FOUNDATION

F07-30min Spearman's Rank Interpretation: 30-minute Pack

Total Marks

EDEXCEL 1ST0 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State whether rs = -0.55 shows a positive or negative association.

(Total for Question 1 is 1 mark)

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2 Before a school egg-and-spoon race, a PE teacher predicts the finishing order of 6 runners. In the actual race, every runner finishes in exactly the reverse of the predicted order.

Runner	Predicted rank	Actual rank
Freya	1	6
Marcus	2	5
Ines	3	4
Tyler	4	3
Zara	5	2
Callum	6	1

The Spearman's rank correlation coefficient for the predicted and actual rankings is rs = -1.

(a) Write down whether rs = -1 shows a positive or negative association. **(1)**

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(b) State what -1 tells you about the strength of the association. **(1)**

(c) Explain what rs = -1 means about the relationship between the predicted rank and the actual rank of each runner. **(2)**

(Total for Question 2 is 4 marks)

3 Write down the value of rs that shows perfect positive agreement between two rankings.

(Total for Question 3 is 1 mark)

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4 Two coefficients are given: rs = 0.63 for Pair X and rs = 0.29 for Pair Y. Write down which pair shows the stronger association, explaining your reasoning.

(Total for Question 4 is 2 marks)

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5 In a design competition, two judges score 4 entries. Judge B gives two entries the same score, which would otherwise occupy positions 2 and 3. Work out the rank that should be given to each of these two tied entries.

(Total for Question 5 is 2 marks)

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6 Two examiners rank 5 essays. The Spearman's rank correlation coefficient between their rankings is rs = 0.85. Describe the strength and direction of the association.

(Total for Question 6 is 2 marks)

7 A teacher wants to find out whether pupils' mock exam results are a good predictor of their final exam results. She carries out a statistical enquiry in four stages: plan, collect, process and interpret.

(a) (Plan) Give one reason why the teacher chooses to rank the pupils' marks, rather than compare the raw marks directly, when checking the relationship between the two exams. **(1)**

(b) (Collect) The table shows the mock exam rank and final exam rank for 6 pupils. **(1)**

Pupil	Mock exam rank	Final exam rank
Aisha	1	2
Ben	2	1
Chloe	3	4
Dev	4	3
Ella	5	6
Farah	6	5

Write down the name of the pupil whose mock exam rank and final exam rank are the same.

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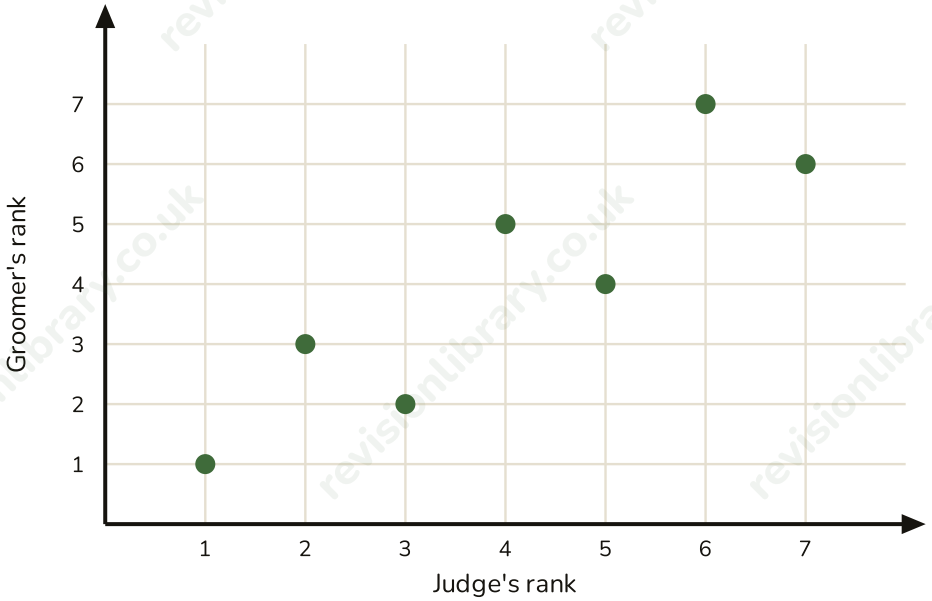
(c) (Process) Using this data, the Spearman's rank correlation coefficient is calculated to be $r_s = 0.83$. State whether this value is consistent with the ranks in the table. **(1)**

(d) (Interpret) The teacher concludes: 'Mock exam rank is a reliable predictor of final exam rank for this class.' Use the value of r_s to comment on whether this conclusion is reasonable. **(2)**

(Total for Question 7 is 5 marks)

8 At a dog show, two independent assessments are made of the same 7 dogs: a professional groomer ranks the dogs by coat condition, and a judge ranks the dogs by overall appearance. The scatter graph shows the groomer's rank plotted against the judge's rank for each dog.



(a) Describe the pattern shown by the scatter graph. **(1)**

(b) The Spearman's rank correlation coefficient for this data is rs = 0.89. State whether this value is consistent with the pattern in the scatter graph. **(1)**

(c) Explain why rs = 0.89 rather than rs = 1, even though the scatter graph shows a clearly rising pattern. **(2)**

(Total for Question 8 is 4 marks)

9 Two recruiters independently rank 6 candidates by suitability for a job. The Spearman's rank correlation coefficient between their rankings is rs = -0.2.

(a) State whether rs = -0.2 shows a strong or a weak association. **(1)**

(b) Explain what this value suggests about the two recruiters' views on the candidates, and explain why 'weak' is a better description than 'no association at all'. **(2)**

(Total for Question 9 is 3 marks)

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10 At an art exhibition, Critic A and Critic B each score 5 paintings out of 25. Critic B gives two paintings the same score.

Painting	Critic A score	Critic A rank	Critic B score	Critic B rank
1	22	1	23	1
2	15	3	17	?
3	12	4	17	?
4	18	2	15	4
5	8	5	9	5

(a) Painting 2 and Painting 3 both scored 17 from Critic B. Work out the rank that should be given to each of these two paintings. **(2)**

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(b) Explain why Painting 2 and Painting 3 are given the same rank instead of one being placed above the other. **(1)**

(c) The Spearman's rank correlation coefficient for this data is calculated to be rs = 0.95. Interpret this value in the context of the two critics' rankings. **(1)**

(Total for Question 10 is 4 marks)

11 A student is asked to interpret a Spearman's rank correlation coefficient of rs = 0.4, calculated between two judges' rankings of a bake-off competition. The student writes: 'Since rs = 0.4, the two judges completely disagree with each other.'

(a) Identify what is wrong with the student's statement. **(1)**

(b) Give a correct interpretation of rs = 0.4. **(1)**

(c) Write down the value of rs that would represent the two judges completely disagreeing with each other. **(1)**

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(Total for Question 11 is 3 marks)

Mark scheme · F07-30min Spearman's Rank Interpretation: 30-minute Pack

Question 1

- **B1** Negative cao
- **Answer: Negative**

Question 2

- (a) **B1** Negative cao
- **(a) Answer: Negative**
- (b) **B1** the strongest/maximum possible association (perfect) oe
- **(b) Answer: The strongest possible association (a perfect correlation).**
- (c) **B1** identifies that the rank order is completely reversed
- (c) **B1** links this to the context, e.g. the runner predicted to finish 1st actually finished last (6th), and this pattern holds for every runner
- **(c) Answer: The actual finishing order is the exact reverse of the predicted order for every runner.**

Question 3

- **B1** 1 cao
- **Answer: 1**

Question 4

- **M1** compares the sizes of the coefficients, 0.63 and 0.29
- **A1** Pair X cao
- **Answer: Pair X**

Question 5

- **M1** recognises the tied entries would occupy positions 2 and 3, oe
- **A1** 2.5 for both cao
- **Answer: 2.5 (for both entries)**

Question 6

- **B1** Positive
- **B1** Strong (close to +1)
- **Answer: Strong positive association.**

Question 7

- (a) **B1** ranking removes the effect of the two exams having different total marks/difficulty, so the two sets of results can be compared fairly oe
- **(a) Answer: Ranking lets the two exams be compared fairly even if they are marked out of different totals or have different levels of difficulty.**
- (b) **B1** no pupil / none cao
- **(b) Answer: None - every pupil's rank changes between the two exams.**
- (c) **B1** Yes, consistent - the rank orders are similar but not identical, matching a high but not perfect coefficient oe
- **(c) Answer: Yes - the two rank orders are close but not identical, which fits a high value close to but below 1.**
- (d) **B1** rs = 0.83 is fairly close to 1, showing a strong positive association, so the conclusion has some support
- (d) **B1** balanced comment, e.g. the coefficient is not exactly 1, so mock rank does not predict final rank perfectly for every pupil
- **(d) Answer: The conclusion is broadly reasonable - rs = 0.83 shows a strong positive link, but since it is not 1, the mock exam does not predict every pupil's final rank exactly.**

Question 8

- (a) **B1** an upward/rising trend, with points fairly close to a straight line oe
- **(a) Answer: The points show a rising trend, lying fairly close to a straight line.**
- (b) **B1** Yes - a strong positive coefficient matches a rising pattern of points close to a straight line oe
- **(b) Answer: Yes, it is consistent.**
- (c) **B1** identifies that the points do not lie exactly on a straight line / some pairs of ranks are swapped from the perfect order
- (c) **B1** links this to rs being less than 1: only a perfect match of every rank (all points exactly on a rising line) would give rs = 1
- **(c) Answer: Not every point lies exactly on the line - a few dogs' ranks are swapped slightly, so the coefficient is high but below the maximum of 1.**

Question 9

- (a) **B1** Weak cao
- **(a) Answer: Weak**
- (b) **B1** there is little agreement/link between the two rankings, oe
- (b) **B1** -0.2 is close to but not exactly 0, so there is a very slight tendency for the rankings to disagree, not none at all, oe
- **(b) Answer: There is little agreement between the two recruiters' rankings; -0.2 shows only a very slight tendency for their views to disagree, not a total lack of any association.**

Question 10

- (a) **M1** recognises the two tied scores would occupy positions 2 and 3, oe
- (a) **A1** 2.5 for both cao
- **(a) Answer: 2.5 (for both Painting 2 and Painting 3)**
- (b) **B1** they scored exactly the same, so there is no fair way to place one above the other, oe
- **(b) Answer: They scored exactly the same, so neither can fairly be placed above the other.**
- (c) **B1** the two critics agree very strongly on the order of the paintings, since rs is close to +1, oe
- **(c) Answer: The two critics agree very strongly on the order of the paintings.**

Question 11

- (a) **B1** rs = 0.4 is positive, so it cannot show disagreement/a negative association oe
- **(a) Answer: The statement is wrong because rs = 0.4 is positive, so it shows some agreement, not disagreement.**
- (b) **B1** a weak/fairly weak positive association between the two judges' rankings oe
- **(b) Answer: There is a weak positive association - the judges show only a small tendency to agree.**
- (c) **B1** -1 cao
- **(c) Answer: -1**