HIGHER

4.4 Spearman's Rank Correlation: 1-hour Pack

Total Marks

EDEXCEL 1ST0 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 8 people have a height and a jump distance.

height: 44, 71, 60, 52, 36, 46, 63, 97
jump distance: 51, 71, 43, 70, 84, 59, 36, 38

(a) Rank each set from 1 (smallest).
(b) Work out the sum of the squared differences in ranks, sum of d^2.
(c) Use $r_s = 1 - 6 \times (\text{sum of } d^2) / (n(n^2 - 1))$ to work out the Spearman rank correlation coefficient, to 2 decimal places.

(Total for Question 1 is 5 marks)

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2 5 people have a maths mark and a physics mark.

maths mark: 81, 93, 24, 87, 34
physics mark: 17, 42, 89, 28, 29

(a) Rank each set from 1 (smallest).
(b) Work out the sum of the squared differences in ranks, sum of d^2.
(c) Use $r_s = 1 - 6 \times (\text{sum of } d^2) / (n(n^2 - 1))$ to work out the Spearman rank correlation coefficient, to 2 decimal places.

(Total for Question 2 is 5 marks)

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3 For the scores given by a judge to some entries, the values are 10, 18, 18, 10, 11. Rank them from 1 (smallest). Where values are equal, give each the mean of the ranks they share. Write down the ranks in the same order as the values.

(Total for Question 3 is 3 marks)

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4 5 people have a age of car and a price.

age of car: 43, 32, 24, 46, 77
price: 73, 62, 56, 82, 38

(a) Rank each set from 1 (smallest).
(b) Work out the sum of the squared differences in ranks, sum of d^2.
(c) Use $r_s = 1 - 6 \times (\text{sum of } d^2) / (n(n^2 - 1))$ to work out the Spearman rank correlation coefficient, to 2 decimal places.

(Total for Question 4 is 5 marks)

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5 The data below could be plotted on a scatter graph. A teacher records hours spent revising (x) and test mark (y).

x	1	7	9	10	13	16
y	61	74	81	83	82	95

A line of best fit is drawn so that it passes through the points (7, 74) and (13, 82).
(a) Work out the gradient of the line.
(b) Find the equation of the line in the form $y = mx + c$.

(Total for Question 5 is 4 marks)

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6 7 people have a hours of practice and a performance score.

hours of practice: 69, 97, 49, 92, 79, 14, 90
performance score: 33, 66, 20, 56, 23, 43, 85

(a) Rank each set from 1 (smallest).
(b) Work out the sum of the squared differences in ranks, sum of d^2.
(c) Use $r_s = 1 - 6 \times (\text{sum of } d^2) / (n(n^2 - 1))$ to work out the Spearman rank correlation coefficient, to 2 decimal places.

(Total for Question 6 is 5 marks)

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7 5 people have a age of car and a price.

age of car: 80, 67, 41, 27, 51
price: 72, 42, 39, 97, 35

(a) Rank each set from 1 (smallest).
(b) Work out the sum of the squared differences in ranks, sum of d^2.
(c) Use $r_s = 1 - 6 \times (\text{sum of } d^2) / (n(n^2 - 1))$ to work out the Spearman rank correlation coefficient, to 2 decimal places.

(Total for Question 7 is 5 marks)

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8 The data below could be plotted on a scatter graph. A taxi firm records distance travelled in kilometres (x) and the fare in pounds (y).

x	3	7	8	10	11	13	16
y	70	59	64	56	59	56	49

A line of best fit is drawn so that it passes through the points (7, 59) and (13, 56).

(a) Work out the gradient of the line.

(b) Find the equation of the line in the form $y = mx + c$.

(c) Use your equation to estimate y when $x = 23$.

(d) State whether your estimate in (c) is interpolation or extrapolation, and whether it is likely to be reliable.

(Total for Question 8 is 7 marks)

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9 7 people have a height and a jump distance.

height: 18, 78, 35, 73, 14, 25, 32
jump distance: 15, 96, 48, 17, 85, 40, 42

(a) Rank each set from 1 (smallest).

(b) Work out the sum of the squared differences in ranks, sum of d^2.

(c) Use $r_s = 1 - 6 \times (\text{sum of } d^2) / (n(n^2 - 1))$ to work out the Spearman rank correlation coefficient, to 2 decimal places.

(Total for Question 9 is 5 marks)

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10 7 people have a age of car and a price.

age of car: 41, 22, 40, 84, 64, 51, 17
price: 52, 20, 38, 87, 41, 45, 53

(a) Rank each set from 1 (smallest).
(b) Work out the sum of the squared differences in ranks, sum of d^2.
(c) Use $r_s = 1 - 6 \times (\text{sum of } d^2) / (n(n^2 - 1))$ to work out the Spearman rank correlation coefficient, to 2 decimal places.

(Total for Question 10 is 5 marks)

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11 The data below could be plotted on a scatter graph. A shop records the number of rainy days in a month (x) and umbrellas sold (y).

x	7	9	10	11	13	14	17	18
y	57	52	57	51	47	49	45	41

(a) Work out the mean of x and the mean of y, giving the coordinates of the mean point.
(b) Describe the type of correlation between x and y.

(Total for Question 11 is 4 marks)

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12 The Spearman rank correlation coefficient between hours of sleep and reaction time for a group is $r_s = 0.21$.

(a) Describe the correlation. Use: very strong (0.8 or more in size), strong (0.6 up to 0.8), moderate (0.4 up to 0.6), weak (under 0.4).

(b) What does the sign of r_s tell you about how the ranks of hours of sleep and reaction time are related?

(Total for Question 12 is 3 marks)

13 8 people have a age of car and a price.

age of car: 19, 67, 83, 51, 43, 30, 40, 56
price: 87, 41, 62, 14, 44, 21, 11, 96

(a) Rank each set from 1 (smallest).

(b) Work out the sum of the squared differences in ranks, sum of d^2.

(c) Use $r_s = 1 - 6 \times (\text{sum of } d^2) / (n(n^2 - 1))$ to work out the Spearman rank correlation coefficient, to 2 decimal places.

(Total for Question 13 is 5 marks)

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Mark scheme · 4.4 Spearman's Rank Correlation: 1-hour Pack

Question 1

ranks 2, 7, 5, 4, 1, 3, 6, 8 and 4, 7, 3, 6, 8, 5, 1, 2	**B1**
difference in ranks squared and summed	**M1**
sum of $d^2 = 126$	**A1**
1 - 6 x 126 / (8 x 63)	**M1**
-0.5 cao	**A1**

Answer: (a) 2, 7, 5, 4, 1, 3, 6, 8 and 4, 7, 3, 6, 8, 5, 1, 2; (b) 126; (c) -0.5

Question 2

ranks 3, 5, 1, 4, 2 and 1, 4, 5, 2, 3	**B1**
difference in ranks squared and summed	**M1**
sum of $d^2 = 26$	**A1**
1 - 6 x 26 / (5 x 24)	**M1**
-0.3 cao	**A1**

Answer: (a) 3, 5, 1, 4, 2 and 1, 4, 5, 2, 3; (b) 26; (c) -0.3

Question 3

ranks the values (consistent direction)	**M1**
tied values share the mean of their ranks	**A1**
1.5, 4.5, 4.5, 1.5, 3 cao	**A1**

Answer: 1.5, 4.5, 4.5, 1.5, 3

Question 4

ranks 3, 2, 1, 4, 5 and 4, 3, 2, 5, 1	**B1**
difference in ranks squared and summed	**M1**
sum of $d^2 = 20$	**A1**
1 - 6 x 20 / (5 x 24)	**M1**
0 cao	**A1**

Answer: (a) 3, 2, 1, 4, 5 and 4, 3, 2, 5, 1; (b) 20; (c) 0

Question 5

change in y divided by change in x	**M1**
gradient 1.3333333333 cao	**A1**
substitutes a point into y = mx + c	**M1**
y = 1.3333333333x + 64.6666666667 cao	**A1**

Answer: (a) 1.3333333333; (b) y = 1.3333333333x + 64.6666666667

Question 6

ranks 3, 7, 2, 6, 4, 1, 5 and 3, 6, 1, 5, 2, 4, 7	**B1**
difference in ranks squared and summed	**M1**
sum of $d^2 = 20$	**A1**
1 - 6 x 20 / (7 x 48)	**M1**
0.64 cao	**A1**

Answer: (a) 3, 7, 2, 6, 4, 1, 5 and 3, 6, 1, 5, 2, 4, 7; (b) 20; (c) 0.64

Question 7

ranks 5, 4, 2, 1, 3 and 4, 3, 2, 5, 1	**B1**
difference in ranks squared and summed	**M1**
sum of $d^2 = 22$	**A1**
1 - 6 x 22 / (5 x 24)	**M1**
-0.1 cao	**A1**

Answer: (a) 5, 4, 2, 1, 3 and 4, 3, 2, 5, 1; (b) 22; (c) -0.1

Question 8

change in y divided by change in x	**M1**
-0.5 cao	**A1**
substitutes a point to find c	**M1**
y = -0.5x + 62.5 cao	**A1**
substitutes x = 23	**M1**
51 cao	**A1**
extrapolation and less reliable as outside the data range	**B1**

Answer: (a) -0.5; (b) y = -0.5x + 62.5; (c) 51; (d) extrapolation

Question 9

ranks 2, 7, 5, 6, 1, 3, 4 and 1, 7, 5, 2, 6, 3, 4	**B1**
difference in ranks squared and summed	**M1**
sum of $d^2 = 42$	**A1**
1 - 6 x 42 / (7 x 48)	**M1**
0.25 cao	**A1**

Answer: (a) 2, 7, 5, 6, 1, 3, 4 and 1, 7, 5, 2, 6, 3, 4; (b) 42; (c) 0.25

Question 10

ranks 4, 2, 3, 7, 6, 5, 1 and 5, 1, 2, 7, 3, 4, 6	**B1**
difference in ranks squared and summed	**M1**
sum of $d^2 = 38$	**A1**
1 - 6 x 38 / (7 x 48)	**M1**
0.32 cao	**A1**

Answer: (a) 4, 2, 3, 7, 6, 5, 1 and 5, 1, 2, 7, 3, 4, 6; (b) 38; (c) 0.32

Question 11

sum of x divided by n or sum of y divided by n	**M1**
(12.4, 49.9) cao	**A1**
negative correlation	**B1**
as x increases y decreases oe	**B1**

Answer: (a) (12.4, 49.9); (b) negative correlation

Question 12

positive	**B1**
weak	**B1**
as ranks of one increase the ranks of the other increase oe	**B1**

Answer: (a) weak positive; (b) as ranks of hours of sleep increase, ranks of reaction time increase

Question 13

ranks 1, 7, 8, 5, 4, 2, 3, 6 and 7, 4, 6, 2, 5, 3, 1, 8	**B1**
difference in ranks squared and summed	**M1**
sum of $d^2 = 68$	**A1**
1 - 6 x 68 / (8 x 63)	**M1**
0.19 cao	**A1**

Answer: (a) 1, 7, 8, 5, 4, 2, 3, 6 and 7, 4, 6, 2, 5, 3, 1, 8; (b) 68; (c) 0.19

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