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Chapter - Correlation

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chapter-10 Correlation

Degree of Correlation	Positive	Negative
Perfect	1	-1
High	0.75 to 0.99	0.75 to 0.99
Moderate	0.25 to 0.75	0.25 to 0.75
Low	0 to 0.25	0 to 0.25
Absence	0	0

Methods of Correlation.

1) Karl pearson's coefficient of Correlation Method.
2) Spearman's Rank Difference Method.
3) Concurrent Deviation Method.
4) Least Square Method.

1. Karlpearson's Coefficient of Correlation Method

(A) Direct Method.

$$r = \frac{\Sigma dxdy}{N \cdot \sigma_x \cdot \sigma_y} \quad \text{or} \quad \frac{\Sigma dxdy}{N\sqrt{\frac{\Sigma dx^2}{N}} \times \sqrt{\frac{\Sigma dy^2}{N}}}$$

$$\text{or} \quad \frac{\Sigma dxdy}{N \cdot \frac{\sqrt{\Sigma dx^2}}{\sqrt{N}} \cdot \frac{\sqrt{\Sigma dy^2}}{\sqrt{N}}} \quad \text{or} \quad \frac{\Sigma dxdy}{\sqrt{\Sigma dx^2 \cdot \Sigma dy^2}}$$

(B) Indirect Method

$$r = \frac{\Sigma dxdy - N \times \frac{\Sigma dx}{N} \times \frac{\Sigma dy}{N}}{N \cdot \sqrt{\left[\frac{\Sigma dx^2}{N} - \left(\frac{\Sigma dx}{N}\right)^2\right]\left[\frac{\Sigma dy^2}{N} - \left(\frac{\Sigma dy}{N}\right)^2\right]}}$$

or

$$\frac{\Sigma dxdy \cdot N - (\Sigma dx \cdot \Sigma dy)}{\sqrt{[\Sigma dx^2 \cdot N - (\Sigma dx)^2][\Sigma dy^2 \cdot N - (\Sigma dy)^2]}}$$

Direct Method

Ex:-

X	dx (A=30)	dx^2	Y	dy (A=25)	dy^2	$dx\,dy$
23	-7	49	18	-7	49	49
27	-3	9	20	-5	25	15
28	-2	4	22	-3	9	6
28	-2	4	27	2	4	-4
29	-1	1	21	-4	16	4
30	0	0	29	4	16	0
31	1	1	27	2	4	2
33	3	9	29	4	16	12
35	5	25	28	3	9	15
36	6	36	29	4	16	24
300	0	138	250	0	164	123

$$\bar{X} = \frac{\Sigma x}{N}$$

$$= \frac{300}{10} = 30$$

$$\bar{Y} = \frac{\Sigma y}{N}$$

$$= \frac{250}{10} = 25$$

$$r = \frac{\Sigma dx\,dy}{\sqrt{\Sigma dx^2 \times \Sigma dy^2}}$$

$$= \frac{123}{\sqrt{138 \times 164}}$$

$$= \frac{123}{150.43}$$

$$= +0.82$$

It indicates of high degree in positive correlation

Indirect Method

X	$dx = A-28$	dx^2	Y	$dy = B-29$	dy^2	$dx \times dy$
23	-5	25	18	-11	121	55
27	-1	1	20	-9	81	9
28	0	0	22	-7	49	0
28	0	0	27	-2	4	0
29	1	1	21	-8	64	-8
30	2	4	29	0	0	0
31	3	9	27	-2	4	-6
33	5	25	29	0	0	0
35	7	49	28	-1	1	-7
36	8	64	29	0	0	0
	20	178		-40	324	43

$$r = \frac{\Sigma dxdy - N \times \frac{\Sigma dx}{N} \times \frac{\Sigma dy}{N}}{N \cdot \sqrt{\left[\frac{\Sigma dx^2}{N} - \left(\frac{\Sigma dx}{N}\right)^2\right]\left[\frac{\Sigma dy^2}{N} - \left(\frac{\Sigma dy}{N}\right)^2\right]}}$$

$$= 43 - 10 \times \frac{20}{10} \times \left(-\frac{40}{10}\right)$$

$$10 \cdot \sqrt{\left[\frac{178}{10} - \left(\frac{20}{10}\right)^2\right] \times \left[\frac{324}{10} - \left(\frac{-40}{10}\right)^2\right]}$$

$$= \frac{43 + 80}{10\sqrt{[17.8 - 4] \times [32.4 - 16]}}$$

$$= \frac{123}{10\sqrt{13.8 \times 16.4}} \Rightarrow \frac{123}{10 \times 15.04}$$

$$= \frac{123}{150.4}$$

$$= +0.82$$

It indicates of high degree in positive correlation.

Ans.

Karl Pearson's Method

When Deviations taken from Actual Arithmetic Means

1. Calculate the coefficient of correlation from the following data :

X :	12	9	8	10	11	13	7
Y :	14	8	6	9	11	12	3

Ans. $\bar{X} = 10$, $\bar{Y} = 9$, $r = +0.948$

2. Calculate Karl Pearson's coefficient of correlation between X and Y :

X :	45	70	65	30	90	40	50	75	85	60
Y :	35	90	70	40	95	40	60	80	80	50

(B.Com., Meerut 1995)

Ans. $r = +0.903$

Hint : $\bar{x} = 61$, $\bar{y} = 64$

3. Calculate coefficient of correlation between expenditure and sales of following 10 firms :

Firms	:	1	2	3	4	5	6	7	8	9	10
Expenditure	:	11	13	14	16	16	15	15	14	13	13
Sales	:	50	50	55	60	65	65	65	60	60	50

(B.Com., Jabalpur 1991, 94)

Ans. $r = +0.7866$; $\bar{x} = 14$, $\bar{y} = 58$

4. From the following data related to overhead and production cost, calculate the coefficient of correlation by the method of Karl Pearson :

Overheads (Rs. '000) :	80	90	100	110	120	130	140	150	160
Cost (Rs. '000) :	15	15	16	19	17	18	16	18	19

Ans. $r = +0.693$; $\bar{x} = 120$, $\bar{y} = 17$

5. Find Karl Pearson's coefficient of correlation from the following figures of heights of fathers and sons :

Height of Fathers (inches) :	64	65	66	67	68	69	70
Height of sons (inches) :	66	67	65	68	70	68	72

Ans. $\bar{x} = 67$, $\bar{y} = 68$, $r = +0.81$

When ... variable are unknown

... from the actual