IWM2017502

ASSIGNMENT-2

KUMAR RAJU BANDI

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3) ~~X~~ Let X be year
and Y be Revenue in billion rupees.

Therefore, the given data is:

X	2004	2008	2009	2010	2011	2012	2013	2014
Y	61.2	58.3	67.1	69.2	68.9	83.5	89.1	80

2015	2016	2017
92.3	93	97

Equation of line $\Rightarrow$ $y = mx + b$

$n = 11$

$\Sigma xy = 1729766.8$

$\Sigma x = 22129$

$\Sigma y = 859.59$

$\Sigma x^2 = 44517661$

$\Sigma y^2 = 69070.94$

$$m = \frac{n \times \Sigma xy - \Sigma x \times \Sigma y}{n \Sigma x^2 - (\Sigma x)^2}$$

$$= \frac{11 \times 1729766.8 - 22129 \times 859.59}{11 \times 44517661 - 22129 \times 22129}$$

$$\boxed{m = 3.28}$$

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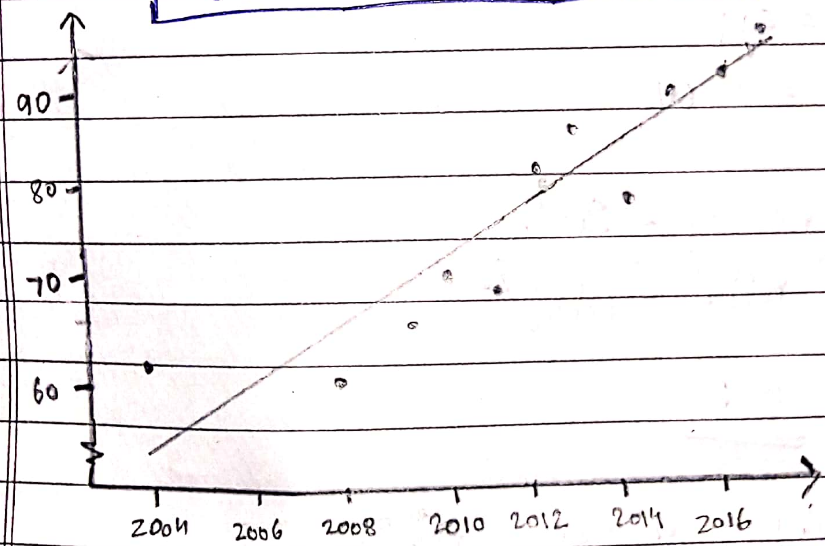
$$c = \frac{\Sigma_i y - m \times \Sigma_i x}{n}$$

$$= \frac{859.59 - 3.28 \times 22129}{11}$$

$$= -6520.32.$$

Thus,
Least square fitting line =>

a) $\boxed{y = 3.28x - 6520.32}$



b) $y = 3.28x - 6520.32$

As, $x = 2019$

$y = 3.28 \times 2019 - 6520.32$

≈ 102.1

c) Expected error $= \frac{\Sigma_i^n |y - \hat{y}|}{n}$

$= 3.383$

4) a) X as independent $\Rightarrow$ variable = x.

$\Sigma_i xy = 66045$

$\Sigma_i x^2 = 64722$

$\Sigma_i x = \cancel{729}\ 798$

$\Sigma_i y = 819$

$\Sigma_i y^2 = 67675$

$$w_0 = \frac{n \times \Sigma_i xy - \Sigma_i x \Sigma_i y}{n \Sigma_i x^2 - (\Sigma_i x)^2}$$

$$= \underline{\underline{0.66}}$$

$$w_1 = \frac{\Sigma_i y - w_0 \times \Sigma_i x}{n}$$

$$= \frac{819 - 0.66 \times 798}{10}$$

$$= 29.129$$

Therefore, $y = w_0 x + w_1$

$$\boxed{y = 0.66x + 29.12}$$

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b) Y as independent, let variable => x.

$\Sigma_i xy = 66045$

$\Sigma_i x^2 = 67675$

$\Sigma_i y^2 = 64722$

$\Sigma_i x = 819$

$\Sigma_i y = 798$

$$w_0 = \frac{n\Sigma_i xy - \Sigma_i x \Sigma_i y}{n\Sigma_i x^2 - (\Sigma_i x)^2}$$

$$= 1.15$$

$$w_1 = \frac{\Sigma_i y - w_0 \times \Sigma_i x}{n}$$

$$= -14.39$$

$$y = w_0 x + w_1$$

$$\boxed{y = 1.15x - 14.39}$$

~~Here, x → ML HR and y →~~

Here, $x \to$ HUR and $y \to$ ML.

c) $x_{ML} = 96$

$$y_{(HUR)} = 0.66x + 29.12$$
$$= 92.6$$

d) $x_{HUR} = 95$

$$y_{ML} = 1.15x - 14.39$$
$$= 94.9$$

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e) After plotting the two fitting lines, it is observed that the line with ML as independent variable ($y = 0.66x + 29.1$) is close to the inverse equation of the line with HUR as independent variable ($y = 1.15x - 14.39$).

5) $PV^{\gamma} = c$

Taking log on both sides

$$\log(PV^{\gamma}) = \log c$$

$$\log P + \log V^{\gamma} = \log c$$

$$\log P + \gamma \log V = \log c.$$

Let $y \rightarrow \log P$ and $x \rightarrow \log\left(\frac{1}{V}\right)$

Thus,

$$\cancel{\log}\ y - \gamma x = \log c$$

$$y = \gamma x + \log c$$

The above equation is equivalent to linear regression line with $W_0 = \gamma$ and $W_1 = \log c$.

a) From the given data,

$\Sigma_i xy = -89.35$
$\Sigma_i x^2 = 121.97$
$\Sigma_i y^2 = 70.56$
$\Sigma_i x = -26.93$
$\Sigma_i y = 20.25$

Thus, $$W_0 = \frac{n\Sigma_i xy - \Sigma_i x \Sigma_i y}{n\Sigma_i x^2 - (\Sigma_i x)^2}$$

$$\gamma = \underline{\underline{1.4}}$$

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$$\log c = w_1 = \frac{\sum_i y - w_0 \sum_i x}{n}$$

$$= 9.67$$

logc=9.
0

b) From above calculations,

$$\log P = \gamma \log\left(\frac{1}{V}\right) + \log C$$

$$\log P = \cancel{9} \; 1.4 \log\left(\frac{1}{V}\right) + 9.67$$

Thus, $\boxed{PV^{1.4} = e^{9.67}}$

c) $V = 100$

$\cancel{\log\left(\frac{1}{V}\right)}$

$$\log P = \gamma \log\left(\frac{1}{V}\right) + \log C$$

$$\log P = 1.4 \log\left(\frac{1}{100}\right) + 9.67$$

$$\boxed{P = 24.8}$$

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6) $y = w_0 + w_1 x + w_2 x^2$

X	0	1	2	3	4	5	6
Y	2.4	2.1	3.2	5.6	9.3	14.6	21.9.

$n = 7$

$\Sigma_i x = 21$

$\Sigma_i x^2 = 91$

$\Sigma_i x^3 = 441$

$\Sigma_i x^4 = 2275$

$\Sigma_i y = 59.1$

$\Sigma_i xy = 266.9$

$\Sigma_i x^2 y = 1367.5$

$$\begin{bmatrix} n & x & x^2 \\ x & x^2 & x^3 \\ x^2 & x^3 & x^4 \end{bmatrix} \begin{bmatrix} w_0 \\ w_1 \\ w_2 \end{bmatrix} = \begin{bmatrix} y \\ xy \\ x^2 y \end{bmatrix}$$

$$\begin{bmatrix} w_0 \\ w_1 \\ w_2 \end{bmatrix} = \begin{bmatrix} n & x & x^2 \\ x & x^2 & x^3 \\ x^2 & x^3 & x^4 \end{bmatrix}^{-1} \begin{bmatrix} y \\ xy \\ x^2 y \end{bmatrix}$$

$$\begin{bmatrix} w_0 \\ w_1 \\ w_2 \end{bmatrix} = \begin{bmatrix} 7 & 21 & 91 \\ 21 & 91 & 441 \\ 91 & 441 & 2275 \end{bmatrix}_{3\times3} \begin{bmatrix} 59.1 \\ 266.9 \\ 1367.5 \end{bmatrix}_{3\times1}$$

$$\begin{bmatrix} w_0 \\ w_1 \\ w_2 \end{bmatrix} = \begin{bmatrix} 2.5 \\ -1.2 \\ 0.73 \end{bmatrix}$$

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Thus,

$$\boxed{\begin{aligned} W_0 &= 2.5 \\ W_1 &= -1.2 \\ W_2 &= 0.73 \end{aligned}}$$

$\therefore$ Equation of curve $= W_0 + W_1 x + W_2 x^2$

$$\boxed{y = 2.5 - 1.2x + 0.73x^2}$$