Sect 3.1 - The Rectangular Coordinate System

Concept #1 Interpreting Graphs

Algebra gives us the tools to model what happens in the real world. Many times we see data and graphs in the news. For example, the number of new houses sold in the US per month might be displayed in a table like:

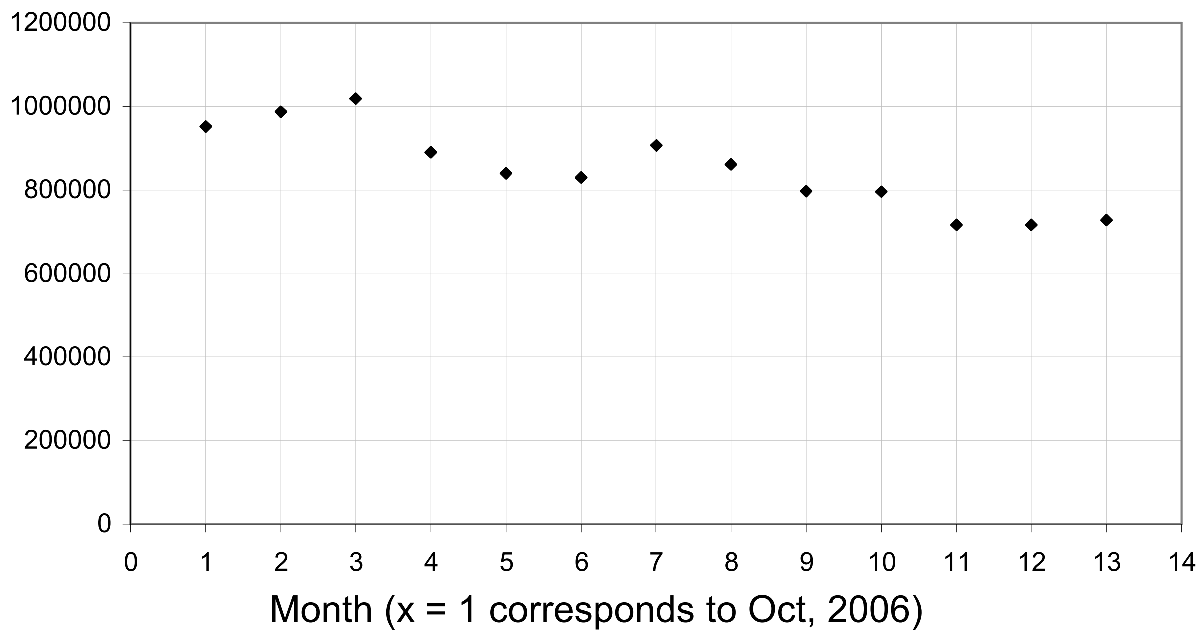
Ex. 1

Month	Number of New Houses Sold in the US
Oct, 2006	952,000 houses
Nov, 2006	987,000 houses
Dec, 2006	1,019,000 houses
Jan, 2007	890,000 houses
Feb, 2007	840,000 houses
Mar, 2007	830,000 houses
Apr, 2007	907,000 houses
May, 2007	861,000 houses
Jun, 2007	797,000 houses
Jul, 2007	796,000 houses
Aug, 2007	717,000 houses
Sep, 2007	716,000 houses
Oct, 2007*	728,000 houses

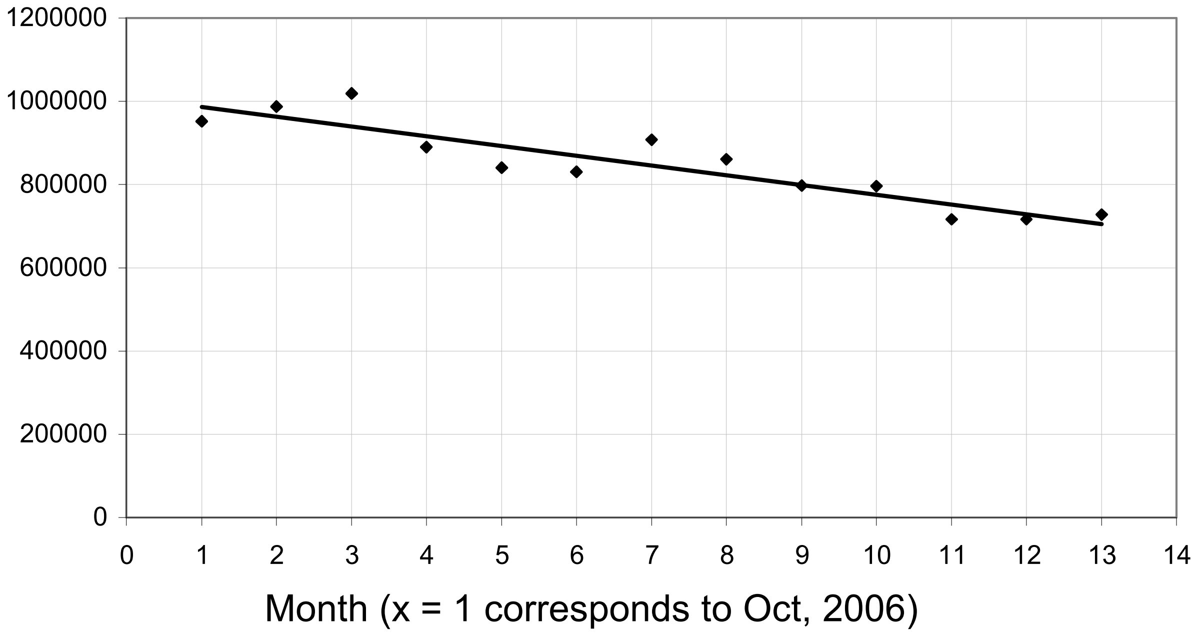
* - preliminary

(Source: http://www.census.gov/const/www/newressalesindex.html)

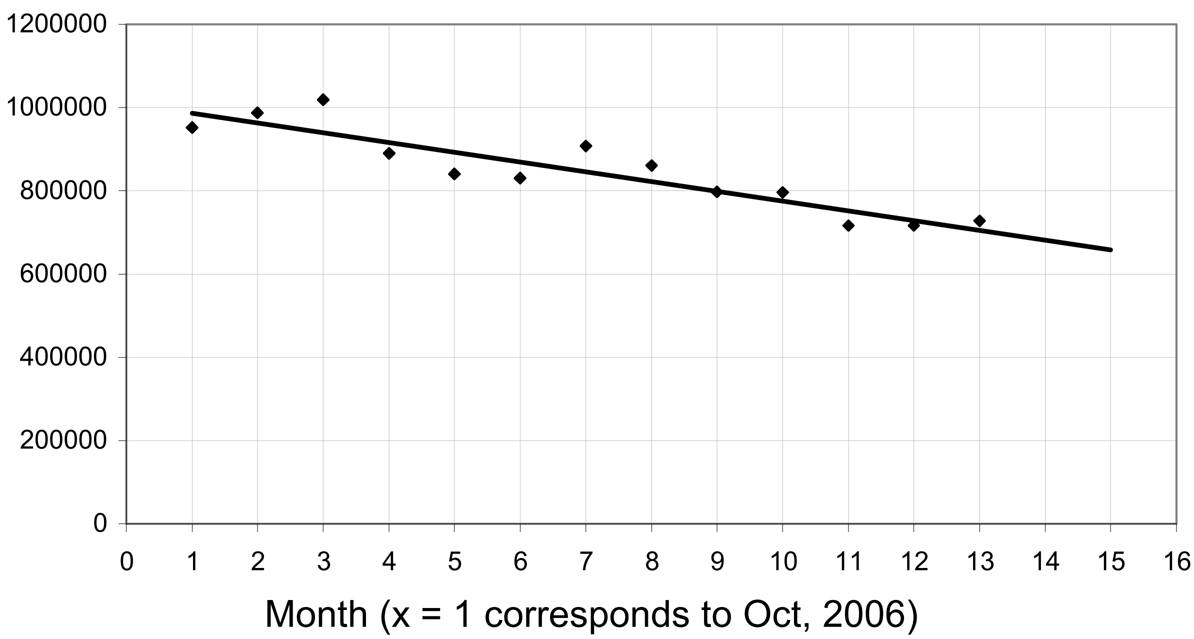
In this form, it is hard to see exactly what is happening to the data. But if we were to graph the data, we can really see what is occurring:



From the graph, we can draw what is called a “trend line” to try to predict what might happen in the future:



If the trend does continue, we can extend the line out and project the number of new homes sold in Nov, 2007 and Dec, 2007:



From the trend line, it looks like the number of new houses sold falls to about 675,000 new houses in Nov, 2007 and to about 650,000 new houses in Dec, 2007.

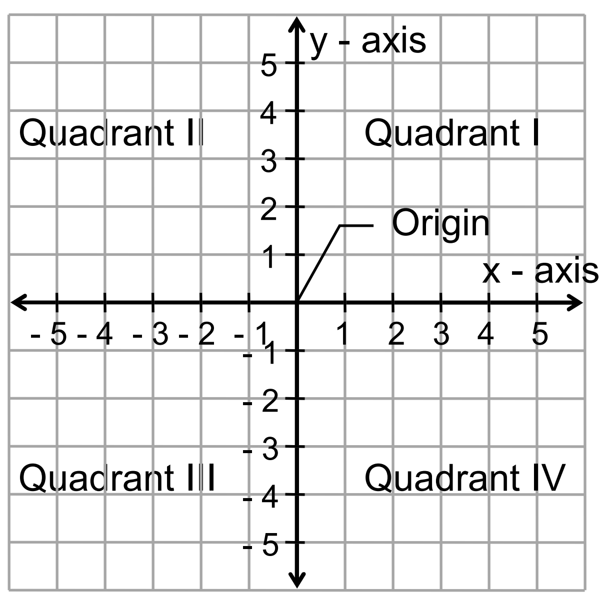
These type of projections are extremely useful to anyone working in the construction industry. If the number of new houses sold in the next two months is projected to go down, then the construction company needs to cut back on the number new homes it builds. Though the data is nation wide, one could use local data to make the same types of projections.

Concept #2 Plotting Points in a Rectangular Coordinate System

In the graph of data from the first example, there were two types values associated with each data point. The first value, x, corresponded to the month. In the graph, x = 1 corresponded to Oct, 2006, x = 2 corresponded to Nov, 2006 and so forth. In fact, the value of x represented the number of months after Sep, 2006. The second value, y, corresponded to the number of new houses sold. So, when x = 1, then
y = 952,000, when x = 2, then y = 987,000, and so forth.

It is clumsy to write our data points this way, so we will introduce a new notation to write a solution to them more compactly. We will write x = 1 and y = 952,000 as (1, 952000), x = 2 and y = 987,000 as (2, 987000), and so forth. This notation is called an **ordered pair**. We write the numbers in alphabetical order; the value for x first and then the value for y. Since our data points have two variables, we will need two number lines to represent our answer. The first number line we will use for the values of x. We will draw the number horizontally and label it the x - axis. The second number line we will use for the values of y. It will be drawn vertically in such a way that it will intersect the x - axis at x = 0 and y = 0. We will call this number line the y -axis.

We will then overlay a grid system. This is known as the rectangular coordinate system. Notice that the two axes split the grid into four sections or **quadrants**. Starting at the upper right and moving counter-clockwise, they are labeled quadrant I, II, III, and IV respectively. The point were the two axes intersect is called the **origin**. Using our ordered pair notation, the origin is the point (0, 0). In general, every ordered



pair can be represented as a point on the rectangular coordinate system. To plot a point that represents an ordered pair on the coordinate system, we start at the origin. The x - value of the ordered pair gives us the **x-coordinate** of the point we are plotting. If the x value is positive, we move that many units to the right on the x - axis and if it is negative, then we move that many units to the left on the x - axis. The y - value of the ordered pair gives us the **y-coordinate** of the point we are plotting. From our current location, if the y value is positive, we move that many unit up and if it is negative, we move that many units down. Our ending location is the point that represents the ordered pair.

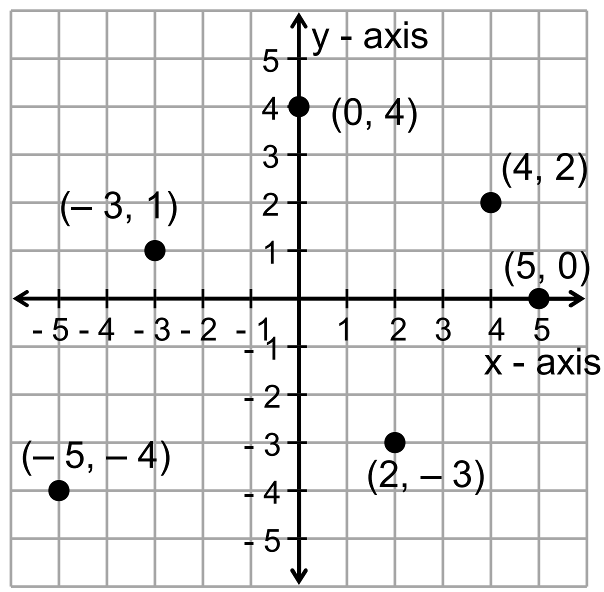
<u>Plot the ordered pairs as points on the same coordinate system:</u>

Ex. 2a (4, 2)
Ex. 2b (– 3, 1)
Ex. 2c (– 5, – 4)
Ex. 2d (2, – 3)
Ex. 2e (5, 0)
Ex. 2f (0, 4)

Solution:

Starting from the origin, move horizontally and then vertically.

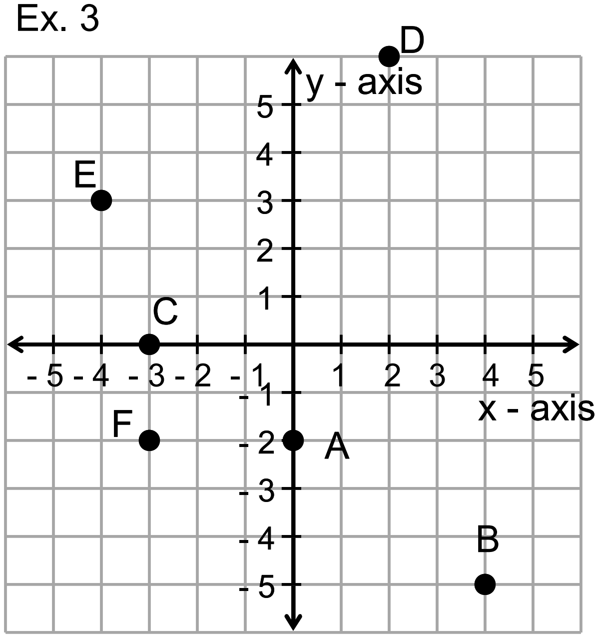
a) Move right 4, up 2.
b) Move left 3, up 1.
c) Move left 5, down 4.
d) Move right 2, down 3.
e) Move right 5.
f) Move 4 up.



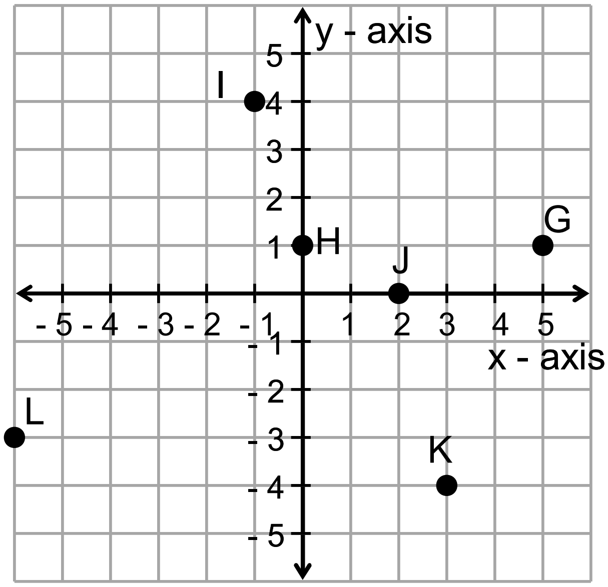
A word of caution: do not confuse this with interval. The point (– 3, 1) represents the solution x = 2 and y = – 3. The interval (– 3, 1) represents all the values of x between – 3 and 1 excluding – 3 and 1. Likewise, the point (2, – 3) represents the solution x = 2 and y = – 3, but (2, – 3) cannot be an interval since in interval notation, the smallest value is listed first, then the largest. The only way to tell them apart is to look at the context that it is being used. If we are talking about graphs, then we are usually talking about points. Hence, in this context, (– 3, 1) means x = – 3 and y = 1. If we are talking about inequalities like – 3 < x < 1, then (– 3, 1) means that x is all values between – 3 and 1.

Identify the coordinates of each point and the quadrant or axis where it is located:

Ex. 3



Ex. 4



Solution:

The coordinates of point A is (0, – 2) and it is on the y-axis.

The coordinates of point B is (4, – 5) and it is in quadrant IV.

The coordinates of point C is (– 3, 0) and it is on the x-axis.

The coordinates of point D is (2, 6) and it is in quadrant I.

The coordinates of point E is (– 4, 3) and it is in quadrant II.

The coordinates of point F is (– 3, – 2) and it is in quadrant III.

The coordinates of point G is (5, 1) and it is in quadrant I.

The coordinates of point H is (0, 1) and it is on the y-axis.

The coordinates of point I is (– 1, 4) and it is in quadrant II.

The coordinates of point J is (2, 0) and it is on the x-axis.

The coordinates of point K is (3, – 4) and it is in quadrant IV.

The coordinates of point L is (– 6, – 3) and it is in quadrant III.

Concept #3 Applications of Plotting and Identifying Points

Ex. 5 The average price of a gallon of 2% milk from thirty selected cities in the US for the first eleven months of the 2007 is given in the table below (Source: www.usda.gov):

a) Write an ordered pair for each row in the table using the number of months after Dec, 2006 as the x-coordinate and the price per gallon as the y-coordinate.

b) Plot the ordered pairs from part a on a rectangular coordinate system.

Month	Price per Gallon of 2% Milk
Jan, 2007	$3.19
Feb, 2007	$3.18
Mar, 2007	$3.21
Apr, 2007	$3.22
May, 2007	$3.30
Jun, 2007	$3.47
Jul, 2007	$3.70
Aug, 2007	$3.77
Sep, 2007	$3.80
Oct, 2007	$3.76
Nov, 2007	$3.77

Solution:

a) Since Jan, 2007 corresponds to x = 1, Feb, 2007 corresponds to x = 2, etc, then our ordered pairs are:

(1, $3.19)	(2, $3.18)	(3, $3.21)	(4, $3.22)
(5, $3.30)	(6, $3.47)	(7, $3.70)	(8, $3.77)
(9, $3.80)	(10, $3.76)	(11, $3.77)	

b)