1.

Object	Frequency
Rock	11
Paper	10
Scissors	15
Total	36

2.

Player	Wins
1	7
2	8
Tie	3
Total	18

3. 0.11

4. 0.89

5. 0.53

6.

Outcome	Probability
Red	$\frac{1}{7}$
Green	$\frac{3}{7}$
Blue	$\frac{2}{7}$
Yellow	$\frac{1}{7}$
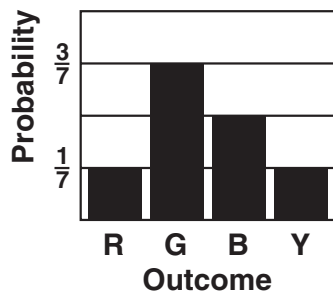
7. Number of Days Per Month

Days	28	29	30	31
Frequency	3	1	16	28
Probability	$\frac{3}{48}$	$\frac{1}{48}$	$\frac{16}{48}$	$\frac{28}{48}$

8.

9.
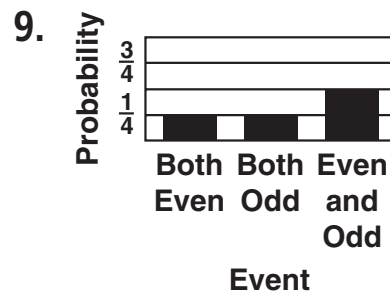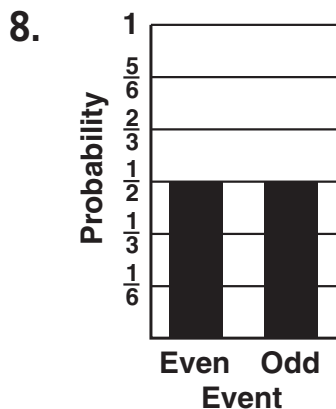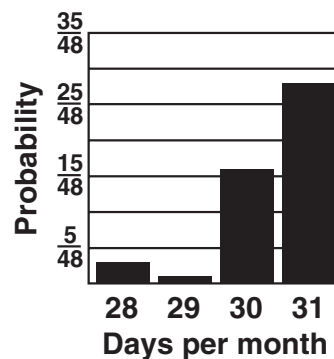
10. Answers will vary. Sample design: Use random numbers. Assign numbers 1 to 1000 to each event, based on its probability.

| Age	Probability	Cumulative Probability	Assigned Numbers
<20	0.048	0.048	1–48
20–29	0.175	0.223	49–223
30–39	0.199	0.422	224–422
40–49	0.211	0.633	423–633
50–59	0.167	0.800	634–800
60–69	0.102	0.902	801–901
70–79	0.066	0.968	902–968
≥80	0.032	1.000	969–1000

Random numbers generated: 697, 420, 488, 567, 272, 396, 474, 870, 896, 282, 464, 681, 274, 663, 681, 282, 376, 363, 860, 129
Results of simulation: Age 20–29: 1, Age 30–39: 8; Age 40–49: 4, Age 50–59: 4; Age 60–69: 3

11. Answers will vary. Sample design: Use random numbers. Assign numbers 1 to 1000 to each event, based on its probability.

Type	Prob.	Cum. Prob.	Assigned Numbers
Luxury	0.165	0.165	1–165
Large	0.076	0.241	166–241
Midsize	0.527	0.768	242–768
Small	0.232	1	769–1000

Random numbers generated: 612, 904, 249, 194, 435, 772, 93, 236, 80, 370, 849, 468, 819, 800, 371, 14, 396, 278, 303, 662, 637, 572, 700, 196, 810, 314, 496, 408, 737, 624
Results of simulation: 3 luxury cars, 3 large cars, 18 midsize cars, and 6 small cars

Answers for Lesson 12-1   Exercises (cont.)

12.

P(x)

13.

P(x)
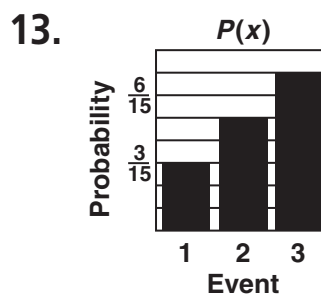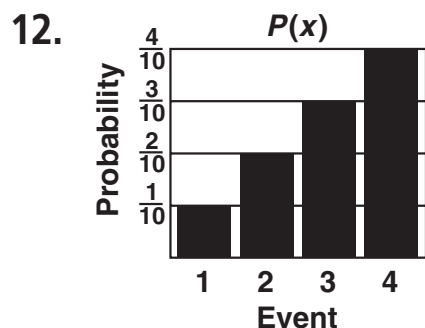
14. a.

Weather Conditions in Dayton, Ohio

Type	Frequency	Probability
Clear	82	0.225
Partly Cloudy	118	0.323
Mostly Cloudy	34	0.093
Rain	75	0.205
Light Snow	45	0.123
Snow	11	0.030

b. The independent variable is the type of weather. The dependent variable is the probability that a type of weather occurs.

**c.** $\frac{131}{365}$ OR 0.359

15. Check students' work.

16. a. The independent variable is the amount of gas in the tank; the dependent variable is the percent of people who fill their tanks when they have a given amount of gas.

b.

Gas in Tank
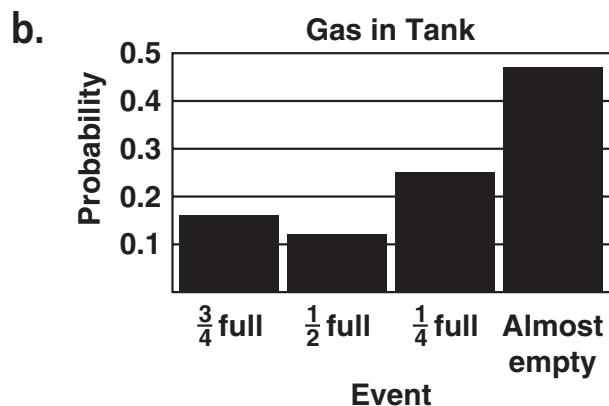
c. 0.28 or 28%

Answers for Lesson 12-1   Exercises (cont.)

17. Answers may vary. Sample: Suppose the events in a probability distribution are *not* equally likely. By assigning the appropriate number of *equally likely* outcomes to each event, you can design a simulation that reflects the actual probabilities expected.

18.
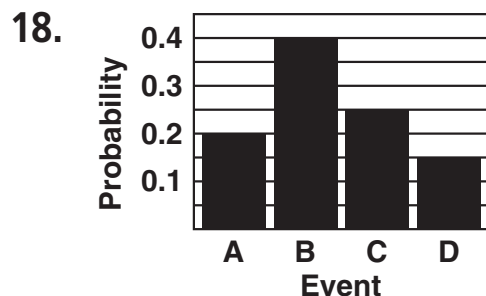
19. Answers may vary. Sample:

a.

| Calls	$P(c)$	Cum. Prob.	Assigned #s
0	0.21	0.21	1–21
1	0.30	0.51	22–51
2	0.18	0.69	52–69
3	0.13	0.82	70–82
4	0.09	0.91	83–91
5	0.05	0.96	92–96
6	0.03	0.99	97–99
7	0.01	1.00	100

b. There were six hours in which 3 calls were received, and two in which 4 calls were received. A total of ten callers would have to wait.

c. $\frac{10}{47}$

d. An additional response team would reduce the probability of having to wait from $\frac{10}{47}$ to $\frac{2}{47}$, a considerable improvement.

20. a. 0.0000001, 0.16, ≈0.84

b. Check students' work.

c. Check students' work.
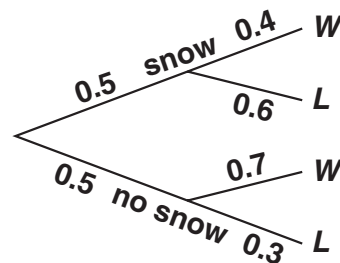
Answers for Lesson 12-2   Exercises

1. 0.9

2. 0.6

3. $0.\overline{6}$

4. ≈0.085

5. ≈0.406

6. ≈0.519

7. ≈0.562

8. ≈0.784

9. ≈45%

10. ≈23%

11.

M = male
F = female
R = right
L = left
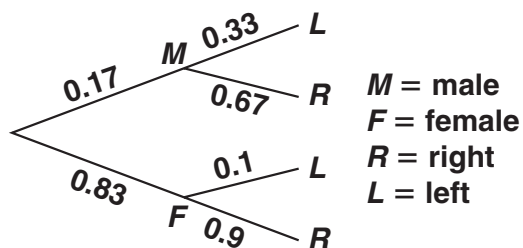
0.1, 0.114

12.

$P(W) = 0.55$

13. a. 0.15

   b. 0.60

   c. $P(A)$ is equal to $P(A \mid B)$

   d. The fact that $P(A) = P(A \mid B)$ illustrates that the probability of A is the same, regardless of the occurrence of B.

14–18. Check students' work.

19. $P(C)$

20. $P(S \text{ and } W)$ **21.** $P(R \mid W)$ **22.** $P(W \mid S)$

23. a. The four right branches represent probabilities conditional upon the person being an adult or a minor. For example, the top branch represents the probability that a person is licensed given that he or she is an adult.

   b. No; the probability of a minor being licensed is not the same as the probability of an adult being licensed.
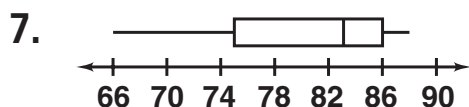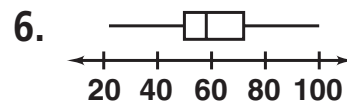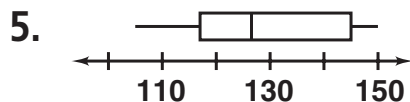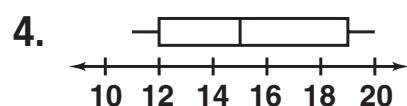
   c. Check students' work.

24. $P(I \mid N) = 0.2$

Answers for Lesson 12-3   Exercises

1. $4.\overline{36}$, 3, 1

2. 338.5, 316, no mode

3. 600.3, 535.5, 499

4.

5.

6.

7.

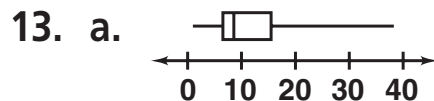**8.** 5896, 6381

9. 6, 18

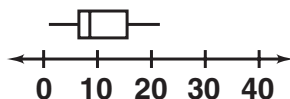**10.** 9.8

11. 0

12. a. 0%

   b. No; if there is an even number of items in a data set, the median may lie between data values.

   c. No; 50% of a data set will always lie at or below the median.

13. a.

   b. 37, 39

   c. The main effect of removing the outlier is a shortening of the long whisker. The median decreases from 8.5 to 8.

14. 103; this value lowers the mean.

**15.** 381; this value raises the mean.

16. 0th

17. 60th

18. Only 14 out of 20 values are below 89, so 89 is at the 70th percentile. For a number to be at the 100th percentile, 100% of the values must be below that number. That is impossible since a number cannot be less than itself.

19. a. 18.9, 19

   b. No; none of the values is significantly less or greater than the others.

   c. Recent earthquakes have been more consistent in their numbers, with fewer light years as well as fewer extremely heavy years; this is indicated by the shorter whiskers on the box-and-whisker plot for 1991 through 2000.

20. The median is a better representation for the data; a few outliers can heavily influence the mean without drastically affecting the median.

21. a.

Men:

Women:

14 15 16 17 18 19 20 21
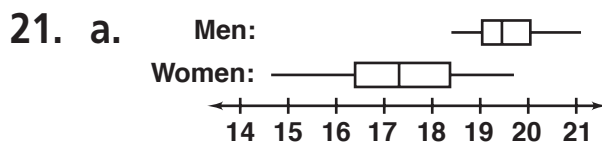
   b. Answers may vary. Sample: The range for women's shot put is greater than men's. The men are more consistent, as indicated by the shorter box and whiskers. Overall the men tend to throw farther.

22. a.

30   40   50   60
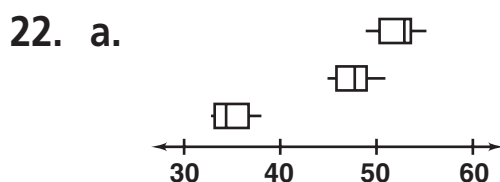
   b. A Presidential election greatly increases voter turnout rate for the House of Representatives. The median turnout increases by 13.4%. The minimum turnout in a Presidential election year is 6.9% greater than the maximum turnout for a non-Presidential election year.

Answers for Lesson 12-4   Exercises

1. 5, 2.5   **2.** 105, 57   **3.** 704, 461

4. 258.6, 228.3   **5.** 15.1, 3.5   **6.** 3816.43, 67.22

7. 10,259.18, 300.28   **8.** 2 standard deviations

9. 3 standard deviations   **10.** 2.8

11. -1.4 **12.** 20   **13.** 0   **14.** -2.8

15. 14.6, 52.3; the bird speeds are more spread out than the cat speeds.

16. 4.1, 2.0; the number of buttons is more spread out than the number of pockets.

17. 2001: $\approx$6707; 2002: $\approx$6738

18. The range dropped slightly from 7715 in 2001 to 7611 in 2002. Overall farm income increased slightly, but there was less variability among the states in 2002.

19. 2678.9, 2759.0; The incomes in 2001 clustered more tightly around the mean.

20. Iowa

21. a. 53.8, $\approx$3.4
    b. 7; 9; 10

22. $\approx$10.9; $\approx$3.3   **23.** $\approx$75.8; $\approx$8.7

24. $\approx$1.9; $\approx$1.4   **25.** $\approx$0.007; $\approx$0.08

26. Answers may vary. Sample: standard deviation; it has the same units of measure as the data, and it doesn't magnify the variation as much as the variance does.

27. Minh; one standard deviation encompasses all values within one standard deviation above and below the mean. The graph actually shows that all values are within 3 standard deviations of the mean.

Answers for Lesson 12-4   Exercises (cont.)

28. Check students' work.

29. a. men: 14; 22.9; 3.2
women: 12; 25.9; 3.8

b. No; the men's team has a broader range of ages, but a smaller standard deviation than the women's team.

30. a. union: $641; $279
nonunion: $564; $317

b. union: $98
nonunion: $92

c. union: 3;
nonunion: 2

d. On average, union workers are paid more than nonunion workers. The pay range is broader for nonunion workers. Union workers' pay is more broadly distributed than nonunion workers'.
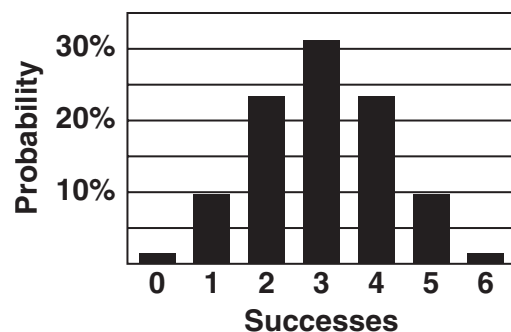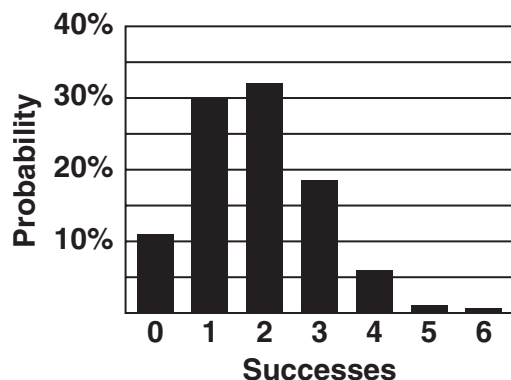
Answers for Lesson 12-5   Exercises

1. 73% **2.** 45% **3.** 92%

4. This sampling method overrepresents shoppers buying greeting cards.

5. very little bias

6. If students walk or drive to school, or are involved in other after-school activities, they are not represented by this sample method.

7. C; this sample has the smallest standard deviation, which most likely indicates a larger sample.

8. Group B probably was the smaller sample; it has the greater variation in the percentages represented in the graph.

9. ±7% **10.** ±4% **11.** ±3%

12. 156 **13.** 400 **14.** 10,000

15. ±4%; 55% to 63% **16.** ±5%; 57% to 67%

17. a. 63%
　　b. ±5%
　　c. 58% to 68%

18. a. 92%
　　b. ±4%
　　c. 88% to 96%

19. a. 94%
　　b. ±18%
　　c. 76% to 100%

20. a. 6%
　　b. ±25%
　　c. 0% to 31%

21. Check students' work.

22. Doubling a sample size multiplies the margin of error by $\frac{1}{\sqrt{2}} \approx 0.71$, so the margin is about 71% of its former value.

23. Check students' work.

24. A sample proportion is an experimental probability; it is based on actual measurements.

25. This method is biased because it overrepresents people who respond to the online advertisement. A less biased method could involve surveying a group of people selected at random.

26. 11%, ±3%

27. 31%, ±13%

28. 40%, ±6%

29. 63%, ±5%

30. a. $22,220

   b. $50,000; more than doubling the cost of the survey has made only a small improvement in the margin of error.

31. a. There is an 8% margin of error; the candidate should be aware that 52% of the voters could actually prefer the opponent.

   b. The candidate should feel more confident after the second poll; it has a margin of error of only 4%, which means this candidate is preferred by at least 51% of voters.

32. 51 black bears

Answers for Lesson 12-6   Exercises

1. Each guess is a trial. There are 5 trials. Each correct answer is a success. The probability of a success on a single trial is 0.5. Check students' designs and simulations.

2. Each voter selected is a trial. There are 10 trials. A vote in favor of the bond is a success. The probability of a success on a single trial is 0.4. Check students' designs and simulations.

3. Each shift is a trial. There are 3 trials. Not experiencing a breakdown is a success. The probability of a success on a single trial is 0.9. Check students' designs and simulations.

4. 6.25%   **5.** 25%   **6.** 25%   **7.** 0%

8. 0.2541   **9.** 0.1361   **10.** 0.2461   **11.** 0.0015

12. $P(0) = 0.1176$
$P(1) = 0.3025$
$P(2) = 0.3241$
$P(3) = 0.1852$
$P(4) = 0.0595$
$P(5) = 0.0102$
$P(6) = 0.0007$

13. $P(0) = 0.0156$
$P(1) = 0.0938$
$P(2) = 0.2344$
$P(3) = 0.3125$
$P(4) = 0.2344$
$P(5) = 0.0938$
$P(6) = 0.0156$

14. $P(0) = 0.000001$
$P(1) = 0.000054$
$P(2) = 0.0012$
$P(3) = 0.0146$
$P(4) = 0.0984$
$P(5) = 0.3543$
$P(6) = 0.5314$
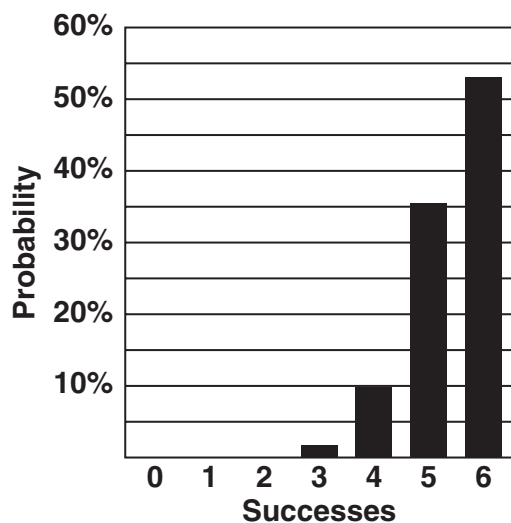
15. 0.2824   **16.** 0.8891   **17.** 0.1109

18. 0.2461   **19.** 0.2051   **20.** 0.6230

21. Each term of a binomial expansion $(p + q)^n$ involves a power of p times a power of q. The coefficient of each term is the number of times that combination of powers results when $(p + q)^n$ is expanded. In a binomial experiment of n trials, each trial results in success or failure, with probabilities p and q. The probability of each outcome contains n factors, each of which is either p or q. The coefficient of each term is the number of ways that outcome can be achieved.

22. a. 0.0914

 b. The probability that 3 boxes would be underweight is 0.0001. Thus I would conclude that there is a malfunction in the machinery that must be corrected.

Answers for Lesson 12-6 Exercises (cont.)

23. Check students' work.

24. The probability of a group of 30 students having 4 or fewer left-handed students is 77.05%. This percentage means that more than three quarters of the classes will have enough left-handed desks; 4 is an adequate number.

25. a. $_{40}C_3\left(\frac{1}{7}\right)^3\left(\frac{6}{7}\right)^{37} \approx 0.0960 = 9.6\%$

    b. Answers may vary. Sample: Generate 40 numbers ranging from 1 to 7. Let the number 4 represent Wednesday birthdays. Repeat 10 times. Count the number of runs that 4 came up exactly 3 times; divide that number by 10 to get the probability that exactly 3 of 40 people will have Wednesday birthdays. Check students' work for probability.

    c. 10 runs is too few to get an accurate probability.

26. Answers may vary. Sample: 60% of the summer days in Eastport are sunny. What is the probability of a week containing just two sunny days?

27. Getting 5 or more items right by guessing would be statistically rare. The probability of getting 10, 9, 8, 7, or 6 correct is each less than 1%. The probability of getting 5 right is 2.6%. The probability of getting 4 right is 8.8%.

28. Check students' work.

29. a. The graph is symmetrical about the line $x = 3.5$.

    b.

x	y
0	0.0078
1	0.0547
2	0.1641
3	0.2734
4	0.2734
5	0.1641
6	0.0547
7	0.0078

    c. No; the bulge in the graph has shifted right.
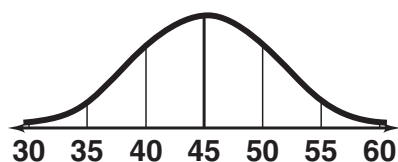
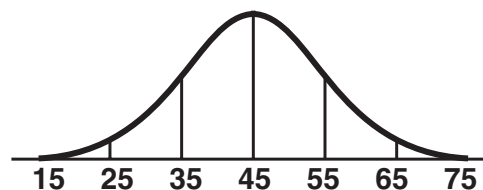# Answers for Lesson 12-7   Exercises

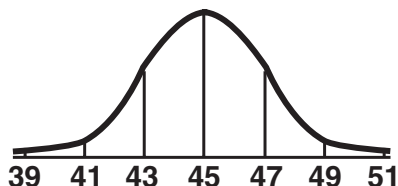**1.** 43%   **2.** 39%   **3.** 43 men   **4.** 66%

5.

30 35 40 45 50 55 60

6.

15   25   35   45   55   65   75

7.

39   41   43   45   47   49   51

8.

34.5 38 41.5 45 48.5 52 55.5
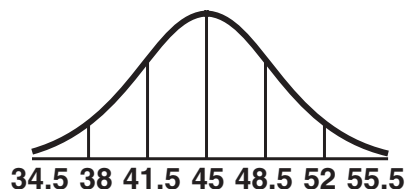
9. 79.1   **10.** 56.3   **11.** 68%   **12.** 97.5%
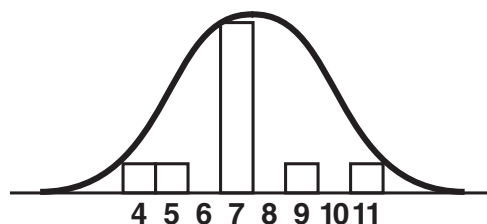
13. 50%   **14.** 47.5%   **15.** 32%

16. The student's grade is an outlier; 99% of all grades are expected to be within 3 standard deviations of the mean, and this score is 4.4 standard deviations above the mean.

17. a. set 2

b & c.

4 5 6 7 8 9 1011

18. 59 minutes **19.** 2.5%   **20.** 47.5%   **21.** 100%

22. 81.5%   **23.** 50%   **24.** 84%   **25.** 97.5%

26. The first plant was in the top 16% of its group.

27. a. 209

b. 41

c. 127−250

28. a.

Worldwide Earthquakes in 2000
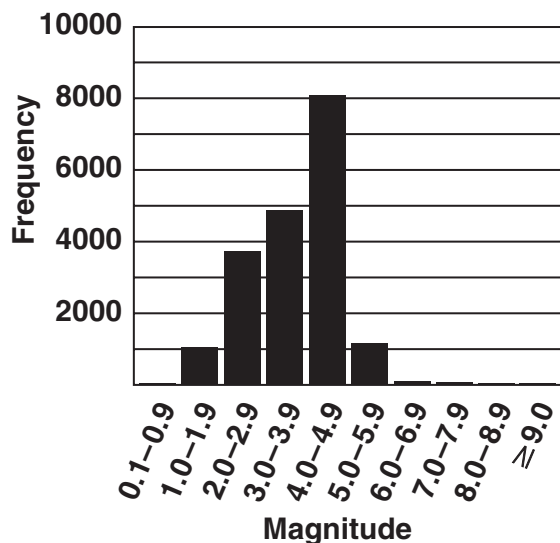
b. The data do not fit a normal curve; the data are too skewed to the left.

29. Elena scored within the top 10% of her group. Her score is 2.75 std. dev. above the mean, which places her in the top 1%. Jake did not score in the top 10%. His score is 1.16 std. dev. above the mean, or at the 88th percentile.

30. 480 tubs

31. a. 162 balls

b. 930 balls

c. Check students' work.