



H09-test Spearman's Rank Correlation: Test Pack

EDEXCEL 1ST0 · Calculator allowed · about 25 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** Spearman's rank correlation coefficient is given by the formula

$$r_s = 1 - (6 \times \text{sum of } d^2) / (n(n^2-1))$$

where n is the number of items ranked and d is the difference between a pair of ranks.

For a particular set of rankings, $n = 5$ and sum of $d^2 = 10$.

- (a) State what the letter n represents in the formula. (1)
- (b) Substitute $n = 5$ and sum of $d^2 = 10$ into the formula for r_s . (1)
- (c) Calculate the value of r_s . (1)
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- (d) Interpret this value of r_s in terms of the strength and direction of agreement between the two rankings. (1)

(Total for Question 1 is 4 marks)

- 2 In a cookery competition, 6 dishes are given a presentation score out of 20 by a judge. Two dishes receive exactly the same presentation score. Each dish has also already been given a taste rank from 1 (best) to 6 (worst) by a separate taste panel.

Dish	Presentation score	Taste rank
Tart	18	2
Terrine	14	4
Souffle	14	3
Consomme	9	6
Roulade	20	1
Galette	11	5

- (a) Explain why Terrine and Souffle should be given the same rank for presentation score, instead of one being ranked 3rd and the other 4th. (1)
- (b) Complete the ranking of presentation scores for all 6 dishes, giving the tied dishes the mean of the ranks they would otherwise share. (2)
- (c) Calculate d for each dish and find sum of d^2 . (2)
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- (d) Calculate r_s , giving your answer correct to 3 significant figures. (2)
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- (e) Interpret this value of r_s in the context of the presentation scores and taste ranks. (1)

(Total for Question 2 is 8 marks)

- 3** A talent show has 6 acts. Two judges, Judge Reyes and Judge Okafor, independently score each act out of 30, without seeing each other's scores until both have finished.

Act	Judge Reyes score	Judge Okafor score
Magic	24	17
Ballad	19	22
Street dance	27	19
Stand-up	14	15
Juggling	22	25
Choir	30	29

- (a) (Plan) Give one reason why the two judges should score the acts independently, without seeing each other's scores first. (1)
- (b) (Collect) Rank the acts according to Judge Reyes's scores, and separately according to Judge Okafor's scores (rank 1 = highest score). (2)
- (c) (Process) Calculate sum of d^2 and hence find r_s , giving your answer correct to 3 significant figures. (3)
- (d) (Interpret) Judge Reyes says: 'Okafor and I are judging this competition very similarly.' Use your value of r_s to evaluate this statement. (2)

(Total for Question 3 is 8 marks)

4 For a set of $n = 6$ pairs of rankings, Spearman's rank correlation coefficient is $r_s = 0.8$.

(a) Show that sum of $d^2 = 7$ for this data. (3)

(b) A different pair of rankings, also with $n = 6$, gives sum of $d^2 = 70$, the largest value sum of d^2 can take for $n = 6$. State the value of r_s , and explain what this tells you about the two rankings. (2)

(Total for Question 4 is 5 marks)

Mark scheme · H09-test Spearman's Rank Correlation: Test Pack

Question 1

- (a) **B1** the number of items/pairs being ranked oe
- (a) **Answer: The number of items (pairs of ranks) being compared.**
- (b) **M1** $rs = 1 - (6 \times 10) / (5 \times (5^2 - 1))$, oe
- (b) **Answer: $rs = 1 - (6 \times 10) / (5 \times 24)$**
- (c) **A1** 0.5 cao
- (c) **Answer: 0.5**
- (d) **B1** a weak to moderate positive association oe
- (d) **Answer: A weak to moderate positive association between the two rankings.**

Question 2

- (a) **B1** they have exactly the same presentation score (14), so there is no fair way to place one above the other oe
- (a) **Answer: Terrine and Souffle both scored 14, so they are tied - neither can fairly be placed above the other.**
- (b) **M1** Terrine and Souffle would occupy positions 3 and 4, so both are given rank 3.5 oe
- (b) **A1** full set of presentation ranks: Tart 2, Terrine 3.5, Souffle 3.5, Consomme 6, Roulade 1, Galette 5
- (b) **Answer: Presentation ranks: Roulade 1, Tart 2, Terrine 3.5, Souffle 3.5, Galette 5, Consomme 6.**
- (c) **M1** d values 0, -0.5, 0.5, 0, 0, 0 oe
- (c) **A1** sum of $d^2 = 0.5$ cao
- (c) **Answer: sum of $d^2 = 0.5$**
- (d) **M1** $rs = 1 - (6 \times 0.5) / (6 \times 35)$, oe
- (d) **A1** awrt 0.986
- (d) **Answer: $rs = 0.986$ (3sf)**
- (e) **B1** a very strong positive association - dishes that look good tend to also taste good (and vice versa) oe
- (e) **Answer: A very strong positive association: dishes with a high presentation score also tend to have a good taste rank.**

Question 3

- (a) **B1** so that neither judge is influenced by the other's opinion, keeping the two sets of scores independent oe
- (a) **Answer: So that neither judge's score is influenced by seeing the other's opinion first.**
- (b) **B1** Reyes ranks: Magic 3, Ballad 5, Street dance 2, Stand-up 6, Juggling 4, Choir 1
- (b) **B1** Okafor ranks: Magic 5, Ballad 3, Street dance 4, Stand-up 6, Juggling 2, Choir 1
- (b) **Answer: Reyes: 3, 5, 2, 6, 4, 1. Okafor: 5, 3, 4, 6, 2, 1 (Magic, Ballad, Street dance, Stand-up, Juggling, Choir).**
- (c) **M1** d values -2, 2, -2, 0, 2, 0 oe
- (c) **A1** sum of $d^2 = 16$ cao
- (c) **A1** $rs =$ awrt 0.543
- (c) **Answer: sum of $d^2 = 16$, $rs = 0.543$ (3sf)**
- (d) **B1** $rs = 0.543$ is positive, so there is some genuine agreement between the two judges oe
- (d) **B1** however 0.543 is only a moderate value (well below 1), so the statement overstates how closely they agree oe
- (d) **Answer: Reyes's statement is only partly justified - $rs = 0.543$ shows a positive but moderate association, so the judges agree to some extent but not as closely as 'very similarly' suggests.**

Question 4

- (a) **M1** rearranges the formula to sum of $d^2 = n(n^2-1)(1-r_s) / 6$, oe
- (a) **M1** substitutes $n = 6$ and $r_s = 0.8$: sum of $d^2 = (6 \times 35 \times 0.2) / 6$, oe
- (a) **A1** sum of $d^2 = 7$ cao, correctly shown
- **(a) Answer: sum of $d^2 = 7$**
- (b) **B1** $r_s = -1$ cao
- (b) **B1** this means the two rankings are exact reverses of one another (perfect disagreement) oe
- **(b) Answer: $r_s = -1$; the two rankings are exact opposites of one another - whichever item is ranked highest by one ranking is ranked lowest by the other, and so on.**