Interpreting Pearson's and Spearman's coefficients

Grade 8 | Worked solutions

GCSE Statistics topic practice

1 Ama collects data on 12 days at a beach cafe. She calculates Pearson's product moment correlation coefficient (PMCC) for three pairs of variables.

Variables	PMCC
Hours of sunshine and ice cream sales	0.92
Rainfall and ice cream sales	−0.71
Wind speed and ice cream sales	−0.08

a. Interpret the value 0.92 in context. (1)

b. Interpret the value −0.08 in context. (1)

c. Ama's brother works out the PMCC for temperature and ice cream sales. His answer is 1.3. Explain why his answer must be wrong. (1)

(3 marks)

a) 0.92 is close to 1

Strong positive correlation

On days with more sunshine, more ice creams tend to be sold

b) -0.08 is very close to 0

Almost no correlation between wind speed

and ice cream sales

c)

A correlation coefficient is always between -1 and 1

1.3 is greater than 1

a) strong positive b) almost none c) must be -1 to 1

2 Three judges, A, B and C, each rank the same 8 cakes in a baking competition. Spearman's rank correlation coefficient for judges A and B is 0.86. Spearman's rank correlation coefficient for judges A and C is −0.9

a. Interpret the value 0.86 in context. (1)

b. Interpret the value −0.9 in context. (1)

c. Is Spearman's rank correlation coefficient for judges B and C likely to be positive or negative? Give a reason for your answer. (2)

(4 marks)

a) 0.86 is close to 1

Strong positive correlation between the ranks

Judges A and B mostly agree on the order of the cakes

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

b) -0.9 is close to -1

Strong negative correlation between the ranks

Cakes ranked high by A tend to be ranked low by C

c)

Negative

B ranks the cakes in a similar order to A

C ranks them in nearly the opposite order to A

So B and C are likely to disagree

a) A and B agree b) A and C disagree c) negative

3 The scatter diagram shows the age, in years, and the value, in thousands of pounds, of 8 cars of the same model.

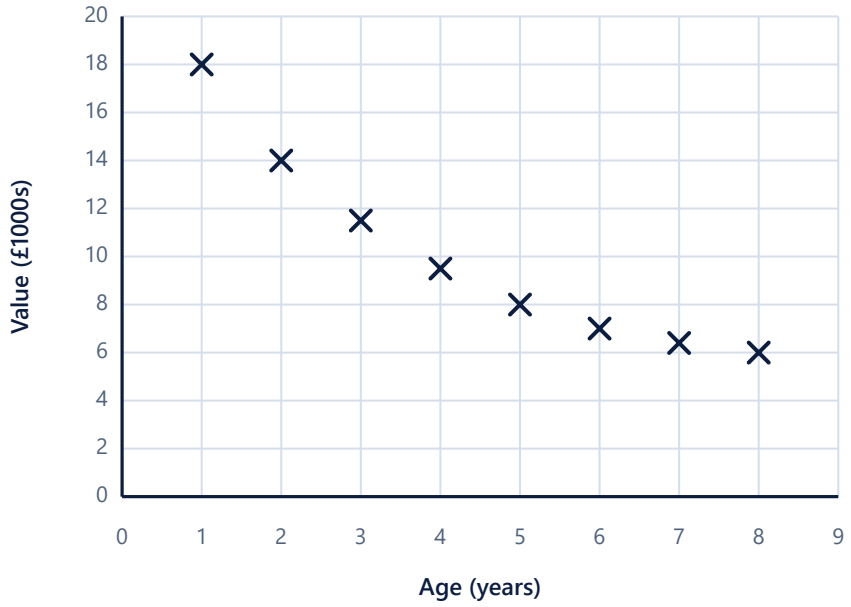
For these data, Spearman's rank correlation coefficient is −1 and Pearson's product moment correlation coefficient is −0.95

a. Explain what Spearman's rank correlation coefficient of −1 shows about these cars. (1)

b. Interpret the value of Pearson's product moment correlation coefficient. (1)

c. Use the scatter diagram to explain why Pearson's coefficient is not exactly −1 (1)

d. For the same 8 cars, Spearman's rank correlation coefficient between age and number of seats is 0.06. Interpret this value. (1)



(4 marks)

a)

The ranks are in exactly opposite order

As age goes up, value always goes down

b) -0.95 is close to -1

Strong negative linear correlation

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

Older cars tend to have lower values

c)

Pearson measures how close the points are

to a straight line

These points lie on a curve, not a straight line

d) 0.06 is very close to 0

Almost no correlation between the age of a car

and its number of seats

a) opposite order b) strong negative c) curve d) none

4 The scatter diagram shows the distance from the railway station, in km, and the price, in thousands of pounds, of 9 flats in a town.

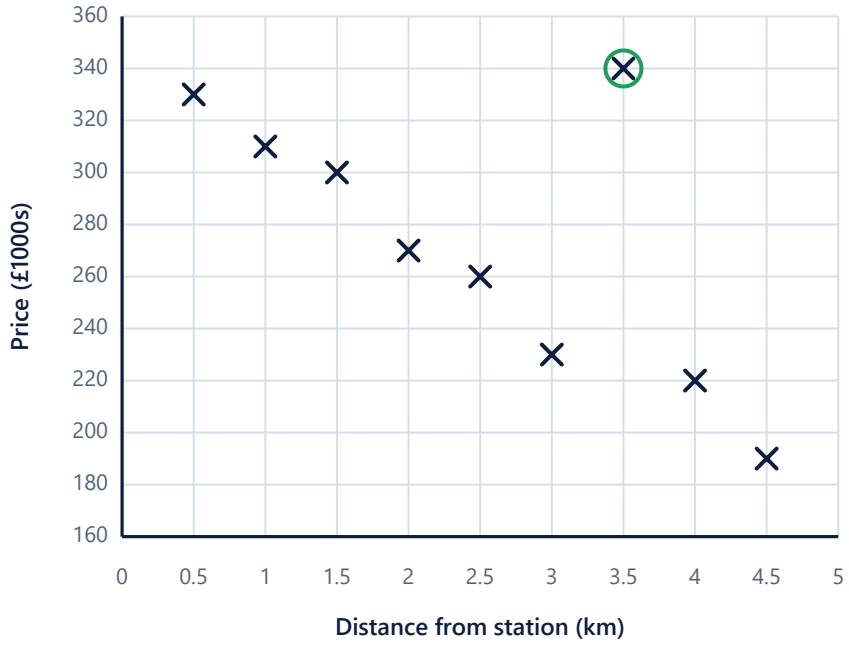
Pearson's product moment correlation coefficient for all 9 flats is −0.69. When one of the flats is left out, the coefficient for the other 8 flats is −0.99

a. On the scatter diagram, draw a ring around the flat that was left out. (1)

b. Interpret the value −0.99 in context. (1)

c. Explain why leaving out this one flat changes the coefficient so much. (1)

d. Give one reason why this flat should not simply be ignored. (1)



(4 marks)

a)

Ring the point (3.5, 340)

b) -0.99 is close to -1

Strong negative linear correlation

Flats further from the station tend to cost less

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

c)

This point is an outlier, far from the other points

With it, the points are much less close to a straight line

d)

The price may be correct, not a mistake

Leaving out real data could make the results misleading

a) ringed b) strong negative c) outlier d) may be real

5 A researcher records the number of takeaway shops and the number of GP surgeries in each of 10 towns. For these data, Pearson's product moment correlation coefficient is 0.89

a. Interpret the value 0.89 in context. (1)

b. A newspaper headline says, "Opening more takeaways makes a town need more doctors." Comment on this headline. (2)

c. For the same data, Spearman's rank correlation coefficient is 0.98. Explain what it suggests about the relationship that Spearman's coefficient is closer to 1 than Pearson's coefficient. (2)

(5 marks)

a) 0.89 is close to 1

Strong positive linear correlation

Towns with more takeaways tend to have more GP surgeries

b)

Correlation does not mean one thing causes the other

Both are likely to depend on a third variable,

the population of the town

c) Spearman uses the ranks of the data

The towns are in almost the same order for both variables

Pearson is lower, so the points are not as close

to a straight line

The relationship may be a curve (non-linear)

a) strong positive b) not causation c) may be non-linear

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.