STATISTICS FOR DATA SCIENCE

Power Test &
Simple Linear Regression

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STATISTICS FOR DATA SCIENCE

Unit 5 : Power Test & Simple Linear Regression

Session : 5 (Continued Session)

Sub Topic : Correlation & Regression Analysis

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Regression Analysis

❖Regression Analysis is basically the study of a set of data to make the best guess or some kind of prediction.

- For Example : By studying a data which provides information of how much you eat and how much you weigh, you can conclude that there exists a relationship between the two.

- Regression analysis can help you to quantify that and can help you to predict how much you will weigh in 10 years time if you continue to put on weight at the same rate.

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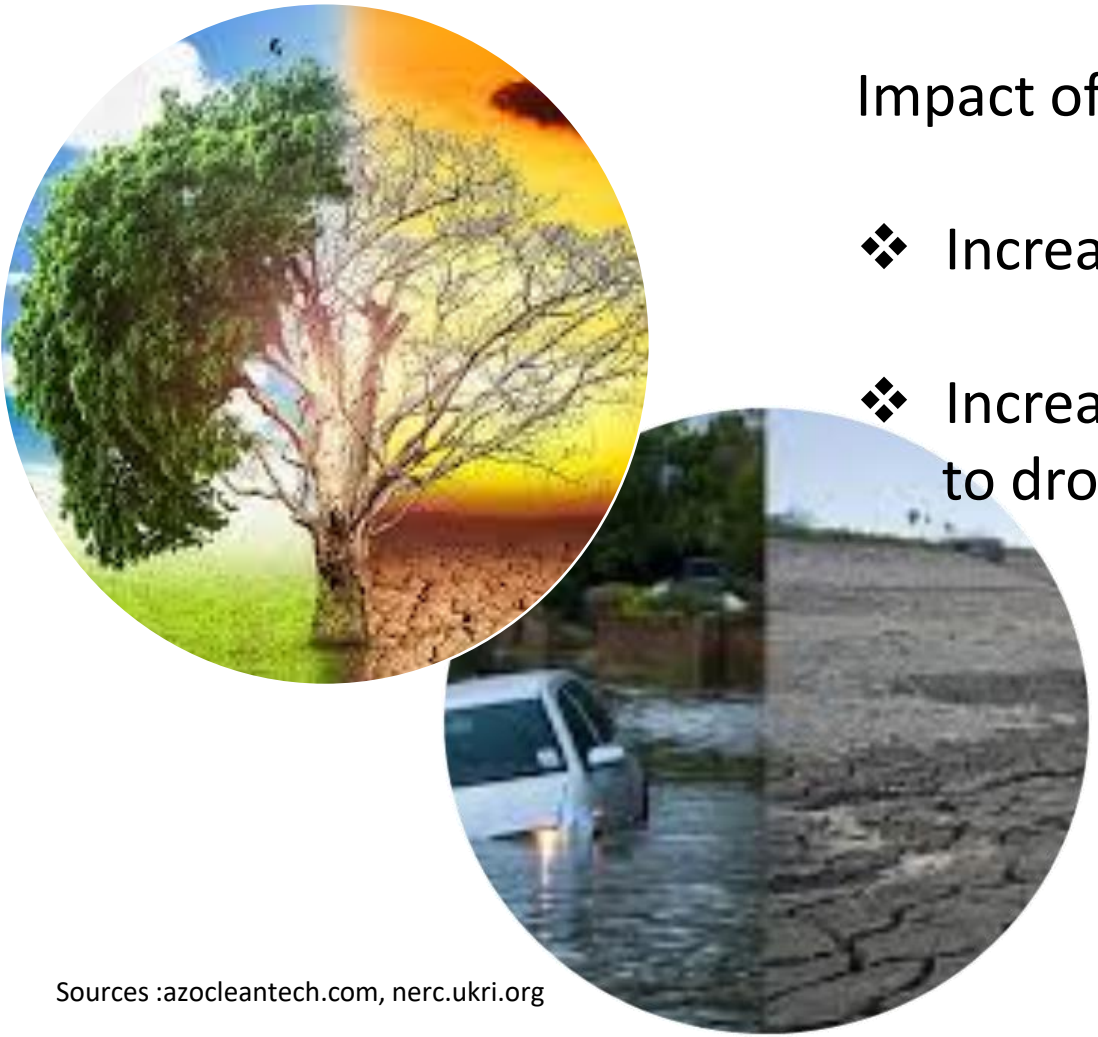
Prediction of Floods / Droughts



Impact of Global warming :

- Increase in rainfall resulting in Floods
- Increase in amount of dry land leading to droughts

Sources :azocleantech.com, nerc.ukri.org

Impact of Global Warming

Global Warming in Wet areas

- Evaporation of water from land and sea
- More rainfall
- Increase in Floods

Global Warming in Dry areas

- Increase in evapotranspiration of water from land , water surfaces and plants
- Dry areas become drier
- Increase in droughts

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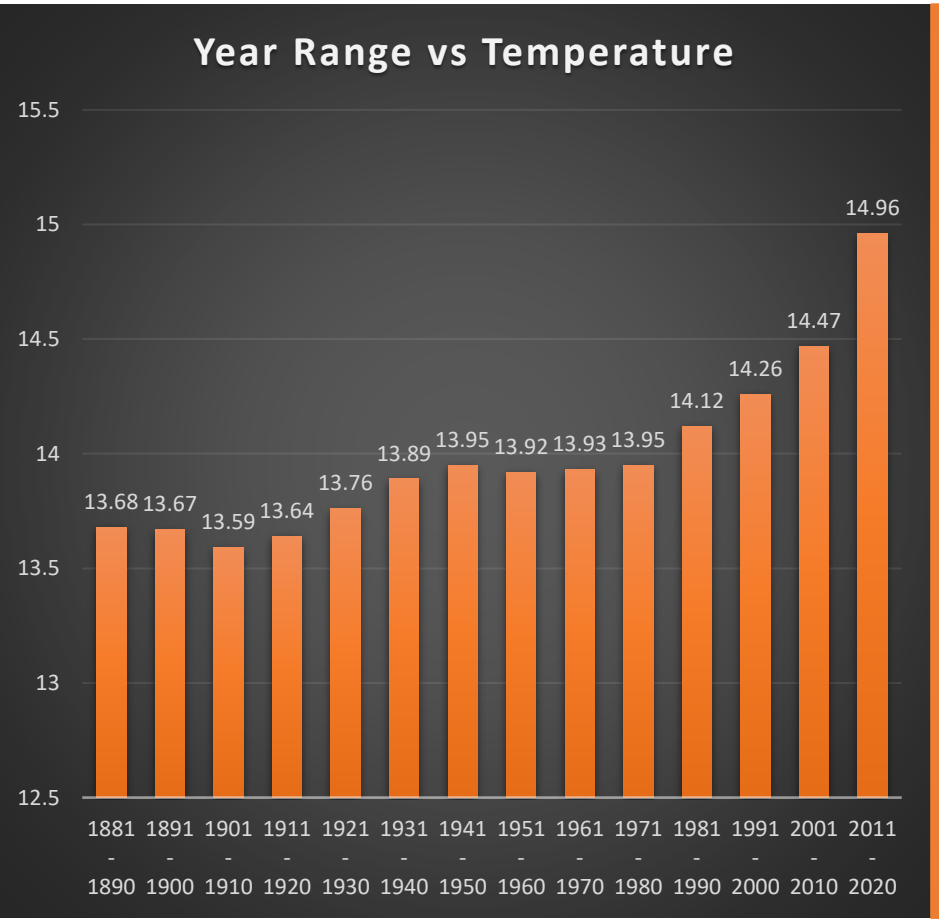
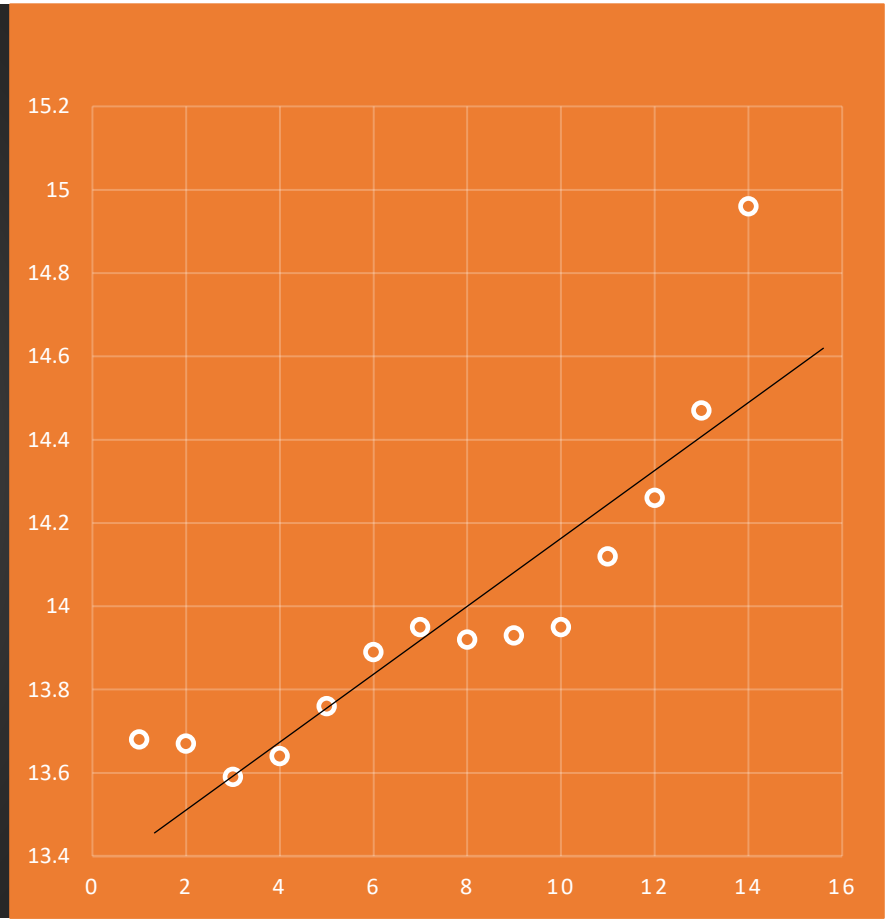
Impact of Global warming : Graphs!!!





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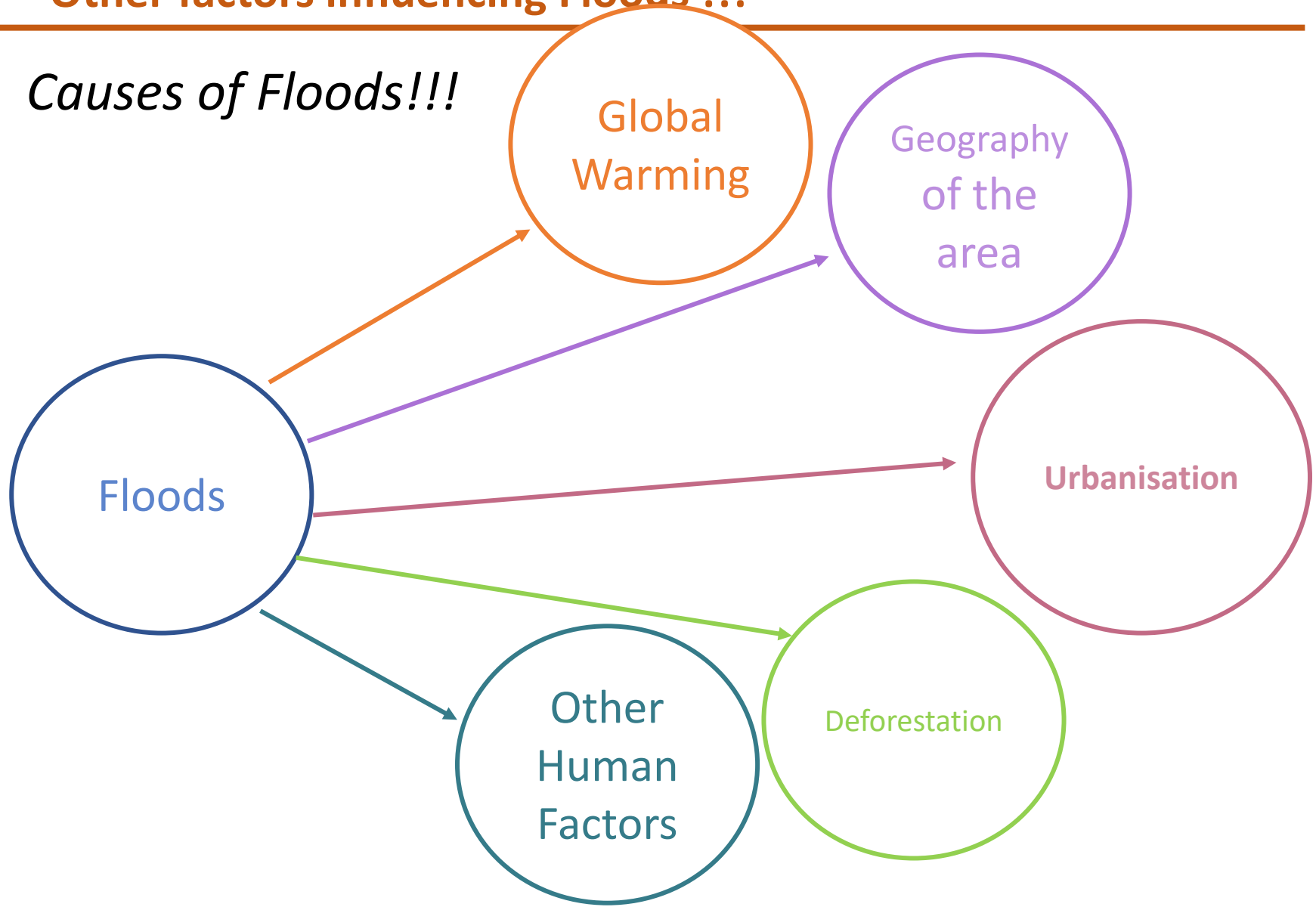
Other factors influencing Floods !!!

Causes of Floods!!!



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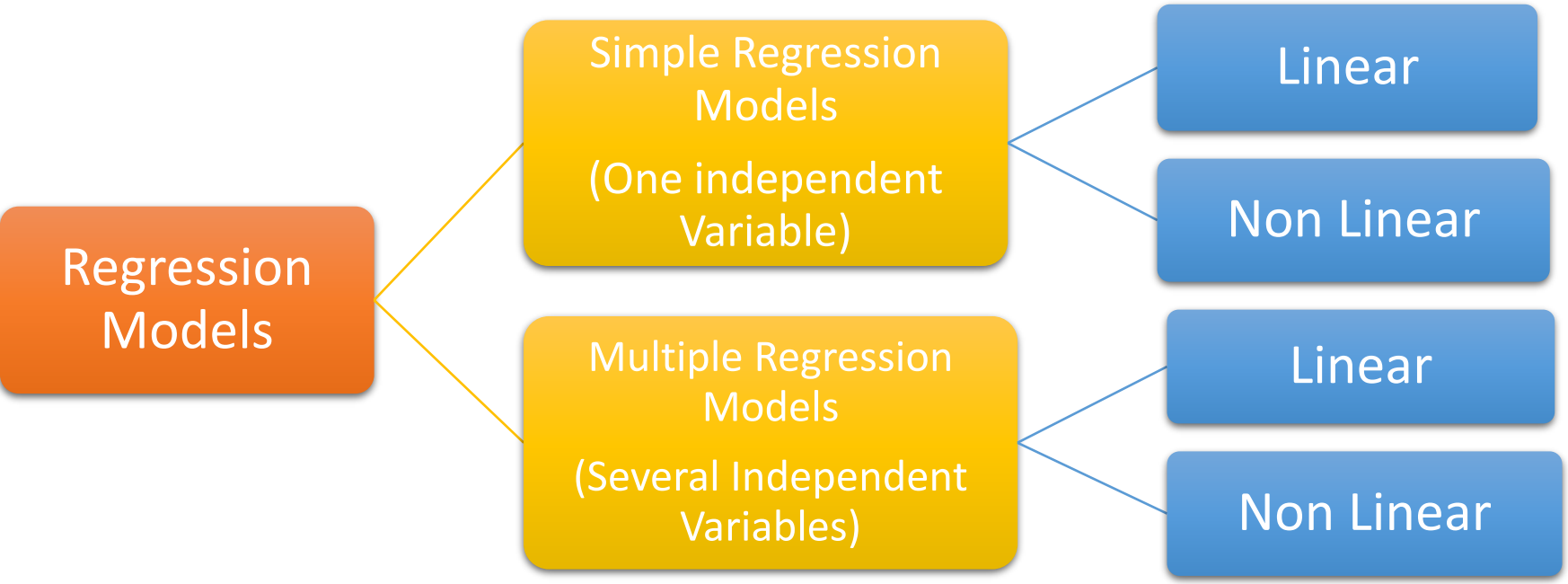
Regression Analysis

- In statistical modeling, **regression analysis** is a set of statistical processes for estimating the relationships between a dependent variable and one or more independent variables
- It is a way of mathematically sorting out which of those variables indeed have an impact
- Which factors matter most ?
- Which can we ignore ?
- How do the factors interact with each other?
- And most importantly, how certain are we about all these factors?

Regression Analysis – A Broad Classification



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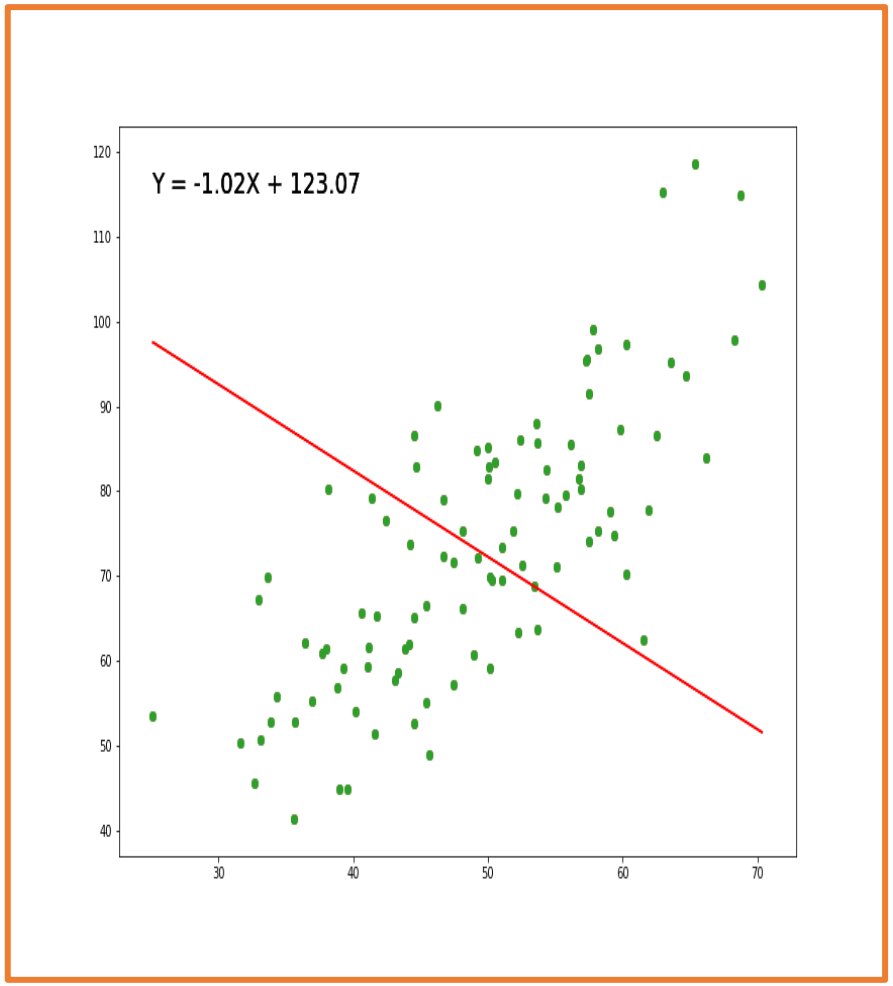
The Least – Squares Line

- When two variables have a linear relationship, the scatter plot tends to be clustered around a straight line.

- This line is referred to as the Least Squares Line.



Source : dphi.tech

The least squares line

- Consider the least square line given by,

$$y_i = \widehat{\beta_0} + \widehat{\beta_1} x_i$$

where

- $\widehat{\beta_1} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$
- $\widehat{\beta_0} = \bar{y} - \widehat{\beta_1}\bar{x}$

Example :

- The details pertaining to the no. of hours spent by students in preparing for an entrance exam and the marks scored (on a scale of (0 – 100) is provided in the following table.

Using these values,

i. Estimate the marks scored by a student who has spent 2.35 hours.

ii. Predict the marks that a student can score if he/she invests 20 hours.

SL No.	No. of hours spent	Marks Scored
1	6	82
2	10	88
3	2	56
4	4	64
5	6	77
6	7	92
7	0	23
8	1	41
9	8	80
10	5	59
11	3	47

Computing the least squares line

❖ *We need to first obtain the least square line which is given by,*

$$y = \widehat{\beta_0} + \widehat{\beta_1} x$$

- $\widehat{\beta_1} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$

- $\widehat{\beta_0} = \bar{y} - \widehat{\beta_1}\bar{x}$

$\bar{y}$ → mean of y

$\bar{x}$ → mean of x

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Example :

SL No.	No. of hours spent (x)	Marks Scored(y)	$x - \bar{x}$	$(x - \bar{x})^2$	$y - \bar{y}$	$(x - \bar{x})(y - \bar{y})$
1	6	82	1.27	1.6129	17.55	22.33
2	10	88	5.27	27.7729	23.55	124.15
3	2	56	-2.73	7.4529	-8.45	23.06
4	4	64	-0.73	0.5329	-0.45	0.33
5	6	77	1.27	1.6129	12.55	15.97
6	7	92	2.27	5.1529	27.55	62.60
7	0	23	-4.73	22.3729	-41.45	195.97
8	1	41	-3.73	13.9129	-23.45	87.42
9	8	80	3.37	11.3569	15.55	50.88
10	5	59	0.27	0.0729	-5.45	-1.49
11	3	47	-1.73	2.9929	-17.45	30.15
	$\bar{x} = 4.73$	$\bar{y} = 64.45$		94.8459		611.37

Example :

From the table we have,

$\bar{x} =$ 4·73 ; $\bar{y} =$ 64·45

- $\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) =$ 611·37
- $\sum_{i=1}^{n}(x_i - \bar{x})^2 =$ 94·8459
- $\widehat{\beta_1} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2} =$ $\frac{94·8459}{611·37} =$ 6·49
- $\widehat{\beta_0} = \bar{y} - \widehat{\beta_1}\bar{x} =$ 64·45 − (6·49)(4·73) = 30·18
- The equation of the least squares line is given by,

  $y_i = \widehat{\beta_0} + \widehat{\beta_1} x_i \Rightarrow$ $\Rightarrow$ $y =$ 30·18 + 6·49x

Example :

- The equation of the least squares line is given by,
  $y = 30.18 + 6.49x$

i. To estimate the marks scored by a student who has spent 2.35 hours.

$y = 30.18 + (6.49)(2.35) = 45.43$

ii. To predict the marks that a student can score if he/she invests 20 hours.

$y = 30.18 + (6.49)(20) = 160$

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THANK YOU

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