LESSON MAKER PRO

Patterns in Pairs

Find and interpret linear correlation.

HIGH SCHOOL · MT.CORE.DATA.INT.6.e

MT.CORE.DATA.INT.6.e "Analyze the relationship between two quantitative data distributions in context that have a linear association. This standard should incorporate cultural context relating to Montana Indigenous Peoples and local communities by:..."

NAME _____ DATE _____

FINDING CORRELATION

Subtract each column's mean from its values. The correlation coefficient is $r = S_{xy} / \text{sqrt}(S_{xx} S_{yy})$, where S_{xy} is the sum of paired deviation products and S_{xx} and S_{yy} are the sums of squared deviations. Values near 1 or -1 show a stronger linear pattern than values near 0.

WORKED EXAMPLE

Find r for these paired values.

PAIRED VALUES

x	y
2	3
4	7
6	5

1. The means are x = 4 and y = 5.
2. The deviations are x: -2, 0, 2 and y: -2, 2, 0.
3. $S_{xy} = 4$; $S_{xx} = 8$; $S_{yy} = 8$.
4. $r = 4 / \text{sqrt}(8 \times 8) = 1/2$.

Answer: r = 1/2

PRACTICE 4 problems

1 Find r for (10, 20), (11, 21), (12, 22).

ANSWER _____

2 Find r for (10, 22), (11, 21), (12, 20).

ANSWER _____

3 Find r for (10, 20), (11, 22), (12, 21).

ANSWER _____

4 Find r for (10, 21), (11, 22), (12, 21).

ANSWER _____

APPLY IT Show your work

1 A fictional river cleanup led by a Montana tribal youth group records hours worked and bags collected. Find r and name the direction of the linear association.

RIVER CLEANUP SHIFTS

Hours	Bags
1	8
2	10
3	9

ANSWER _____

2 A Montana town running club records practice hours and minutes to run a loop. Find r and name the direction of the linear association.

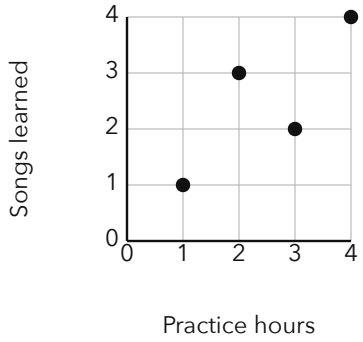
RUNNING CLUB

Practice hours	Loop minutes
1	14
2	12
3	13

ANSWER _____

CHALLENGE One step up

The graph shows practice hours and songs learned by four students. Find r. Does this correlation prove that practicing longer causes a student to learn more songs? Explain.



WORK SPACE AND ANSWER

Patterns in Pairs

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Find r for (10, 20), (11, 21), (12, 22).	**r = 1**
2	Find r for (10, 22), (11, 21), (12, 20).	**r = -1**
3	Find r for (10, 20), (11, 22), (12, 21).	**r = 1/2**
4	Find r for (10, 21), (11, 22), (12, 21).	**r = 0**

PART 2 · APPLY IT

1. **r = 1/2; positive association** $S_{xy} = 1$, $S_{xx} = 2$, and $S_{yy} = 2$, so r = 1/2.
2. **r = -1/2; negative association** $S_{xy} = -1$, $S_{xx} = 2$, and $S_{yy} = 2$, so r = -1/2.

CHALLENGE

r = 4/5. No. The positive association does not prove causation; another factor, such as prior experience, could affect songs learned.

Accept 0.5 and -0.5 in place of 1/2 and -1/2. For the challenge, accept any valid explanation that correlation alone does not establish causation.