## Applications

For Exercises 1 and 2, use the table below. It shows the height and stride distance for 10 students.

For humans, walking is the most basic form of transportation. An average person is able to walk at a pace of about 3 miles per hour.

The distance a person covers in one step depends on his or her stride. To measure stride distance, measure from the heel of the first foot to the heel of that same foot on the next step.

Height (cm)	Stride Distance (cm)
150.8	125.2
149.5	124.2
151.2	125.2
153.1	126.8
150.6	124.4
149.9	123.8
146.5	121.8
146.5	120.8
151.5	125.6
153.5	126.8
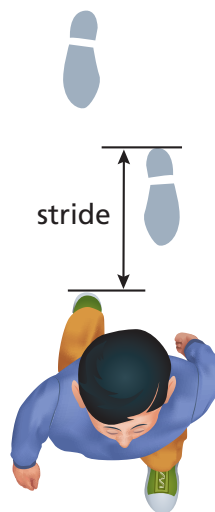
stride

1. **a.** What is the median height of these students? Explain how you found the median.

   b. What is the median stride distance of these students? Explain how you found the median.

   c. What is the ratio of median height to median stride distance? Explain.

2. a. Draw a coordinate graph with height (in centimeters) on the horizontal axis and stride distance (in centimeters) on the vertical axis. To choose a scale for each axis, look at the greatest and least values of each measure.

  b. Explain how you can use your graph to determine whether the shortest student also has the shortest stride distance.

  c. Describe how to estimate the heights of people with each stride distance.

  i. 1.50 meters   **ii.** 0.90 meters   **iii.** 1.10 meters

3. In Problem 4.1 you explored the relationship between arm span and height. The scatter plot below shows data for another group of middle school students.
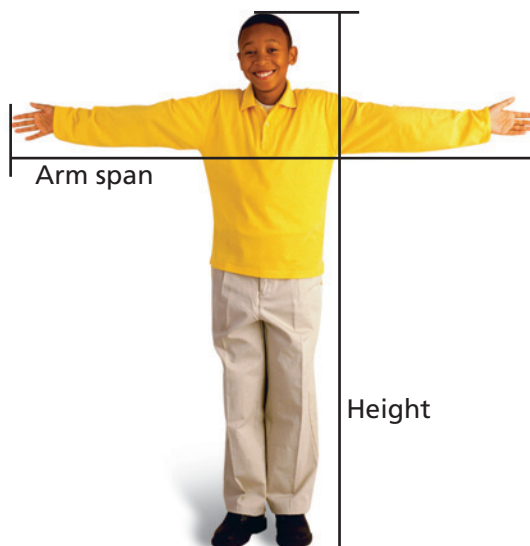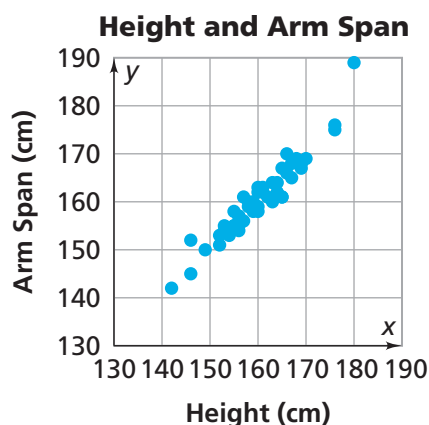
Height and Arm Span

a. Draw a model line from (130, 130) to (190, 190) on your scatter plot.

  b. Use the line to describe the relationship between height and arm span.

  c. Write an equation for the line using h for height and a for arm span.

  d. What is true about the relationship between height and arm span for points in each part of the graph?

  i. points on the model line

  ii. points above the model line

  iii. points below the model line

4. **a.** Make a scatter plot from the table. To keep track of engine type, use two different colors as you plot the points. Use one color for jet engines and one color for propeller engines.

Airplane Comparisons

Plane	Engine type	Body length (m)	Wingspan (m)
Boeing 707	jet	47	44
Boeing 747	jet	71	60
Ilyushin IL-86	jet	60	48
McDonnell Douglas DC-8	jet	57	45
Antonov An-124	jet	69	73
British Aerospace 146	jet	29	26
Lockheed C-5 Galaxy	jet	76	68
Antonov An-225	jet	84	88
Airbus A300	jet	54	45
Airbus A310	jet	46	44
Airbus A320	jet	38	34
Boeing 737	jet	33	29
Boeing 757	jet	47	38
Boeing 767	jet	49	48
Lockheed Tristar L-1011	jet	54	47
McDonnell Douglas DC-10	jet	56	50
Douglas DC-4 C-54 Skymaster	propeller	29	36
Douglas DC-6	propeller	32	36
Lockheed L-188 Electra	propeller	32	30
Vickers Viscount	propeller	26	29
Antonov An-12	propeller	33	38
de Havilland DHC Dash-7	propeller	25	28
Lockheed C-130 Hercules/L-100	propeller	34	40
British Aerospace 748/ATP	propeller	26	31
Convair 240	propeller	24	32
Curtiss C-46 Commando	propeller	23	33
Douglas DC-3	propeller	20	29
Grumman Gulfstream I/I-C	propeller	19	24
Ilyushin IL-14	propeller	22	32
Martin 4-0-4	propeller	23	28
Saab 340	propeller	20	21

Source: *Airport Airplanes*

b. Use your results from Exercise 3. Does your equation for the relationship between height and arm span also describe the relationship between body length and wingspan for airplanes? Explain.

c. Predict the wingspan of an airplane with a body length of 40 meters.

d. Predict the body length of an airplane with a wingspan of 60 meters.

5. The scatter plot below shows the relationship between body length and wingspan for different birds.

Bird Body Length and Wingspan
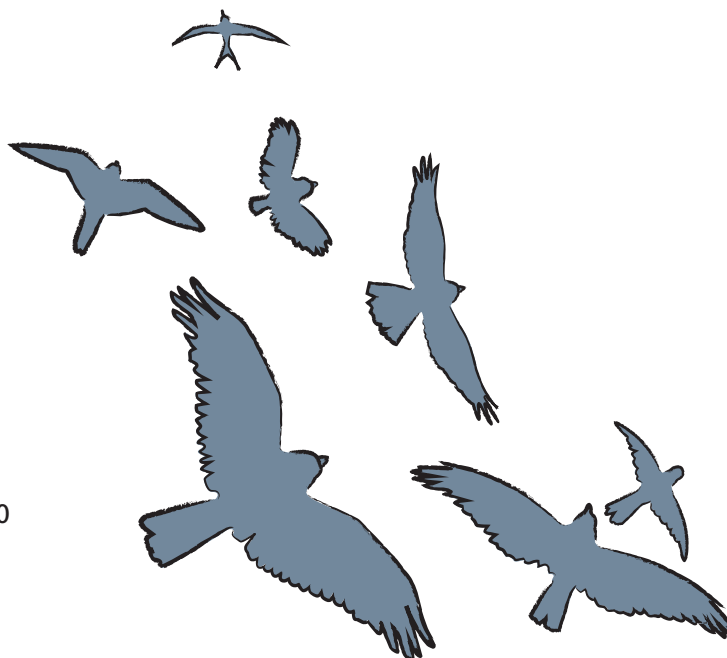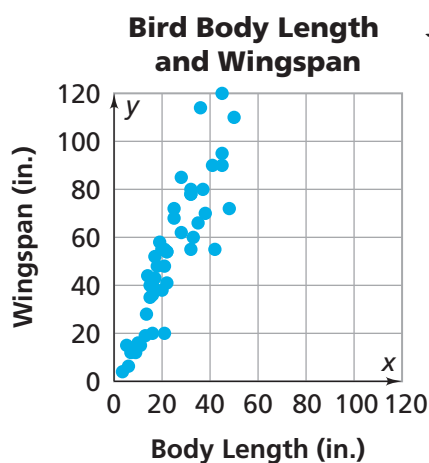
a. Use your results from Exercise 3. Does your equation for the relationship between height and arm span also describe the relationship between body length and wingspan for birds? Explain.

b. Find a line that fits the overall pattern of points in the scatter plot. What is the equation of your line?

c. Predict the wingspan of a bird with a body length of 60 inches. Explain your reasoning.

6. a. The table shows math and science test scores for 10 students. Make a scatter plot of the data.

Student	1	2	3	4	5	6	7	8	9	10
Math	67	51	87	36	56	44	72	63	45	93
Science	71	69	85	35	60	47	74	63	46	96

b. Describe the relationship between the math and science scores.

c. If the data are linear, sketch a line that fits the data.

d. Identify any data values that you think are outliers. Explain why they are outliers.

e. Estimate a correlation coefficient for the data. Is it closest to −1, −0.5, 0, 0.5, or 1? Explain your choice.

7. a. The table shows math scores and distances from home to school for 10 students. Make a scatter plot of the data.

Student	1	2	3	4	5	6	7	8	9	10
Math Score	67	51	87	36	56	44	72	63	45	93
Distance from home to school (miles)	0.6	1.7	0.3	2.2	3.1	0.25	2.6	1.5	0.75	2.1

b. Describe the relationship between the math score and distance from home to school.

c. Estimate a correlation coefficient for the data. Is it closest to −1, −0.5, 0, 0.5, or 1? Explain your choice.

8. a. The table shows the number of servers and average time to fill an order at fast-food restaurants. Make a scatter plot of the data.

Number of Servers	3	4	5	6	7
Average Time to Fill an Order (min)	0.6	1.7	0.3	2.2	3.1

  b. Describe the relationship between the number of servers and average time to fill an order.

  c. Identify any data values that you think are outliers. Explain why they are outliers.

  d. Estimate a correlation coefficient for the data. Is it closest to -1, -0.5, 0, 0.5, or 1? Explain your choice.
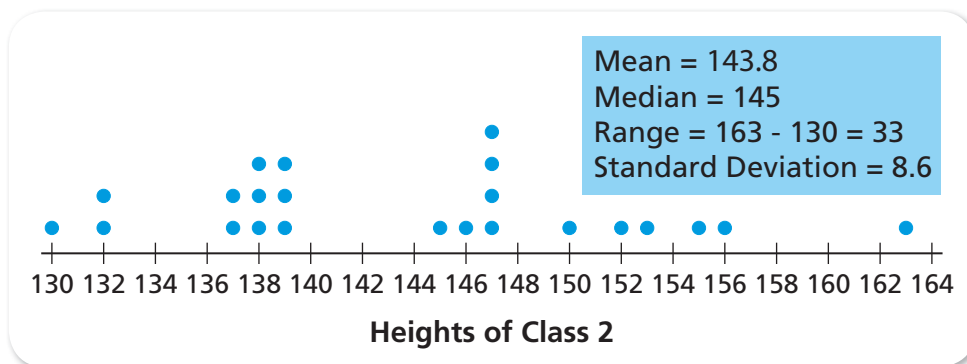
9. a. The table shows the number of absences from school and math scores. Make a scatter plot of the data.

  b. Describe the relationship between the number of absences and math scores.

  c. If the data are linear, write an equation for a line that models the data.

  d. Estimate a correlation coefficient for the data. Is it closest to -1, -0.5, 0, 0.5, or 1? Explain your choice.

Absences	Math Scores
3	67
5	49
1	96
1	82
3	79
7	37
5	71
3	55
0	100
8	34
7	46
2	69
10	32
0	94
6	53
6	41
2	90
0	92
5	60
7	50
11	10
1	80

Students collected height measurements from two eighth-grade classes. The measurements are in centimeters.

10. Use the dot plot, data, and summary statistics of height measurements from Class 2 below. Describe the distribution of heights in this class.

Class 2: 130, 132, 132, 137, 137, 138, 138, 138, 139, 139, 139, 145, 146, 147, 147, 147, 147, 150, 152, 153, 155, 156, 163

Mean = 143.8
Median = 145
Range = 163 - 130 = 33
Standard Deviation = 8.6

Heights of Class 2

11. a. The data below show heights from another class of eighth graders. Make a dot plot of the data below.

Class 1: 130, 132, 134, 135, 136, 136, 137, 138, 138, 138, 139, 139, 139, 140, 140, 141, 142, 142, 142, 142, 143, 147, 148

b. Calculate the mean, median, range, and standard deviation of the distribution.

c. Use information from parts (a) and (b) to describe the distribution of heights.

d. Compare the distribution of heights in this class to that of the class in Exercise 10.

e. Could you use either distribution to predict the typical height for eighth-graders? Explain your thinking.

12. Use data sets A, B, and C.

$$\text{Set A} = \{9, 10, 11, 7, 13\}$$

$$\text{Set B} = \{10, 10, 10, 10, 10\}$$

$$\text{Set C} = \{1, 1, 10, 19, 19\}$$

a. Calculate the mean of each data set.

b. Calculate the standard deviation of each data set.

c. Explain how you could identify the data set with the greatest standard deviation before doing any calculations.

13. The table shows the monthly salaries of 20 people.

Number of People	5	8	5	2
Salary (dollars)	3,500	4,000	4,200	4,300

   a. Calculate the mean of the salaries.

   b. Calculate the standard deviation of the salaries.

Connections

14. The table shows height, arm span, and the ratio of arm span to height.

   a. Recall Problem 4.1 and the line $s = h$. Where would you find a point with a ratio greater than 1 (*on*, *above*, or *below* the line)? What does it mean when the ratio is greater than 1?

   b. For the line $s = h$, where would you find a point with a ratio equal to 1 (*on*, *above*, or *below* the line)? What does it mean when the ratio equals 1?

   c. For the line $s = h$, where would you find a point with a ratio less than 1 (*on*, *above*, or *below* the line)? What does it mean when the ratio is less than 1?

Height (inches)	Arm Span (inches)	Ratio of Arm Span to Height
172	169	0.98
167	163	0.98
163	164	1.01
162	164	1.01
163	159	0.97
164	158	0.96
161	159	0.99
161	155	0.96
159	161	1.01
156	156	1.00
154	162	1.05
154	157	1.02
154	156	1.01
155	150	0.97
155	154	0.99
177	174	0.98
171	172	1.01
149	144	0.97
143	148	1.03
142	142	1.00

15. **Multiple Choice** In testing two new sneakers, the shoe designers judged performance by measuring the heights of jumps. Now a shoe designer needs to choose the better sneaker. Which measure is best for deciding between the two sneakers? Use the graph for each sneaker.

Jump Height—Shoe 1
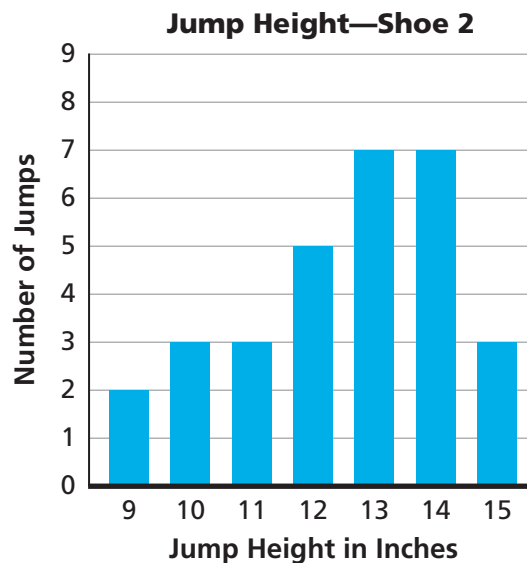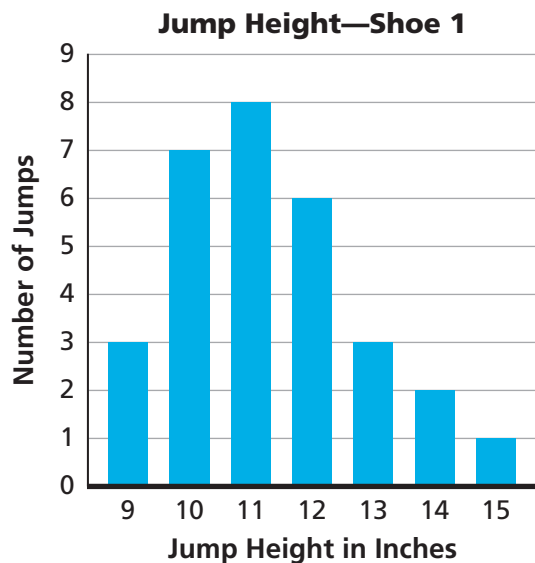
Jump Height—Shoe 2

A. Use the mode. The most frequent height jumped for Shoe 1 was 11 inches, and the most frequent height jumped for Shoe 2 was 13 or 14 inches.

B. Use the mean. The average jump height for Shoe 1 was 11 inches. For Shoe 2, it was 12.5 inches.

C. Use clusters. Overall, 70% of the students jumped 10 inches to 12 inches in Shoe 1, and the data vary from 9 inches to 15 inches. About 63% of the students jumped 12 inches to 14 inches in Shoe 2, and the data vary from 9 inches to 15 inches.

D. None of the above.

16. **a.** What is the shape of a distribution when the mean is greater than the median?

b. What is the shape of a distribution when the mean is less than the median?

c. What is the shape of a distribution when the mean and the median are about the same value?
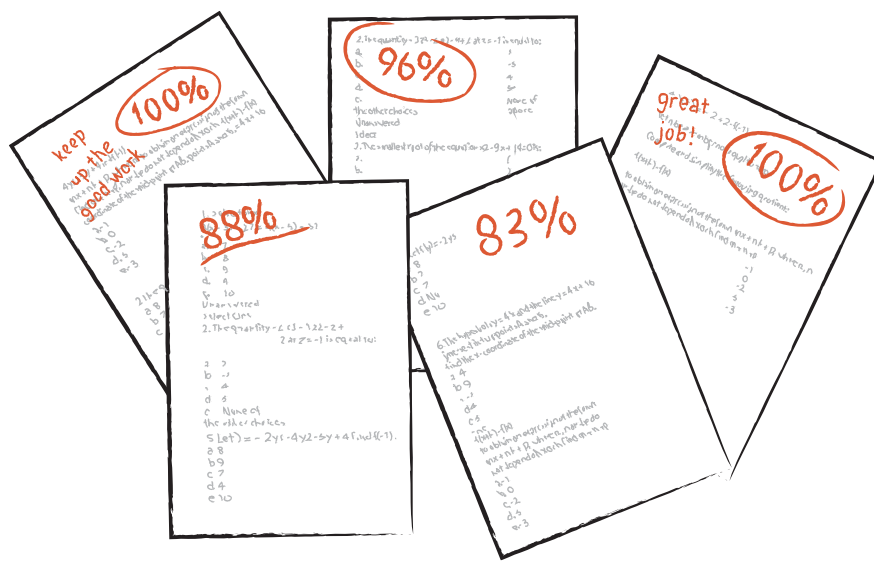
17. **Multiple Choice** Del Kenya's test scores are 100, 83, 88, 96, and 100. His teacher told the class that they could choose whichever measure of center they wanted her to use to determine final grades. Which measure do you think Del Kenya should choose?

   F. Mean   **G.** Median   **H.** Mode   **J.** Range

18. **Multiple Choice** Five packages with a mean weight of 6.7 pounds were shipped by the Send-It-Quick Mail House. If the mean weight for four of these packages is 7.2 pounds, what is the weight of the fifth package?

   A. 3.35 lb   **B.** 4.7 lb   **C.** 6.95 lb   **D.** 8.7 lb

19. **Multiple Choice** In Mr. Mamer's math class, there are three times as many girls as boys. The girls' mean grade on a recent quiz was 90, and the boys' mean grade was 86. What was the mean grade for the entire class?

   F. 88   **G.** 44   **H.** 89   **J.** 95

20. Some numbered cards are put in a hat, and one is drawn at random. There is an even number of cards, no two of which are alike. How many cards might be in the hat to give the probability equal to the following values of choosing a number greater than the median?

   a. $\frac{1}{2}$ **b.** $\frac{1}{3}$ **c.** 0
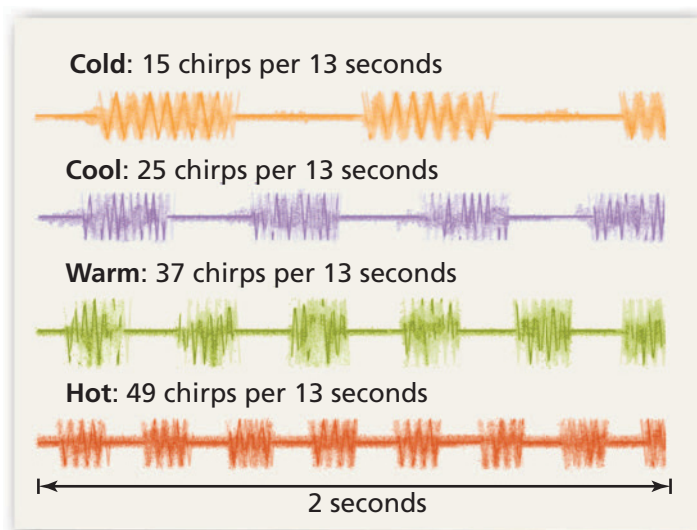
Extensions

21. If you know the number of chirps a cricket makes in a certain period of time, you can estimate the temperature in degrees Fahrenheit or Celsius.

   a. Count the number of chirps in one minute, divide by 4, and add 40 to get the temperature in degrees Fahrenheit. Write a formula using F for temperature and s for chirps per minute.

   b. Graph your formula. Use a temperature scale from 0 to 212° F.

   c. Use your graph to estimate the number of chirps at each temperature.

      i. 0° F   **ii.** 50° F   **iii.** 100° F   **iv.** 212° F

22. a. The chirp frequency of a different kind of cricket allows you to estimate temperatures in degrees Celsius rather than in degrees Fahrenheit. Graph the data in the table.

| Frequency	195	123	212	176	162	140	119	161	118	175	161	171	164	174	144
Temperature (°C)	31.4	22	34.1	29.1	27	24	20.9	27.8	20.8	28.5	26.4	28.1	27	28.6	24.6

   b. Find a formula that lets you predict the temperature in degrees Celsius from the number of chirps.

   c. Use your formula from part (b) to draw a line on the graph using the points plotted in part (a). How well does the line fit the data?

Cold: 15 chirps per 13 seconds

Cool: 25 chirps per 13 seconds

Warm: 37 chirps per 13 seconds
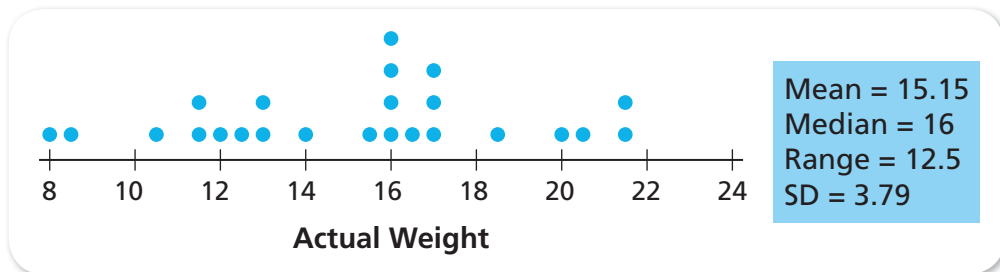
Hot: 49 chirps per 13 seconds

2 seconds

23. A newspaper article said students carry heavy backpacks. One middle school class decided to check whether the claim was true. Each student estimated the weight of his or her backpack and then weighed it. The scatter plot shows the estimated and actual backpack weights for each student. The dot plots show the distributions for each variable with their mean.
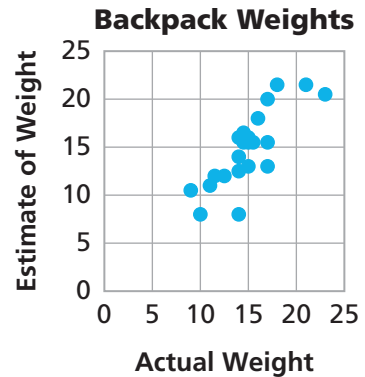
Backpack Weights

a. Use the statistics in the box to describe the spread of the estimated backpack weights.

Estimate of Weight

Mean = 15.53
Median = 15
Range = 13
SD = 3.14
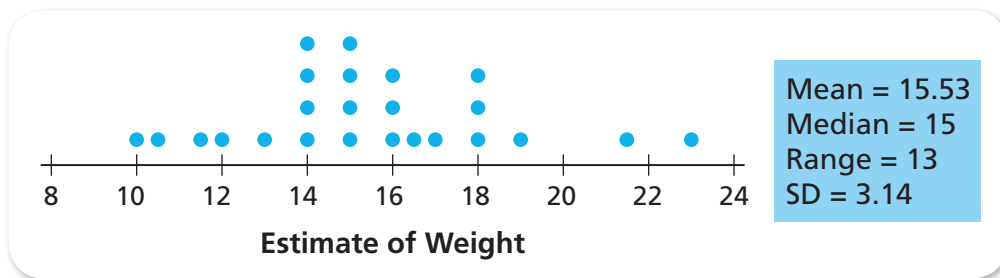
b. Use the statistics in the box to describe the spread of the actual backpack weights.

Actual Weight

Mean = 15.15
Median = 16
Range = 12.5
SD = 3.79

c. Estimate a correlation coefficient for the scatter plot. Is it closest to −1, −0.5, 0, 0.5, or 1? Explain your choice.

24. A group of students estimated, and then counted, the number of seeds in several pumpkins. The two tables show the same data sorted differently: One shows the data sorted by actual count and the other by estimate.

Number of Pumpkin Seeds Sorted by Actual Count

Actual	Estimate
309	630
325	621
336	1,423
354	1,200
365	1,200
367	621
381	801
384	604
387	1,900
387	1,100
408	605
410	622
423	759
441	655
442	300
446	621
455	722
462	556
467	621
479	900
486	680
492	1,000
494	564
498	1,458
505	720
506	624
507	200
512	500
523	350
545	2,000
553	202
568	766
606	521
607	1,200

Number of Pumpkin Seeds Sorted by Estimate

Actual	Estimate
507	200
553	202
442	300
523	350
512	500
606	521
462	556
494	564
384	604
408	605
325	621
367	621
446	621
467	621
410	622
506	624
309	630
441	655
486	680
505	720
455	722
423	759
568	766
381	801
479	900
492	1,000
387	1,100
354	1,200
365	1,200
607	1,200
336	1,423
498	1,458
387	1,900
545	2,000

a. How do the actual counts vary? Find the median, the least, and the greatest counts.

b. How do the estimates vary? Find the median, the least, and the greatest estimates.

c. Make a scatter plot of the data. Draw a line on the graph to connect the points (0, 0), (250, 250), (500, 500), and (2250, 2250). What is true about the estimates and actual counts for points near the line?

d. What is true about the estimates and actual counts for points *above* the line you graphed in part (c)?

e. What is true about the estimates and actual counts for points *below* the line you graphed in part (c)?

f. In general, did the students make good estimates? Use the median and the range of the data to explain your reasoning.

g. Would a correlation coefficient be closest to −1, −0.5, 0, 0.5, or 1? Explain your choice.

h. One student graphed the data on the scatter plot below. It shows the data bunched together. How could you change the scale(s) on the graph to show the data points better?
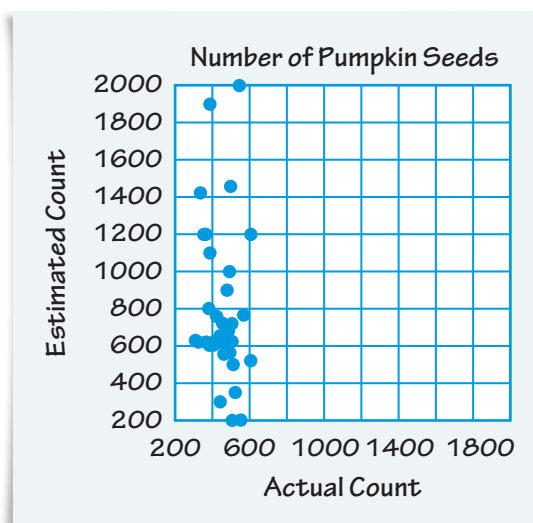
25. Multiple Choice Janelle made a scatter plot that shows the relationship between her MP3 music downloads and the unused space on her music player. Which statement would you expect to be true?

A. As the number of MP3s downloaded increases, the amount of unused space increases.

B. As the number of MP3s downloaded increases, the amount of unused space stays the same.

C. As the number of MP3s downloaded increases, the amount of unused space decreases.

D. As the number of MP3s downloaded decreases, the amount of space used decreases.

26. a. The graph shows a model of the relationship between pumpkin circumference and pumpkin weight. How does the graph suggest that the linear equation $w = c$ would not be a very accurate model for the relationship of weight and circumference?

Pumpkin Measurements
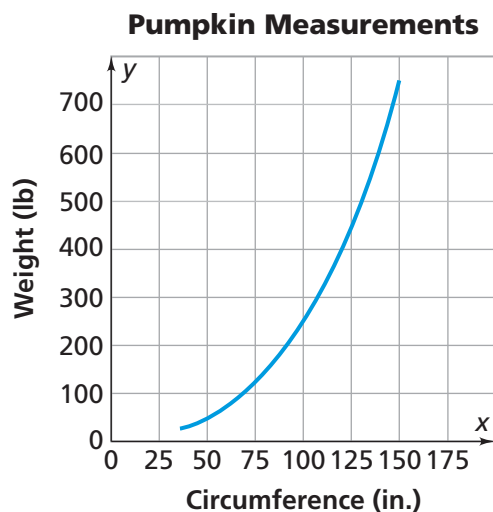
b. Which of the following functions would you expect to express the relationship between pumpkin circumference and pumpkin weight? Explain your choice.

$$w = kc \qquad w = kc^2 \qquad w = kc^3 \qquad w = \frac{k}{c}$$