f. Which graph (bar or pie) do you think best represents this data? Justify your choice.

9. A student teacher has the grade for each of her 22 students as a percentage. Most grades are passing, that is, higher than 70%. Explain why a pie graph should not be used to represent this data.
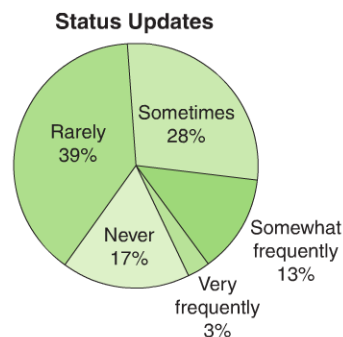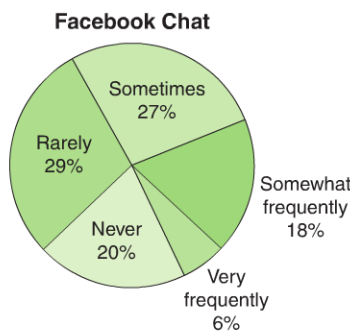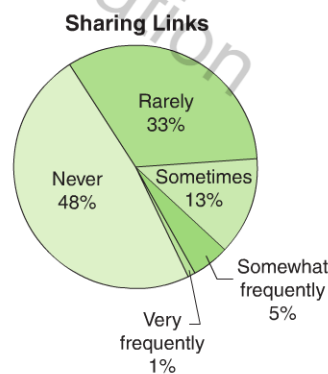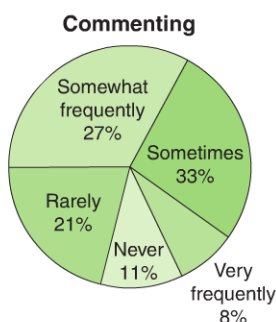
1.8 Two by Two

Explore

Will spending too much time on Facebook have a negative impact on your performance in college? Many studies have been done to answer this and other related questions. It appears that *how* you use Facebook is as important as *how much* you use it.

Consider the following pie graphs, which show the percentage of students in one study who use various features on Facebook. Responses in the study used this ranking system from low to high: never, rarely, sometimes, somewhat frequently, very frequently.

Commenting

- Somewhat frequently 27%
- Sometimes 33%
- Rarely 21%
- Never 11%
- Very frequently 8%

Sharing Links

- Rarely 33%
- Never 48%
- Sometimes 13%
- Somewhat frequently 5%
- Very frequently 1%

Facebook Chat

- Sometimes 27%
- Rarely 29%
- Never 20%
- Somewhat frequently 18%
- Very frequently 6%

Status Updates

- Sometimes 28%
- Rarely 39%
- Never 17%
- Somewhat frequently 13%
- Very frequently 3%
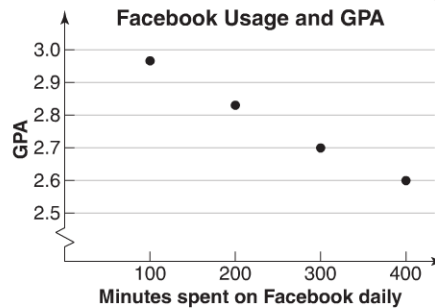
Graphs based on: http://edudemic.com/2011/12/facebook-and-grades/

Remember?

To take a percent of a number, multiply the percent in decimal form by the number.

1. If the study consisted of 1,839 college students, how many of them claimed that they commented on Facebook somewhat frequently?

2. If the study consisted of 1,839 college students, how many of them claimed that they make status updates at most rarely?

3. Of the listed Facebook features, which seems to be the least popular with college students? Explain your answer choice.

4. Do you think bar graphs would be a better choice for presenting this information? Explain your answer.

The following graph from the study on Facebook use is called a **scatterplot** and it shows how time spent on Facebook is related to college GPA.

STICKY note

If the minimum value on an axis is something other than zero, there should be a jagged start to the axis. You will see many graphs in the press where this is not done, however. The important point is to **always pay attention to the axes labels** since they affect the look and impression of graphs.

Facebook Usage and GPA

Source: edudemic.com

5. What was the GPA for students who spent about 200 minutes daily on Facebook?

6. What was the GPA for students who spent about 400 minutes daily on Facebook?

7. What trend do you think this graph suggests about time spent on Facebook and GPA?

Discover

You already know how to make and interpret bar and pie graphs, but not all data can be represented with these two types of graphs. Sometimes a situation involves related or paired data such as height/weight, study time/grades, or education/income. If a situation involves paired data and you wish to investigate or illustrate the relationship between the two types of data, then a scatterplot is a useful graph to make.

look IT UP

Scatterplot

A **scatterplot** is a graph that shows the relationship between two variables. The horizontal axis is used to represent one variable, and the vertical axis is used to represent the other variable. The data values are plotted as ordered pairs, but the points are not connected.

For example, the graph comparing minutes on Facebook to GPA is a scatterplot. Notice that the vertical axis does not start at zero. This has been indicated by a jagged start to the axis, which shows a break in the scale.

In the study on Facebook use, the researchers wanted to explore how time spent on Facebook is related to college GPA. The scatterplot you saw in the *Explore* is a useful tool since it shows several examples of this paired data.

8. Each point on the scatterplot corresponds to an ordered pair. Which variable would be listed first in the ordered pair, and which would be listed second?

The researchers displayed the data in this way because they suspected that the time spent on Facebook affects GPA and not the reverse. In this case, the minutes spent on Facebook daily are considered the **independent variable** and the GPA is considered the **dependent variable** since it depends on the amount of time spent on Facebook.

look IT UP

Independent and Dependent Variables

When two variables are paired, the one that is thought to depend on the other is called the **dependent variable**. The other is called the **independent variable**. This distinction is often a matter of perspective and is not set in stone.

For example, suppose you are driving 60 mph. If you travel for 1 hour, then you will go 60 miles. If you travel for 2 hours, then you will go 120 miles. In this sense, your distance would depend on the time. You might consider distance to be the dependent variable.

However, you could also say that in order to go 60 miles, you need to drive for 1 hour. From this perspective, travel time could be considered the dependent variable.

In a scatterplot, the independent variable is plotted on the horizontal axis and the dependent variable is plotted on the vertical axis. It makes sense to plot the value of the independent variable (x) first and then the value of the dependent variable (y).

Let's look more closely at the steps needed to create a scatterplot.

A CLOSER LOOK

LEARN

To make a scatterplot, first decide which variable will be the independent variable (and plotted on the horizontal axis) and which will be the dependent variable (and plotted on the vertical axis) for the given data. Sometimes this will be decided for you.

Next, a scale will need to be determined for each axis. To determine a scale, consider the smallest and largest numbers (approximately) that need to be graphed for each variable and then choose a consistent increment to cover the distance between them. For example, you might need to show numbers from 100 to 250 on an axis and choose to use an increment, or step, of 25 to cover that range. To show this scale, you would draw tick marks at 100, 125, 150, and so on, until you reach 250.

Once the axes and scales are determined, plot each pair of values as an ordered pair on the graph. The value of the independent variable will be the first number in the ordered pair, and the value of the dependent variable will be the second number in the ordered pair. Do not connect the individual points after they are plotted.

EXAMPLE Consider the following data for a car traveling at 60 miles per hour.

Time (hours)	Distance (miles)
5	300
8	480
10	600
12	720
18	1,080

Complete the following items to prepare for making the scatterplot. Keep in mind that there is no single correct answer for the minimum/maximum values and increment. Since your choices will affect the look of your scatterplot, it is important to make reasonable choices that will display the data well.

Which variable is the independent variable?

On which axis will this variable be graphed?

Minimum value for this axis:

Maximum value for this axis:

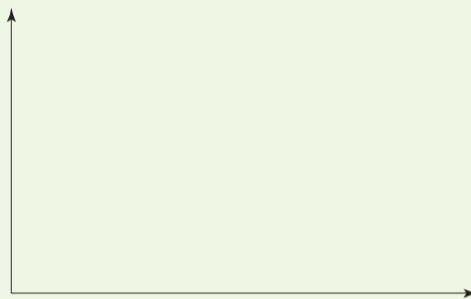Increment:

Which variable is the dependent variable?

On which axis will this variable be graphed?

Minimum value for this axis:

Maximum value for this axis:

Increment:

Now draw the scatterplot. Since all of the points will fall in the first quadrant, concentrate on and show only that quadrant.

What conclusions can be drawn from this scatterplot?

How it works

To make a scatterplot:

1. Decide which variable is the independent variable and which is the dependent variable in the paired data.
2. Draw axes and label each axis with the appropriate variable name.
3. Choose a minimum and maximum value to be graphed on each axis by considering the range of data values. If an axis does not start at zero, indicate this with a jagged line.
4. Choose a convenient increment for each axis.
5. Plot the data as ordered pairs with the value of the independent variable first.
6. Do not connect the points. The dots will not necessarily fall in a line or other pattern.

For example, make a scatterplot to represent the following data.

Time Spent Studying per Week (hours)	College GPA
2	1.8
4	2.2
7	2.4
10	3.2
14	3.8

It makes sense to consider the time spent studying as the independent variable and graph it on the horizontal axis.

College GPA will be the dependent variable and graphed on the vertical axis.

For the time spent studying, the scale can go from 0 to 15 hours with an increment of 1 hour.

For the College GPA, the scale can go from 0 to 4 since that represents the full range of possibilities, or it can be shortened to show just the data in the table. A reasonable increment for this scale might be 0.2.

GPA vs. Study Time
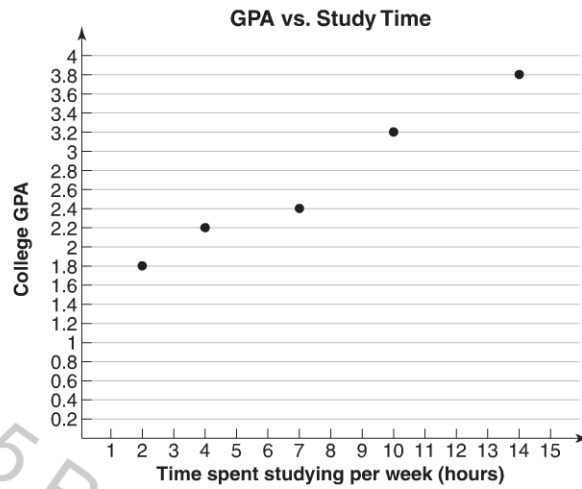
PRACTICE

Consider the following data on years of experience and salaries for a department.

Experience (years)	Salary (dollars)
0	48,000
1	67,000
3	54,000
4	58,000
5	62,000
5	64,000
11	74,000
15	81,000
16	85,000
23	92,000

Complete the following items to prepare for making a scatterplot. Keep in mind that there is no single correct answer for the minimum/maximum values and increment. Since your choices will affect the look of your scatterplot, it is important to make reasonable choices that will display the data well.

Which variable is the independent variable?

On which axis will this variable be graphed?

Minimum value for this axis:

Maximum value for this axis:

Increment:

Which variable is the dependent variable?

On which axis will this variable be graphed?

Minimum value for this axis:

Maximum value for this axis:

Increment:

Now, draw the scatterplot. Since all of the points will fall in the first quadrant, you can show only this quadrant in the graph.

What conclusions can be drawn from this scatterplot?

Connect

9. The scatterplot shown below from the beginning of the lesson gives the impression that GPA falls fairly significantly as the number of minutes spent on Facebook increases. This impression is determined in part by the scale on the y-axis, which is from 2.5 to 3.0 and has an increment of 0.1. Redraw the scatterplot with a scale of 0–4 and an increment of 1 on the y-axis and comment on the impression the new graph gives about the relationship between GPA and time spent on Facebook.

Facebook Usage and GPA

GPA

3.0
2.9
2.8
2.7
2.6
2.5

100   200   300   400

Minutes spent on Facebook daily
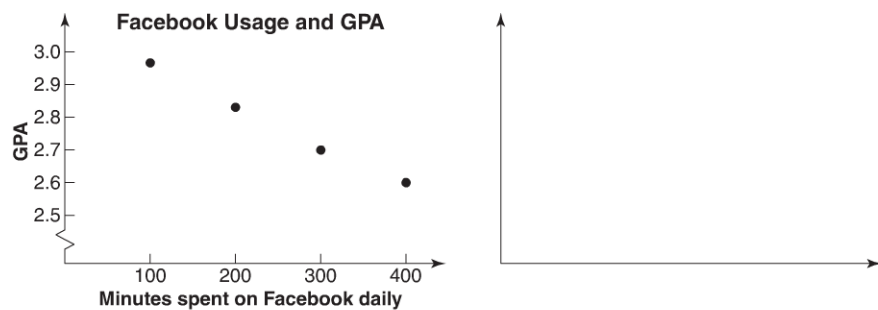
Neither of the scatterplots are incorrect, but they certainly give different impressions of the trend in the data. When you create a scatterplot, choose the scale thoughtfully to try to display the data well without making it misleading. When you view a scatterplot, remember to look at the scale used on each axis and consider why the maker of the graph chose that scale and whether or not it was a reasonable choice. Consider that the maker of the graph might have an agenda and could be presenting the data in a certain way to make a point.

Reflect

WRAP-UP

What's the point?

Scatterplots can be helpful for illustrating paired data from two related variables. It is important to choose the scale for the axes thoughtfully since the scale will affect the appearance of the graph and the impression it gives a viewer.

What did you learn?

How to determine which variable is independent and which is dependent in paired data
How to choose an appropriate scale for the axes when graphing paired data
How to create and interpret scatterplots

Cycle 1 Question: What can be learned?

The scatterplots in this lesson contained valuable advice for success in college. List something you learned from the scatterplots.

1.8 Homework

Skills   MyMathLab

- Determine which variable is independent and which is dependent in sets of paired data.
- Create and interpret scatterplots.

1. From each verbal description, identify the independent and dependent variables.

   a. A tree grows approximately 6 inches per year and is 10 feet tall when planted.

   b. When a swimmer gets 8 hours of sleep the night before, she is able to complete a 200-meter swim in 3 minutes. When she only gets 6 hours of sleep, it takes her 3.16 minutes to complete the same swim.

Concepts and Applications

- Determine which variable is independent and which is dependent in sets of paired data.
- Choose an appropriate scale for each axis on a graph.
- Create and interpret scatterplots.

2. The number of times per day that students check Facebook seems to have a negative effect on the amount of time they spend preparing for class. Consider the following data.

Number of Times FB Checked per Day	Time Spent Preparing for College Classes per Day (minutes)
0	120
3	95
5	90
6	80
6	60
7	70
8	40
9	20
10	10

Complete the following items to prepare for making a scatterplot. Keep in mind that there is no single correct answer for the minimum/maximum values and increment. Since your choices will affect the look of your scatterplot, it is important to make reasonable choices that will display the data well.

Which variable is the independent variable?　　　Which variable is the dependent variable?

On which axis will this variable be graphed?　　　On which axis will this variable be graphed?

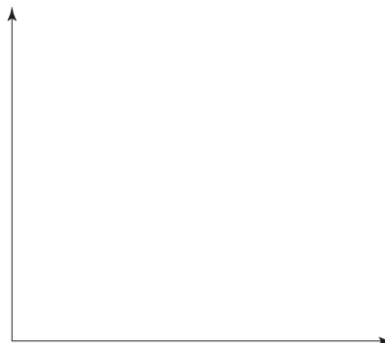Minimum value for this axis:　　　Minimum value for this axis:

Maximum value for this axis:　　　Maximum value for this axis:

Increment:　　　Increment:

Draw the scatterplot.

What conclusions can be drawn from this scatterplot?

3. High school GPA is well known to be a good predictor of college GPA. Consider the following data.

HS GPA	College GPA
3.9	3.7
3.6	3.5
3.5	3.6
3.1	3.0
2.5	2.0
2.3	2.2
2.1	1.8
1.9	1.5
1.5	1.0

Complete the following items to prepare for making a scatterplot. Keep in mind that there is no single correct answer for the minimum/maximum values and increment. Since your choices will affect the look of your scatterplot, it is important to make reasonable choices that will display the data well.

Which variable is the independent variable?

On which axis will this variable be graphed?

Minimum value for this axis:

Maximum value for this axis:

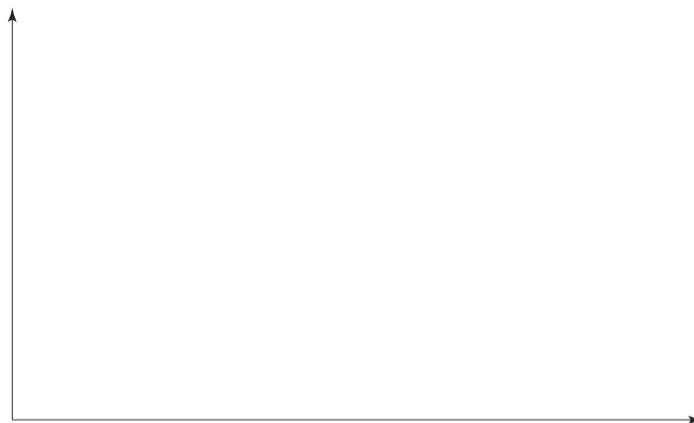Increment:

Which variable is the dependent variable?

On which axis will this variable be graphed?

Minimum value for this axis:

Maximum value for this axis:

Increment:

Draw the scatterplot.

What conclusions can be drawn from this scatterplot?