

## Lesson 2.18: Distinguishing Between Correlation and Causation

## Instruction

## Guided Practice 2.18

## Example 1

Alex coaches basketball, and wants to know if there is a relationship between height and free throw shooting percentage. Free throw shooting percentage is the number of free throw shots completed divided by the number of free throw shots attempted, multiplied by 100:

$$\frac{\text{free throw shots completed}}{\text{free throw shots attempted}} \cdot 100$$

He takes some notes on the players in his team, and records his results in the following table. What is the correlation between height and free throw shooting percentage? Alex looks at his data and decides that increased height causes a reduced free throw shooting percentage. Is he correct?

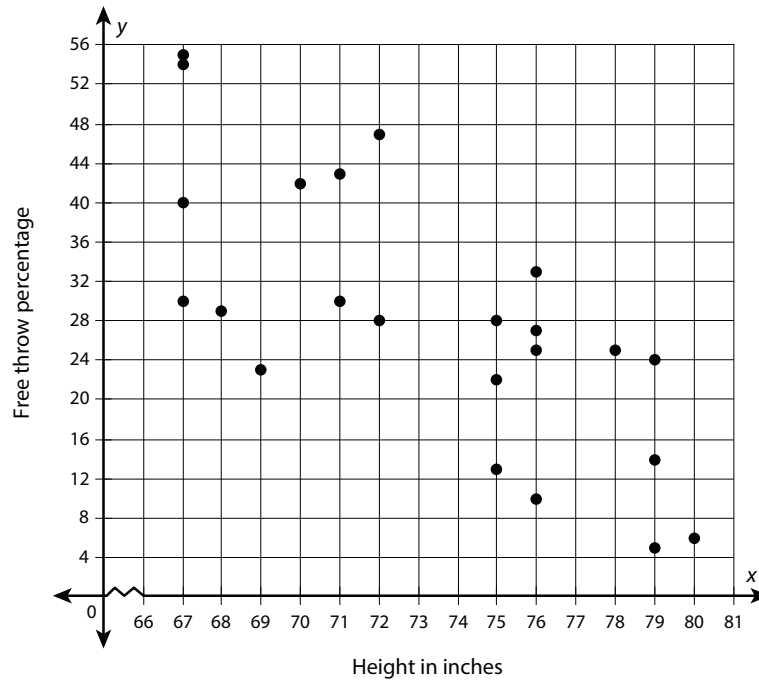
Height in inches	Free throw percentage	Height in inches	Free throw percentage
75	28	72	28
75	22	76	33
67	30	76	25
80	6	67	54
71	43	79	5
67	40	67	55
76	10	78	25
76	25	75	13
70	42	71	30
72	47	68	29
79	24	79	14
69	23	78	25
76	27		

Lesson 2.18: Distinguishing Between Correlation and Causation

Instruction

1. Create a scatter plot of the data.

Let the  $x$ -axis represent height in inches, and the  $y$ -axis represent free throw shooting percentage.



2. Analyze the scatter plot, and describe any relationship between the two events.

As height increases, free throw shooting percentage decreases. It appears that there is a weak negative linear correlation between the two events.

3. Find the correlation coefficient using a graphing calculator. Follow the steps in the Key Concepts section.

$$r = -0.727$$

## Lesson 2.18: Distinguishing Between Correlation and Causation

## Instruction

4. Describe the correlation between the two events.

$-0.727$  is close to  $-1$ . There is a negative linear correlation between the events.



5. Consider the causal relationship between the two events.

Determine if it is likely that height is responsible for the decrease in free throw shooting percentage.

Even if there is a correlation between height and free throw percentage, it is not likely that height causes a basketball player to have more difficulty making free throw shots. If two equally skilled players were of different heights, would you expect one of them to make fewer free throws based only on his or her height? What about a very tall player who spends more time practicing free throws than a very short player? What if the sample size is too small to gather data that's true for the larger population? There is most likely not a causal relationship between height and free throw percentage.



## Lesson 2.18: Distinguishing Between Correlation and Causation

## Instruction

**Example 2**

Mr. Gray's students are interested in learning how studying can improve test performance. Mr. Gray provides students with practice problems related to particular tests. The class records the number of practice problems completed and the score on that related test in the following table. What is the correlation between the number of practice problems completed and the test score? Is there a causal relationship between the number of practice problems completed and the test score?

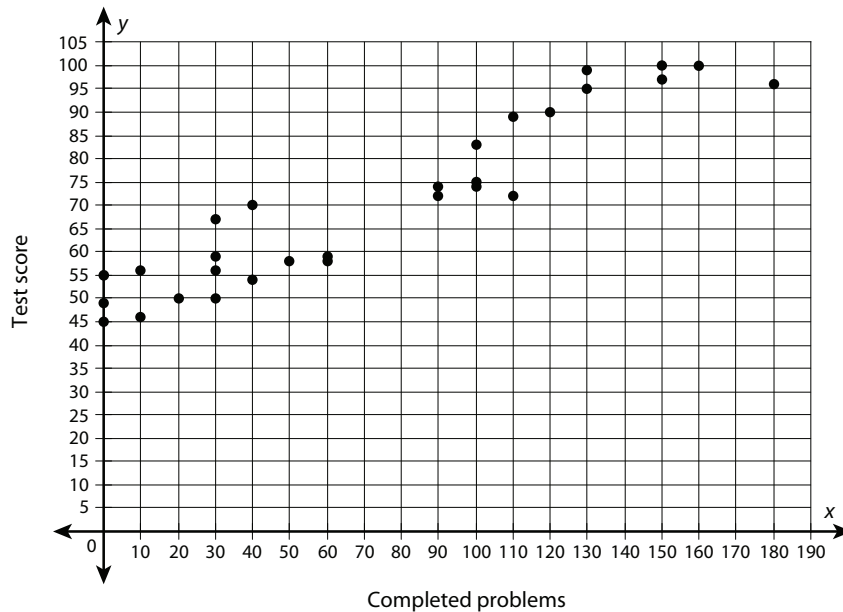
Problems completed	Test score, out of 100 points	Problems completed	Test score, out of 100 points
10	56	100	75
40	70	110	72
100	83	100	74
40	54	120	90
0	45	130	99
50	58	160	100
90	72	0	49
150	97	60	59
30	50	0	55
60	58	180	96
90	74	150	100
110	89	30	67
30	59	30	56
130	95	20	50
10	46		

Lesson 2.18: Distinguishing Between Correlation and Causation

Instruction

1. Create a scatter plot of the data.

Let the  $x$ -axis represent the number of completed practice problems and the  $y$ -axis represent the test score.



2. Analyze the scatter plot, and describe any relationship between the two events.

As the number of completed practice problems increases, the test score also increases. The shape of the graph is approximately a line, and it appears there is a positive linear correlation between the number of practice problems completed and the test score.

3. Find the correlation coefficient using a graphing calculator. Follow the steps in the Key Concepts section.

$$r = 0.942$$

Lesson 2.18: Distinguishing Between Correlation and Causation

Instruction

- Describe the correlation between the two events.

0.942 is close to 1. There is a strong positive linear correlation between the number of practice problems completed and the test score.



- Consider the causal relationship between the two events.

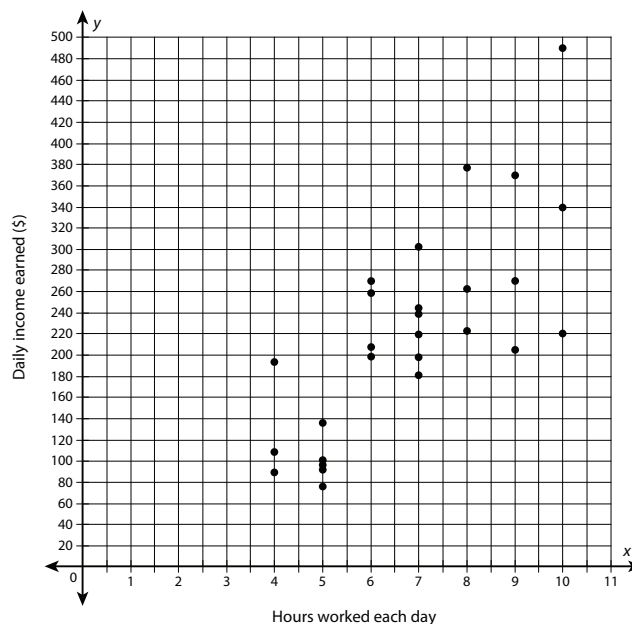
Determine if it is likely that the number of practice problems completed is responsible for increased test scores. Note any other factors that could influence test scores.

There is a strong correlation between the two events. A score on a test is related to a student’s knowledge of the test content, and a student’s ability to use content to solve problems. Completing practice problems allows students to develop skills directly related to test performance, and although there are other factors that are related to test performance, such as parental involvement and length of time spent studying, it is likely that there is a causal relationship between the number of practice problems completed and the test score.



**Example 3**

Nadia is a salesperson at a car dealership. She earns money each time she sells a car. To determine if there is a relationship between the number of hours she works and her income, she records the number of hours worked and the amount of money she earns each day. Her data is in the scatter plot that follows. Is there a causal relationship between the hours Nadia works and her daily income?



## Lesson 2.18: Distinguishing Between Correlation and Causation

## Instruction

1. Analyze the scatter plot, and describe any relationship between the two events.

As the number of hours increase, the daily income also increases, but there is much variation in the increase of income as hours increase. There appears to be a weak linear correlation between hours and income.



2. Consider the causal relationship between the two events.

Determine if the number of hours worked is responsible for an increase in income.

Nadia earns money when she sells a car. The more hours she works, the greater the opportunity she has to sell more cars. However, the only way to earn more money is to either sell more cars or to sell cars that are more expensive. She could work for 10 hours, but if she doesn't sell any cars, or make no effort to sell any cars, then her income will reflect this lack of sales or effort. Working more hours does not cause the increase in income. Selling more cars causes the increase in income. There is likely not a direct causal relationship between hours worked and income earned.

