Correlation

Standard difficulty · 20 questions · 40 marks · Time: 38 minutes

Name: _____ Date: _____ Score: ____ / 40

Write full answers in Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. When two variables move in the same direction, the correlation is:
(a) zero **(b)** undefined **(c)** negative **(d)** positive

2. Which pair of variables has positive correlation?
(a) height and weight of children
(b) a student's roll number and height
(c) the day of the month a person was born and their weight
(d) shoe size and marks in economics

3. What does r = −1 show?
(a) low positive correlation **(b)** low negative correlation
(c) perfect positive correlation **(d)** perfect negative correlation

4. For 8 pairs of ranks, $\Sigma d^2 = 92$. Find Spearman's rank correlation coefficient.
(a) −0.10 **(b)** −7.76 **(c)** 1.10 **(d)** 0.00

5. Which of these can NOT be a value of the correlation coefficient r?
(a) 0.8 **(b)** 0.35 **(c)** −3 **(d)** −1

6. The covariance of X and Y is −27, the standard deviation of X is 6 and of Y is 9. Find r.
(a) −1 **(b)** 0.5 **(c)** −0.5 **(d)** −1.8

7. Ranks of 6 students in two subjects: Economics 1, 2, 3, 4, 5, 6; Maths 5, 3, 2, 1, 6, 4. Find Σd^2.
(a) 64 **(b)** 34 **(c)** 12 **(d)** 32

8. From deviations about the means, $\Sigma xy = 97$, $\Sigma x^2 = 144$ and $\Sigma y^2 = 256$. Find Karl Pearson's coefficient of correlation.
(a) −0.51 **(b)** 0.51 **(c)** 0.24 **(d)** 0.67

Section B — Short answer — 8 × 2 = 16 marks

9. What is correlation?

10. Two judges rank 6 contestants. Judge A: 1, 2, 3, 4, 5, 6. Judge B: 4, 6, 3, 5, 1, 2. Find Spearman's rank correlation coefficient.

11. Find Karl Pearson's coefficient of correlation for X: 17, 6, 17, 9, 6 and Y: 94, 61, 95, 67, 63 (to two decimal places).

12. Is the correlation positive, negative, or is there no correlation? (a) the speed of a car and the time to cover a fixed distance (b) the number of letters in a name and monthly income

13. Explain each term: (a) spurious correlation (b) linear relationship

14. The covariance of two variables is 66, and their standard deviations are 12 and 10. Find r and say what kind of correlation it shows.

15. Marks of five students in Economics: 91, 96, 65, 67, 52; in Statistics: 58, 93, 57, 40, 42. Rank each (highest = 1), then find Spearman's rank correlation.

16. Given $\Sigma xy = 23$, $\Sigma x^2 = 162$ and $\Sigma y^2 = 162$ (deviations from the means), find r and describe the correlation.

Section C — Longer answers — 4 × 4 = 16 marks

17. Explain the scatter diagram with different patterns.

18. For X: 8, 10, 17, 16, 19 and Y: 50, 54, 53, 56, 62: (a) find the means of X and Y (b) find Σxy, Σx^2 and Σy^2 using deviations from the means (c) find r to two decimal places (d) describe the correlation.

19. Two judges rank 7 entries in a contest. Judge A: 1, 2, 3, 4, 5, 6, 7. Judge B: 5, 6, 2, 3, 4, 1, 7. (a) Find each d and Σd^2. (b) Find Spearman's coefficient. (c) Do the judges broadly agree?

20. Say what kind of correlation you expect, and draw a rough scatter diagram for each: (a) the speed of a car and the time to cover a fixed distance (b) a student's roll number and height. Why does a high r not prove that one causes the other?

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Answer key

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Q	Answer	Working
1	**(d) positive**	—
2	**(a) height and weight of children**	—
3	**(d) perfect negative correlation**	—
4	**(a) −0.10**	rs = 1 − 6 × 92 ÷ (8^3 − 8) = 1 − 552 ÷ 504
5	**(c) −3**	—
6	**(c) −0.5**	r = −27 ÷ (6 × 9)
7	**(d) 32**	d = −4, −1, 1, 3, −1, 2
8	**(b) 0.51**	r = 97 ÷ √(144 × 256) = 97 ÷ 192
9	**A measure of the direction and intensity of the linear relationship between two variables.**	—
10	**−0.66**	Σd^2 = 58; rs = 1 − 6 × 58 ÷ (6^3 − 6) = 1 − 348 ÷ 210
11	**0.99**	Σxy = 380, Σx^2 = 126, Σy^2 = 1160; r = Σxy ÷ √(Σx^2 × Σy^2)
12	**(a) negative (b) no correlation**	—
13	**(a) a chance correlation between unrelated variables (b) a relationship shown by a straight line**	—
14	**r = 0.55; positive correlation**	66 ÷ (12 × 10)
15	**ranks 2, 1, 4, 3, 5 and 2, 1, 3, 5, 4; rs = 0.7**	Σd^2 = 6; 1 − 6 × 6 ÷ 120
16	**r = 0.14; positive correlation**	√(162 × 162) = 162
17	**Points rising from left to right show positive correlation, falling show negative, a straight line shows perfect correlation, and a shapeless spread shows no correlation.**	—
18	**(a) 14, 55 (b) 65, 90, 80 (c) 0.77 (d) positive, high**	r = Σxy ÷ √(Σx^2 × Σy^2)
19	**(a) d = −4, −4, 1, 1, 1, 5, 0; Σd^2 = 60 (b) −0.07 (c) no, their rankings move in opposite directions**	rs = 1 − 6 × 60 ÷ (7^3 − 7) = 1 − 360 ÷ 336
20	**(a) negative (b) no correlation; the link may be by chance or due to a third factor.**	—

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