

# Bivariate Data

## Spearman's Rank Correlation Coefficient

- 1 Two people with the same occupation were asked to give ratings out of 100 for each of five different aspects of their job. Their ratings are given in the table below.

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Aspect	A	B	C	D	E
Person 1	71	63	84	57	64
Person 2	12	62	20	85	31

- (i) Calculate Spearman's rank correlation coefficient for the above data. [4]
- (ii) Explain what your answer to part (i) tells you about the two people's ratings. [1]

- 2 In a game show a contestant was asked to identify the years in which each of 10 events occurred. The table below shows the year in which each event actually occurred and the year given by the contestant for that event.

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Actual year of occurrence	1963	1968	1971	1973	1983	1984	1986	1990	1991	1997
Year given by contestant	1970	1983	1964	1977	1969	1992	1981	1986	1994	1997

- (i) Calculate Spearman's rank correlation coefficient between the actual year of occurrence and the year given by the contestant. [4]
- (ii) Does the value of this correlation coefficient suggest that the contestant is good at remembering the dates of these events? Give a reason for your answer. [2]

- 1 Two judges gave marks for each of six performers in a talent show. The marks are given in the table below.

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Performer	1	2	3	4	5	6
Mark given by Judge A	74	33	70	68	53	36
Mark given by Judge B	48	81	68	60	53	24

Find Spearman's rank correlation coefficient between the marks given by Judge A and the marks given by Judge B. [4]

- 1 Seven A-level projects were marked by a teacher and a moderator. The marks are given in the table below.

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Project	A	B	C	D	E	F	G
Teacher's mark	21	19	16	5	11	17	15
Moderator's mark	19	20	11	7	14	18	16

- (i) Calculate Spearman's rank correlation coefficient for the data. [4]
- (ii) What can be said about the level of agreement between the teacher and the moderator in their assessments of the projects? [1]

# Spearman's Rank (cont 1)

- 1 Three judges gave marks for each of five performers in a talent show. The marks are given in the table below.

Performer	1	2	3	4	5
Mark given by Judge A	71	32	70	60	52
Mark given by Judge B	45	83	38	60	54
Mark given by Judge C	57	40	42	70	39

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- (i) Find Spearman's rank correlation coefficient between the marks given by Judge A and the marks given by Judge B. [4]
- (ii) Spearman's rank correlation coefficient between the marks given by Judge A and the marks given by Judge C is 0.6. State which of the two judges B or C agrees more closely with Judge A in ranking the five performers. Give a reason for your answer. [1]

- Spec 2 Two independent assessors awarded marks to each of 5 projects. The results were as shown in the table.

Project	A	B	C	D	E
First assessor	38	91	62	83	61
Second assessor	56	84	41	85	62

- (i) Calculate Spearman's rank correlation coefficient for the data. [5]
- (ii) Show, by sketching a suitable scatter diagram, how two assessors might have assessed 5 projects in such a way that Spearman's rank correlation coefficient for their marks was +1 while the product moment correlation coefficient for their marks was not +1. (Your scatter diagram need not be drawn accurately to scale.) [2]

- 4 The table below shows the mean GCSE score and A Level mathematics grade of 6 randomly chosen students. The mean GCSE score for a student can take values from 0 to 8, with 8 representing the highest performance and 0 representing the lowest performance. The A Level grades are A, B, C, D, E and U, with A representing the highest performance and U the lowest performance.

Student	1	2	3	4	5	6
Mean GCSE score	4.1	5.2	6.4	5.3	7.4	3.6
A Level grade	E	C	D	B	A	U

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- (i) Calculate Spearman's rank correlation coefficient for the data. [4]

For the same 6 students Spearman's rank correlation coefficient between their GCSE mathematics grade and their A Level mathematics grade was 0.943. The head teacher of a school wishes to use either the mean GCSE score or the GCSE mathematics grade as a predictor of students' A Level mathematics grades.

- (ii) On the basis of the values of Spearman's rank correlation coefficient for these 6 students, state, giving a reason, which should be used. [2]
- (iii) Give a reason why the choice of predictor might be wrong. [1]

# Spearman's Rank (cont 2)

- 5 The following table gives the heights, in cm, of nine pairs of identical twins measured on their first birthday.

Pair	A	B	C	D	E	F	G	H	I
Height of first born (cm)	53.5	55.0	57.5	60.0	63.5	64.0	67.0	68.5	71.0
Height of second born (cm)	50.5	56.5	53.5	58.0	63.0	65.0	68.5	63.5	69.5

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- On graph paper draw a scatter diagram to illustrate the data, labelling the points  $A, B, C, \dots, I$ . [3]
- Explain how you can tell from the diagram that Spearman's rank correlation coefficient is not equal to 1. [1]
- Calculate the value of Spearman's rank correlation coefficient. [4]
- State what the value of the coefficient indicates about the heights. [1]
- If the heights were given in inches rather than centimetres, which (if any) of your answers to parts (ii), (iii) and (iv) would change? [1]

- 1 A student was investigating the relationship between the performance of two football teams,  $A$  and  $B$ , which had been in the same league for many years. She recorded the number of points gained by the two teams for each of 7 randomly chosen years. The results are given in the table below.

Year	1	2	3	4	5	6	7
Points gained by team $A$	41	82	62	58	50	60	80
Points gained by team $B$	65	79	81	66	83	36	70

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- Find the value of Spearman's rank correlation coefficient between the points gained by team  $A$  and the points gained by team  $B$ . [4]
- State what the value found in part (i) shows about the relationship between the performance of teams  $A$  and  $B$  over the selected 7 years. [1]

- 1 Two directors of a company each interviewed seven candidates for a job. Director 1 gave each candidate a score from 0 to 100 and a high score meant that the director liked the candidate. Director 2 ranked the candidates and gave the candidate she liked most a rank of 7 and the candidate she liked least a rank of 1. The results are given in the table below.

Candidate	A	B	C	D	E	F	G
Director 1	74	83	64	58	27	91	28
Director 2	6	5	2	4	3	7	1

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- Calculate Spearman's rank correlation coefficient between the assessments given by Director 1 and Director 2. [5]
- What can be said about the amount of agreement between the two directors in their assessment of the 7 candidates? [1]