EXPLORING DATA AND STATISTICS

4.1

Coordinates and Scatter Plots

What you should learn

GOAL 1 Plot points in a coordinate plane.

GOAL 2 Draw a scatter plot and make predictions about **real-life** situations as in **Example 3**.

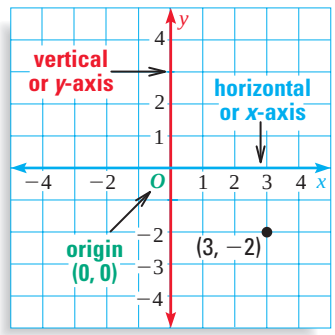
Why you should learn it

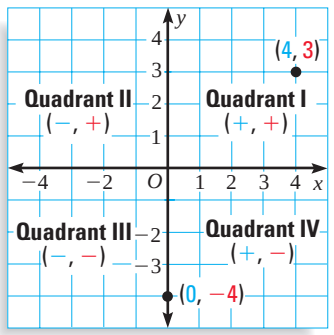
▼ To solve **real-life** problems such as predicting how much film will be developed for the Winter Olympics in the year 2002 in **Ex. 38**.

GOAL 1 PLOTTING POINTS IN A COORDINATE PLANE

A **coordinate plane** is formed by two real number lines that intersect at a right angle. Each point in the plane corresponds to an **ordered pair** of real numbers.

The first number in an ordered pair is the ***x*-coordinate** and the second number is the ***y*-coordinate**. The ordered pair $(3, -2)$ has an x-coordinate of 3 and a y-coordinate of -2 as shown in the graph at the left below.





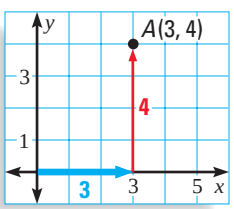
The x-axis and the y-axis (the *axes*) divide the coordinate plane into four quadrants. You can tell which quadrant a point is in by looking at the signs of its coordinates.

In the diagram at the right above, the point $(4, 3)$ is in Quadrant I. The point $(0, -4)$ is on the y-axis and is not inside any of the four quadrants.

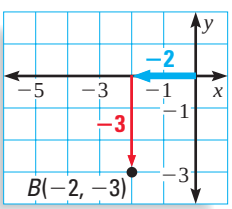
The point in the plane that corresponds to an ordered pair (x, y) is called the **graph** of (x, y). To plot a point, you draw the point in the coordinate plane that corresponds to an ordered pair of numbers.

EXAMPLE 1 *Plotting Points in a Coordinate Plane*

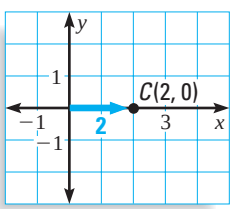
a. To plot the point $(3, 4)$, start at the origin. Move 3 units to the right and 4 units up.



b. To plot the point $(-2, -3)$, start at the origin. Move 2 units to the left and 3 units down.



c. To plot the point $(2, 0)$, start at the origin. Move 2 units to the right and 0 units up.



GOAL 2 USING A SCATTER PLOT

Many real-life situations can be described in terms of pairs of numbers. Medical charts record both the height and weight of the patient, while weather reports may include both temperature and windspeed. One way to analyze the relationships between two quantities is to graph the pairs of data on a coordinate axis. Such a graph is called a **scatter plot**.

REAL LIFE Sports

EXAMPLE 2 *Making a Scatter Plot*

You are the student manager of your high school soccer team. You are working on the team's program guide and have recorded the height and weight of the eleven starting players in the given table.

Height (in.)	72	70	71	70	69	70	69	73	66	70	76
Weight (lb)	190	170	180	175	160	160	150	180	150	150	200

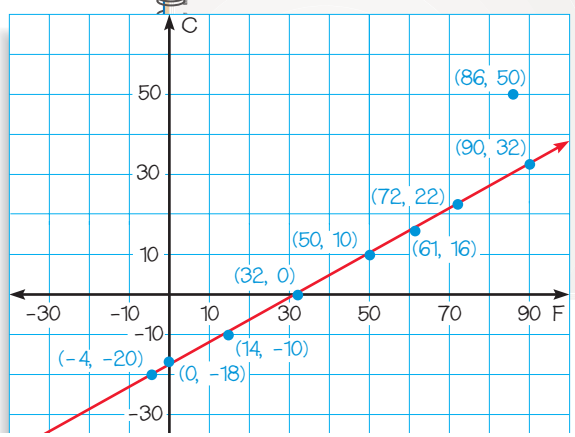
a. Make a scatter plot of the data. Put height h on the horizontal axis and weight w on the vertical axis.

b. Use the scatter plot to estimate the weight of a player who is 69 inches tall and of one who is 71 inches tall.

c. In general, how does weight change as height changes?

d. What would you expect a player who is 74 inches tall to weigh?

(66, 150), (69, 150), (70, 150)
(69, 160), (70, 160)
(70, 170), (70, 175)
(71, 180), (73, 180)
(72, 190)
(76, 200)



SOLUTION

a. Plot each ordered pair, as shown at the right.

b. The two players who are 69 inches tall weigh 150 pounds and 160 pounds, so a good estimate would be about 155 pounds. The player who is 71 inches tall weighs 180 pounds, so a possible estimate would be about 180 pounds.

c. As height increases, it appears that weight increases.

d. There is no given data value for a player who is 74 inches tall. However, the 72-inch-tall player weighs 190 pounds, the 73-inch-tall player weighs 180 pounds, and the 76-inch-tall player weighs 200 pounds, so a good estimate of the weight of a 74-inch-tall player would be between 190 and 195 pounds.

STUDENT HELP
INTERNET HOMEWORK HELP
Visit our Web site www.mcdougallittell.com for extra examples.

You can use scatter plots to see trends in data and to make predictions about the future.

EXAMPLE 3 *Describing Patterns from a Scatter Plot*

WINTER SPORTS EQUIPMENT The amount (in millions of dollars) spent in the United States on snowmobiles and ski equipment is shown in the table.

a. Draw a scatter plot of each set of data in the same coordinate plane.

b. Describe the pattern of the amount spent on snowmobiles.

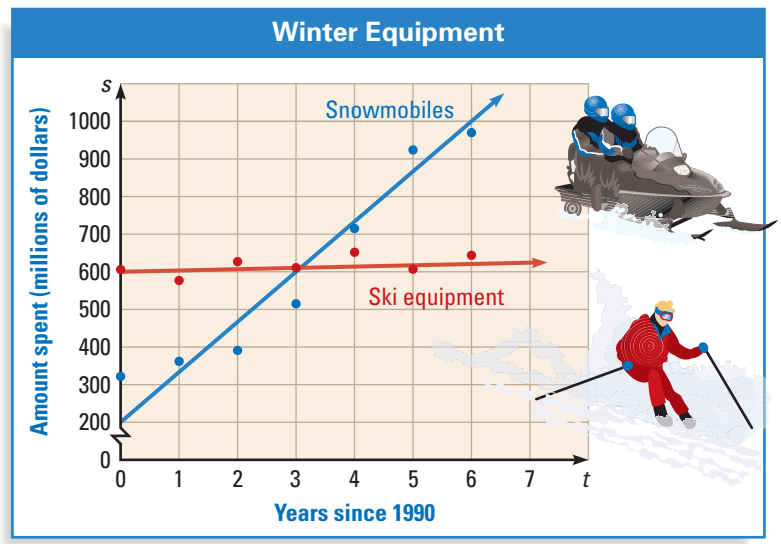
c. Describe the pattern of the amount spent on ski equipment.

Year	1990	1991	1992	1993	1994	1995	1996
Snowmobiles	322	362	391	515	715	924	970
Ski equipment	606	577	627	611	652	607	644

INTERNET **DATA UPDATE** of National Sporting Goods Association data at www.mcdougallittell.com

SOLUTION

a. Because you want to see how spending changes over time, put time t on the horizontal axis and spending s on the vertical axis. Let t be the number of years since 1990. The scatter plot is shown below.



b. From the scatter plot, you can see that the amount spent on snowmobiles has been increasing rapidly since 1990.

c. The amount spent on ski equipment has been fairly constant since 1990. The amount spent has stayed around $600 million.

FOCUS ON APPLICATIONS

REAL LIFE **SNOWMOBILES** have proven essential in the search and rescue field. They can often reach mountainous areas more quickly than an aircraft.

GUIDED PRACTICE

Vocabulary Check ✓

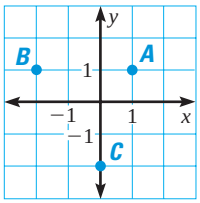
Concept Check ✓

Skill Check ✓

1. In the ordered pair (4, 9), the x-coordinate is ?.

2. Decide whether the following statement is *true* or *false*. *Each point in a coordinate plane corresponds to an ordered pair of real numbers.*

3. Write the ordered pairs that correspond to the points labeled A, B, and C in the coordinate plane at the right.



Ex. 3

Plot the ordered pairs in a coordinate plane.

4. $A(4, -1)$, $B(5, 0)$

5. $A(-2, -3)$, $B(-3, -2)$

6. The point $(-2, 5)$ lies in Quadrant ?.

SCATTER PLOT **In Exercises 7 and 8, draw a scatter plot of the given data.**

7.

Time	1:00	3:00	5:00	7:00
Temp.	71°	74°	68°	63°

8.

TV size	19 in.	27 in.	32 in.	36 in.
Price	$179	$349	$499	$659

9. **SNOWMOBILE SALES** Use the scatter plot in Example 3. If you were given the amounts spent on snowmobiles from 1990 through 1992 only, would your description of the pattern be different than the one given in the Example?

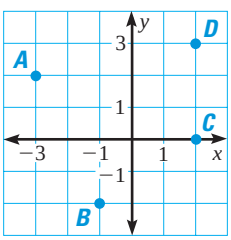
PRACTICE AND APPLICATIONS

STUDENT HELP

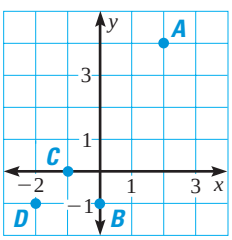
Extra Practice to help you master skills is on p. 800.

IDENTIFYING ORDERED PAIRS **Write the ordered pairs that correspond to the points labeled *A, B, C,* and *D* in the coordinate plane.**

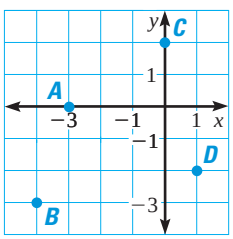
10.



11.



12.



PLOTTING POINTS **Plot and label the ordered pairs in a coordinate plane.**

13. $A(0, 3)$, $B(-2, -1)$, $C(2, 0)$

14. $A(5, 2)$, $B(4, 3)$, $C(-2, -4)$

15. $A(4, 1)$, $B(0, -3)$, $C(3, 3)$

16. $A(0, 0)$, $B(2, -2)$, $C(-2, 0)$

17. $A(-4, 1)$, $B(-1, 5)$, $C(0, -4)$

18. $A(3, -5)$, $B(1.5, 3)$, $C(-3, -1)$

STUDENT HELP

HOMEWORK HELP

Example 1: Exs. 10–26
Example 2: Exs. 33–37
Example 3: Exs. 27–32

IDENTIFYING QUADRANTS **Without plotting the point, tell whether it is in Quadrant I, Quadrant II, Quadrant III, or Quadrant IV.**

19. $(5, -3)$

20. $(-2, 7)$

21. $(6, 17)$

22. $(14, -5)$

23. $(-4, -2)$

24. $(3, 9)$

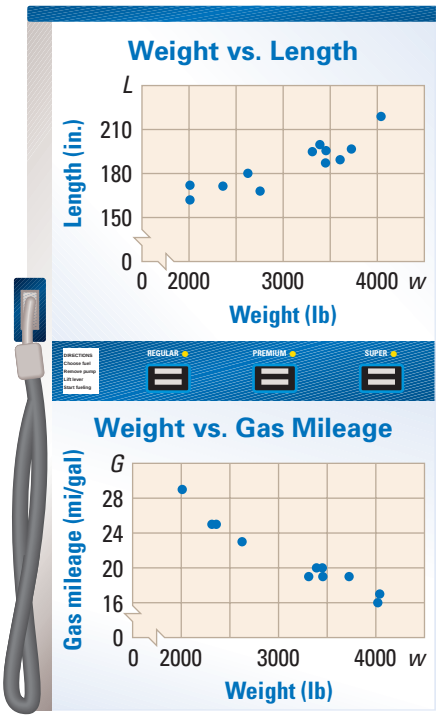
25. $(-5, -2)$

26. $(-5, 6)$

STUDENT HELP

Look Back
For help with breaks in the scale of a graph, see p. 41.

CAR COMPARISONS **In Exercises 27–32, use the scatter plots.**



27. In the Weight vs. Length graph, what are the units on the horizontal axis? What are the units on the vertical axis?

28. In the Weight vs. Length graph, estimate the coordinates of the point for a car that weighs about 4000 pounds.

29. Which of the following is true?

A. Length tends to decrease as weight increases.

B. Length is constant as weight increases.

C. Length tends to increase as weight increases.

D. Length is not related to weight.

30. In the Weight vs. Gas Mileage graph, what is the value of w in the ordered pair (2010, 29)? What is the value of G?

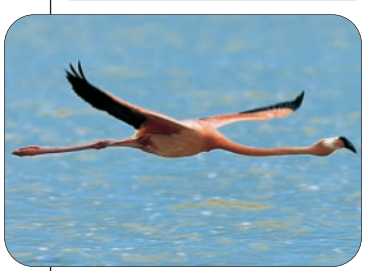
31. **INTERPRETING DATA** In the Weight vs. Gas Mileage graph, how does gas mileage tend to change as weight increases?

32. **CRITICAL THINKING** How would you expect the length of a car to affect its gas mileage? Explain your reasoning.

33. **GATHERING DATA** Write a list of ten songs in alphabetical order. Put songs you like on the list and some you don't like. Make two copies. On one copy, rank the songs from 1 to 10 (1 for the most liked and 10 for the least liked). Then ask a friend to rank the songs without looking at your rankings.

34. **INTERPRETING A GRAPH** Make a scatter plot with your song ratings from Exercise 33 on the horizontal axis and your friend's ratings on the vertical axis. What conclusions (if any) can you draw from the scatter plot?

FOCUS ON APPLICATIONS



REAL LIFE **AMERICAN FLAMINGOES** have distinctive and unusual features. Their extremely long neck and legs give the impression that the bird could fly backwards. When the flamingo's wings are fully extended, you can see the black in its wings.

BIOLOGY CONNECTION **In Exercises 35–37, the table shows the wing length in millimeters and the wing-beat rate in beats per second.**

Bird	Flamingo	Shellduck	Velvet Scoter	Fulmar	Great Egret
Wing length	400	375	281	321	437
Wing-beat rate	2.4	3.0	4.3	3.6	2.1

35. Make a scatter plot that shows the wing lengths and wing-beat rates for the six birds. Use the horizontal axis to represent the wing length.

36. What is the slowest wing-beat rate shown on the scatter plot? What is the fastest? Where are these located on your scatter plot?

37. **INTERPRETING DATA** Describe the relationship between the wing length and the wing-beat rate.

Test Preparation

38. MULTI-STEP PROBLEM The table below shows the number of rolls of film developed for the United States media at the Winter Olympics.

Number of years since 1980, t	4	8	12	14	18
Rolls of film, f	48,200	53,750	60,500	67,500	75,000

a. Construct a scatter plot of the data. Describe the pattern of the number of rolls of film developed for the Winter Olympics from 1984 to 1998.

b. *Writing* Predict the number of rolls of film that will be developed for the Winter Olympics in the year 2002. Explain how you made your prediction.

★ Challenge

MUSIC Sara thought that there might be a relationship between the number of songs and the number of minutes of music recorded on a CD. She collected the following data from five CDs she had on her desk.

Number of songs, s	15	12	13	16	18
Number of minutes, m	44.9	31.5	40.6	50.5	71.6

39. Make a scatter plot of Sara's data. What relationship do the data suggest?

40. To check her findings, Sara collected data from five more CDs. Make a new scatter plot of these data. What relationship do the data suggest?

Number of songs, s	12	13	9	11	10
Number of minutes, m	46.8	40.6	67.0	53.0	56.1

41. CRITICAL THINKING Do you think there is a relationship between the number of songs and the number of minutes on a CD? Explain your reasoning. How could you test whether there is a relationship?

EXTRA CHALLENGE
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MIXED REVIEW

EVALUATING EXPRESSIONS Evaluate the expression for the given value of the variable. (Review 1.3 and 2.5 for 4.2)

42. $3x + 9$ when $x = 2$

43. $13 - (y + 2)$ when $y = 4$

44. $4.2t + 17.9$ when $t = 3$

45. $-3x - 9y$ when $x = -2$ and $y = -1$

USING EXPONENTS Evaluate the expression. (Review 1.2)

46. $x^2 - 3$ when $x = 4$

47. $12 + y^3$ when $y = 3$

ABSOLUTE VALUE In Exercises 48–51, evaluate the expression. (Review 2.1)

48. $|-2.6|$

49. $|1.07|$

50. $\left|\frac{9}{10}\right|$

51. $\left|\frac{-2}{3}\right|$

52. TEEN SAVINGS In a survey of 500 teens, 345 said they have a savings account. What is the experimental probability that a randomly chosen teen in the survey has a savings account? (Review 2.8)