

UNIT 4 • DESCRIBING DATA

Lesson 2: Working with Two Categorical and Quantitative Variables

Instruction

Guided Practice 4.2.4

Example 1

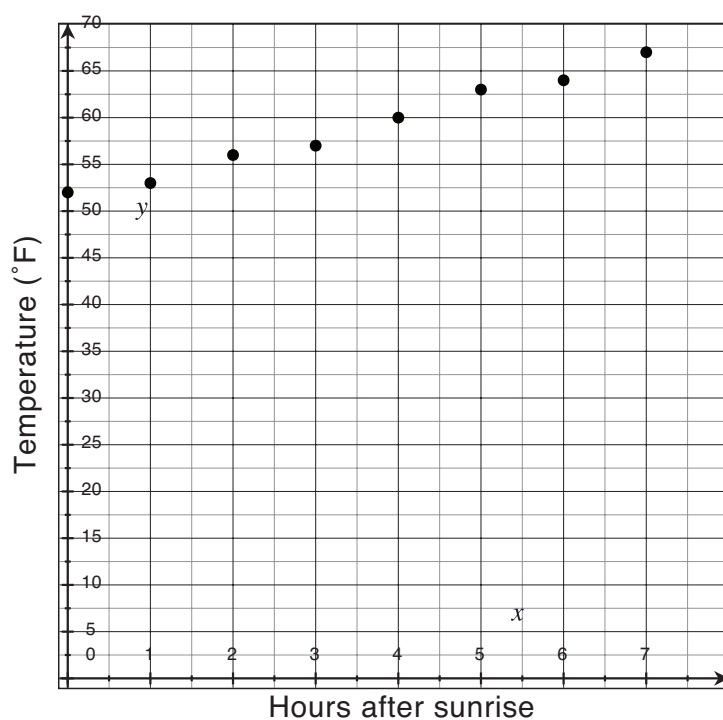
A weather team records the weather each hour after sunrise one morning in May. The hours after sunrise and the temperature in degrees Fahrenheit are in the table below.

Hours after sunrise	Temperature in °F
0	52
1	53
2	56
3	57
4	60
5	63
6	64
7	67

Can the temperature 0–7 hours after sunrise be represented by a linear function? If yes, find the equation of the function.

1. Create a scatter plot of the data.

Let the x -axis represent the hours after sunrise and the y -axis represent the temperature in degrees Fahrenheit.



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2. Determine if the data can be represented by a linear function.

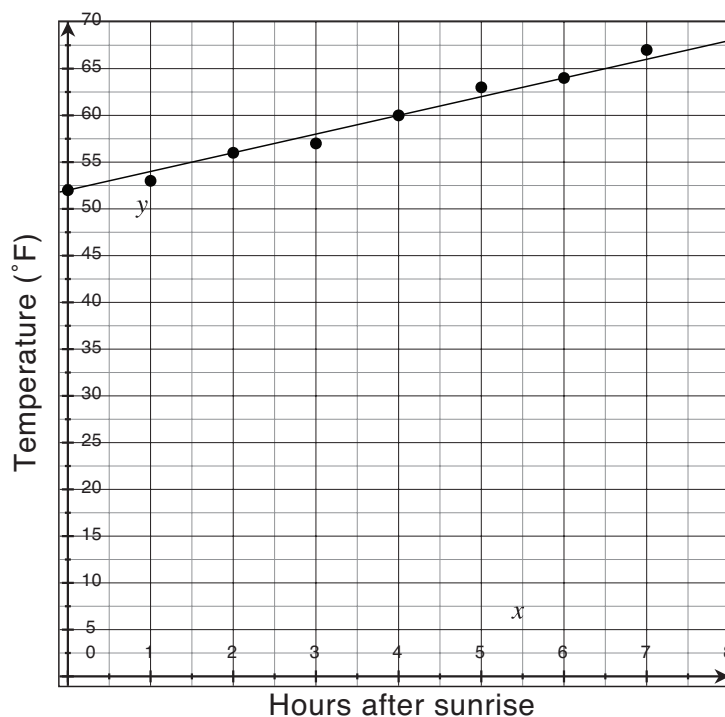
The graph of a linear equation is a line. If the data looks like it could fit a line, then a linear equation could be used to represent the data.

The temperatures appear to increase in a line, and a linear equation could be used to represent the data set.

3. Draw a line to estimate the data set.

Two points in the data set can be used to draw a line that estimates that data. When the line is drawn, some of the data values should be above the line, and some should be below the line.

A line through (2, 56) and (6, 64) looks like a good fit for the data.



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4. Find the equation of the line.

The general equation of a line in point-slope form is $y = mx + b$, where m is the slope, and b is the y -intercept.

Find the slope, m , of the line through the two chosen points. The slope is $\frac{\text{change in } y}{\text{change in } x}$. For any two points (x_1, y_1) and (x_2, y_2) , the slope is $\frac{y_2 - y_1}{x_2 - x_1}$.

For the two points $(2, 56)$ and $(6, 64)$, the slope is $\frac{64 - 56}{6 - 2} = 2$.

Next, find the y -intercept, b . Use the general equation of a line to solve for b . Substitute x and y from a known point on the line, and replace m with the calculated slope.

$$y = mx + b$$

For the point $(2, 56)$: $56 = 2(2) + b$; $b = 52$

Replace m and b with the calculated values in the general equation of a line.

$$y = 2x + 52$$

The temperature between 0 and 7 hours after sunrise can be approximated with the equation $y = 2x + 52$.



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Example 2

To learn more about the performance of an engine, engineers conduct tests and record the time it takes the car to reach certain speeds. A car starts from a stop and accelerates to 75 miles per hour. The table below shows the time, in seconds, after the car starts to accelerate and the speed it reaches at each time.

Time in seconds	Speed in miles per hour
0	0
1	2.3
2	6.6
3	13.5
4	22.4
5	32.2
6	44.2
7	57.8
8	74.6

Can the speed between 0 and 8 seconds be represented by a linear function? If yes, find the equation of the function.

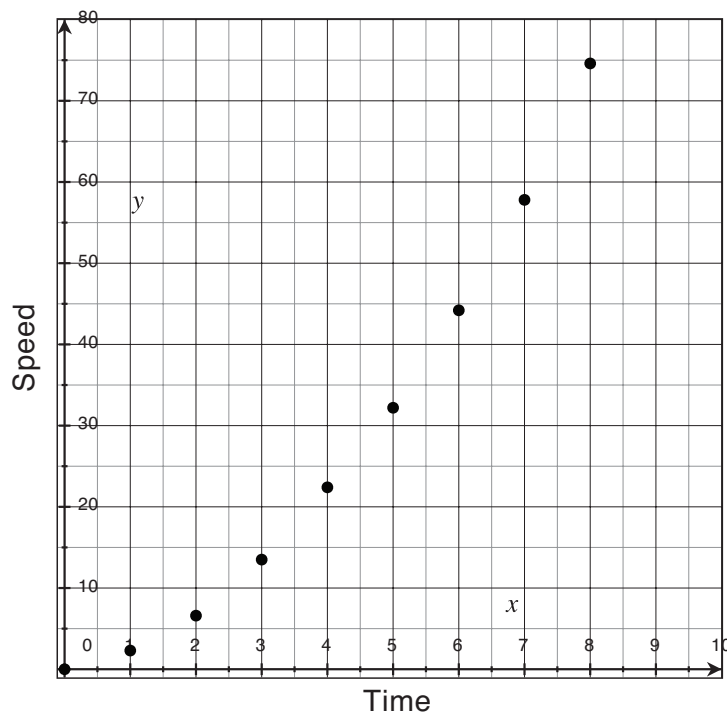
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1. Create a scatter plot of the data set.

Let the x -axis represent the time, in seconds, and the y -axis represent the speed.



2. Determine if the data can be represented by a linear function.

The x -values of each point are increasing by 1 unit. The y -values of each point are increasing by greater amounts as x gets larger. The first two points are close together, but the last two points show a large change in the speed. A curved graph has been created.

This data should not be approximated using a line, and therefore should not be represented by a linear equation.

No, the speed should not be represented by a linear equation. ✓

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Instruction**Example 3**

Automated tractors can mow lawns without being driven by a person. A company runs trials using fields of different sizes, and records the amount of time it takes the tractor to mow each field. The field sizes are measured in acres.

Acres	Time in hours
5	15
7	10
10	22
17	32.3
18	46.8
20	34
22	39.6
25	75
30	70
40	112

Can the time to mow acres of a field be represented by a linear function? If yes, find the equation of the function.

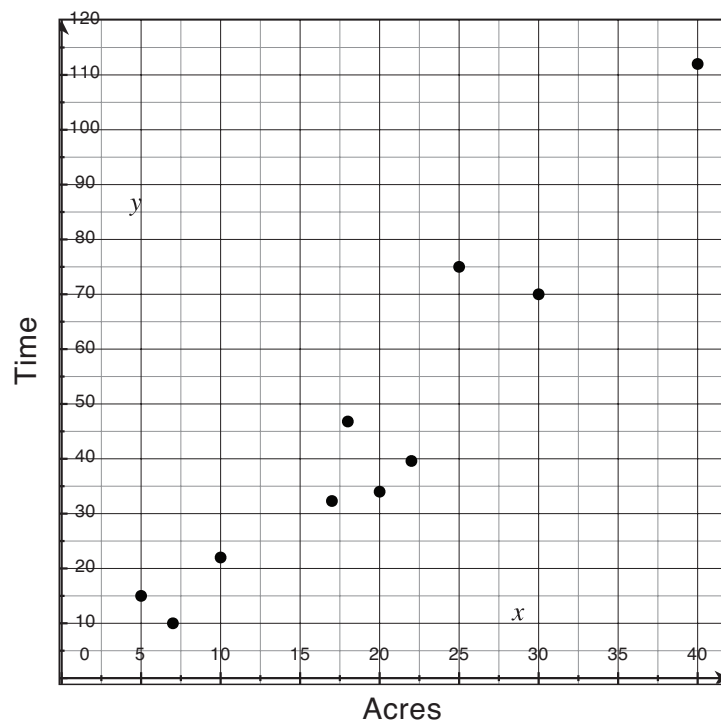
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Instruction

1. Create a scatter plot of the data.

Let the x -axis represent the acres and the y -axis represent the time in hours.



2. Determine if the data can be represented by a linear function.

The graph of a linear equation is a line. If the data looks like it could fit a line, then a linear equation could be used to represent the data.

The temperatures appear to increase in a line, and a linear equation could be used to represent the data set.

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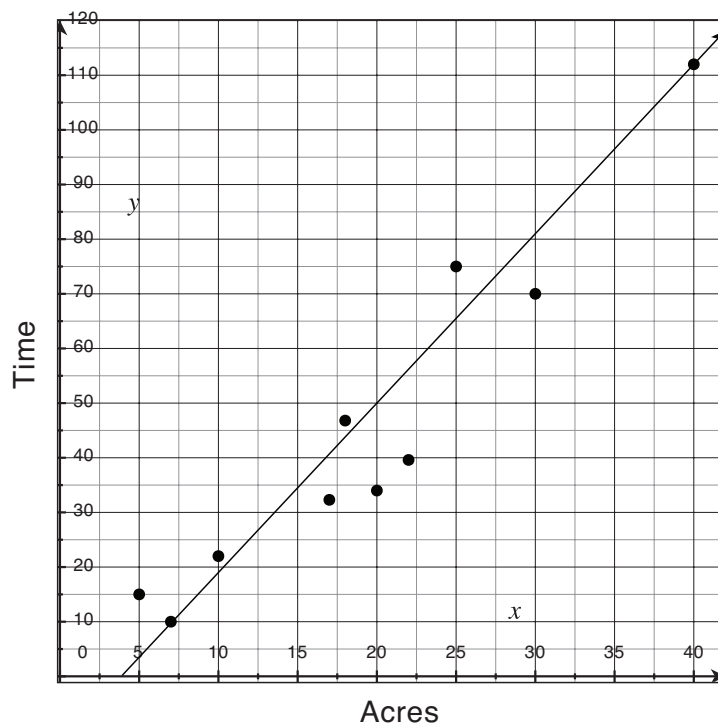
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3. Draw a line to estimate the data set.

Two points in the data set can be used to draw a line that estimates the data. When the line is drawn, some of the data values should be above the line, and some should be below the line.

A line through $(7, 10)$ and $(40, 112)$ looks like a good fit for the data.



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4. Find the equation of the line.

The general equation of a line in point-slope form is $y = mx + b$, where m is the slope, and b is the y -intercept.

Find the slope, m , of the line through the two chosen points. The slope is $\frac{\text{change in } y}{\text{change in } x}$. For any two points (x_1, y_1) and (x_2, y_2) , the slope is $\frac{y_2 - y_1}{x_2 - x_1}$.

For the two points $(7, 10)$ and $(40, 112)$, the slope is $\frac{112 - 10}{40 - 7} = 3.1$.

Next, find the y -intercept, b . Use the general equation of a line to solve for b . Substitute x and y from a known point on the line, and replace m with the calculated slope.

$$y = mx + b$$

For the point $(7, 10)$: $10 = 3.1(7) + b$; $b = -12$

Replace m and b with the calculated values in the general equation of a line.

$$y = 3.1x - 12$$

The amount of time to mow the acres of a field can be represented using the equation $y = 3.1x - 12$.



NAME: _____

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Problem-Based Task 4.2.4: Lion Cub Births

A zoologist studies different prides, or groups of lions, living throughout Africa. He records the number of adult females in each pride, and the number of newborn cubs. His results are in the table that follows.

Adult females	Cubs
6	5
13	7
7	6
17	9
14	7
3	1
10	6
7	4
4	3
15	8
8	5
3	0
13	8
12	7
11	7
14	9
6	4

The zoologist would like to use this information estimate the number of cubs born each year. He would like an equation that relates the number of adult females to the number of newborn cubs. Can this relationship be estimated using a linear function? If yes, find the equation of the function.