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Correlation

Question 18:

Calculate the correlation coefficient between the heights of fathers in inches (X) and their sons (Y)

X	65	66	57	67	68	69	70	72
Y	67	56	65	68	72	72	69	71

ANSWER:

X	Y	XY	X²	Y²
65	67	4355	4225	4489
66	56	3696	4356	3136
57	65	3705	3249	4225
67	68	4556	4489	4624
68	72	4896	4624	5184
69	72	4968	4761	5184
70	69	4830	4900	4761
72	71	5112	5184	5041
$\sum X = 534$	$\sum Y = 540$	$\sum XY = 36118$	$\sum X^2 = 35788$	$\sum Y^2 = 36644$

$$r = \dfrac{\sum XY - \dfrac{(\sum X)(\sum Y)}{N}}{\sqrt{\sum X^2 - \dfrac{(\sum X)^2}{N}}\sqrt{\sum Y^2 - \dfrac{(\sum Y)^2}{N}}}$$

$$= \dfrac{36118 - \dfrac{534 \times 540}{8}}{\sqrt{35788 - \dfrac{(534)^2}{8}}\sqrt{36644 - \dfrac{(540)^2}{8}}}$$

$$= \dfrac{36118 - \dfrac{288360}{8}}{\sqrt{35788 - \dfrac{285156}{8}}\sqrt{36644 - \dfrac{291600}{8}}}$$

$$= \dfrac{36118 - 36045}{\sqrt{35788 - 35644.5}\sqrt{36644 - 36450}}$$

$$= \dfrac{73}{\sqrt{143.5}\sqrt{194}}$$

$$= \dfrac{73}{11.98 \times 13.93}$$

$$= \dfrac{73}{166.88}$$

$$= 0.44$$

Note: As per textbook, correlation coefficient is 0.603. However, as per the above solution, correlation coefficient should be 0.44.

Question 19:

Calculate the correlation coefficient between X and Y and comment on their relationship:

X	−3	−2	−1	1	2	3
Y	9	4	1	1	4	9

ANSWER:

X	Y	XY	X²	Y²
−3	9	−27	9	81
−2	4	−8	4	16
−1	1	−1	1	1
1	1	1	1	1
2	4	8	4	16
3	9	27	9	81
$\sum X = 0$	$\sum Y = 28$	$\sum XY = 0$	$\sum X^2 = 28$	$\sum Y^2 = 196$

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sqrt{\sum X^2 - \frac{(\sum X)^2}{N}} \sqrt{\sum Y^2 - \frac{(\sum Y)^2}{N}}}$$

$$= \frac{0 - \frac{0 \times 28}{6}}{\sqrt{28 - \frac{(28)^2}{6}} \sqrt{196 - \frac{(196)^2}{6}}}$$

$$= \frac{0}{\sqrt{28 - \frac{(28)^2}{6}} \sqrt{196 - \frac{(196)^2}{6}}}$$

$r = 0$

As the value of r is zero, so there is no linear correlation between X and Y