0x

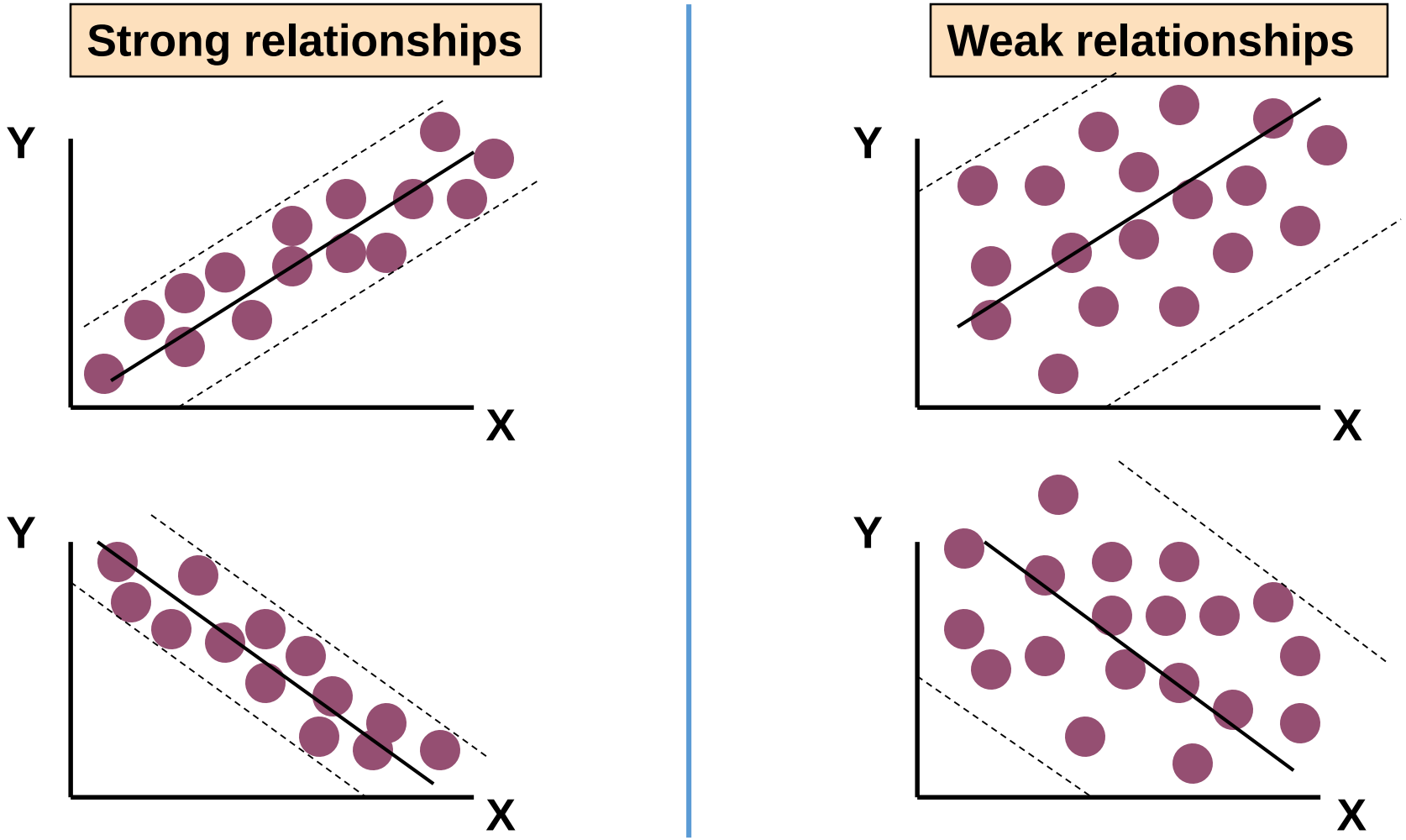


E(Y) = 48 + 8.5x





3. Check correlation coefficient (optional) “r”



y hat = 12

bill amount	tip amount
36	7
110	19
66	13
90	10
101	16
53	7

y hat = 12

bill amount	tip amount
36	7
110	19
66	13
90	10
101	16
53	7

hypothesis: lower bill amount will result in lower tips; higher bill amount will result in higher tips

DV: tip amount
IV: bill amount

y hat = 12

bill amount	tip amount
36	7
110	19
66	13
90	10
101	16
53	7

mean of DV: Y = 12
mean of IV: X = 76

hypothesis: lower bill amount will result in lower tips; higher bill amount will result in higher tips

DV: tip amount
IV: bill amount

Centroid

y hat = 12

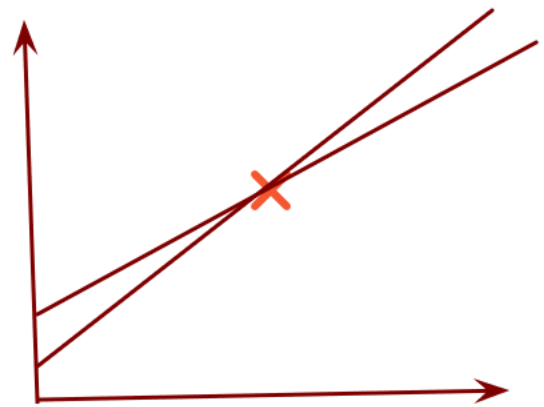
bill amount	tip amount
36	7
110	19
66	13
90	10
101	16
53	7

mean of DV: Y = 12
mean of IV: X = 76

hypothesis: lower bill amount will result in lower tips; higher bill amount will result in higher tips

DV: tip amount
IV: bill amount

Centroid



y hat = 12

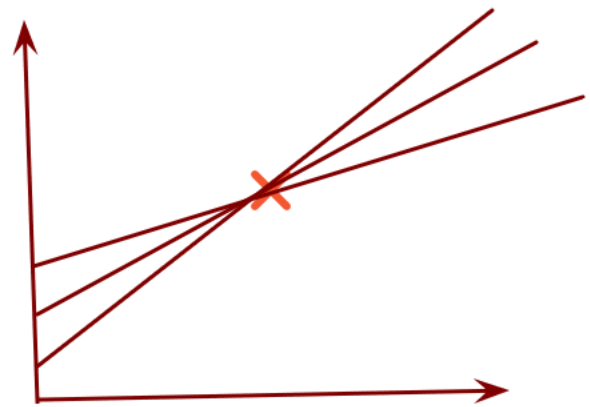
bill amount	tip amount
36	7
110	19
66	13
90	10
101	16
53	7

mean of DV: Y = 12
mean of IV: X = 76

hypothesis: lower bill amount will result in lower tips; higher bill amount will result in higher tips

DV: tip amount
IV: bill amount

Centroid



Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7
Mean	76 = X Bar	12 = Y bar

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7
Mean	76 = X Bar	12 = Y bar

$\hat{Y} = b_0 + b_1 (X_i)$

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7
Mean	76 = X Bar	12 = Y bar

$$\hat{Y} = b_0 + b_1 (X_i)$$

$$b_1 = \sum (X_i - \bar{X})(Y_i - \bar{Y}) / \sum (X_i - \bar{X})^2$$

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7
Mean	76 = X Bar	12 = Y bar

$$\hat{Y} = b_0 + b_1 (X_i)$$

$$b_1 = \sum (X_i - \bar{X})(Y_i - \bar{Y}) / \sum (X_i - \bar{X})^2$$

(Xi - X bar)	(Yi - Y bar)
40	5
34	7
10	1
14	2
25	4
23	5

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7
Mean	76 = X Bar	12 = Y bar

Y hat = b sub 0 + b sub 1 (Xi)

b sub 1 = sum (Xi-X bar) (Yi-Y bar) / sum (Xi - X bar)2

(Xi - X bar)	(Yi - Y bar)
40	5
34	7
10	1
14	2
25	4
23	5

b sub 1 = 200 + 238 + 10 + 28 + 100 + 115 /(1600 + 1156 + 100 + 196 + 625 + 529)

b sub 1 = 0.1644

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7

Mean 76 = X Bar 12 = Y bar

Y hat = b sub 0 + b sub 1 (Xi)

b sub 1 = sum (Xi-X bar) (Yi-Y bar) / sum (Xi - X bar)2

(Xi - X bar)	(Yi - Y bar)
40	5
34	7
10	1
14	2
25	4
23	5

b sub 1 = 200 + 238 + 10 + 28 + 100 + 115 /(1600 + 1156 + 100 + 196 + 625 + 529)

b sub 1 = 0.1644

b sub 0 = Y bar - b sub 1 (X bar)

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7

Mean 76 = X Bar 12 = Y bar

Y hat = b sub 0 + b sub 1 (Xi)

b sub 1 = sum (Xi-X bar) (Yi-Y bar) / sum (Xi - X bar)2

(Xi - X bar)	(Yi - Y bar)
40	5
34	7
10	1
14	2
25	4
23	5

b sub 0 = -0.4944

b sub 1 = 200 + 238 + 10 + 28 + 100 + 115 /(1600 + 1156 + 100 + 196 + 625 + 529)

b sub 1 = 0.1644

b sub 0 = Y bar - b sub 1 (X bar)

Y hat = -0.4944 + 0.1644 Xi

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7
Mean	76 = X Bar	12 = Y bar

Y hat = b sub 0 + b sub 1 (Xi)

b sub 1 = sum (Xi-X bar) (Yi-Y bar) / sum (Xi - X bar)2

(Xi - X bar)	(Yi - Y bar)
40	5
34	7
10	1
14	2
25	4
23	5

b sub 0 = -0.4944

b sub 1 = 200 + 238 + 10 + 28 + 100 + 115 /(1600 + 1156 + 100 + 196 + 625 + 529)

b sub 1 = 0.1644

b sub 0 = Y bar - b sub 1 (X bar)

Y hat = -0.4944 + 0.1644 Xi

Error = 120

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7

Mean 76 = X Bar 12 = Y bar

Y hat = b sub 0 + b sub 1 (Xi)

b sub 1 = sum (Xi-X bar) (Yi-Y bar) / sum (Xi - X bar)2

(Xi - X bar)	(Yi - Y bar)
40	5
34	7
10	1
14	2
25	4
23	5

b sub 0 = -0.4944

b sub 1 = 200 + 238 + 10 + 28 + 100 + 115 /(1600 + 1156 + 100 + 196 + 625 + 529)

b sub 1 = 0.1644

b sub 0 = Y bar - b sub 1 (X bar)

Y hat = -0.4944 + 0.1644 Xi

Meal	Bill Amount	Tip Amount
1	36	7
2	110	19
3	66	13
4	90	10
5	101	16
6	53	7

Mean 76 = X Bar 12 = Y bar

b sub 1 = 200 + 238 + 10 + 28 + 100 + 115 /(1600 + 1156 + 100 + 196 + 625 + 529)

b sub 1 = 0.1644

Error = 120

error = 31.4649

Y hat = b sub 0 + b sub 1 (Xi)

b sub 1 = sum (Xi-X bar) (Yi-Y bar) / sum (Xi - X bar)2

(Xi - X bar)	(Yi - Y bar)
40	5
34	7
10	1
14	2
25	4
23	5

b sub 0 = -0.4944

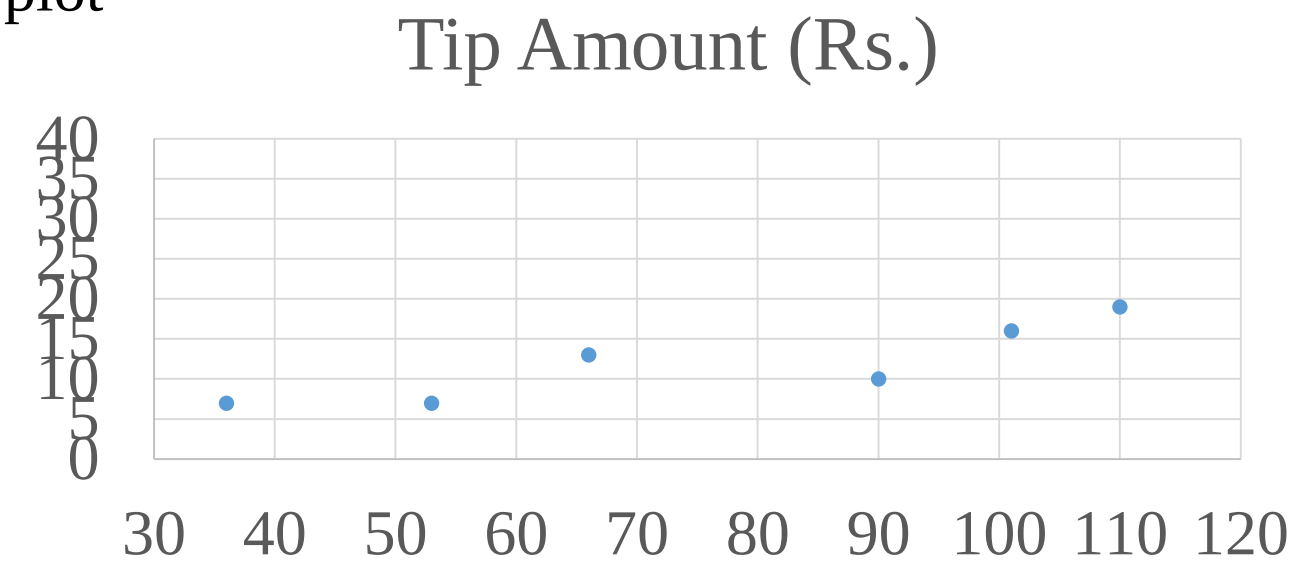
b sub 0 = Y bar - b sub 1 (X bar)

Least Square Method

Least square criterion: Min $\sum(yi - \widehat{yi})2$

The objective is to minimize the sum of squared difference between the observed value for the dependent variable and the estimated/predicted value of the dependent variable that is provided by the regression line

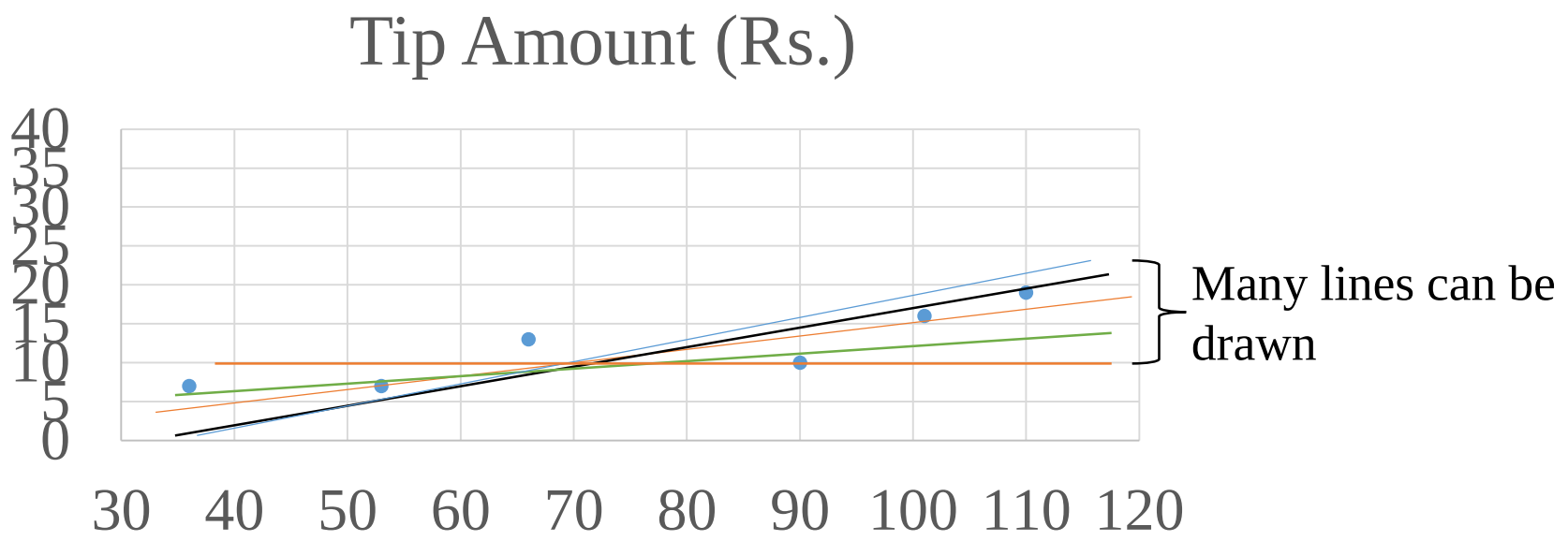
1. Scatter plot



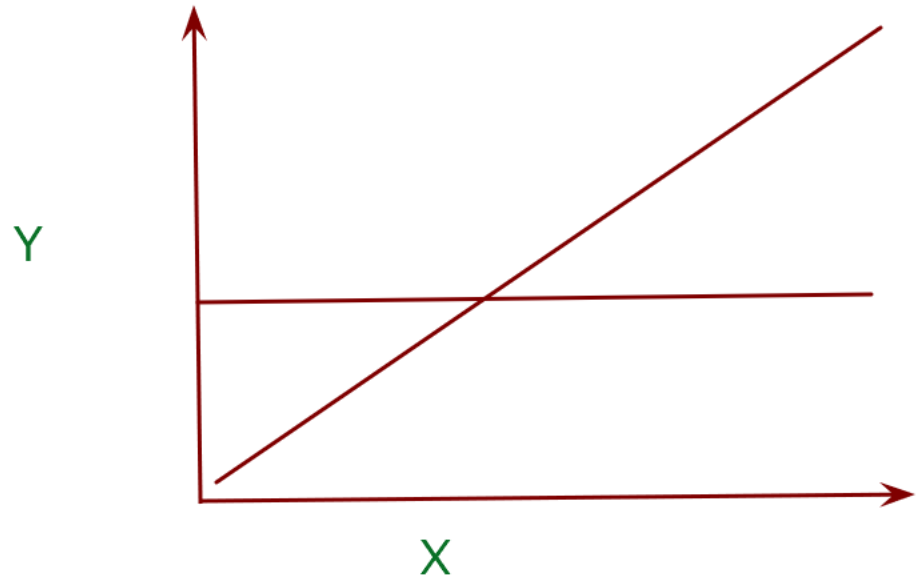
To observe general pattern and find outliers?

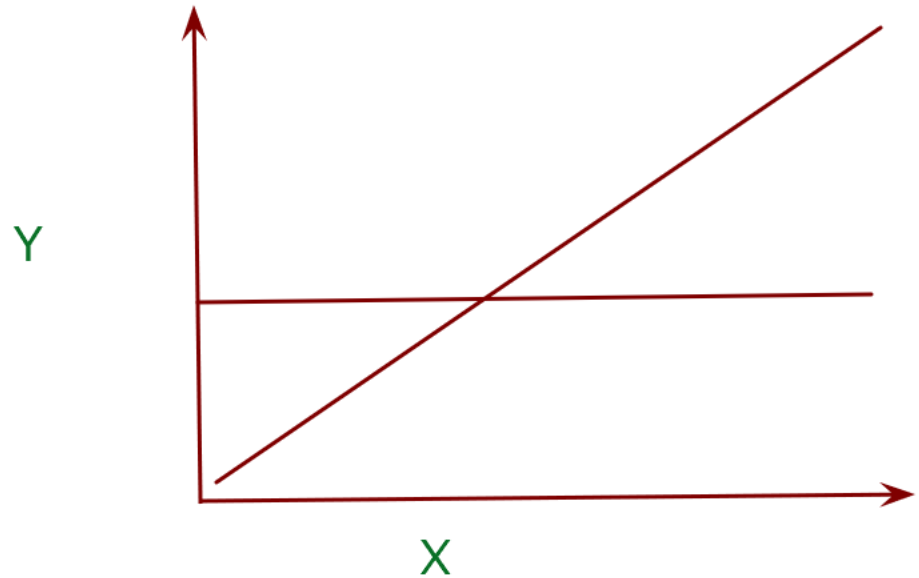
Least Square Method

2. **Look for a visual line**



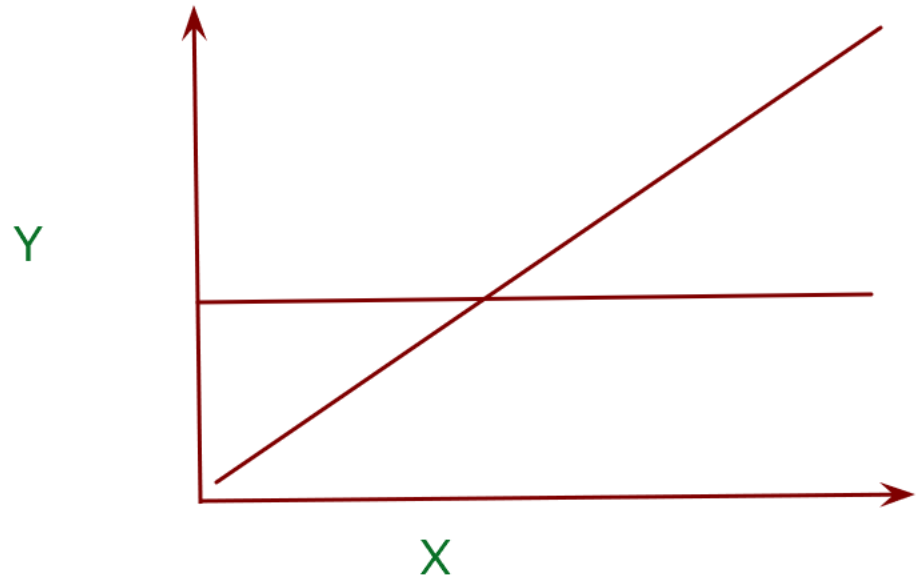
Is there a linear pattern?


Y
X



SST = 120 = SSE
SST = 120
SSE = 31.469

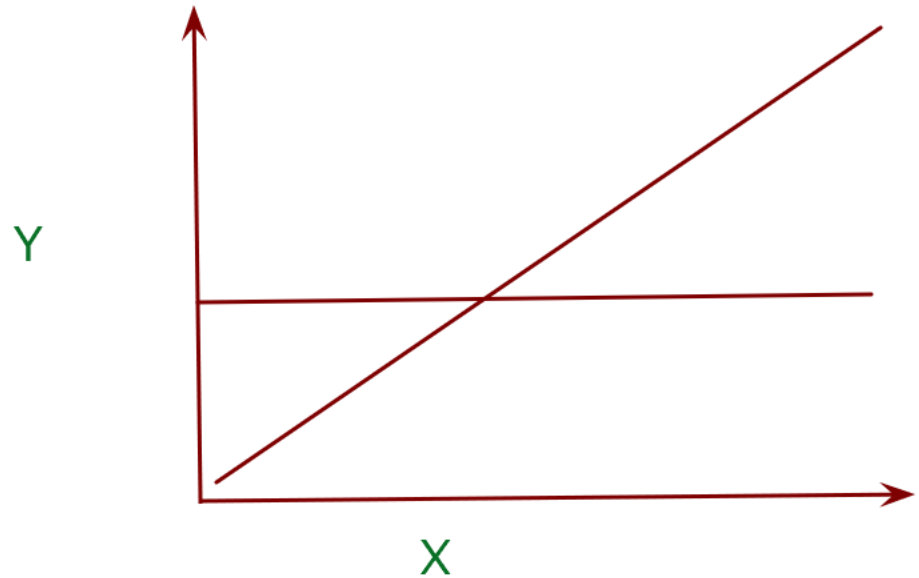
31.4649



SST = 120 = SSE
SST = 120
SSE = 31.469

31.4649

SST - SSE = 88.51 = SSR



SST = 120 = SSE
SST = 120
SSE = 31.469

31.4649

SST - SSE = 88.51 = SSR

SSE = summation (yi-yi hat)2
SST = summation (yi-yi bar)2
SSR = summation (yi hat - yi bar)2

Tip Amount Vs. Bill Amount