

Pearson's product moment correlation coefficient

About 50 minutes Calculator allowed 36 marks



Hints online, answers free with an account:
mathswariz.uk/worksheets/stats-pearsons-product-moment-correlation-coefficient/

Date _____

A Do Now

The first question is what today's lesson needs. The others bring back earlier topics.

- A1** Needed today [2 marks]
Two customers rank 8 players. The sum of the squares of the differences between the two ranks is $\sum d^2 = 168$. Work out Spearman's rank correlation coefficient. Give your answer to 3 decimal places.
- A2** From chapter 1 [2 marks]
As part of a statistical investigation, Jon is describing the correlation on a scatter diagram. Which stage of the enquiry cycle is Jon at? Name the next stage and say what happens in it.

Answer

- A3** From chapter 1 [2 marks]
For each of these, write qualitative, discrete or continuous, and give a reason.
(i) the make of a phone (ii) the height of a tree
- A4** From chapter 10 [2 marks]
The mean of the x values is 10 and the mean of the y values is 106. Ben draws a line of best fit with gradient -1.5 . Its equation is $y = a + bx$. Work out the value of a .

Answer

B Examples, then your turn

Your teacher works through each example with you. Then try the one beside it. The product moment correlation coefficient (PMCC), r , measures how close the points on a scatter diagram are to a straight line. It is always between -1 and 1 .

EXAMPLE 1

For 12 days, the PMCC between the amount of rain and the number of umbrellas a shop sells is 0.91 . Interpret this value in context.

Hint Say how strong it is and which way, then use the words in the question.

- B1** [2 marks]
For 15 days, the PMCC between the temperature at noon and the number of hot drinks a café sells is -0.84 . Interpret this value in context.

EXAMPLE 2

One PMCC is -0.62 and another is 0.79 . Which shows the stronger correlation?

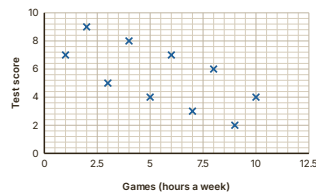
Hint Ignore the sign.

- B2** Write these values of the PMCC in order of strength, strongest first: 0.35 , -0.81 , 0.6 , -0.05 . [2 marks]

Answer ... , ... , ... , ...

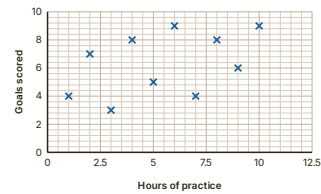
EXAMPLE 3

The scatter diagram shows the hours some students spend on computer games each week and their test scores. Which of these is the PMCC: -0.98 , -0.67 , 0.05 or 0.67 ? Give a reason.



Hint Decide the direction first, then how close to a line the points are.

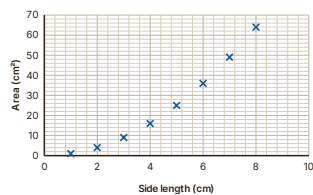
- B3** The scatter diagram shows some players' hours of practice and goals scored. Which of these is the PMCC: -0.96 , -0.46 , 0.46 or 0.96 ? [1 mark]



Answer

EXAMPLE 4

The scatter diagram shows the side length and area of some squares. Spearman's rank correlation coefficient is 1 but the PMCC is 0.98 . Explain why they are different.



Hint Does the area always go up? Do the points lie on a straight line?

- B4** For a set of data, Spearman's rank correlation coefficient is -1 and the PMCC is -0.9 . Describe what the scatter diagram looks like. [2 marks]

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EXAMPLE 5

A café records the number of coffees it sells each day for 30 days. Explain why the owner cannot work out a PMCC from this data.

Hint How many variables does the PMCC need?

- B5** A teacher measures the heights of 20 boys and the heights of 20 different girls. Explain why she cannot work out a PMCC between the boys' heights and the girls' heights. [1 mark]

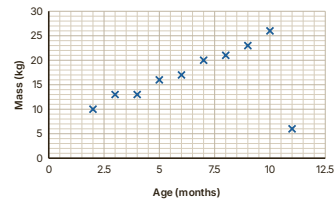
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C Practice

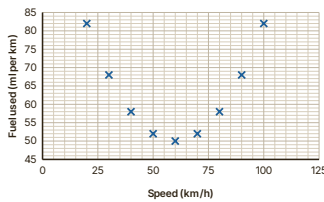
- C1** Some points all lie exactly on the line $y = 12 - 3x$. Write down the PMCC. [1 mark]

Answer

- C2** The scatter diagram shows the age and mass of ten lambs. One mass was written down wrongly. The PMCC is 0.37. Liam removes the wrong value. Which could be the new PMCC: 0.12, 0.37 or 0.99? Give a reason. [2 marks]



- C3** The scatter diagram shows the speed of a car and the fuel it uses. The PMCC is 0. Nina says, "There is no relationship between speed and fuel used." Is Nina correct? Explain why. [2 marks]



- C4** For 20 phones, the PMCC between the price and the battery life is -0.48 . Interpret this value in context. [2 marks]

D Exam-style questions

- D1** For 15 towns, the PMCC between distance from the coast and house price is -0.85 . For 15 other towns, the PMCC between population and house price is 0.62. Ella says, "The second shows the stronger correlation, because 0.62 is greater than -0.85 ." [2 marks]

Is Ella correct? Give a reason for your answer.

- D2** A teacher wants to predict students' exam scores. The PMCC between exam score and hours of revision is 0.72, between exam score and hours of sleep is 0.31, and between exam score and hours on a phone is -0.81 . Which variable should she use to make the most reliable prediction? Give a reason. [2 marks]

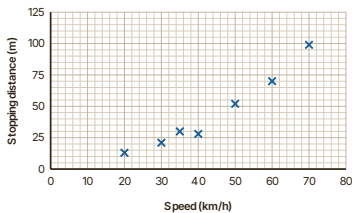
D3 The table shows the speed and the stopping distance of seven cars in a test.

Car	A	B	C	D	E	F	G
Speed (km/h)	20	30	35	40	50	60	70
Stopping distance (m)	13	21	30	28	52	70	99

(a) Use the table to find Spearman's rank correlation coefficient, to 3 decimal places. [3 marks]

Answer

(b) The scatter diagram shows the same data. The PMCC is 0.97. Explain why Spearman's rank is a better measure of this relationship. [2 marks]



(c) Interpret your answer to part (a) in the context of the question. [1 mark]

Total for D3: 6 marks

E Extension

No route is given. The hints are at the end of the sheet. Use one at a time.

E1 For 10 days, the PMCC between the temperature, T °C, and the number of ice creams sold is 0.84. (i) Ryan changes every temperature to °F, using $F = 1.8T + 32$. Write down the PMCC between the temperature in °F and the ice creams sold. (ii) Zoe uses $D = 30 - T$, how many degrees below 30 °C it was. Write down the PMCC between D and the ice creams sold. [3 marks]

Answer (i) (ii)

Extension hints

Cover these with paper. Uncover one at a time.

- E1 **Hint 1** Think about what each rule does to the scatter diagram: does it change the shape, or only the scale on one axis?
- Hint 2** Multiplying by 1.8 and adding 32 stretches and slides the axis. The points stay just as close to a straight line.
- Hint 3** $30 - T$ turns the axis round: the highest temperature has the lowest value of D . The strength stays the same; the direction changes.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

- I can interpret the PMCC in context. ☐ ☐ ☐
- I can match a PMCC to a scatter diagram. ☐ ☐ ☐
- I can say when Spearman's rank suits the data better. ☐ ☐ ☐