



ANSWER BOOK

Correlation coefficients: product moment and Spearman

Further Statistics 2 · Year FM

6 questions · 20 marks

NAVY EDITION

SECTION A · Warm-up

- A1** It measures the strength and direction of the linear association between two variables and always lies between -1 and 1 inclusive. Values at the ends mean the points lie exactly on a straight line, falling or rising; zero means no linear association, which is not the same as no relationship.
- A2** $r = 58 / \sqrt{(40 \times 86)} = 58 / \sqrt{3440} = 58 / 58.65 = 0.989$ to three decimal places. That is very strong positive linear correlation: the points lie almost exactly on a rising straight line.

SECTION B · Standard

- B1** Coding by a shift and a positive scale factor leaves r unchanged, because the scatter is only translated and stretched, so its straightness is untouched. The gradient does change: if the regression of v on u has gradient B , then $b = B \times (10/5) = 2B$, since y varies ten units for every one of v and x five for every one of u . A negative scale factor on exactly one variable would flip the sign of r .
- B2** The differences are 0, -1, 1, -1, 1, -1, 1, so $\sum d^2 = 0 + 1 + 1 + 1 + 1 + 1 + 1 = 6$. With $n = 7$, $n(n^2 - 1) = 7 \times 48 = 336$, so $r_s = 1 - 36/336 = 1 - 0.1071 = 0.893$. The two rankings agree closely.
- B3** Tied items share the average of the ranks they would have occupied, so two tying for third and fourth both take rank 3.5, and the next item takes rank 5. With $n = 6$, $n(n^2 - 1) = 6 \times 35 = 210$, so $r_s = 1 - 48/210 = 0.771$. With ties present the formula is an approximation; the product moment coefficient applied to the ranks is exact.

SECTION C · Stretch

- C1** $\sum x = 0$ and $\sum xy = -8 - 1 + 0 + 1 + 8 = 0$, so $S_{xy} = 0$ and therefore $r = 0$. Yet y is exactly x^2 , so the two variables determine each other completely. The coefficient measures linear association only, and a perfect symmetric parabola has none. It is the standard warning against reading r without a scatter diagram.