Q.1]

Eqn of Regression Line : $Y = a + bX$

To get Reg. line, we use 2 eqn

$$\Sigma y = na + b\Sigma x$$ ← total data points / observations

$$\Sigma xy = a\Sigma x + b\Sigma x^2$$

 # NOTE : Price is taken as X (independent variable) & Demand is taken as Y because demand depends on price, but vice-versa is not true

X	Y	x y	x^2
100	20	2000	10000
150	18	2700	22500
200	15	3000	40,000
300	12	3600	90,000
400	9	3600	160,000
500	5	2500	250,000
600	2	1200	360,000
Σ 2250	81	18600	932500

n=7

So, eqn becomes

$$81 = 7a + b\,2250$$

$$18600 = 2250a + 932500\,b$$

Using @ Crammer's Rule

$$D = \begin{vmatrix} 7 & 2250 \\ 2250 & 932500 \end{vmatrix}$$

$$= 6527500 - 5062500$$

$$= 1,465,000$$

NOTE

$$a = \begin{vmatrix} 81 & 2250 \\ 18600 & 932500 \end{vmatrix}$$

$$\overline{\qquad\qquad D \qquad\qquad}$$

$$= \frac{33,682,500}{1,465,000} = 22.991$$

$$b = \begin{vmatrix} 7 & 81 \\ 2250 & 18600 \end{vmatrix}$$

$$\overline{\qquad\qquad D \qquad\qquad}$$

$$= \frac{-52,050}{1,465,000} = -0.0355$$

Regression line

$$Y = 22.991 + (-0.0355)X$$

Q2] Income in independent, but consumption depends on Income. So income is X.

$n = 7$

X	Y	XY	X^2	$\hat{Y}$	$|\hat{Y} - \bar{Y}|^2$	$|Y - \bar{Y}|^2$
260	150	39000	67600	158.01	2444.3	1716.4
80	70	5600	6400	64.41	1950.1	1487.6
240	155	37200	57600	147.61	1524.12	2155.7
100	65	6500	10000	74.81	1139.73	1898.3
160	110	17600	25600	106.01	6.55	2.04
180	115	20700	32400	116.41	61.46	41.34
140	95	13300	19600	95.61	167.96	184.14
$\Sigma=$ 1160	760	139900	219200		7294.22	8085.52

$$\bar{Y} = \frac{760}{7} = 108.57$$

eqn to calc. regression line $(Y = 22.81 + 0.52x)$

$$\Sigma y = na + b\Sigma x \rightarrow 760 = 7a + 1160b$$
$$\Sigma xy = a\Sigma x + b\Sigma x^2 \rightarrow 139900 = 1160a + 219200$$

$$D = \begin{vmatrix} 7 & 1160 \\ 1160 & 219200 \end{vmatrix} = \cancel{-0000000000000} \; 188,800$$

$$a = \frac{\begin{vmatrix} 760 & 1160 \\ 139900 & 219200 \end{vmatrix}}{D} = \frac{4,308,000}{188,800} = 22.817$$

$$b = \frac{\begin{vmatrix} 7 & 760 \\ 1160 & 139900 \end{vmatrix}}{D} = \frac{97700}{188,800} = 0.517$$

So, Regression line is

$$Y = 22.81 + 0.52X$$

Coefficient of Determination $= R^2 = \dfrac{\Sigma(\hat{Y}-\bar{Y})^2}{\Sigma(Y-\bar{Y})^2}$

$$= \frac{7294.22}{8085.52} = 0.9021$$

Regression line eqⁿ's

$$\Sigma y = na + b\Sigma x \longrightarrow 70 = 10a + 130b$$
$$\Sigma xy = a\Sigma x + b\Sigma x^2 \longrightarrow 949 = 130a + 1818b$$

$$D = \begin{vmatrix} 10 & 130 \\ 130 & 1818 \end{vmatrix} = 1280$$

$$a = \begin{vmatrix} 70 & 130 \\ 949 & 1818 \end{vmatrix} \div D = 3890 \div 1280 = 3.039 \approx 3.04$$

$$b = \begin{vmatrix} 10 & 70 \\ 130 & 949 \end{vmatrix} \div D = 390 \div 1280 = 0.304$$

eqⁿ $Y = 3.04 + 0.304X$

$$S_b = \sqrt{\frac{\Sigma (Y-\hat{Y})^2}{(n-k-1)\Sigma(x-\bar{x})^2}}$$

$$= \sqrt{\frac{27\cdot 84}{(10-1-1)\ 128}} = \underline{0\cdot 16339}$$

$$t = \frac{b}{S_b} = \frac{0\cdot 304}{0\cdot 163} = \underline{\underline{1\cdot 8650}}$$

$$\underset{1\cdot 865}{\overset{tcal}{}} < \underset{2\cdot 306}{\overset{t_{table}}{}} \Big\} \text{So, relation is not significant}$$

→ Confidence interval

$$b \pm 2\cdot 306\ (S_b)$$

$$0\cdot 304 \pm 2\cdot 306\ (0\cdot 163)$$

$$0\cdot 304 \pm 0\cdot 375$$

$$[-0\cdot 071 - 0\cdot 679]$$

As zero lies b/w the interval there is no significant relation b/w n & y.