

AN INTRODUCTION TO GRAPHS

This is an introduction to drawing, reading, and understanding graphs. This material can also be used as a review. Graphs are important because much of what is done in economics can be understood more easily when translated into graphical form. You should think of a graph as a picture and try to see what the picture shows.

THE ORIGIN, OVER AND UP

The explorer Fella della Hydrant was leading a tourist party through the North American wilderness. At 10:06 a.m. on Saturday, July 18, 1784, he turned to his chief guide, a one-eyed Frenchman named Quainto, and said "Where are we?" Any useful reply given by Quainto requires knowing where they started. The "Where are we?" question is really asking "Where are we compared to some starting point?" The same is true for any location or point on a graph. The starting point on a graph, the point where measurement begins, is called the origin. Before we can know where we are on a graph, or otherwise, we must know the origin.

Suppose that for Fella the origin point is Washington D.C. and Quainto replies, "We are 50.421 miles as the crow flies from Washington D.C." The problem is that 50.421 miles could be in any direction. By itself, 50.421 miles would not locate Fella, Quainto, and party. What if Quainto replies, "We are northwest of Washington D.C." The problem now is that Fella could be any distance northwest of Washington D.C. What we are discovering is that location is not determined by one measure alone; we need two measurements, both distance and direction, as well as an origin.

Consider a different example. Fella and Quainto are in a town called Pumpnickel. They make a street corner acquaintance, Mr. Plotkin, who assures them that a tourist party from Pumpnickel can be arranged for Fella and Quainto to lead. Fella and Quainto agree to meet at Plotkin's house to make arrangements. Plotkin says he lives at 422. Given that information, will Fella and Quainto find the house? It is unlikely. What if Plotkin says only that he lives on 4th Street? Again it is unlikely that they will find the house. They need both the street and the house number, and of course an origin.

Similarly, we will need two numbers and an origin to locate a point on a graph. We shall call the two numbers the over number and the up number. The origin is identified in Figure 1 as the zero point. The over number tells how far over, straight right, we go from the origin. The up number tells how far straight up we go from the origin. It does not matter whether we go over first and then up, or up first and then over: we always end at the same point. For each over and up pair, there is one and only one point on a graph. And for each point on a graph there is one and only one origin over and up pair. Suppose that you go over six and up four in Figure 2. Now go over four first and then over six. You

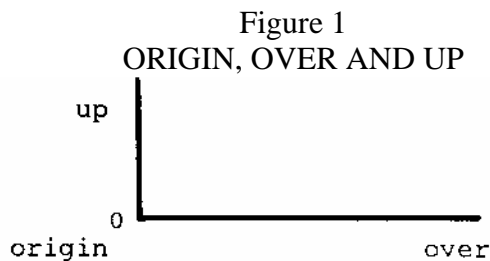


Figure 2
USING OVER AND UP

will come to the same point. Just remember which number is the over number and which number is the up number.

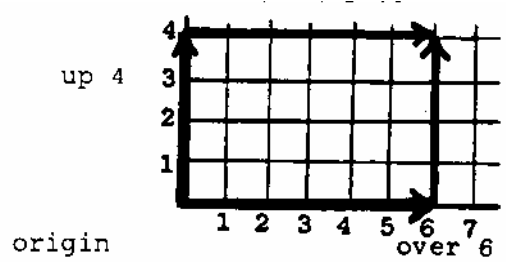


Figure 3
PRACTICING OVER AND UP

Suppose that we are told to go over 5 and up 3. Where will we be? In Figure 3, we show over 5 which puts us at the five, and then up three. What if we want to go over 2 and up 4? We go over 2 and then up 4 as shown in Figure 4. To read the point A in Figure 4, remember that a point is a combination of two numbers. This point is not 2, nor is it 4. This point is over 2 and up 4.

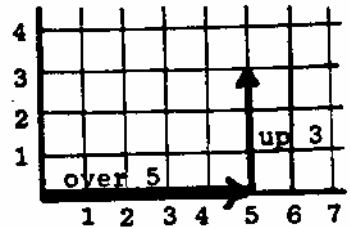


Figure 4
PRACTICING OVER AND UP

If we only go over, and not up, then we are moving along the horizontal axis, or line. If we only move up and not over, we are moving along the vertical axis. The axes are important because they guide us in locating points. We can also name and measure an economic quantity along each axis. For example, we may measure the quantity of a good on the horizontal (the over) axis and the price of the good on the vertical (the up) axis. As we move right along the horizontal axis, the quantity measured on this axis increases, as shown in Figure 5. As we move left along the horizontal axis, the quantity measured decreases. As we go up the vertical axis, the quantity measured increases; as we move down the vertical axis, the quantity measured decreases.

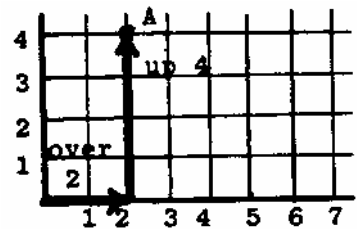
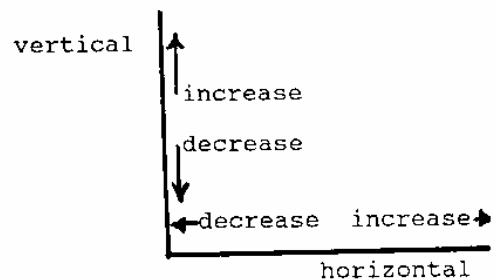


Figure 5
HORIZONTAL AND VERTICAL



So far we have stayed on the right side and above the origin. We will not need to do more than that, but you can be sure that it is possible to move left and/or down from the origin.

LINES

Once we can locate points on a graph, we can also discuss lines. This is because a line is simply a collection of connected points. One of the most useful aspects of lines is that they illustrate a relationship (also called a relation) between two different quantities. The relationship may be direct, inverse or constant.

A direct relation means that when one quantity increases, so does the other. An example is the relationship between the number of miles you drive your car and the number of gallons of gas used. The more miles you drive, the more gas you use. This is a direct relationship; it is shown in Figure 6. Here, as the used quantity on the horizontal axis, miles, increases, the quantity on the vertical axis, gallons of gas, also increases. As the quantity miles driven on the horizontal axis decreases, the

quantity on the vertical axis also decreases. The fewer miles you drive the less gas you use. The result is a line that slopes upward from left to right.

The second kind of relation is an inverse relation.

In this relation, when one quantity goes up, the other goes down. No matter which goes up, the other goes down. An example is the relation between the amount you run your furnace and the temperature outdoors. This is shown in Figure 7. The hotter it is outside, the further right we move on the horizontal axis. The hotter it is outside, the less you run your furnace, so the further down we go on the vertical axis. An inverse

relation shows that as the quantity on the horizontal axis increases, the quantity on the vertical axis decreases. And as the quantity on the horizontal axis decreases, the quantity on the vertical axis increases. The less hot it is outside, the more you run your furnace. The result is a line that slopes downward from left to right.

The third possible relation between two quantities is a constant relationship. In this case as one quantity changes, the other quantity does not change. This is the relation between your age and the number of frogs in a pond. One quantity does not depend on the other. In the constant relation shown in Figure 8, you can see that as the quantity on the horizontal axis changes, there is no change in the quantity on the vertical axis.

Graphs can be simplified by leaving out the numbers on the axes. The important information is whether the relationship is inverse, direct, or constant. Do not be bothered by the absence of numbers, but focus on what the graph is telling you about the relation between the two quantities.

Figure 6
A DIRECT RELATION

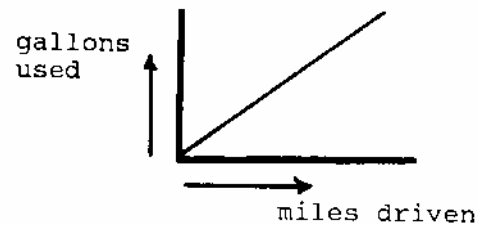


Figure 7
AN INVERSE RELATION

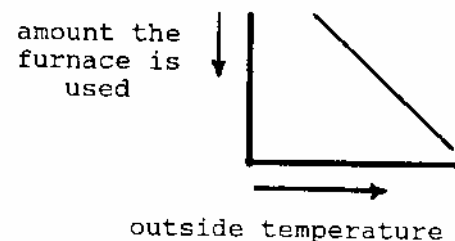
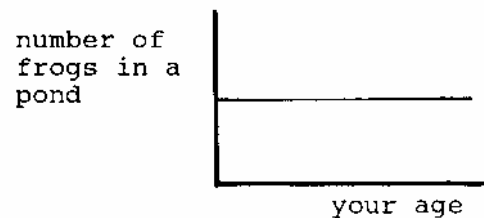


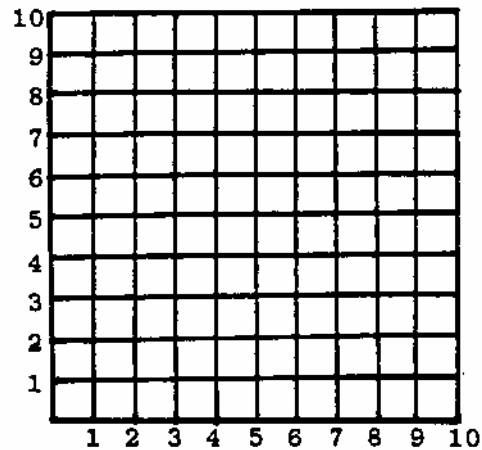
Fig. 8
A CONSTANT RELATION



Frequently you will see two (or sometimes more) lines together on a graph. Each line is one relationship. When there are two lines on a graph, economic quantities are being determined. There are economic forces pushing the quantities on the horizontal and vertical axes to a particular location. Be sure to look at how the axes are labeled and what the lines in the graph represent. Then pay close attention to the text's discussion of the economic forces. When there are two lines on the graph, the graph is indicating a process which determines some economic outcome. The graph is a shorthand for that process, and you should try to understand what that process is.

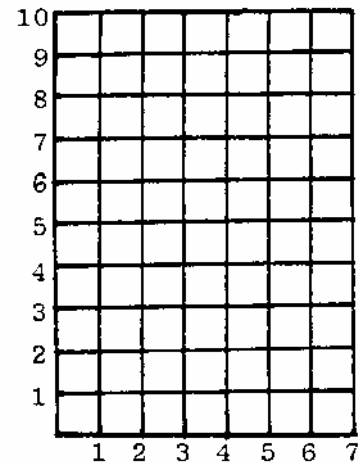
EXERCISES

1. Find and label the following points:
 - a. over 6 and up 3
 - b. over 4 and up 6
 - c. over 3 and up 6
 - d. over 2 and up 2
 - e. over 6 and up 0
 - f. over 0 and up 2



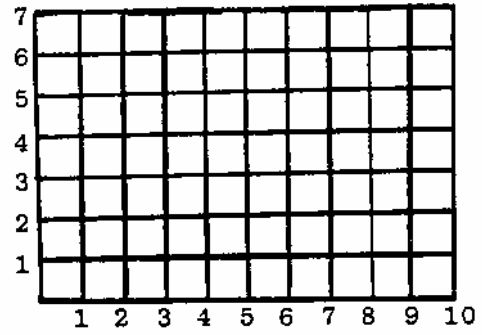
2. Find the following points:
 - a. over 4 and up 3.
 - b. up 3 and over 4.

How are these two points related?

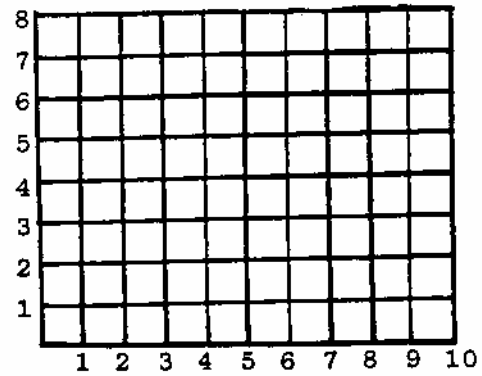


3. Which way do you move if you increase the quantity on the horizontal axis? _____
 Decrease? _____ Increase on the vertical axis? _____ Decrease on
 the vertical axis? _____

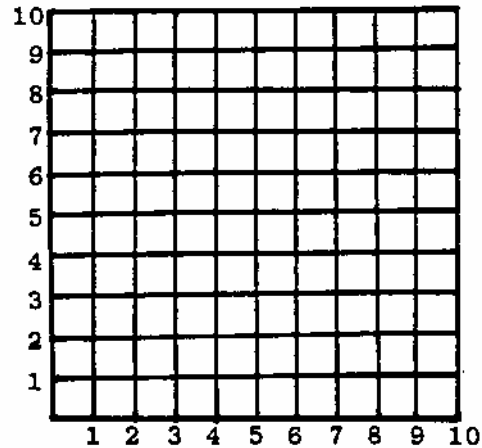
4. a. Find over 2, up 1, and over 3, up 4.
Draw a line connecting these two points.
- b. Is this line a direct, inverse, or constant relation?
-
- c. As the quantity on the horizontal axis increases, does the quantity on the vertical axis increase, decrease, or remain constant?
-



5. a. Find over 1, up 6, and over 4, up 3.
Draw a line connecting these two points.
- b. Is this line a direct, inverse, or constant relation?
-
- c. As the quantity on the horizontal axis increases, does the quantity on the vertical axis increase, decrease, or remain constant?
-



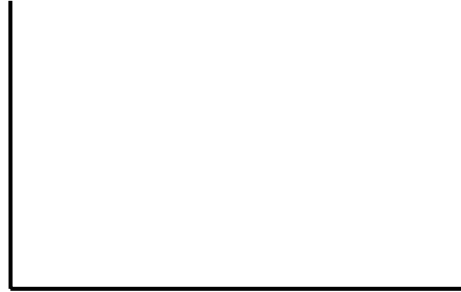
6. a. Find over 1, up 6, and over 4, up 6.
Draw a line connecting these two points.
- b. Is this line a direct, inverse, or constant relation?
-
- c. As the quantity on the horizontal axis increases, does the quantity on the vertical axis increase, decrease, or remain constant?
-



7. a. We are told that for certain cars, the larger the engine size the greater the possible top speed. Measure engine size on the horizontal axis and top speed on the vertical axis. Is this relation direct, inverse, or constant?
-



b. We know that as the temperature rises, tar becomes softer and more liquid. Measure temperature on the horizontal axis and viscosity (a measure of fluidity) on the vertical axis. Is this relation direct, inverse, or constant?



c. The amount of radioactivity from a certain amount of nuclear material decreases over time. Measure time on the horizontal axis and radioactivity on the vertical axis. Is this relation direct, inverse, or constant?



d. The amount of radioactivity will increase as the amount of radioactive material is increased. Measure the amount of radioactive material on the horizontal axis and the amount of radioactivity on the vertical axis. Is this relation direct, inverse, or constant?



e. The more you use your scissors, the duller they become. Measure the number of times you use your scissors on the horizontal axis and the sharpness of the scissors on the vertical axis. Is this relation direct, inverse, or constant?

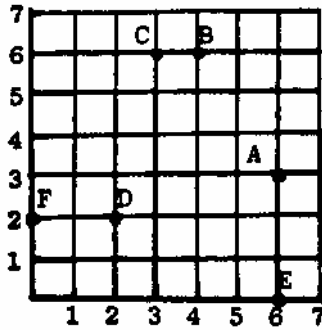


f. The amount of time you use your textbook does not change as the price of the text changes. Measure the hours the text is used on the horizontal axis and the price of the text on the vertical axis. Is this relation direct, inverse, or constant?

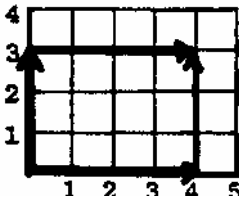


ANSWERS

1.

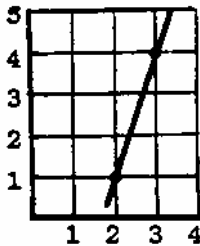


2. These are the same point.



3. To increase the quantity on the horizontal axis, move to the right. To decrease the quantity on the horizontal axis, move to the left. To increase the quantity on the vertical axis, move up. To decrease the quantity on the vertical axis, move down.

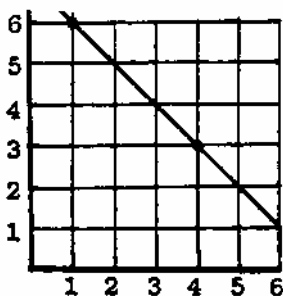
4.a.



b. This is a direct relation.

c. The quantity on the vertical axis goes up as the quantity on the horizontal axis goes up.

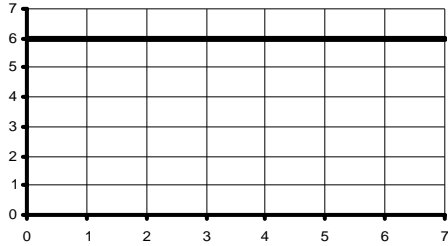
5.a.



b. This is an inverse relation.

c. When the quantity on the horizontal axis goes up, the quantity on the vertical axis goes down.

6.a.



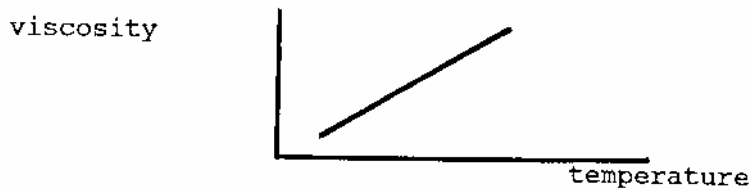
b. This is a constant relation.

c. As the quantity on the horizontal axis goes up, quantity on the vertical axis does not change.

7.a. This is a direct relation.



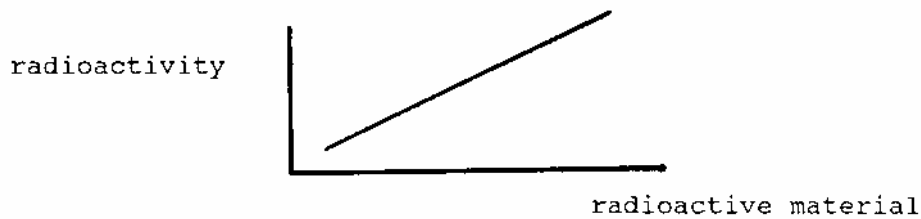
b. This is a direct relation.



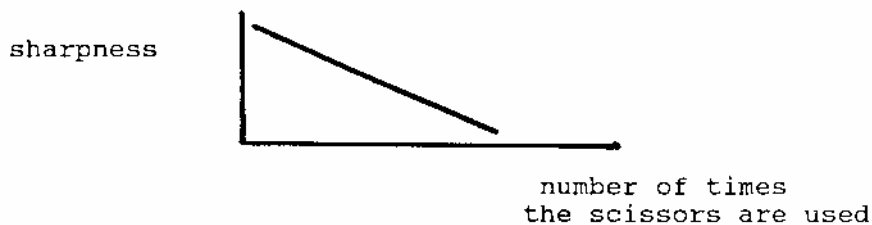
c. This is an inverse relation.



d. This is a direct relation.



e. This is an inverse relation.



f. This is a constant relation.

