

Standard 8.SP.1 (M–H)

Patterns of Association

Scatter plots allow you to see relationships between two variables. A **relationship** is a pattern in a scatter plot that shows one variable tends to vary in a way that corresponds to a change in the other variable.

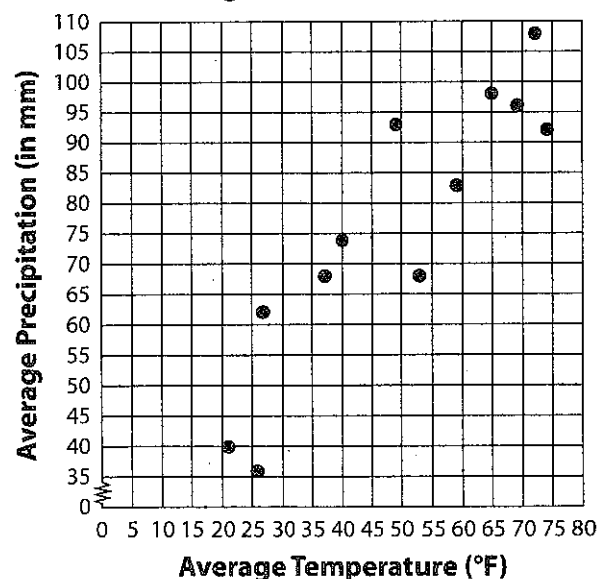
What You Need to Know: Even if a scatter plot shows a pattern between two variables, you cannot conclude a cause-and-effect relationship between the two variables. You cannot say that the change in one variable causes the change in the other variable.

The table below shows the average monthly temperature and average monthly precipitation in Chicago.

Chicago Weather Averages

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average Temperature (°F)	21	26	37	49	59	69	74	72	65	53	40	27
Average Precipitation (in mm)	40	36	68	93	83	96	92	108	98	68	74	62

The data from the table was used to create the scatter plot below.

Chicago Weather Averages*continue to next page*

An **association** describes how two sets of data are related. The data are said to have **no association** when a change in one data set does not affect the other data set.

Talk About It-1: Does the scatter plot on page 62 show any associations between the average monthly temperature and the average monthly precipitation? How do you know?

An association can be described as positive or negative. A **positive association** occurs when both data sets increase together. An increase in one variable corresponds to an increase in the other variable. The pattern created by the data points seems to have a positive slope. A **negative association** occurs when one data set increases, but the other data set decreases. An increase in one variable corresponds to a decrease in the other variable. The pattern created by the data points seems to have a negative slope.

Talk About It-2: Does the scatter plot on page 62 show a positive or a negative association between the average monthly temperature and the average monthly precipitation? How do you know?

An association can also be described as linear or nonlinear. A **linear association** occurs when the data points closely resemble a straight line. The data points seem to increase or decrease at a constant rate. A **nonlinear association** occurs when the data points do not resemble a straight line. The data points seem to increase or decrease at a variable (non-constant) rate.

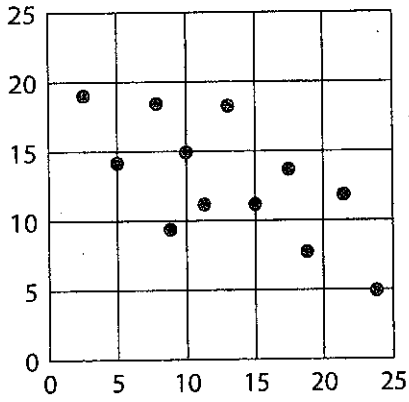
Talk About It-3: Does the scatter plot on page 62 show a linear or a nonlinear association between the average monthly temperature and the average monthly precipitation? How do you know?

Write About It: Based on your answers to the questions above, write a sentence to describe the association between the average monthly temperature and the average monthly precipitation in Chicago.

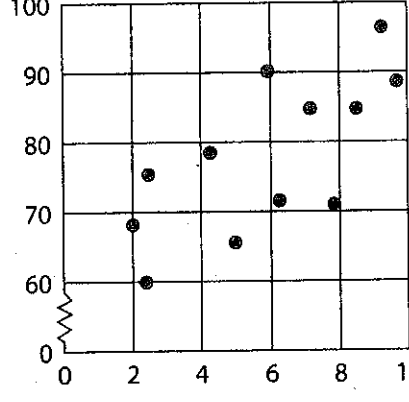
Standard 8.SP.1 (M)

Describing Scatter Plots I

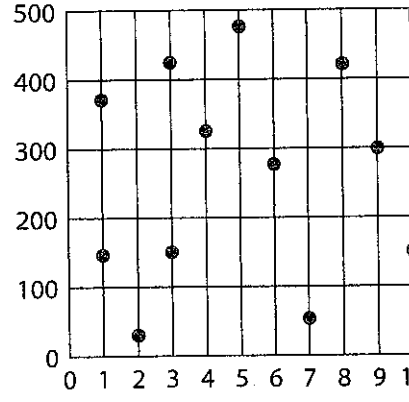
Directions: Determine whether the data sets on each of the following scatter plots show an association or no association. If the scatter plot shows an association, describe the association as positive or negative and as linear or nonlinear. Write your complete answer on the lines provided.

1. 

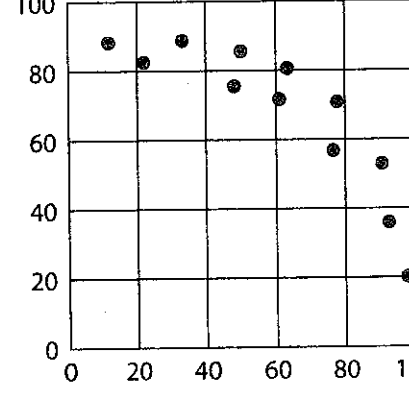
Answer: _____

3. 

Answer: _____

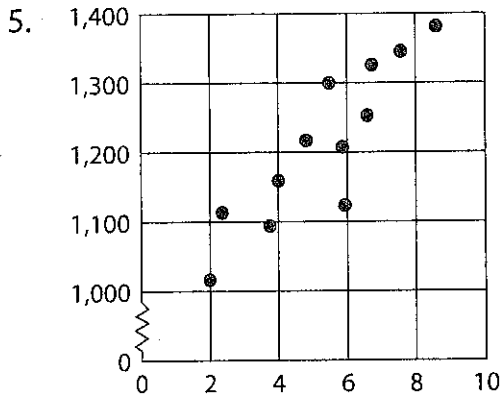
2. 

Answer: _____

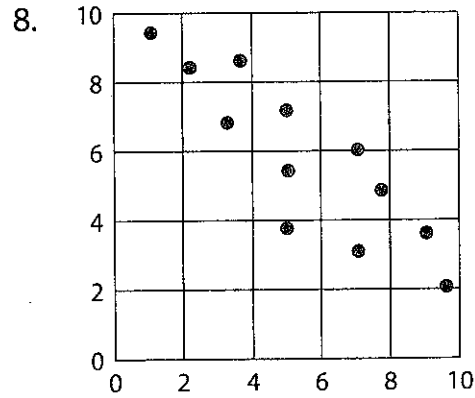
4. 

Answer: _____

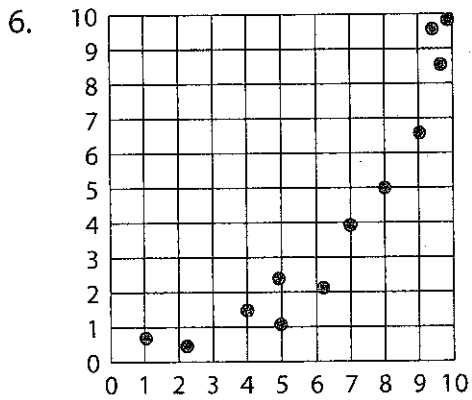
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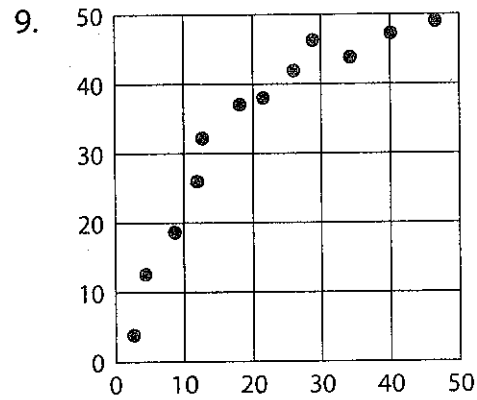
Answer: _____



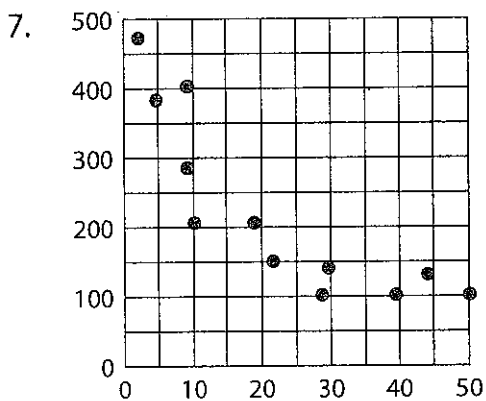
Answer: _____



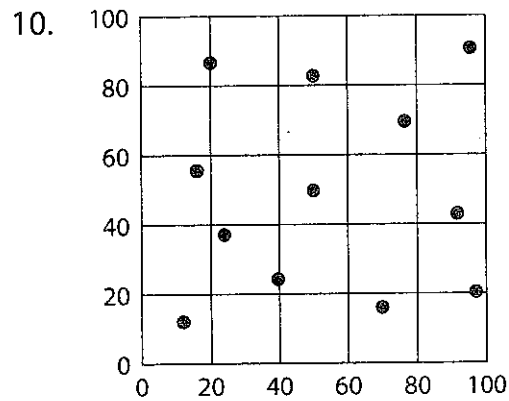
Answer: _____



Answer: _____



Answer: _____



Answer: _____

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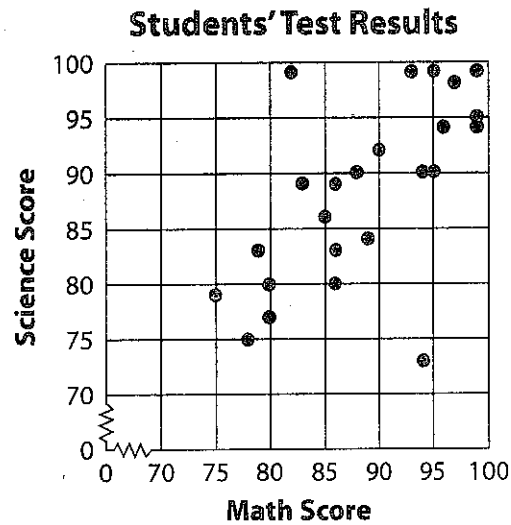
Identifying Outliers & Clusters

Outliers

An **outlier** is a value that is much less or much greater than other values in a data set. On a scatter plot, an outlier is a point that does not seem to fit the pattern created by the rest of the data points.

Example

The scatter plot below shows the scores of 24 eighth-grade students on a math test and a science test last week.



Talk About It-1

- Describe the association shown on the scatter plot.
- Identify the outliers, if any.

As you can see on the scatter plot, the outliers are far away from the rest of the data points.

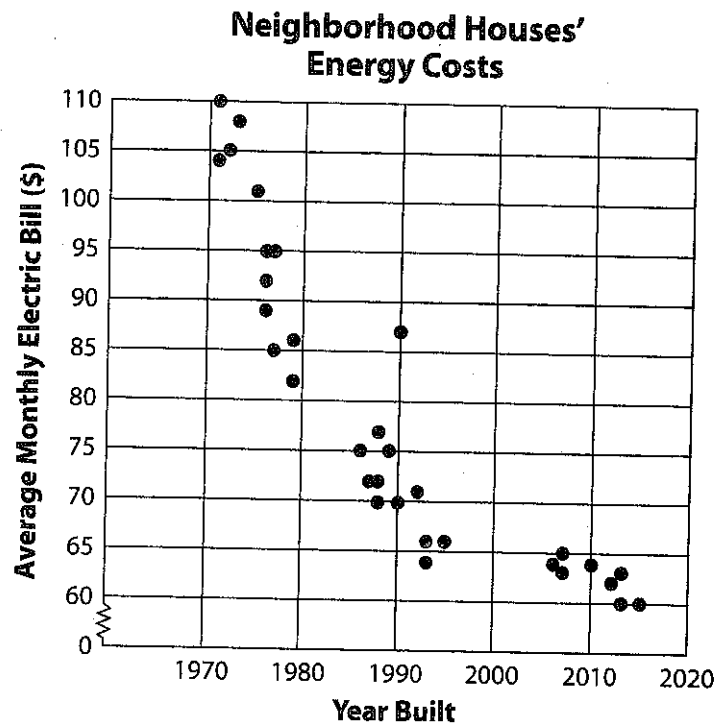
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Clusters

Sometimes the data points on a scatter plot form two or more separate groups of points. These closely grouped sets of data points are called **clusters**.

Example

The scatter plot below shows the year that houses in a neighborhood were built and the average monthly electric bill the homeowners pay.



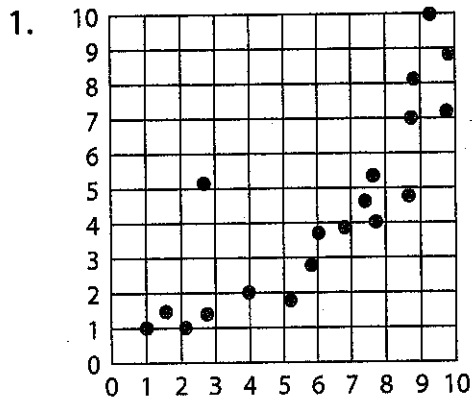
Talk About It-2

- Describe the association shown on the scatter plot.
- Identify the clusters, if any.
- Identify the outliers, if any.

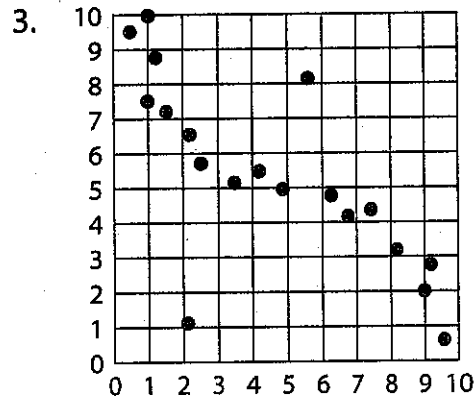
Standard 8.SP.1 (M)

Describing Scatter Plots II

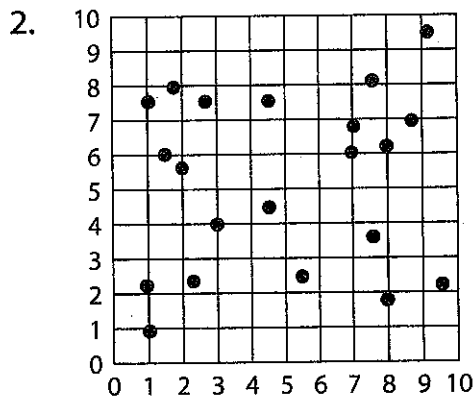
Directions: Determine whether the data sets on each scatter plot below show an association or no association. If the scatter plot shows an association, describe the association as positive or negative and as linear or nonlinear. Write your complete answer on the lines provided. Then, draw a circle around any clusters and draw a box around any outliers. Note: A scatter plot might not have any clusters or outliers.



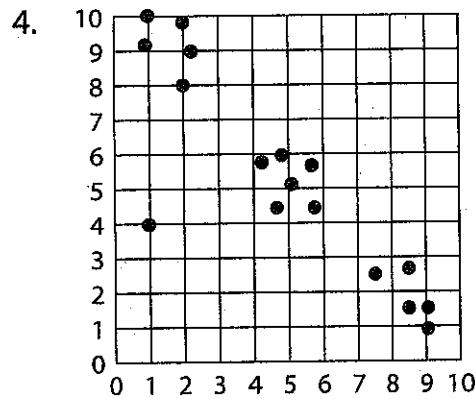
Answer: _____



Answer: _____



Answer: _____



Answer: _____

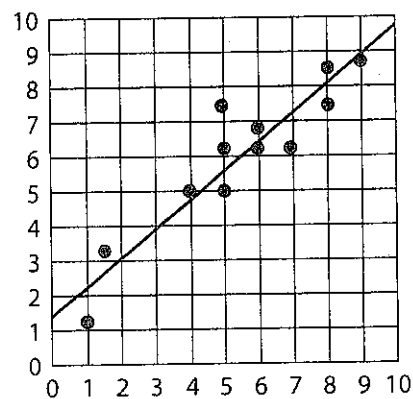
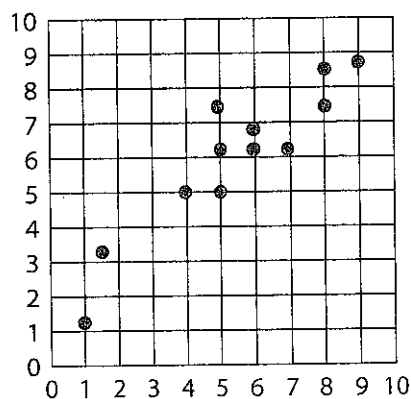
Standard 8.SP.2 (M)

Linear Models

A linear model can be drawn on a scatter plot to approximate and model the relationship between the two variables. A **linear model** is a straight line that represents the linear association between variables, and it can be used to approximate or predict the value of one variable when the value of the other variable is known.

Trend is another word for association. A **trend** describes the visible pattern in the scatter plot. A linear model doesn't show the exact data values. It shows a line that best "fits" the trend in the data. A linear model is also known as a trend line or a line of best fit.

Look at the scatter plots below.



The linear model represents the relationship between the two sets of data on the scatter plot.

What You Need to Know: You can only draw a linear model if the scatter plot suggests a linear association between the two variables.

Talk About It

- Describe what you think when you hear "linear model."
- Describe what you think when you hear "trend line."
- Describe what you think when you hear "line of best fit."
- Which term do you prefer? Why?

Linear equations can represent linear models on scatter plots. You will learn how to do this in a later lesson. In the next lesson, you will learn how to draw linear models.

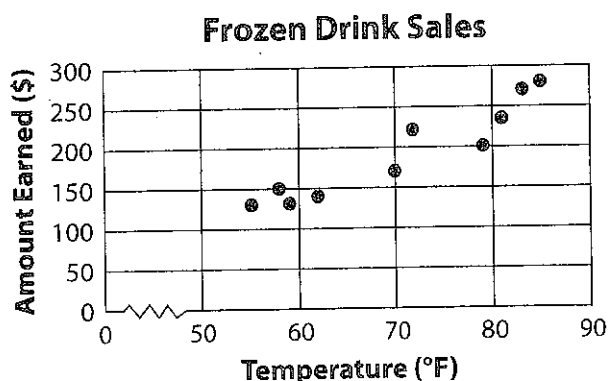
Standard 8.SP.2 (M–H)

Strategies for Drawing Linear Models

Before you can draw a linear model on a scatter plot, you must determine whether the scatter plot suggests a linear association between the two data sets. Remember, a linear association occurs when the data points resemble a straight line and seem to increase or decrease at a constant rate. If the scatter plot does not suggest a linear association, you cannot draw a linear model. Linear models can only represent linear associations.

After you have determined that a scatter plot suggests a linear association between the two data sets, you can consider how to draw a linear model.

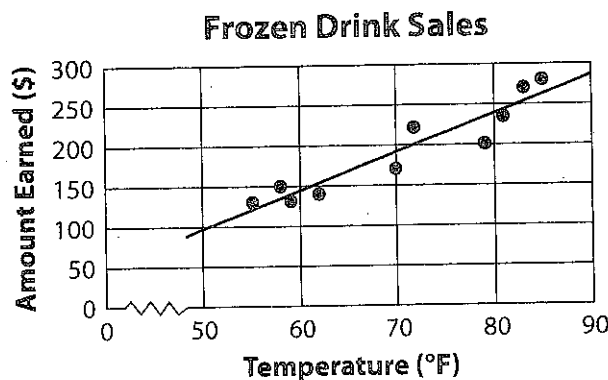
Look at the scatter plot below, and think about the association between the two data sets.



The scatter plot suggests a positive linear association between the data sets, so we can draw a linear model.

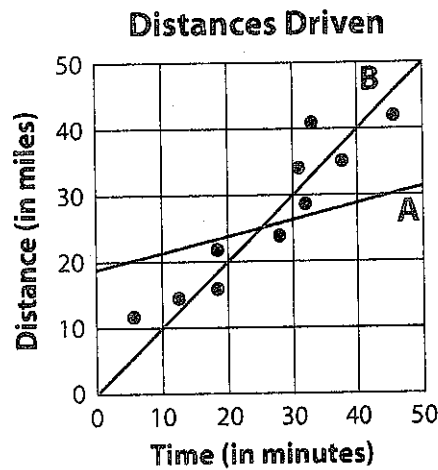
A linear model should be drawn so that about half of the data points are above the linear model and about half of the data points are below the linear model. Most of the data points should be *relatively close* to the line. (Outliers may be quite far away from the linear model.) The linear model may pass through all, most, some, or none of the data points on the scatter plot.

The scatter plot below includes a linear model that meets the requirements described above.



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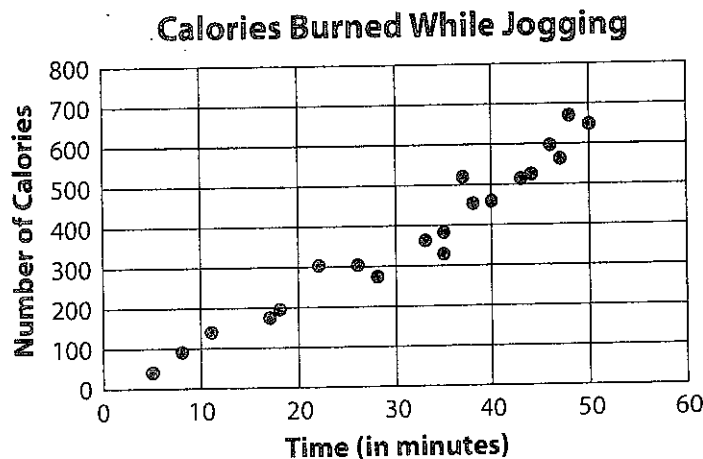
It is important that linear models follow the pattern or trend shown in the data. Look at the two linear models drawn on the scatter plot below.



Talk About It-1: Which linear model do you think is best, A or B? Why?

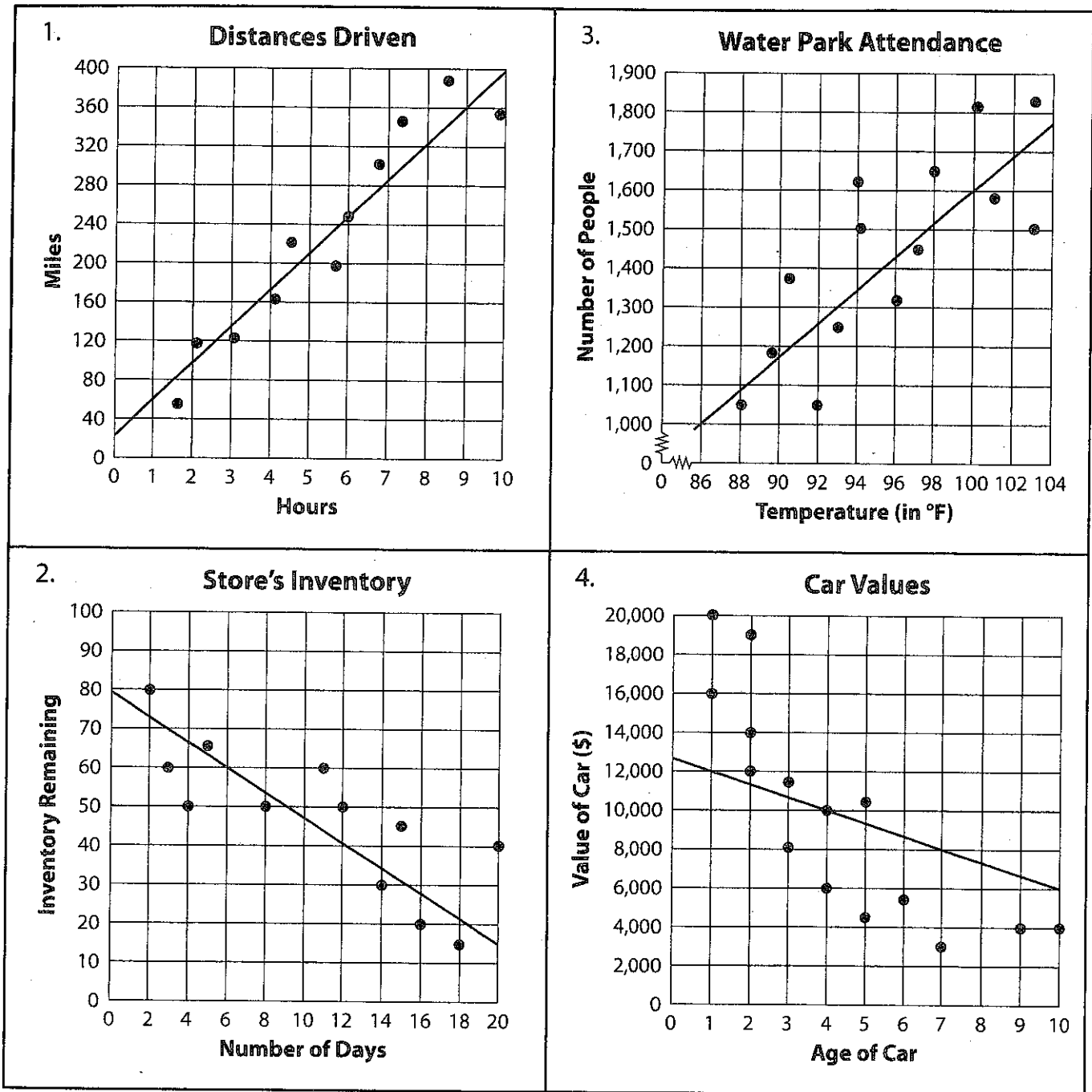
Both linear models are drawn so that about half of the data points are above them and about half of the data points are below them. The data points are relatively close to both linear models. However, linear model B is more accurate because it better represents the pattern of the data. Linear model B shows a greater positive relationship than linear model A.

Working Together: Working in groups of three or four, each student will draw a linear model to represent the relationship between the two sets of data shown on the scatter plot below. Group members will then compare their linear models and choose the one they think best represents the data. The group will explain its choice to the entire class. (Hint: Use a ruler or straight edge to help you draw linear models.)



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Talk About It-2: Look at the linear model drawn on each scatter plot below. Explain to the entire class why the linear model is properly drawn or improperly drawn. Then, if the linear model is improperly drawn, redraw it.



Think About It: What is the purpose of linear models?

Standard 8.SP.2 (M)

Drawing Linear Models I

Directions: Draw a linear model to represent the relationship between the two sets of data on each scatter plot below, if the scatter plot suggests a linear relationship.

