Linear Regression:-

1) $X = [2,3,4,5,6]$

$Y = [12.8978, 17.7586, 23.3192, 28.3129, 32.1351]$

X	Y	X^2	XY
2	12.8978	4	25.7956
3	17.7586	9	53.2758
4	23.3192	16	93.2768
5	28.3129	25	141.5645
6	32.1351	36	192.8106
$\Sigma x = 20$	$\Sigma y = 114.4236$	$\Sigma x^2 = 90$	$\Sigma xy = 506.7233$
$\bar{x} = 4$	$\bar{y} = 22.8847$		

$$a = \frac{n\Sigma xy - (\Sigma x \Sigma y)}{n\Sigma x^2 - (\Sigma x)^2} = \frac{5(506.7233) - (20 \times 114.423}{5(90) - (20)^2}$$

$$\boxed{a = 4.902}$$

$$b = \bar{y} - a\bar{x} = 22.8847 - (4.902 \times 4)$$

$$\boxed{b = 3.276}$$

∴ The equation of straight line $y = ax + b$ is $\boxed{y = 4.902x + 3.276}$

X	actual y	predicted $\hat{y}$	$(\hat{y}-y)^2$	$(y-\bar{y})^2$
2	12·8978	13·080	0·0332	99·7386
3	17·7586	17·982	0·0499	26·2771
4	23·3192	22·884	0·1894	0·1888
5	28·3129	27·786	0·2776	29·4651
6	32·1351	32·688	0·3057	85·5695
			$\Sigma(\hat{y}-y)^2 =$	$\Sigma(y-\bar{y})^2 =$
			0·8558	241·2391

$$R^2 = 1 - \frac{\text{Sum Squared Regression Error}}{\text{sum Squared Total Error}}$$

$$= 1 - \frac{SSR}{SST}$$

$$= 1 - \frac{\Sigma(\hat{y}-y)^2}{\Sigma(y-\bar{y})^2}$$

$$= 1 - \frac{0·8558}{241·2391}$$

$$= 0·996$$

$\therefore R^2 = 99·6\%$

Sunday 20

$$\text{Adj } R^2 = 1 - \frac{(1-R^2)(n-1)}{n-p-1}$$

$$= 1 - \frac{(1-0·996)(5-1)}{5-1-1}$$

$$= 0·995$$

$\therefore \text{Adj } R^2 = 99·5\%$

October 2019

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

- Charlie Chaplin

X	y	$\hat{y}$	$\lvert\hat{y}-y\rvert$
2	12.8978	13.080	0.1822
3	17.7586	17.982	0.2234
4	23.3192	22.884	0.4352
5	28.3129	27.786	0.5269
6	32.1351	32.688	0.5529

$$\Sigma|\hat{y}-y| = 1.92$$

Mean absolute error $MAE = \frac{\Sigma|\hat{y}-y|}{n}$

$$= \frac{1.92}{5}$$

$$\boxed{MAE = 0.384}$$

Mean Squared error $MSE = \frac{\Sigma(\hat{y}-y)^2}{n}$

$$= \frac{0.8558}{5}$$

$$\boxed{MSE = 0.1711}$$

Root Mean Squared error $RMSE = \sqrt{MSE}$

$$= \sqrt{\frac{\Sigma(\hat{y}-y)^2}{n}}$$

$$= \sqrt{0.1711}$$

$$\boxed{RMSE = 0.4137}$$

X	$X-\bar{X}$	$(X-\bar{X})^2$
2	-2	4
3	-1	1
4	0	0
5	1	1
6	2	4

$$\Sigma(X-\bar{X})^2 = 10$$

Residual : $\hat{\sigma}^2 = MSE = \dfrac{\sum_{i=1}^{n} \gamma_i^2}{n-p-1}$

$$= \frac{\sum_{i=1}^{n} (\hat{y}-y)^2}{n-p-1}$$

$$= \frac{0.8558}{5-1-1}$$

$$\boxed{\hat{\sigma}^2 = 0.285}$$

Standard error of x $SE(X) = \sqrt{\dfrac{\hat{\sigma}^2}{S_{xx}}}$

$$SE(X) = \sqrt{\frac{\hat{\sigma}^2}{\Sigma(X-\bar{X})^2}}$$

$$= \sqrt{\frac{0.285}{10}}$$

$$\boxed{SE(X) = 0.169}$$

October 2019

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Let him who would enjoy a good future waste none of his present

• Standard error of Intercept

$$SE(b) = \sqrt{\hat{\sigma}^2 \left[\frac{1}{n} + \frac{\bar{x}^2}{S_{xx}}\right]}$$

$$= \sqrt{0.285 \left[\frac{1}{5} + \frac{4^2}{10}\right]}$$

$$\boxed{SE(b) = 0.717}$$

t-value of X $t_x = \frac{a}{SE(x)} = \frac{4.902}{0.169}$

$$\boxed{t_x = 29.011}$$

t-value of Intercept $t_b = \frac{b}{SE(b)} = \frac{3.275}{0.717}$

$$\boxed{t_b = 4.565}$$

calculating p-value using python

```
from scipy.stats import t
t.sf(abs(t-statisc_value, df) * 2
```

p-value for intercept:-

```
t.sf(abs(4.565, 5-1-1) *2 = 0.02
```

p-value for x:-

```
t.sf(abs(29.011, 5-1-1) *2 = 0.0
```

t critical value $t_{\alpha/2, df} = t_{0.025, 3} = 3.182$

t.ppf (1 − 0.025, 3) = 3.182

Confidence interval for x

$CI(x) = a \pm t_{crit}(SE(x))$

$= 4.902 \pm 3.182 \times 0.169$

$= [4.365, 5.440]$

Confidence Interval for Intercept

$CI(b) = b \pm t_{crit}(SE(b))$

$= 3.276 \pm 3.182 \times 0.717$

$= [0.993, 5.554]$

Regression Results:-

R-Squared = 0.996

Adj-R-Squared = 0.995

	coef	stderr	t	P>|t|	CI
Intercept	3.276	0.717	4.565	0.02	[0.993, 5.554]
x	4.902	0.169	29.011	0	[4.365, 5.440]

New Moon Sunday 27

October 2019

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If we have no peace, it is because we have