Appendix H

Selected Answers*

Chapter 1

Review Exercises

1. Descriptive statistics describe the data set. Inferential statistics use the data to draw conclusions about the population.

3. Answers will vary.

5. A sample is a subset or portion of the population that we actually do study to find out information about the population. Samples are used to save time and money when the population is large and when the units must be destroyed to gain information.

6. *a.* Inferential *b.* Descriptive *c.* Descriptive *d.* Descriptive *e.* Inferential *f.* Inferential *g.* Descriptive *h.* Inferential

7. *a.* Ratio *b.* Ordinal *c.* Interval *d.* Ratio *e.* Ratio *f.* Ratio *g.* Ordinal *h.* Ratio *i.* Ratio *j.* Nominal

9. *a.* Discrete *b.* Continuous *c.* Discrete *d.* Continuous *e.* Continuous *f.* Discrete *g.* Continuous

11. Random, systematic, stratified, cluster

12. *a.* Cluster *b.* Systematic *c.* Random *d.* Systematic *e.* Stratified

13. Answers will vary.

15. Answers will vary.

17. *a.* Experimental *b.* Observational *c.* Observational *d.* Experimental

19. Possible answers:
a. Workplace of subjects, smoking habits, etc.
b. Gender, age, etc.
c. Diet, type of job, etc.
d. Exercise, heredity, age, etc.

21. The only time claims can be proved is when the entire population is used.

23. Since the results are not typical, the advertisers selected only a few people for whom the weight loss product worked extremely well.

25. "74% more calories" than what? No comparison group is stated.

27. What is meant by "24 hours of acid control"?

29. Possible answer: It could be the amount of caffeine in the coffee or tea. It could have been the brewing method.

31. Answers will vary.

Chapter Quiz

1. True **2.** True
3. True **4.** False
5. True **6.** True
7. False **8.** *c*
9. *b* **10.** *d*
11. *a* **12.** *c*
13. *a* **14.** Descriptive, inferential
15. Gambling, insurance **16.** Population
17. Sample
18. *a.* Saves time *b.* Saves money *c.* Use when population is infinite
19. *a.* Random *b.* Systematic *c.* Cluster *d.* Stratified
20. Quasi-experimental **21.** Random
22. *a.* Descriptive *b.* Inferential *c.* Descriptive *d.* Inferential *e.* Inferential

*Answers may vary due to rounding or use of technology.

Note: These answers to odd-numbered and selected even-numbered exercises include *all* quiz answers.

23. *a.* Nominal *d.* Interval
b. Ratio *e.* Ratio
c. Ordinal

24. *a.* Continuous *d.* Continuous
b. Discrete *e.* Discrete
c. Continuous

25. *a.* 31.5–32.5 minutes
b. 0.475–0.485 millimeter
c. 6.15–6.25 inches
d. 18.5–19.5 pounds
e. 12.05–12.15 quarts

Chapter 2

Exercises 2–1

1. To organize data in a meaningful way, to determine the shape of the distribution, to facilitate computational procedures for statistics, to make it easier to draw charts and graphs, to make comparisons among different sets of data

3. *a.* 31.5–38.5, 35, 7
b. 85.5–104.5, 95, 19
c. 894.5–905.5, 900, 11
d. 12.25–13.55, 12.9, 1.3
e. 3.175–4.965, 4.07, 1.79

5. *a.* Class width is not uniform.
b. Class limits overlap, and class width is not uniform.
c. A class has been omitted.
d. Class width is not uniform.

7.

Class	Tally	Frequency	Percent
A	////	4	10
M	𝍸 𝍸 𝍸 𝍸 ///	28	70
H	𝍸 /	6	15
S	//	2	5
		40	100

9.

Limits	Boundaries	*f*
165–185	164.5–185.5	4
186–206	185.5–206.5	6
207–227	206.5–227.5	15
228–248	227.5–248.5	13
249–269	248.5–269.5	9
270–290	269.5–290.5	1
291–311	290.5–311.5	1
312–332	311.5–332.5	1
		50

A peak occurs in class 207–227 (206.5–227.5). There are no gaps in the distribution, and there is one value in each of the three highest classes.

	cf
Less than 164.5	0
Less than 185.5	4
Less than 206.5	10
Less than 227.5	25
Less than 248.5	38
Less than 269.5	47
Less than 290.5	48
Less than 311.5	49
Less than 332.5	50

11.

Limits	Boundaries	*f*
746–752	745.5–752.5	4
753–759	752.5–759.5	6
760–766	759.5–766.5	8
767–773	766.5–773.5	9
774–780	773.5–780.5	3
		30

	cf
Less than 745.5	0
Less than 752.5	4
Less than 759.5	10
Less than 766.5	18
Less than 773.5	27
Less than 780.5	30

13.

Limits	Boundaries	*f*
27–33	26.5–33.5	7
34–40	33.5–40.5	14
41–47	40.5–47.5	15
48–54	47.5–54.5	11
55–61	54.5–61.5	3
62–68	61.5–68.5	3
69–75	68.5–75.5	2
		55

	cf
Less than 26.5	0
Less than 33.5	7
Less than 40.5	21
Less than 47.5	36
Less than 54.5	47
Less than 61.5	50
Less than 68.5	53
Less than 75.5	55

15.

Limits	Boundaries	f
6–132	5.5–132.5	16
133–259	132.5–259.5	3
260–386	259.5–386.5	0
387–513	386.5–513.5	0
514–640	513.5–640.5	1
		20

The lowest class has the most data values, 16, and the next class has 3 values. There is one extremely large data value, 635, and it is in the last class, 514–640 (513.5–640.5).

	cf
Less than 5.5	0
Less than 132.5	16
Less than 259.5	19
Less than 386.5	19
Less than 513.5	19
Less than 640.5	20

17. $H = 123 \qquad L = 77$
Range $= 123 - 77 = 46$
Width $= 46 \div 7 = 6.6$ or 7

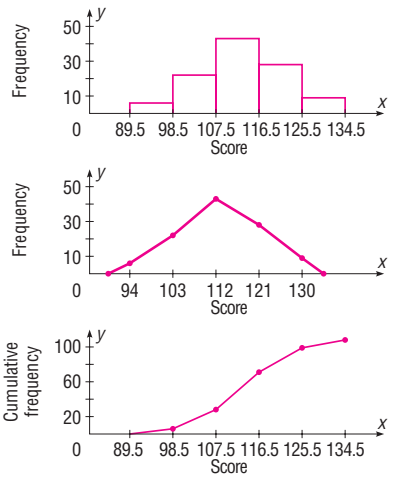
Limits	Boundaries	f
77–83	76.5–83.5	1
84–90	83.5–90.5	1
91–97	90.5–97.5	6
98–104	97.5–104.5	14
105–111	104.5–111.5	8
112–118	111.5–118.5	1
119–125	118.5–125.5	1
		32

	cf
Less than 76.5	0
Less than 83.5	1
Less than 90.5	2
Less than 97.5	8
Less than 104.5	22
Less than 111.5	30
Less than 118.5	31
Less than 125.5	32

19. The percents sum to 101. They should sum to 100% unless rounding was used.

Exercises 2–2

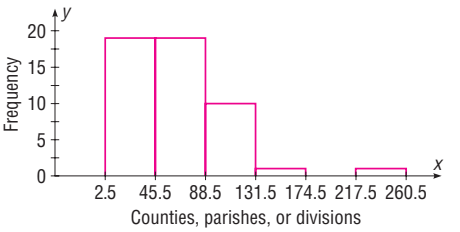
1. Eighty applicants do not need to enroll in the developmental programs.



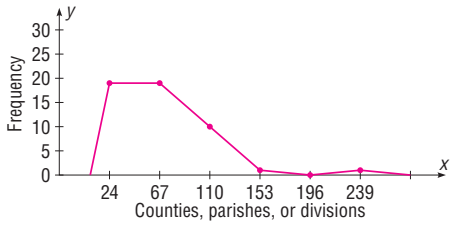
3.

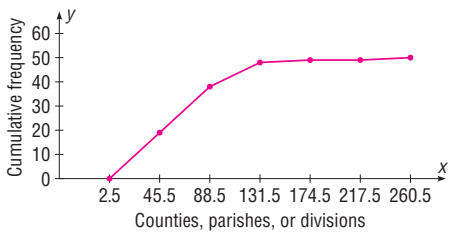
Limits	Boundaries	f
3–45	2.5–45.5	19
46–88	45.5–88.5	19
89–131	88.5–131.5	10
132–174	131.5–174.5	1
175–217	174.5–217.5	0
218–260	217.5–260.5	1
		50

	cf
Less than 2.5	0
Less than 45.5	19
Less than 88.5	38
Less than 131.5	48
Less than 174.5	49
Less than 217.5	49
Less than 260.5	50



The distribution is positively skewed.



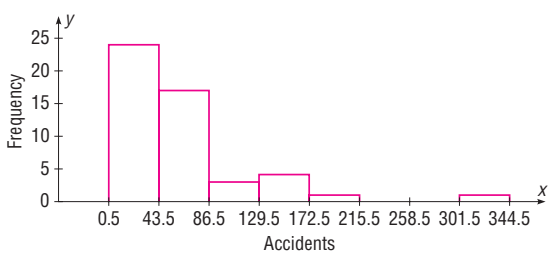


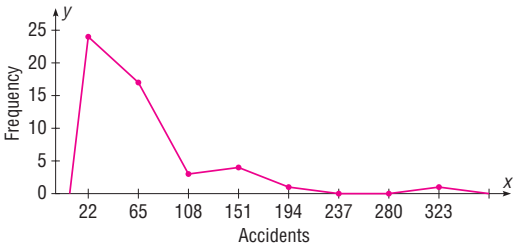
5.

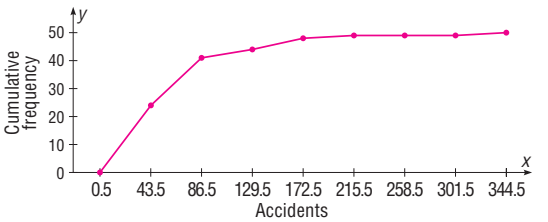
Limits	Boundaries	f
1–43	0.5–43.5	24
44–86	43.5–86.5	17
87–129	86.5–129.5	3
130–172	129.5–172.5	4
173–215	172.5–215.5	1
216–258	215.5–258.5	0
259–301	258.5–301.5	0
302–344	301.5–344.5	1

	cf
Less than 0.5	0
Less than 43.5	24
Less than 86.5	41
Less than 129.5	44
Less than 172.5	48
Less than 215.5	49
Less than 258.5	49
Less than 301.5	49
Less than 344.5	50

The distribution is positively skewed.



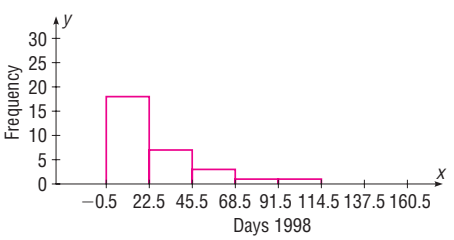


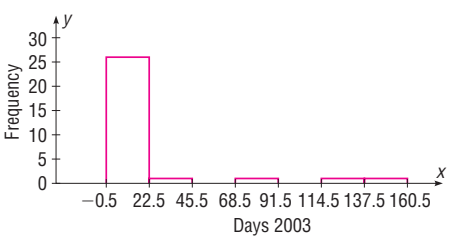


7.

Limits	Boundaries	f(1998)	f(2003)
0–22	−0.5–22.5	18	26
23–45	22.5–45.5	7	1
46–68	45.5–68.5	3	0
69–91	68.5–91.5	1	1
92–114	91.5–114.5	1	0
115–137	114.5–137.5	0	1
138–160	137.5–160.5	0	1
		30	30

Both distributions are positively skewed, but the data are somewhat more spread out in the first three classes in 1998 than in 2003, and there are two large data values in the 2003 data.

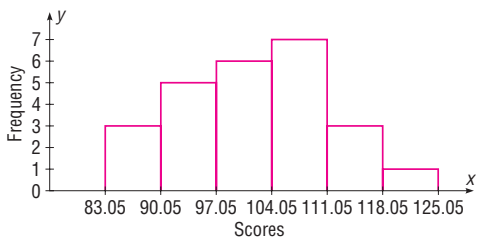


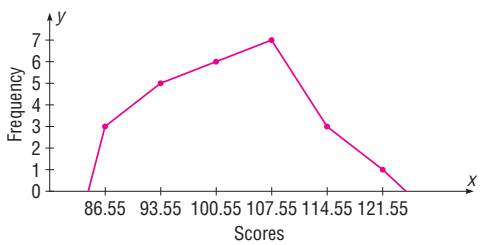


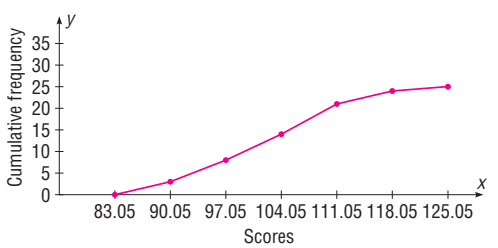
9.

Limits	Boundaries	f
83.1–90.0	83.05–90.05	3
90.1–97.0	90.05–97.05	5
97.1–104.0	97.05–104.05	6
104.1–111.0	104.05–111.05	7
111.1–118.0	111.05–118.05	3
118.1–125.0	118.05–125.05	1
		25

	cf
Less than 83.05	0
Less than 90.05	3
Less than 97.05	8
Less than 104.05	14
Less than 111.05	21
Less than 118.05	24
Less than 125.05	25





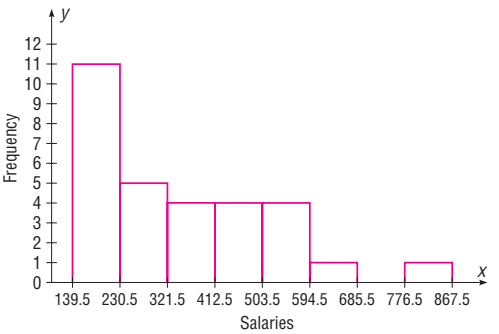


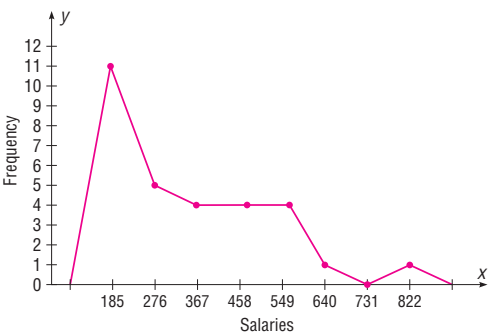
11.

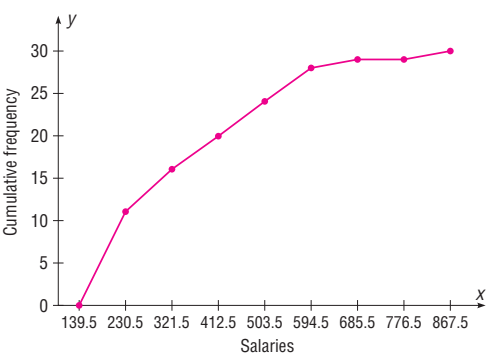
Limits	Boundaries	f
140–230	139.5–230.5	11
231–321	230.5–321.5	5
322–412	321.5–412.5	4
413–503	412.5–503.5	4
504–594	503.5–594.5	4
595–685	594.5–685.5	1
686–776	685.5–776.5	0
777–867	776.5–867.5	1
		30

	cf
Less than 139.5	0
Less than 230.5	11
Less than 321.5	16
Less than 412.5	20
Less than 503.5	24
Less than 594.5	28
Less than 685.5	29
Less than 776.5	29
Less than 867.5	30

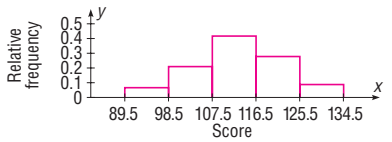
The distribution is positively skewed.

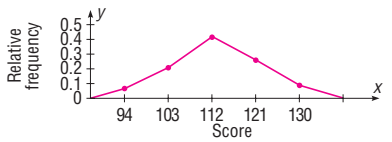


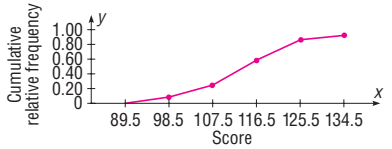




13. The proportion of applicants who need to enroll in the developmental program is about 0.26.





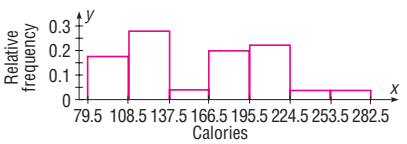


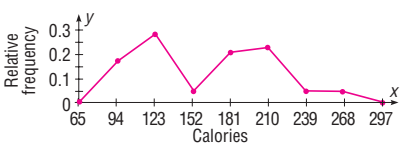
15.

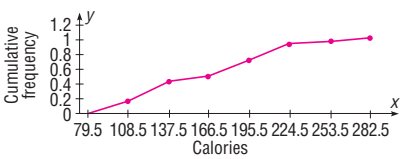
Class boundaries	rf
79.5–108.5	0.17
108.5–137.5	0.28
137.5–166.5	0.04
166.5–195.5	0.20
195.5–224.5	0.22
224.5–253.5	0.04
253.5–282.5	0.04
	0.99

	crf
Less than 79.5	0.00
Less than 108.5	0.17
Less than 137.5	0.45
Less than 166.5	0.49
Less than 195.5	0.69
Less than 224.5	0.91
Less than 253.5	0.95
Less than 282.5	0.99*

*Due to rounding.





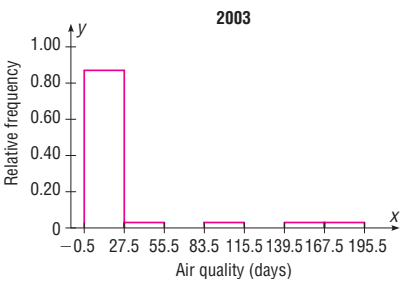


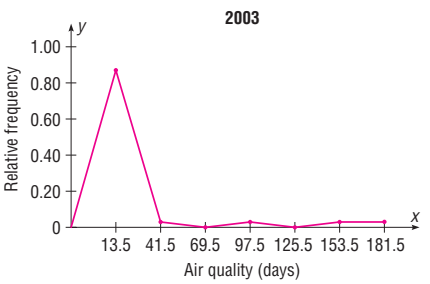
The histogram has two peaks.

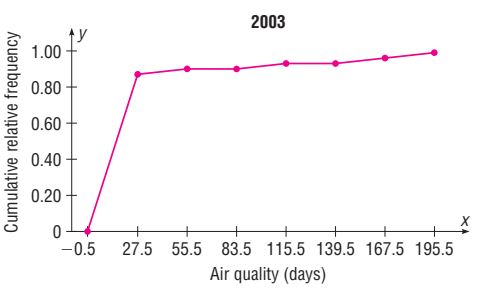
17.

Class boundaries	rf
−0.5–27.5	0.87
27.5–55.5	0.03
55.5–83.5	0.00
83.5–111.5	0.03
111.5–139.5	0.00
139.5–167.5	0.03
167.5–195.5	0.03
	0.99

	crf
Less than −0.5	0.00
Less than 27.5	0.87
Less than 55.5	0.90
Less than 83.5	0.90
Less than 111.5	0.93
Less than 139.5	0.93
Less than 167.5	0.96
Less than 195.5	0.99





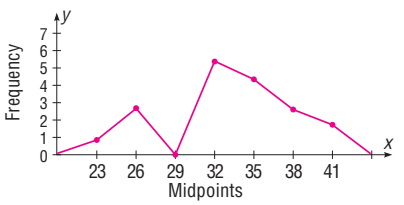


19. *a.*

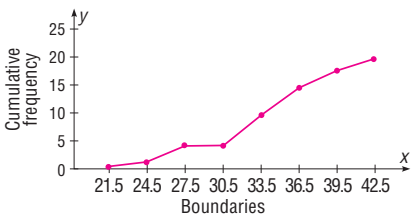
Limits	Boundaries	Midpoints	*f*
22–24	21.5–24.5	23	1
25–27	24.5–27.5	26	3
28–30	27.5–30.5	29	0
31–33	30.5–33.5	32	6
34–36	33.5–36.5	35	5
37–39	36.5–39.5	38	3
40–42	39.5–42.5	41	2

	cf
Less than 21.5	0
Less than 24.5	1
Less than 27.5	4
Less than 30.5	4
Less than 33.5	10
Less than 36.5	15
Less than 39.5	18
Less than 42.5	20

b.

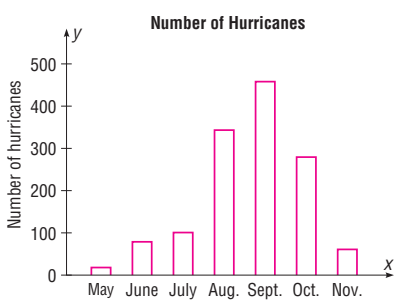


c.



Exercises 2–3

1.



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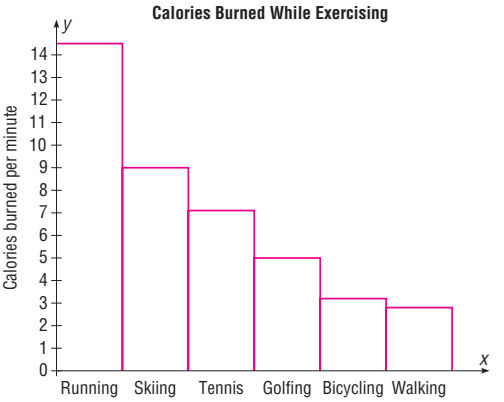

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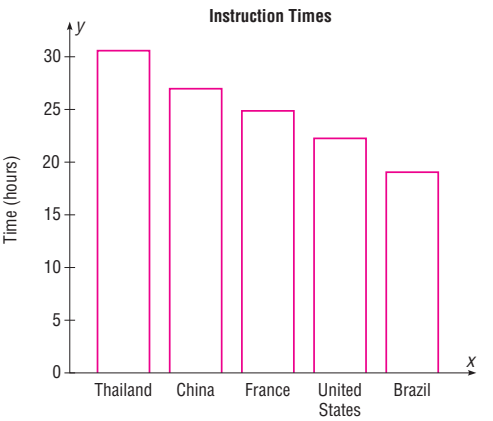

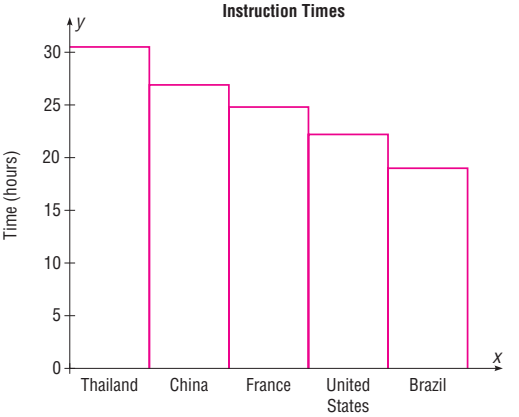

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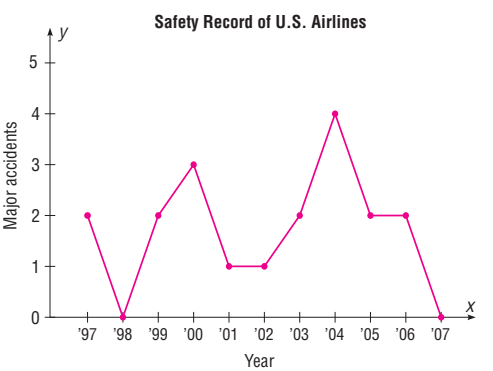
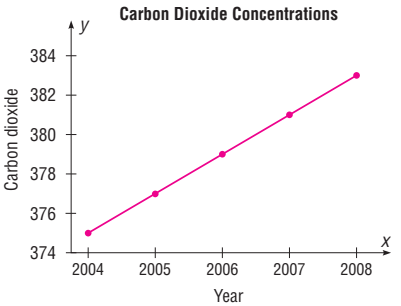
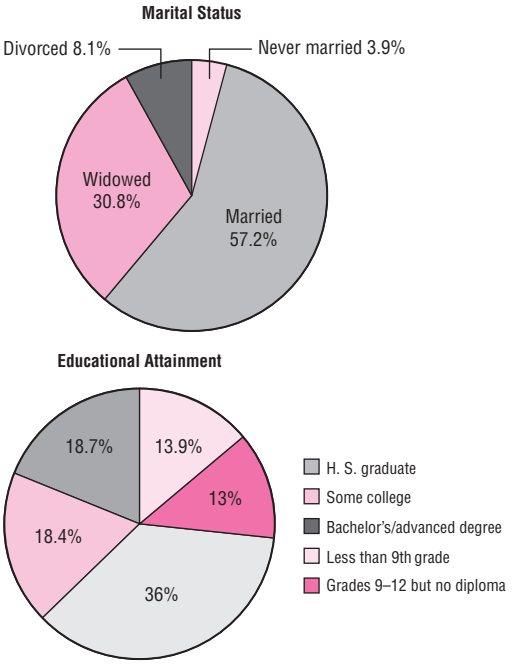


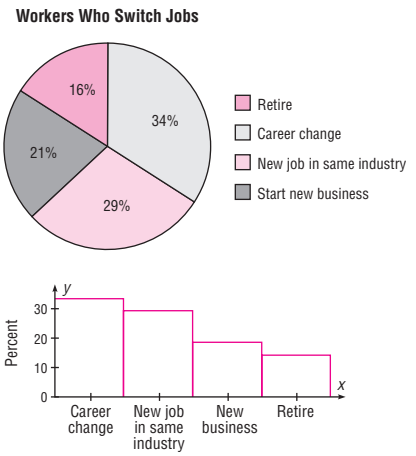
9. The atmospheric concentration of carbon dioxide has been steadily increasing over the years.



11.



13. The pie graph better represents the data since we are looking at parts of a whole.



15. The distribution is somewhat symmetric and unimodal and has a peak in the 50s.

4	2 3
4	6 6 7 7 8 9 9
5	0 1 1 1 1 1 2 2 4 4 4 4 4
5	5 5 5 5 6 6 6 7 7 7 7 8
6	0 1 1 1 2 4 4
6	5 8 9

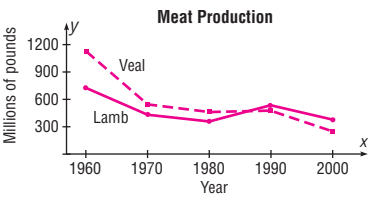
17.

Variety 1		Variety 2
2	1	3 8
3 0	2	5
9 8 8 5 2	3	6 8
3 3 1	4	1 2 5 5
9 9 8 5 3 3 2 1 0	5	0 3 5 5 6 7 9
	6	2 2

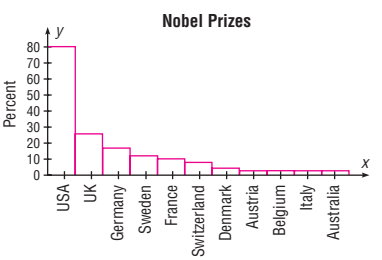
The distributions are somewhat similar in their shapes; however, the variation of the data for variety 2 is slightly larger than the variation of the data for variety 1.

19. Answers will vary.

21. Production of both veal and lamb is decreasing with the exception of 1990, where both show an increase.



23.



25. The values on the *y* axis start at 3.5. Also there are no data values shown for the years 2004 through 2011.

Review Exercises

1.

Class	*f*
Newspaper	10
Television	16
Radio	12
Internet	12
	50

3.

Class	f
Baseballs	4
Golf balls	5
Tennis balls	6
Soccer balls	5
Footballs	5
	25

5.

Class	f
11	1
12	2
13	2
14	2
15	1
16	2
17	4
18	2
19	2
20	1
21	0
22	1
	20

	cf
Less than 10.5	0
Less than 11.5	1
Less than 12.5	3
Less than 13.5	5
Less than 14.5	7
Less than 15.5	8
Less than 16.5	10
Less than 17.5	14
Less than 18.5	16
Less than 19.5	18
Less than 20.5	19
Less than 21.5	19
Less than 22.5	20

7.

Class limits	Class boundaries	f
15–19	14.5–19.5	3
20–24	19.5–24.5	18
25–29	24.5–29.5	18
30–34	29.5–34.5	8
35–39	34.5–39.5	3
		50

	cf
Less than 14.5	0
Less than 19.5	3
Less than 24.5	21
Less than 29.5	39
Less than 34.5	47
Less than 39.5	50

9.

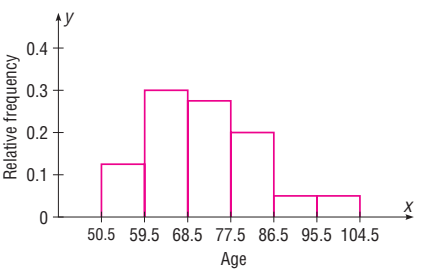
Class limits	Class boundaries	f
170–188	169.5–188.5	11
189–207	188.5–207.5	9
208–226	207.5–226.5	4
227–245	226.5–245.5	5
246–264	245.5–264.5	0
265–283	264.5–283.5	0
284–302	283.5–302.5	0
303–321	302.5–321.5	1
		30

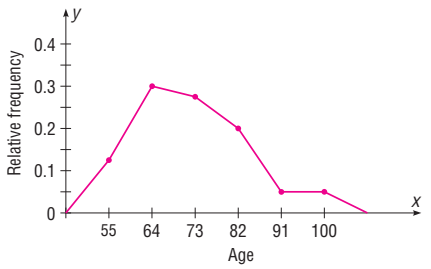
	cf
Less than 169.5	0
Less than 188.5	11
Less than 207.5	20
Less than 226.5	24
Less than 245.5	29
Less than 264.5	29
Less than 283.5	29
Less than 302.5	29
Less than 321.5	30

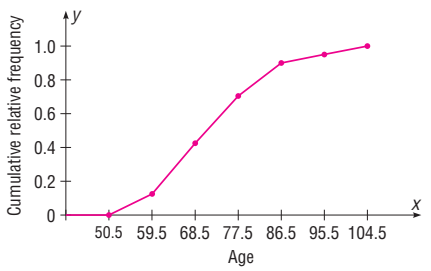
11.

Limits	Boundaries	rf
51–59	50.5–59.5	0.125
60–68	59.5–68.5	0.300
69–77	68.5–77.5	0.275
78–86	77.5–86.5	0.200
87–95	86.5–95.5	0.050
96–104	95.5–104.5	0.050
		1.000

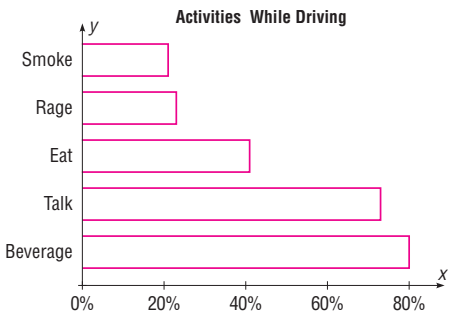
	crf
Less than 50.5	0.000
Less than 59.5	0.125
Less than 68.5	0.425
Less than 77.5	0.700
Less than 86.5	0.900
Less than 95.5	0.950
Less than 104.5	1.000

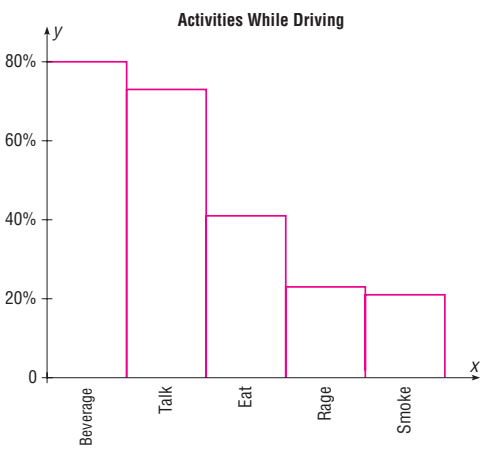




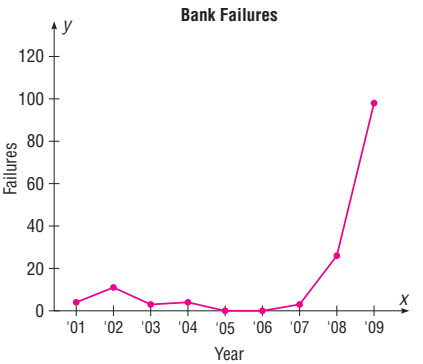


13.

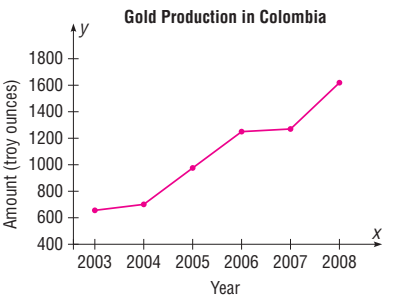




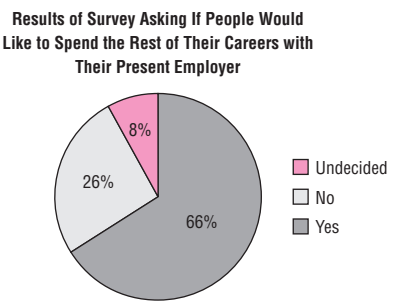
15. The bank failures increased in 2002 from 4 to 11, then dropped until 2008, when they increased to 28. The year 2009 brought an increase to 98.



17. There has been a steady increase in the amount of gold produced by Colombia over the recent years.



19.



21.

10	2 8 8
11	3
12	
13	
14	2 4
15	
16	
17	6 6 6
18	4 9
19	2
20	5 9
21	0

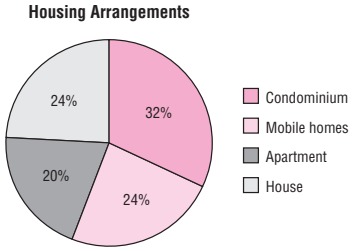
Chapter Quiz

1. False
2. False
3. False
4. True
5. True
6. False
7. False
8. *c*
9. *c*
10. *b*
11. *b*
12. Categorical, ungrouped, grouped
13. 5, 20
14. Categorical
15. Time series
16. Stem and leaf plot
17. Vertical or *y*

18.

Class	*f*
H	6
A	5
M	6
C	8
	25

19.

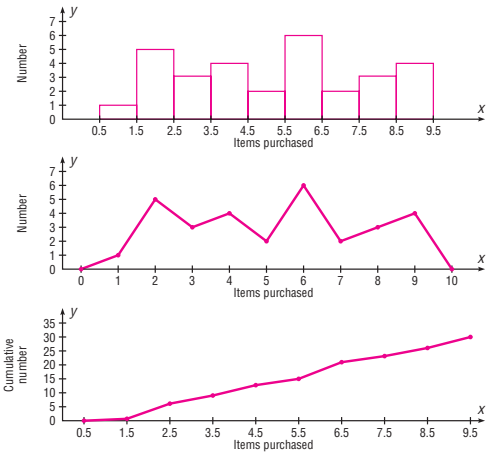


20.

Class boundaries	*f*
0.5–1.5	1
1.5–2.5	5
2.5–3.5	3
3.5–4.5	4
4.5–5.5	2
5.5–6.5	6
6.5–7.5	2
7.5–8.5	3
8.5–9.5	4
	30

	cf
Less than 0.5	0
Less than 1.5	1
Less than 2.5	6
Less than 3.5	9
Less than 4.5	13
Less than 5.5	15
Less than 6.5	21
Less than 7.5	23
Less than 8.5	26
Less than 9.5	30

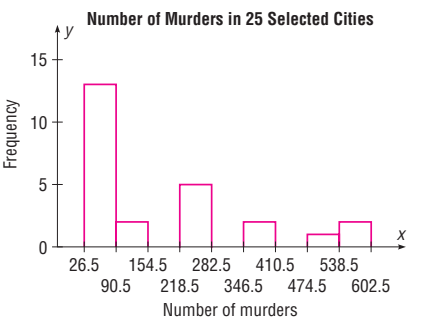
21.

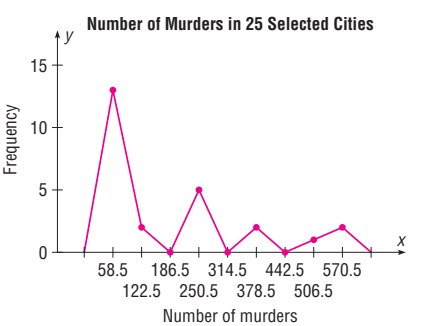


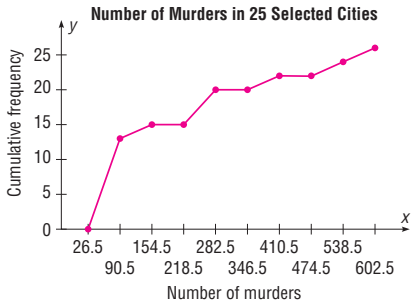
22.

Class limits	*f*	Class boundaries
27–90	13	26.5–90.5
91–154	2	90.5–154.5
155–218	0	154.5–218.5
219–282	5	218.5–282.5
283–346	0	282.5–346.5
347–410	2	346.5–410.5
411–474	0	410.5–474.5
475–538	1	474.5–538.5
539–602	2	538.5–602.5
	25	

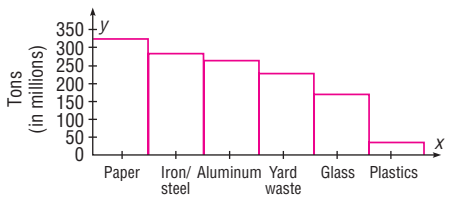
23. The distribution is positively skewed with one more than one-half of the data values in the lowest class.

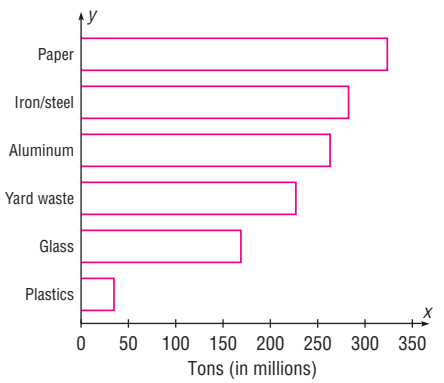




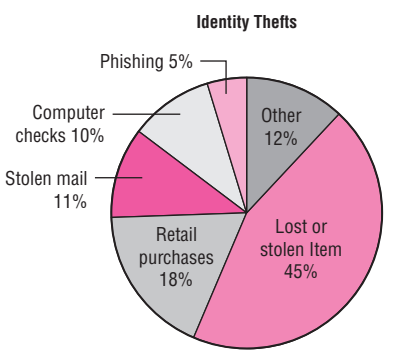


24.

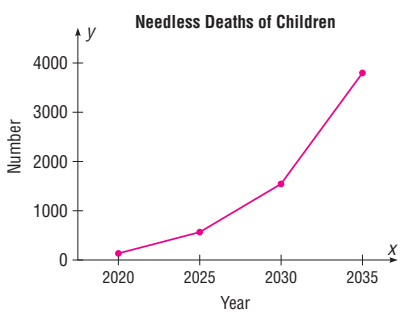




25.



26.



27.

1	5 9
2	6 8
3	1 5 8 8 9
4	1 7 8
5	3 3 4
6	2 3 7 8
7	6 9
8	6 8 9
9	8

Chapter 3

Exercises 3–1

1. *a.* 3.724 *b.* 3.73 *c.* 3.74 and 3.70 *d.* 3.715

3. *a.* 68.1 *b.* 68 *c.* 42, 62, 64, 66, 72, 74 *d.* 64.5

5. *a.* 9422.2 *b.* 8988 *c.* 7552, 12,568, 8632 *d.* 9434. Claim seems a little high.

7. *a.* 6.63 *b.* 6.45 *c.* 5.4, 6.2, 6.4, 7.2 *d.* 6.7; answers will vary

9. *a.* 46.78 *b.* 47.65 *c.* None *d.* 44.05

11. 2004:
a. 8421.2 *b.* 8197 *c.* No mode *d.* 9984.5
1990:
a. 9810 *b.* 9214.5 *c.* No mode *d.* 13345.5
Based on these data, it appears that the population is declining.

13. *a.* 17.68 *b.* 2.48–7.48 and 17.51–22.51. Group mean is less.

15. *a.* 6.5 *b.* 0.8–4.4. Probably not—data are "top heavy."

17. *a.* 26.7 *b.* 24.2–28.6

19. *a.* 34.1 *b.* 0.5–19.5

21. *a.* 23.7 *b.* 21.5–24.5

23. 44.8; 40.5–47.5

25. *a.* 1804.6 *b.* 1013–1345

27. 2.896

29. $545,666.67

31. 82.7

33. *a.* Median *c.* Mode *e.* Mode
b. Mean *d.* Mode *f.* Mean

35. Both could be true since one may be using the mean for the average salary and the other may be using the mode for the average.

37. 6

39. *a.* 36 mph *b.* 30.77 mph *c.* $16.67

41. 5.48

Exercises 3–2

1. The square root of the variance is the standard deviation.

3. σ^2; σ

5. When the sample size is less than 30, the formula for the variance of the sample will underestimate the population variance.

7. 48; 254.7; 15.9 (rounded to 16) The data vary widely.

9.

	Temp. (°F)	Precip. (inches)
Range	32	4
Variance	147.7	1.89
Standard deviation	12.15	1.373

The temperatures are more variable.

11. Houston: $\overline{X} = 55.8$, $s = 8.88$, CVar = 15.91%.
Pittsburgh: $\overline{X} = 41.5$, $s = 9.42$, CVar = 22.7%.
Pittsburgh is more variable.

13. $s \approx R/4$ so $s \approx 5$ years.

15. *a.* 160 *b.* 1984.5 *c.* 44.5

17. *a.* 46 *b.* 77.48 *c.* 8.8

19. 133.6; 11.6

21. 27,941.46; 167.2

23. 167.2; 12.93

25. 211.2; 14.5; no, the variability of the lifetimes of the batteries is quite large.

27. 11.7; 3.4

29. United States: $\overline{X} = 3386.6$, $s = 693.9$, CVar = 20.49%.
World: $\overline{X} = 4997.8$, $s = 803.2$, CVar = 16.07%.
The United States is more variable.

31. 23.1%; 12.9%; age is more variable.

33. *a.* 96% *b.* 93.75%

35. Between 164 and 316 calories

37. Between 385 and 895 pounds

39. 86%

41. 16%

43. All the data values fall within 2 standard deviations of the mean.

45. 56%; 75%; 84%; 88.89%; 92%

47. 4.36

49. It must be an incorrect data value, since it is beyond the range using the formula $s\sqrt{n-1}$.

Exercises 3–3

1. A z score tells how many standard deviations the data value is above or below the mean.

3. A percentile is a relative measurement of position; a percentage is an absolute measure of the part to the total.

5. $Q_1 = P_{25}$; $Q_2 = P_{50}$; $Q_3 = P_{75}$

7. $D_1 = P_{10}$; $D_2 = P_{20}$; $D_3 = P_{30}$; etc.

9. Canada −0.40, Italy 1.47, United States −1.91

11. *a.* 0.6 *b.* −1.2 *c.* 2.4 *d.* −2.2 *e.* 0.2

13. Neither; $z = 1.5$ for each

15. *a.* −0.93 *b.* −0.85 *c.* −1.4; score in part *b* is highest

17. *a.* 24th *b.* 67th *c.* 48th *d.* 88th

18. *a.* 6 *b.* 24 *c.* 68 *d.* 76 *e.* 94

19. *a.* 234 *b.* 251 *c.* 263 *d.* 274 *e.* 284

20. *a.* 375 *b.* 389 *c.* 433 *d.* 477 *e.* 504

21. *a.* 13th *b.* 40th *c.* 54th *d.* 76th *e.* 92nd

23. 597 **25.** 47

27. 2.1 **29.** 12

31. *a.* 12; 20.5; 32; 22; 20 *b.* 62; 94; 99; 80.5; 37

Exercises 3–4

1. 6, 8, 19, 32, 54; 24

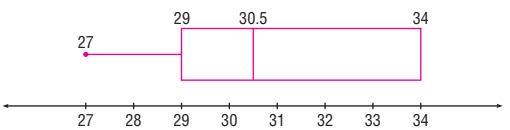
3. 188, 192, 339, 437, 589; 245

5. 14.6, 15.05, 16.3, 19, 19.8; 3.95

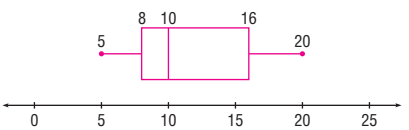
7. 11, 3, 8, 5, 9, 4

9. 95, 55, 70, 65, 90, 25

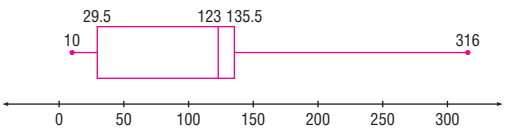
11.



13. The graph of the data is somewhat positively skewed.

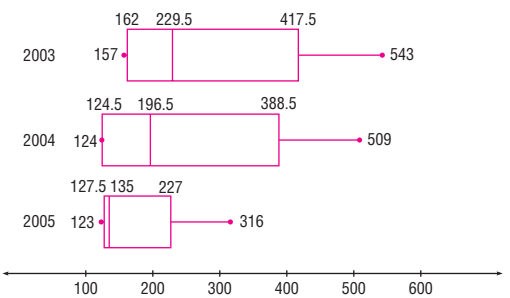


15. Based on the median, the data are left-skewed. Based on the lines, the data are right-skewed.



17. *a.* May: 391.7 *b.* 2003: 289.8

c.



Review Exercises

1. $\overline{X} = 27.2$, MD = 19, mode = 17, MR = 38, $R = 42$, $S^2 = 239.96$, $S = 15.5$

3. *a.* 7.3 *b.* 7–9 *c.* 10.0 *d.* 3.2

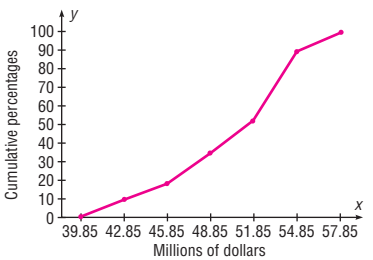
5. *a.* 55.5 *b.* 57.5–72.5 *c.* 566.1 *d.* 23.8

7. 1.43 viewers

9. 6

11. Magazine variance: 0.214; year variance: 0.417; years are more variable

13. *a.*



b. 50, 53, 55

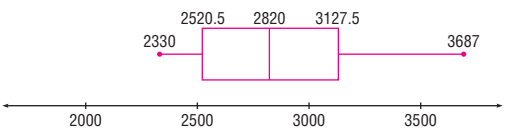
c. 10th; 26th; 78th

15. $0.26–$0.38

17. 56%

19. 88.89%

21. The range is much larger.



23. 23.7−35.7

Chapter Quiz

1. True **2.** True

3. False **4.** False

5. False **6.** False

7. False **8.** False

9. False **10.** *c*

11. *c* **12.** *a* and *b*

13. *b* **14.** *d*

15. *b* **16.** Statistic

17. Parameters, statistics **18.** Standard deviation

19. σ **20.** Midrange

21. Positively **22.** Outlier

23. *a.* 15.3 *b.* 15.5 *c.* 15, 16, and 17 *d.* 15 *e.* 6 *f.* 3.57 *g.* 1.9

24. *a.* 6.4 *b.* 6–8 *c.* 11.6 *d.* 3.4

25. *a.* 51.4 *b.* 35.5–50.5 *c.* 451.5 *d.* 21.2

26. *a.* 8.2 *b.* 7–9 *c.* 21.6 *d.* 4.6

27. 1.6 **28.** 4.5

29. 0.33; 0.162; newspapers **30.** 0.3125; 0.229; brands

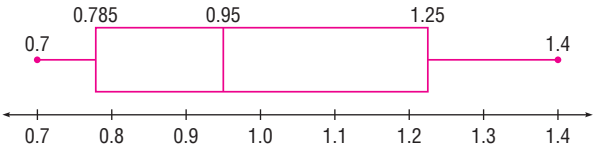
31. −0.75; −1.67; science

32. *a.* 0.5 *b.* 1.6 *c.* 15, *c* is highest

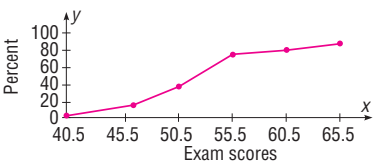
33. *a.* 56.25; 43.75; 81.25; 31.25; 93.75; 18.75; 6.25; 68.75

b. 0.9

c.



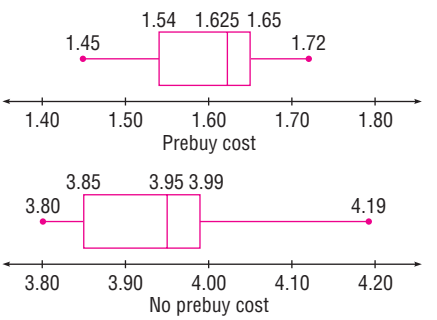
34. *a.*



b. 47; 55; 64

c. 56th, 6th, 99th percentiles

35. The cost of prebuy gas is much less than that of the return without filling gas. The variability of the return without filling gas is larger than the variability of the prebuy gas.



36. 16%, 97.5%

Chapter 4

Exercises 4–1

1. A probability experiment is a chance process that leads to well-defined outcomes.

3. An outcome is the result of a single trial of a probability experiment, but an event can consist of more than one outcome.

5. The range of values is 0 to 1 inclusive.

7. 0

9. 0.80 Since the probability that it won't rain is 80%, you could leave your umbrella at home and be fairly safe.

11. *a.* Empirical *b.* Classical *c.* Empirical *d.* Classical *e.* Empirical *f.* Empirical *g.* Subjective

12. *a.* $\frac{1}{6}$ *c.* $\frac{1}{2}$ *e.* 1 *g.* $\frac{1}{3}$
b. 0 *d.* $\frac{2}{3}$ *f.* $\frac{2}{3}$

13. *a.* $\frac{1}{9}$ *b.* $\frac{2}{9}$ *c.* $\frac{1}{6}$ *d.* $\frac{13}{18}$ *e.* $\frac{1}{6}$

14. *a.* $\frac{1}{13}$ *c.* $\frac{1}{52}$ *e.* $\frac{4}{13}$ *g.* $\frac{1}{26}$ *i.* $\frac{1}{2}$
b. $\frac{1}{4}$ *d.* $\frac{2}{13}$ *f.* $\frac{1}{52}$ *h.* $\frac{1}{26}$ *j.* $\frac{1}{2}$

15. *a.* 0.1 *b.* 0.2 *c.* 0.8

17. *a.* 0.43 *b.* 0.52 *c.* 0.17

19. *a.* 0.04 *b.* 0.52 *c.* 0.4

21. *a.* $\frac{1}{8}$ *b.* $\frac{1}{4}$ *c.* $\frac{3}{4}$ *d.* $\frac{3}{4}$

23. $\frac{1}{9}$

25. *a.* 27% *b.* 33% *c.* 67% *d.* 14%

27. 0.662

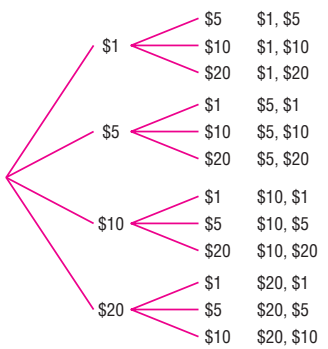
29. *a.* Sample space

	1	**2**	**3**	**4**	**5**	**6**
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18
4	4	8	12	16	20	24
5	5	10	15	20	25	30
6	6	12	18	24	30	36

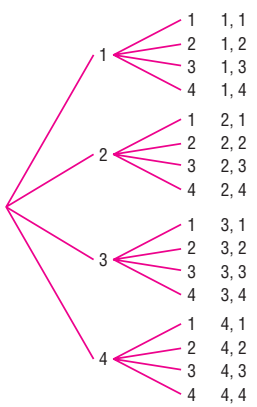
b. $\frac{5}{12}$

c. $\frac{17}{36}$

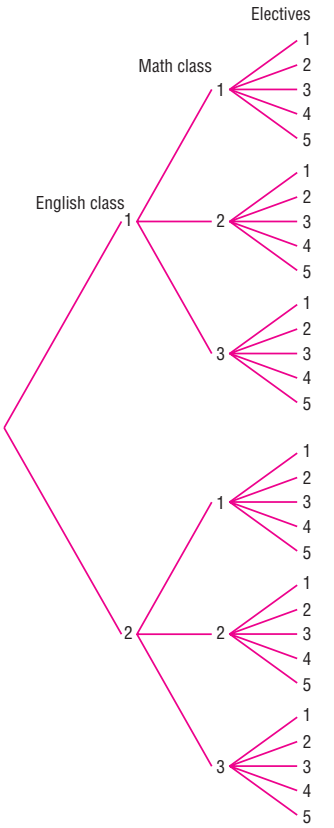
31.



33.



35.



37. *a.* 0.08 *b.* 0.01 *c.* 0.35 *d.* 0.36

39. The statement is probably not based on empirical probability and is probably not true.

41. Answers will vary.

43. *a.* 1:5, 5:1 *d.* 1:1, 1:1 *g.* 1:1, 1:1
b. 1:1, 1:1 *e.* 1:12, 12:1
c. 1:3, 3:1 *f.* 1:3, 3:1

Exercises 4–2

1. Two events are mutually exclusive if they cannot occur at the same time (i.e., they have no outcomes in common). Examples will vary.

3. *a.* 0.707 *b.* 0.589 *c.* 0.011 *d.* 0.731

5. $\frac{11}{19}$

7. *a.* $\frac{7}{11}$ *b.* $\frac{6}{11}$ *c.* $\frac{7}{11}$ *d.* $\frac{1}{2}$

9. 0.55

11. *a.* $\frac{6}{7}$ *b.* $\frac{4}{7}$ *c.* 1

13. *a.* 0.058 *b.* 0.942 *c.* 0.335

15. *a.* 0.056 *b.* 0.004 *c.* 0.076

17. *a.* $\frac{7}{58}$ *b.* $\frac{16}{29}$ *c.* $\frac{12}{29}$

19. *a.* $\frac{1}{15}$ *b.* $\frac{1}{3}$ *c.* $\frac{5}{6}$ *d.* $\frac{5}{6}$ *e.* $\frac{1}{3}$

21. *a.* $\frac{5}{12}$ *b.* $\frac{1}{8}$ *c.* $\frac{2}{3}$ *d.* $\frac{23}{24}$

23. *a.* $\frac{3}{13}$ *b.* $\frac{3}{4}$ *c.* $\frac{19}{52}$ *d.* $\frac{7}{13}$ *e.* $\frac{15}{26}$

25. 0.318

27. 0.06

29. 0.30

Exercises 4–3

1. *a.* Independent *e.* Independent
b. Dependent *f.* Dependent
c. Dependent *g.* Dependent
d. Dependent *h.* Independent

3. *a.* 0.009 *b.* 0.227

5. 0.00194 The event is highly unlikely since the probability is small.

7. 0.5139

9. 0.179

11. *a.* 0.003 *b.* 0.636 *c.* 0.997

13. *a.* $\frac{1}{270{,}725}$ *b.* $\frac{11}{4165}$ *c.* $\frac{46}{833}$

15. $\frac{1}{56}$

17. $\frac{38}{87}$ Number 20 is more likely to occur.

19. *a.* 0.167 *b.* 0.406 *c.* 0.691

21. 0.03

23. 0.071

25. $\frac{1}{7}$

27. 0.2

29. 68.4%

31. *a.* 0.06 *b.* 0.4353 *c.* 0.35
d. 0.1667

33. *a.* 0.327 *b.* 0.119 *c.* No. $P(\text{G}|\text{U.S.}) \neq P(\text{G})$

35. *a.* 0.0197 *b.* 0.611

37. *a.* 0.1717 *b.* 0.8283

39. 0.574

41. 0.9869

43. $\frac{14{,}498}{20{,}825}$

45. *a.* 0.332 *b.* 0.668

47. $\frac{31}{32}$

49. 0.665 It will happen almost 67% of the time. It's somewhat likely.

51. $\frac{7}{8}$

53. No, since $P(A \cap B) = 0$ and does not equal $P(A) \cdot P(B)$.

55. Enrollment and meeting with DW and meeting with MH are dependent. Since meeting with MH has a low probability and meeting with LP has no effect, all students, if possible, should meet with DW.

Exercises 4–4

1. 100,000; 30,240

3. 720

5. 5040 ways

7. 3,628,000

9. 1000; 72

11. 600

13. *a.* 40,320 *c.* 1 *e.* 2520 *g.* 60 *i.* 120
b. 3,628,800 *d.* 1 *f.* 11,880 *h.* 1 *j.* 30

15. 24

17. 7315

19. 840

21. 151,200

23. 5,527,200

25. 495; 11,880

27. *a.* 10 *c.* 35 *e.* 15 *g.* 1 *i.* 66
b. 56 *d.* 15 *f.* 1 *h.* 36 *j.* 4

29. 120

31. 210

33. 15,504

35. 43,758; 12,870

37. 495; 210; 420

39. 475

41. 2970

43. ${}_7C_2$ is 21 combinations + 7 double tiles = 28

45. 330

47. 194,040

49. 125,970

51. 1,860,480

53. 136

55. 120

57. 200

59. 336

61. 2; 6; $(n - 1)!$

63. *a.* 4 *b.* 36 *c.* 624 *d.* 3744

Exercises 4–5

1. $\frac{11}{221}$

3. *a.* $\frac{4}{35}$ *b.* $\frac{1}{35}$ *c.* $\frac{12}{35}$ *d.* $\frac{18}{35}$

5. *a.* 0.129 *b.* 0.107 *c.* 0.0908

7. $\frac{1}{1225}$

9. *a.* 0.120 *b.* 0.296 *c.* 0.182

11. *a.* 0.3216 *b.* 0.1637 *c.* 0.5146
d. It probably got lost in the wash!

13. $\frac{5}{72}$

15. $\frac{1}{60}$

17. 0.727

Review Exercises

1. *a.* 0.167 *b.* 0.667 *c.* 0.5

3. *a.* 0.7 *b.* 0.5

5. $\frac{13}{60}$

7. 0.19

9. 0.98

11. *a.* 0.0001 *b.* 0.402 *c.* 0.598

13. *a.* $\frac{2}{17}$ *b.* $\frac{11}{850}$ *c.* $\frac{1}{5525}$

15. *a.* 0.603 *b.* 0.340 *c.* 0.324 *d.* 0.379

17. 0.4

19. 0.51

21. 57.3%

23. *a.* $\frac{19}{44}$ *b.* $\frac{1}{4}$

25. 0.718

27. 175,760,000; 78,624,000; 88,583,040

29. 350

31. 45

33. 100! (Answers may vary regarding calculator.)

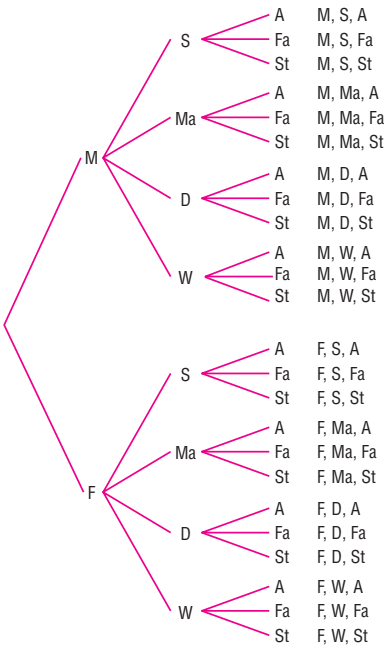
35. 495

37. 15,504

39. 175,760,000; 0.0000114

41. 0.097

43.



Chapter Quiz

1. False **2.** False

3. True **4.** False

5. False **6.** False

7. True **8.** False

9. *b* **10.** *b* and *d*

11. *d* **12.** *b*

13. *c* **14.** *b*

15. *d* **16.** *b*

17. *b* **18.** Sample space

19. 0, 1 **20.** 0

21. 1 **22.** Mutually exclusive

23. *a.* $\frac{1}{13}$ *b.* $\frac{1}{13}$ *c.* $\frac{4}{13}$

24. *a.* $\frac{1}{4}$ *b.* $\frac{4}{13}$ *c.* $\frac{1}{52}$ *d.* $\frac{1}{13}$ *e.* $\frac{1}{2}$

25. *a.* $\frac{12}{31}$ *b.* $\frac{12}{31}$ *c.* $\frac{27}{31}$ *d.* $\frac{24}{31}$

26. *a.* $\frac{11}{36}$ *b.* $\frac{5}{18}$ *c.* $\frac{11}{36}$ *d.* $\frac{1}{3}$ *e.* 0 *f.* $\frac{11}{12}$

27. 0.68 **28.** 0.002

29. *a.* $\frac{253}{9996}$ *b.* $\frac{33}{66{,}640}$ *c.* 0

30. 0.54 **31.** 0.53

32. 0.81 **33.** 0.056

34. *a.* $\frac{1}{2}$ *b.* $\frac{3}{7}$

35. 0.99 **36.** 0.518

37. 0.9999886 **38.** 2646

39. 40,320 **40.** 1365

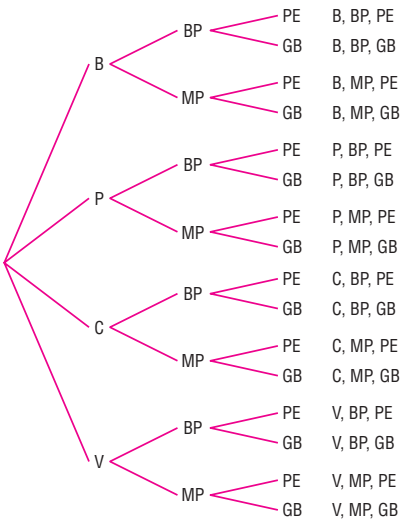
41. 1,188,137,600; 710,424,000

42. 720 **43.** 33,554,432

44. 56 **45.** $\frac{1}{4}$

46. $\frac{3}{14}$ **47.** $\frac{12}{55}$

48.



Chapter 5

Exercises 5–1

1. A random variable is a variable whose values are determined by chance. Examples will vary.

3. The number of commercials a radio station plays during each hour. The number of times a student uses his or her calculator during a mathematics exam. The number of leaves on a specific type of tree. (Answers will vary.)

5. A probability distribution is a distribution that consists of the values a random variable can assume along with the corresponding probabilities of these values. (Examples will vary.)

7. No; probabilities cannot be negative, and the sum of the probabilities is not 1.

9. Yes

11. No. A probability cannot be greater than 1.

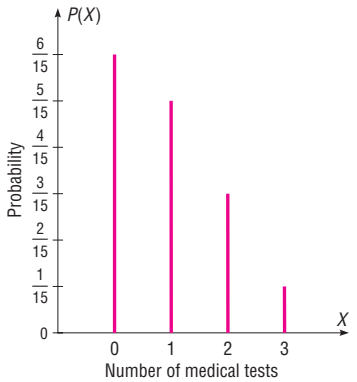
13. Discrete

15. Continuous

17. Discrete

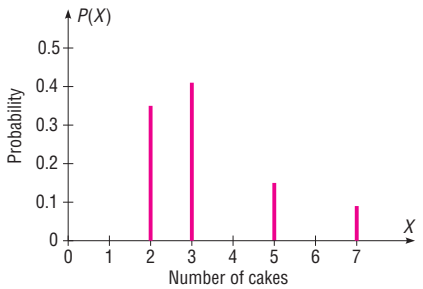
19.

X	0	1	2	3
$P(X)$	$\frac{6}{15}$	$\frac{5}{15}$	$\frac{3}{15}$	$\frac{1}{15}$



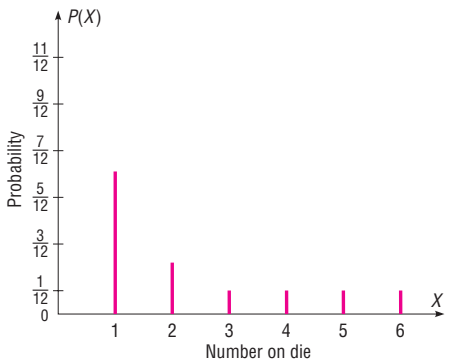
21.

X	2	3	5	7
$P(X)$	0.35	0.41	0.15	0.09



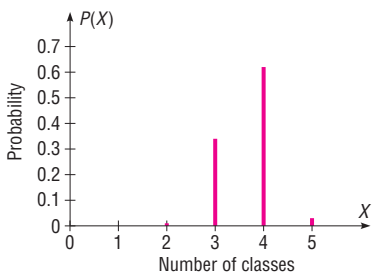
23.

X	1	2	3	4	5	6
$P(X)$	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$



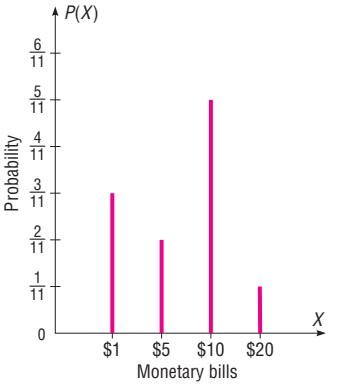
25.

X	2	3	4	5
$P(X)$	0.01	0.34	0.62	0.03



27.

X	1	5	10	20
$P(X)$	$\frac{3}{11}$	$\frac{2}{11}$	$\frac{5}{11}$	$\frac{1}{11}$



29.

X	1	2	3	4
$P(X)$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{8}$

31.

X	1	2	3
$P(X)$	$\frac{1}{6}$	$\frac{1}{3}$	$\frac{1}{2}$

Yes

33.

X	3	4	7
$P(X)$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{7}{6}$

No, the sum of the probabilities is greater than 1.

35.

X	1	2	4
$P(X)$	$\frac{1}{7}$	$\frac{2}{7}$	$\frac{4}{7}$

Yes

Exercises 5–2

1. 0.17; 0.321; 0.567

3. 1.3, 0.9, 1. No, on average, each person has about 1 credit card.

5. 5.4; 2.94; 1.71; 0.027

7. 6.6; 1.3; 1.1

9. 9.4; 5.24; 2.289; 0.25

11. \$260 **13.** \$0.83

15. −\$1.00 **17.** −\$0.50, −\$0.52

19. *a.* −5.26 cents *c.* −5.26 cents *e.* −5.26 cents
b. −5.26 cents *d.* −5.26 cents

21. 10.5

23. Answers will vary.

25. Answers will vary.

Exercises 5–3

1. *a.* Yes *c.* Yes *e.* No *g.* Yes *i.* No
b. Yes *d.* No *f.* Yes *h.* Yes *j.* Yes

2. *a.* 0.420 *c.* 0.590 *e.* 0.000 *g.* 0.418 *i.* 0.246
b. 0.346 *d.* 0.251 *f.* 0.250 *h.* 0.176

3. *a.* 0.0005 *c.* 0.342 *e.* 0.173
b. 0.131 *d.* 0.007

5. 0.021; no, it's only about a 2% chance.

7. *a.* 0.124 *b.* 0.912 *c.* 0.017

9. 0.071

11. *a.* 0.346 *b.* 0.913 *c.* 0.663 *d.* 0.683

13. *a.* 0.242 *b.* 0.547 *c.* 0.306

14. *a.* 75; 18.8; 4.3 *e.* 100; 90; 9.5
b. 90; 63; 7.9 *f.* 125; 93.8; 9.7
c. 10; 5; 2.2 *g.* 20; 12; 3.5
d. 8; 1.6; 1.3 *h.* 6; 5; 2.2

15. 8; 7.9; 2.8 **17.** 9; 8.73; 2.95

19. 210; 165.9; 12.9 **21.** 0.199

23. 0.559 **25.** 0.177

27. 0.246

29.

X	0	1	2	3
$P(X)$	0.125	0.375	0.375	0.125

Exercises 5–4

1. *a.* 0.135 *c.* 0.0096 *e.* 0.0112
b. 0.0324 *d.* 0.18

3. 0.0025

5. $\frac{1}{108}$

7. *a.* 0.1563 *c.* 0.0504 *e.* 0.1241
b. 0.1465 *d.* 0.071

9. *a.* 0.0183 *b.* 0.0733 *c.* 0.1465 *d.* 0.7619

11. 0.3554 **13.** 0.0498

15. 0.1563 **17.** 0.117

19. 0.321 **21.** 0.597

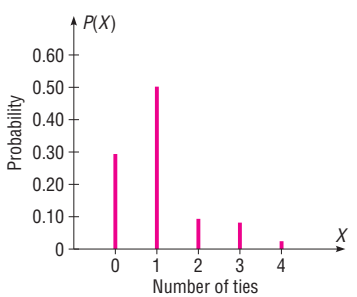
Review Exercises

1. Yes

3. No; the sum of the probabilities is greater than 1.

5. *a.* 0.35 *b.* 1.55; 1.8075; 1.3444

7.



9. 7.22; 2.1716; 1.47

11. 24.2; 1.5; 1.2

13. \$2.15

15. *a.* 0.008 *b.* 0.724 *c.* 0.0002 *d.* 0.276

17. 120; 24; 4.9

19. 0.886 **21.** 0.190

23. 0.0193 **25.** 0.050

27. *a.* 0.5543 *b.* 0.8488 *c.* 0.4457

29. 0.27

31. 0.0862

Chapter Quiz

1. True **2.** False

3. False **4.** True

5. chance **6.** $n \cdot p$

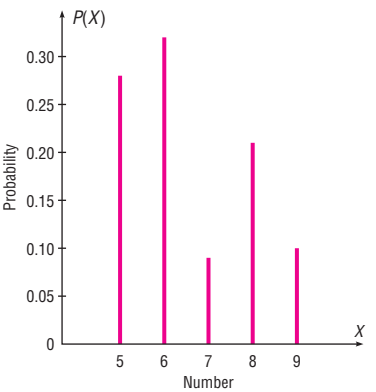
7. 1 **8.** *c*

9. *c* **10.** *d*

11. No, since $\Sigma P(X) > 1$ **12.** Yes

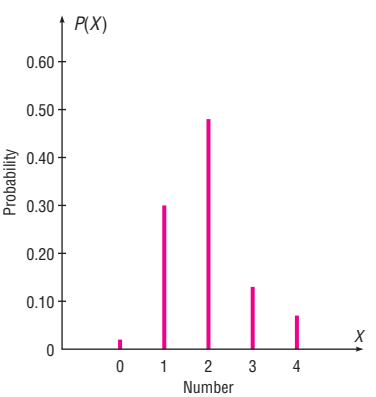
13. Yes **14.** Yes

15.



16.

X	0	1	2	3	4
$P(X)$	0.02	0.3	0.48	0.13	0.07



17. 2.0; 1.3; 1.1
18. 32.2; 1.1; 1.0
19. 5.2
20. $9.65
21. 0.124
22. *a.* 0.075 *b.* 0.872 *c.* 0.125
23. 240; 48; 6.9
24. 9; 7.9; 2.8
25. 0.008
26. 0.0003
27. 0.061
28. 0.122
29. *a.* 0.5470 *b.* 0.9863 *c.* 0.4529
30. 0.128
31. *a.* 0.160 *b.* 0.42 *c.* 0.07

Chapter 6

Exercises 6–1

1. The characteristics of the normal distribution are as follows:
a. It is bell-shaped.
b. It is symmetric about the mean.
c. Its mean, median, and mode are equal.
d. It is continuous.
e. It never touches the x axis.
f. The area under the curve is equal to 1.
g. It is unimodal.

3. 1 or 100%
5. 68%; 95%; 99.7%
7. 0.2734
9. 0.4808
11. 0.3859
13. 0.0823
15. 0.1094
17. 0.0258
19. 0.0482
21. 0.9826
23. 0.5675
25. 0.3574
27. 0.2486
29. 0.4236
31. 0.0023
33. 0.0934
35. 0.9522 (TI: 0.9521)
37. 0.0706 (TI: 0.0707)
39. 0.9222
41. $z = -1.39$ (TI: -1.3885)
43. $z = -2.08$ (TI: -2.0792)
45. -1.26 (TI: -1.2602)
47. *a.* -2.28 (TI: -2.2801)
b. -0.92 (TI: -0.91995)
c. -0.27 (TI: -0.26995)
49. *a.* $z = +1.96$ and $z = -1.96$ (TI: ± 1.95996)
b. $z = +1.65$ and $z = -1.65$, approximately (TI: ± 1.64485)
c. $z = +2.58$ and $z = -2.58$, approximately (TI: ± 2.57583)
51. 0.6827; 0.9545; 0.9973; they are very close.
53. 2.10
55. -1.45 and 0.11
57. $y = \dfrac{e^{-X^2/2}}{\sqrt{2\pi}}$

Exercises 6–2

1. 0.0022
3. *a.* 0.2005 (TI: 0.2007) *b.* 0.4315 (TI: 0.4316)
5. *a.* 0.3023 *b.* 0.0062
7. *a.* 0.3557 (TI: 0.3547)
b. 0.8389 (TI: 0.8391)
9. 0.0262; 0.0001; would want to know why it had only been driven less than 6000 miles (TI: 0.0260; 0.0002)
11. *a.* 0.9803 (TI: 0.9801)
b. 0.2514 (TI: 0.2511)
c. 0.3434 (TI: 0.3430)
13. *a.* 0.3057 *b.* 0.5688
c. The person could assume it will be between the mean time plus or minus 2 standard deviations of the mean.
15. *a.* 0.3281 *b.* 0.4002 *c.* Not usually
17. 0.0080 or 0.8%. A temperature of 63° is unlikely since the probability is about 0.8%.
19. The maximum size is 1927.76 square feet; the minimum size is 1692.24 square feet.
(TI: 1927.90 maximum, 1692.10 minimum)
21. 0.006; $821
23. The maximum price is $9222, and the minimum price is $7290. (TI: $7288.14 minimum, $9223.86 maximum)
25. 6.7; 4.05 (TI: for 10%, 6.657; for 30%, 4.040)
27. $18,840.48 (TI: $18,869.48)
29. 18.6 months
31. *a.* $\mu = 120, \sigma = 20$ *b.* $\mu = 15, \sigma = 2.5$
c. $\mu = 30, \sigma = 5$
33. There are several mathematics tests that can be used.
35. 3.125
37. $\mu = 45, \sigma = 1.34$
39. Not normal
41. Not normal

Exercises 6–3

1. The distribution is called the sampling distribution of sample means.
3. The mean of the sample means is equal to the population mean.
5. The distribution will be approximately normal when the sample size is large.

7. $z = \dfrac{\bar{X} - \mu}{\sigma/\sqrt{n}}$

9. *a.* 0.0026 (TI: 0.0026)
b. 0.8212 (TI: 0.8201)
c. 0.1787 (TI: 0.1799)

11. 0.2673

13. 0.0427; 0.9572 (TI: 0.0423; 0.9577)

15. *a.* 0.3859 (TI: 0.3875) *b.* 0.1841 (TI: 0.1831)
c. Individual values are more variable than means.

17. 0.4176 (TI: 0.4199)

19. 0.1254 (TI: 0.12769)

21. *a.* 0.4052 or 40.52% *b.* 0.0901 or 9.01%
c. Yes, the probability is slightly more than 40%.
d. It's possible since the probability is about 9%.

23. *a.* 0.3707 (TI: 0.3694) *b.* 0.0475 (TI: 0.04779)

25. 0.0174 No—the central limit theorem applies.

27. 0.0143

29. $\sigma_{\bar{X}} = 1.5, n = 25$

Exercises 6–4

1. When p is approximately 0.5, as n increases, the shape of the binomial distribution becomes similar to that of the normal distribution. The conditions are that $n \cdot p$ and $n \cdot q$ are both ≥ 5. The correction is necessary because the normal distribution is continuous and the binomial distribution is discrete.

2. *a.* 0.0811 *c.* 0.1052 *e.* 0.2327
b. 0.0516 *d.* 0.1711 *f.* 0.9988

3. *a.* Yes *c.* No *e.* Yes
b. No *d.* Yes *f.* No

5. 0.8577 **7.** 0.9875

9. 0.3936 **11.** 0.0087

13. 0.9951; yes (TI: 0.9950)

15. *a.* $n \geq 50$ *c.* $n \geq 10$ *e.* $n \geq 50$
b. $n \geq 17$ *d.* $n \geq 25$

Review Exercises

1. *a.* 0.4744 *e.* 0.2139 *h.* 0.9131
b. 0.1443 *f.* 0.8284 *i.* 0.0183
c. 0.0590 *g.* 0.0233 *j.* 0.9535
d. 0.8329 (TI: 0.8330)

3. 0.1131; $4872 and $5676
(TI: $4869.31 minimum, $5678.69 maximum)

5. *a.* 0.3621 or 36.21% *b.* 0.1190 or 11.9%
c. 0.0606 or 6.06%

7. $130.92 **9.** Not normal

11. *a.* 0.0143 (TI: 0.0142) *b.* 0.9641

13. 0.5234

15. 0.7123; 0.9999 (TI: 0.7139; 0.9999)

17. 0.0465

Chapter Quiz

1. False **2.** True
3. True **4.** True
5. False **6.** False
7. *a* **8.** *a*
9. *b* **10.** *b*
11. *c* **12.** 0.5

13. Sampling error

14. The population mean

15. Standard error of the mean

16. 5 **17.** 5%

18. *a.* 0.4332 *d.* 0.1029 *g.* 0.0401 *j.* 0.9131
b. 0.3944 *e.* 0.2912 *h.* 0.8997
c. 0.0344 *f.* 0.8284 *i.* 0.017

19. *a.* 0.4846 *d.* 0.0188 *g.* 0.0089 *j.* 0.8461
b. 0.4693 *e.* 0.7461 *h.* 0.9582
c. 0.9334 *f.* 0.0384 *i.* 0.9788

20. *a.* 0.7734 *b.* 0.0516 *c.* 0.3837
d. Any rainfall above 65 inches could be considered an extremely wet year since this value is 2 standard deviations above the mean.

21. *a.* 0.0668 *b.* 0.0228 *c.* 0.4649 *d.* 0.0934

22. *a.* 0.4525 *b.* 0.3707 *c.* 0.3707 *d.* 0.019

23. *a.* 0.0013 *b.* 0.5 *c.* 0.0081 *d.* 0.5511

24. *a.* 0.0037 *b.* 0.0228 *c.* 0.5 *d.* 0.3232

25. 8.804 centimeters

26. 121.24 is the lowest acceptable score.

27. 0.015 **28.** 0.9738

29. 0.0495; no **30.** 0.0455 or 4.55%

31. 0.8577 **32.** 0.0495

33. Not normal **34.** Approximately normal

Chapter 7

Exercises 7–1

1. A point estimate of a parameter specifies a particular value, such as $\mu = 87$; an interval estimate specifies a range of values for the parameter, such as $84 < \mu < 90$. The advantage of an interval estimate is that a specific confidence level (say 95%) can be selected, and one can be 95% confident that the interval contains the parameter that is being estimated.

3. The margin of error is the likely range of values to the right or left of the statistic that may contain the parameter.

5. A good estimator should be unbiased, consistent, and relatively efficient.

7. For one to be able to determine sample size, the margin of error and the degree of confidence must be specified and the population standard deviation must be known.

9. *a.* 2.58 *c.* 1.96 *e.* 1.88
b. 2.33 *d.* 1.65

11. *a.* 16.6 hours *b.* $15.7 < \mu < 17.5$
c. $15.4 < \mu < 17.8$
d. The 99% confidence interval is larger since you want to be 99% confident that the mean is contained in the interval rather than 95% confident.

13. $1.72 < \mu < 1.88$; lower

15. $145{,}030 < \mu < 154{,}970$

17. $4913 < \mu < 5087$; 4000 hours does not seem reasonable since it is outside the interval.

19. $59.5 < \mu < 62.9$ **21.** 123 subjects

23. 44 subjects **25.** 240 exams

Exercises 7–2

1. The characteristics of the *t* distribution are as follows: It is bell-shaped, it is symmetric about the mean, and it never touches the *x* axis. The mean, median, and mode are equal to 0 and are located at the center of the distribution. The variance is greater than 1. The *t* distribution is a family of curves based on degrees of freedom. As a sample size increases, the *t* distribution approaches the standard normal distribution.

3. The *t* distribution should be used when σ is unknown.

4. *a.* 2.898 *c.* 2.624 *e.* 2.093
b. 2.074 *d.* 1.833

5. $21.8 < \mu < 30.4$

7. $\overline{X} = 33.4$; $s = 28.7$; $21.2 < \mu < 45.6$; the point estimate is 33.4, and it is close to 32. Also, the interval does indeed contain $\mu = 32$. The data value 132 is unusually large (an outlier). The mean may not be the best estimate in this case.

9. $496.8 < \mu < 650.8$. No, 625 homicides would not be considered high since it would be inside the 99% confidence interval.

11. $13.5 < \mu < 15.1$; about 30 minutes.

13. $17.87 < \mu < 20.53$. Assume normal distribution; it's higher.

15. $28.4 < \mu < 38.0$

17. $32.0 < \mu < 71$. Assume normal distribution.

19. Answers will vary.

21. $\overline{X} = 2.175$; $s = 0.585$; $\mu >$ \$1.95 means one can be 95% confident that the mean revenue is greater than \$1.95; $\mu <$ \$2.40 means one can be 95% confident that the mean revenue is less than \$2.40.

Exercises 7–3

1. *a.* 0.5, 0.5 *c.* 0.46, 0.54 *e.* 0.45, 0.55
b. 0.45, 0.55 *d.* 0.58, 0.42

2. *a.* $\hat{p} = 0.25$, $\hat{q} = 0.75$ *d.* $\hat{p} = 0.55$, $\hat{q} = 0.45$
b. $\hat{p} = 0.42$, $\hat{q} = 0.58$ *e.* $\hat{p} = 0.12$, $\hat{q} = 0.88$
c. $\hat{p} = 0.68$, $\hat{q} = 0.32$

3. $0.365 < p < 0.415$

5. $0.092 < p < 0.153$; 11% is contained in the confidence interval.

7. $0.797 < p < 0.883$ **9.** $0.596 < p < 0.704$

11. $0.125 < p < 0.375$. No, since 0.28 is contained in the interval.

13. $0.419 < p < 0.481$

15. 385; 601 **17.** 801 homes; 1068 homes

19. 1089 **21.** 95%

Exercises 7–4

1. Chi-square

3. *a.* 3.816; 21.920 *d.* 0.412; 16.750
b. 10.117; 30.144 *e.* 26.509; 55.758
c. 13.844; 41.923

5. $56.6 < \sigma^2 < 236.3$; $7.5 < \sigma < 15.4$

7. Use $\sigma = r \div 4$
$1{,}593{,}756 < \sigma^2 < 16{,}537{,}507$; $1262.4 < \sigma < 4066.6$;
$8{,}469{,}845 < \sigma^2 < 87{,}886{,}811$; $2910.3 < \sigma < 9374.8$

9. $604 < \sigma^2 < 5837$; $24.6 < \sigma < 76.4$

11. $130{,}136 < \sigma^2 < 413{,}084$
$361 < \sigma < 643$

13. $16.2 < \sigma < 19.8$

Review Exercises

1. $13.99 < \mu < 25.27$ (or $14 < \mu < 25$)
(TI: $14.005 < \mu < 25.255$)

3. 28

5. $76.9 < \mu < 88.3$. Assume normal distribution.

7. $0.409 < p < 0.471$

9. $0.343 < p < 0.457$

11. 460

13. $0.218 < \sigma < 0.435$. Yes. It seems that there is a large standard deviation.

15. $5.1 < \sigma^2 < 18.3$

Chapter Quiz

1. True **2.** True
3. False **4.** True
5. *b* **6.** *a*
7. *b*
8. Unbiased, consistent, relatively efficient
9. Margin of error
10. Point **11.** 90; 95; 99
12. \$121.60; \$119.85 $< \mu <$ \$123.35
13. \$44.80; \$43.15 $< \mu <$ \$46.45
14. 4150; $3954 < \mu < 4346$
15. $45.7 < \mu < 51.5$
16. $418 < \mu < 458$ **17.** $26 < \mu < 36$
18. 180 **19.** 25
20. $0.374 < p < 0.486$ **21.** $0.295 < p < 0.425$
22. $0.342 < p < 0.547$ **23.** 545
24. $7 < \sigma < 13$
25. $30.9 < \sigma^2 < 78.2$
$5.6 < \sigma < 8.8$
26. $1.8 < \sigma < 3.2$

Chapter 8

Note: For Chapters 8–13, specific *P*-values are given in parentheses after the *P*-value intervals. When the specific *P*-value is extremely small, it is not given.

Exercises 8–1

1. The null hypothesis states that there is no difference between a parameter and a specific value or that there is no difference between two parameters. The alternative hypothesis states that there is a specific difference between a parameter and a specific value or that there is a difference between two parameters. Examples will vary.

3. A statistical test uses the data obtained from a sample to make a decision about whether the null hypothesis should be rejected.

5. The critical region is the range of values of the test statistic that indicates that there is a significant difference and the null hypothesis should be rejected. The noncritical region is the range of values of the test statistic that indicates that the difference was probably due to chance and the null hypothesis should not be rejected.

7. α, β

9. A one-tailed test should be used when a specific direction, such as greater than or less than, is being hypothesized; when no direction is specified, a two-tailed test should be used.

11. Hypotheses can be proved true only when the entire population is used to compute the test statistic. In most cases, this is impossible.

12. *a.* ± 1.96 *d.* $+2.33$ *g.* $+1.65$ *i.* -1.75
b. -2.33 *e.* -1.65 *h.* ± 2.58 *j.* $+2.05$
c. $+2.58$ *f.* -2.05

13. *a.* H_0: $\mu = 24.6$ and H_1: $\mu \neq 24.6$
b. H_0: $\mu =$ \$51,497 and H_1: $\mu \neq$ \$51,497
c. H_0: $\mu = 25.4$ and H_1: $\mu > 25.4$
d. H_0: $\mu = 88$ and H_1: $\mu < 88$
e. H_0: $\mu = 70$ and H_1: $\mu < 70$
f. H_0: $\mu =$ \$79.95 and H_1: $\mu \neq$ \$79.95
g. H_0: $\mu = 8.2$ and H_1: $\mu \neq 8.2$

Exercises 8–2

1. H_0: $\mu = 305$; H_1: $\mu > 305$ (claim); C.V. = 1.65; $z = 4.71$; reject. There is enough evidence to support the claim that the mean depth is greater than 305 feet. It might be due to warmer temperatures or more rainfall.

3. H_0: $\mu =$ \$24 billion and H_1: $\mu >$ \$24 billion (claim); C.V. = 1.65; $z = 1.85$; reject. There is enough evidence to support the claim that the average revenue is greater than \$24 billion.

5. H_0: $\mu = 30.9$; H_1: $\mu \neq 30.9$ (claim); C.V. $= \pm 2.58$; $z = 1.89$; do not reject. There is not enough evidence to support the claim that the mean has changed.

7. H_0: $\mu = 29$ and H_1: $\mu \neq 29$ (claim); C.V. $= \pm 1.96$; $z = 0.944$; do not reject. There is not enough evidence to say that the average height differs from 29 inches.

9. H_0: $\mu =$ \$8121; H_1: $\mu >$ \$8121 (claim); C.V. = 2.33; $z = 1.93$; do not reject. There is not enough evidence to support the claim that the mean is greater than \$8121.

11. H_0: $\mu = 500$; H_1: $\mu \neq 500$ (claim); C.V. $= \pm 2.58$; $z = -4.04$; reject H_0. There is sufficient evidence to conclude that the mean differs from 500.

13. H_0: $\mu = 60.35$; H_1: $\mu < 60.35$ (claim); C.V. $= -1.65$; $z = -4.82$; reject H_0. There is sufficient evidence to conclude that the state senators are younger.

15. *a.* Do not reject. *d.* Reject.
b. Reject. *e.* Reject.
c. Do not reject.

17. H_0: $\mu = 264$ and H_1: $\mu < 264$ (claim); $z = -2.53$; *P*-value = 0.0057; reject. There is enough evidence to support the claim that the average stopping distance is less than 264 ft. (TI: *P*-value = 0.0056)

19. H_0: $\mu = 546$ and H_1: $\mu < 546$ (claim); $z = -2.4$; *P*-value = 0.0082. Yes, it can be concluded that the number of calories burned is less than originally thought. (TI: *P*-value = 0.0082)

21. H_0: $\mu = 444$; H_1: $\mu \neq 444$; $z = -1.70$; *P*-value = 0.0892; do not reject H_0. There is insufficient evidence at $\alpha = 0.05$ to conclude that the average size differs from 444 acres. (TI: *P*-value = 0.0886)

23. H_0: $\mu = 30{,}000$ (claim) and H_1: $\mu \neq 30{,}000$; $z = 1.71$; P-value $= 0.0872$; reject. There is enough evidence to reject the claim that the customers are adhering to the recommendation. Yes, the 0.10 level is appropriate. (TI: P-value $= 0.0868$)

25. H_0: $\mu = 10$ and H_1: $\mu < 10$ (claim); $z = -8.67$; P-value < 0.0001; since P-value < 0.05, reject. Yes, there is enough evidence to support the claim that the average number of days missed per year is less than 10. (TI: P-value $= 0$)

27. H_0: $\mu = 8.65$ (claim) and H_1: $\mu \neq 8.65$; C.V. $= \pm 1.96$; $z = -1.35$; do not reject. Yes; there is not enough evidence to reject the claim that the average hourly wage of the employees is \$8.65.

Exercises 8–3

1. It is bell-shaped, it is symmetric about the mean, and it never touches the x axis. The mean, median, and mode are all equal to 0, and they are located at the center of the distribution. The t distribution differs from the standard normal distribution in that it is a family of curves and the variance is greater than 1; and as the degrees of freedom increase, the t distribution approaches the standard normal distribution.

3. *a.* $+1.833$ *c.* -3.365 *e.* ± 2.145 *g.* ± 2.771
b. ± 1.740 *d.* $+2.306$ *f.* -2.819 *h.* ± 2.583

4. Specific P-values are in parentheses.
a. $0.01 < P\text{-value} < 0.025$ (0.018)
b. $0.05 < P\text{-value} < 0.10$ (0.062)
c. $0.10 < P\text{-value} < 0.25$ (0.123)
d. $0.10 < P\text{-value} < 0.20$ (0.138)
e. P-value < 0.005 (0.003)
f. $0.10 < P\text{-value} < 0.25$ (0.158)
g. P-value $= 0.05$ (0.05)
h. P-value > 0.25 (0.261)

5. H_0: $\mu = 179$; H_1: $\mu \neq 179$ (claim); C.V. $= \pm 3.250$; d.f. $= 9$; $t = 3.162$; do not reject H_0. There is insufficient evidence to conclude that the mean differs from \$179.

7. H_0: $\mu = 2.27$; H_1: $\mu \neq 2.27$ (claim); C.V. $= \pm 2.093$; d.f. $= 19$; $t = 3.240$; reject. There is enough evidence to support the claim that the average time differs from 2.27.

9. H_0: $\mu = 700$ (claim) and H_1: $\mu < 700$; C.V. $= -2.262$; d.f. $= 9$; $t = -2.71$; reject. There is enough evidence to reject the claim that the average height of the buildings is at least 700 feet.

11. H_0: $\mu = 73$; H_1: $\mu > 73$ (claim); C.V. $= 2.821$; d.f. $= 9$; $t = 4.063$; reject. There is enough evidence to support the claim that the average is greater than the national average.

13. H_0: $\mu =$ \$54.8 million and H_1: $\mu >$ \$54.8 million (claim); C.V. $= 1.761$; d.f. $= 14$; $t = 3.058$; reject. Yes. There is enough evidence to support the claim that the average cost of an action movie is greater than \$54.8 million.

15. H_0: $\mu =$ \$50.07; H_1: $\mu >$ \$50.07 (claim); C.V. $= 1.833$; d.f. $= 9$; $t = 2.741$; reject. There is enough evidence to support the claim that the average phone bill has increased.

17. H_0: $\mu = 5.8$ and H_1: $\mu \neq 5.8$ (claim); d.f. $= 19$; $t = -3.462$; P-value < 0.01; reject. There is enough evidence to support the claim that the mean number of times has changed. (TI: P-value $= 0.0026$)

19. H_0: $\mu =$ \$15,000 and H_1: $\mu \neq$ \$15,000; d.f. $= 11$; $t = -1.10$; C.V. $= \pm 2.201$; do not reject. There is not enough evidence to conclude that the average stipend differs from \$15,000.

Exercises 8–4

1. Answers will vary.

3. $np \geq 5$ and $nq \geq 5$

5. H_0: $p = 0.686$; H_1: $p \neq 0.686$ (claim); C.V. $= \pm 2.58$; $z = -1.93$; do not reject H_0. There is insufficient evidence to conclude that the proportion differs.

7. H_0: $p = 0.188$; H_1: $p < 0.188$ (claim); C.V. $= -1.65$; $z = -1.00$; do not reject. There is not enough evidence to support the claim that the proportion is less than the national proportion.

9. H_0: $p = 0.47$; H_1: $p \neq 0.47$ (claim); C.V. $= \pm 1.96$; $z = 2.51$; reject. There is enough evidence to support the claim that the proportion is different from the national proportion.

11. H_0: $p = 0.32$; H_1: $p \neq 0.32$ (claim); C.V. $= \pm 2.58$; $z = 3.61$; reject. There is enough evidence to support the claim that the proportion is different than 32%.

13. H_0: $p = 0.54$ (claim) and H_1: $p \neq 0.54$; $z = 0.93$; P-value $= 0.3524$; do not reject. There is not enough evidence to reject the claim that the proportion is 0.54. Yes, a healthy snack should be made available for children to eat after school. (TI: P-value $= 0.3511$)

15. H_0: $p = 0.18$ (claim) and H_1: $p > 0.18$; $z = -0.60$; P-value $= 0.5486$; since P-value > 0.05, do not reject. There is not enough evidence to reject the claim that 18% of all high school students smoke at least a pack of cigarettes a day. (TI: P-value $= 0.5478$)

17. H_0: $p = 0.67$ and H_1: $p \neq 0.67$ (claim); C.V. $= \pm 1.96$; $z = 3.19$; reject. Yes. There is enough evidence to support the claim that the percentage is not 67%.

19. H_0: $p = 0.576$ and H_1: $p < 0.576$ (claim); C.V. $= -1.65$; $z = -1.26$; do not reject. There is not enough evidence to support the claim that the proportion is less than 0.576.

21. No

23. $z = \dfrac{X - \mu}{\sigma}$

$z = \dfrac{X - np}{\sqrt{npq}}$ since $\mu = np$ and $\sigma = \sqrt{npq}$

$z = \dfrac{X/n - np/n}{\sqrt{npq}/n}$

$z = \dfrac{X/n - np/n}{\sqrt{npq/n^2}}$

$z = \dfrac{\hat{p} - p}{\sqrt{pq/n}}$ since $\hat{p} = X/n$

Exercises 8–5

1. *a.* H_0: $\sigma^2 = 225$ and H_1: $\sigma^2 > 225$; C.V. = 27.587; d.f. = 17

b. H_0: $\sigma^2 = 225$ and H_1: $\sigma^2 < 225$; C.V. = 14.042; d.f. = 22

c. H_0: $\sigma^2 = 225$ and H_1: $\sigma^2 \neq 225$; C.V. = 5.629; 26.119; d.f. = 14

d. H_0: $\sigma^2 = 225$ and H_1: $\sigma^2 \neq 225$; C.V. = 2.167; 14.067; d.f. = 7

e. H_0: $\sigma^2 = 225$ and H_1: $\sigma^2 > 225$; C.V. = 32.000; d.f. = 16

f. H_0: $\sigma^2 = 225$ and H_1: $\sigma^2 < 225$; C.V. = 8.907; d.f. = 19

g. H_0: $\sigma^2 = 225$ and H_1: $\sigma^2 \neq 225$; C.V. = 3.074; 28.299; d.f. = 12

h. H_0: $\sigma^2 = 225$ and H_1: $\sigma^2 < 225$; C.V. = 15.308; d.f. = 28

2. *a.* $0.01 < P\text{-value} < 0.025$ (0.015)

b. $0.005 < P\text{-value} < 0.01$ (0.006)

c. $0.01 < P\text{-value} < 0.02$ (0.012)

d. $P\text{-value} < 0.005$ (0.003)

e. $0.02 < P\text{-value} < 0.05$ (0.037)

f. $0.05 < P\text{-value} < 0.10$ (0.088)

g. $0.05 < P\text{-value} < 0.10$ (0.066)

h. $P\text{-value} < 0.01$ (0.007)

3. H_0: $\sigma = 60$ (claim) and H_1: $\sigma \neq 60$; C.V. = 8.672; 27.587; d.f. = 17; $\chi^2 = 19.707$; do not reject. There is not enough evidence to reject the claim that the standard deviation is 60.

5. H_0: $\sigma = 15$ and H_1: $\sigma < 15$ (claim); C.V. = 4.575; d.f. = 11; $\chi^2 = 9.0425$; do not reject. There is not enough evidence to support the claim that the standard deviation is less than 15.

7. H_0: $\sigma = 1.2$ (claim) and H_1: $\sigma > 1.2$; $\alpha = 0.01$; d.f. = 14; $\chi^2 = 31.5$; P-value < 0.005 (0.0047); since P-value < 0.01, reject. There is enough evidence to reject the claim that the standard deviation is less than or equal to 1.2 minutes.

9. H_0: $\sigma = 100$; H_1: $\sigma > 100$ (claim); C.V. = 12.017; d.f. = 7; $\chi^2 = 11.241$; do not reject. There is not enough evidence to support the claim that the standard deviation is greater than 100 mg.

11. H_0: $\sigma = 35$ and H_1: $\sigma < 35$ (claim); C.V. = 3.940; d.f. = 10; $\chi^2 = 8.359$; do not reject. There is not enough evidence to support the claim that the standard deviation is less than 35.

13. H_0: $\sigma = 679.5$; H_1: $\sigma \neq 679.5$ (claim); C.V. = 5.009, 24.736; d.f. = 13; $\chi^2 = 16.723$; do not reject. There is not enough evidence to support the claim that the sample standard deviation differs from the estimated standard deviation.

15. H_0: $\sigma = 0.52$; H_1: $\sigma > 0.52$ (claim); C.V. = 30.144; $\chi^2 = 22.670$; do not reject H_0. There is insufficient evidence to conclude that the standard deviation is outside the guidelines.

Exercises 8–6

1. H_0: $\mu = \$273$; H_1: $\mu \neq \$273$ (claim); C.V. = ± 1.96; $z = 1.31$; $267.03 < \mu < 302.97$; do not reject. There is not enough evidence to support the claim that the mean has changed. The interval supports the result.

3. H_0: $\mu = \$19{,}150$; H_1: $\mu \neq \$19{,}150$ (claim); C.V. = ± 1.96; $z = -3.69$; $15{,}889 < \mu < 18.151$; reject. There is enough evidence to support the claim that the mean differs from \$19,150. Yes, the interval supports the results.

5. H_0: $\mu = 19$; H_1: $\mu \neq 19$ (claim); C.V. = ± 2.145; d.f. = 14; $t = 1.37$; do not reject H_0. There is insufficient evidence to conclude that the mean number of hours differs from 19. 95% C.I.: $17.7 < \mu < 24.9$. Because the mean ($\mu = 19$) is in the interval, there is no evidence to support the idea that a difference exists.

7. The power of a statistical test is the probability of rejecting the null hypothesis when it is false.

9. The power of a test can be increased by increasing α or selecting a larger sample size.

Review Exercises

1. H_0: $\mu = 98°$ (claim) and H_1: $\mu \neq 98°$; C.V. = ± 1.96; $z = -2.02$; reject. There is enough evidence to reject the claim that the average high temperature in the United States is 98°.

3. H_0: $\mu = 18{,}000$; H_1: $\mu < 18{,}000$ (claim); C.V. = -2.33; test statistic $z = -3.58$; reject H_0. There is sufficient evidence to conclude that the mean debt is less than \$18,000.

5. H_0: $\mu = 1229$; H_1: $\mu \neq 1229$ (claim); C.V. = ± 1.96; $z = 1.875$; do not reject H_0. There is insufficient evidence to conclude that the rent differs.

7. H_0: $\mu = 10$; H_1: $\mu < 10$ (claim); C.V. = -1.782; d.f. = 12; $t = -2.230$; reject. There is enough evidence to support the claim that the mean weight is less than 10 ounces.

9. H_0: $p = 0.137$; H_1: $p \neq 0.137$ (claim); C.V. $= \pm 1.96$; $z = 1.51$; do not reject H_0. There is insufficient evidence to conclude that the proportion of union membership differs from 13.7%.

11. H_0: $p = 0.593$; H_1: $p < 0.593$ (claim); C.V. $= -2.33$; $z = -2.57$; reject H_0. There is sufficient evidence to conclude that the proportion of free and reduced lunches is less than 59.3%.

13. H_0: $p = 0.204$; H_1: $p \neq 0.204$ (claim); C.V. $= \pm 1.96$; $z = -1.03$; do not reject. There is not enough evidence to support the claim that the proportion is different from the national proportion.

15. H_0: $\sigma = 4.3$ (claim) and H_1: $\sigma < 4.3$; d.f. $= 19$; $\chi^2 = 6.95$; $0.005 < P\text{-value} < 0.01$ (0.006); since P-value < 0.05, reject. Yes, there is enough evidence to reject the claim that the standard deviation is greater than or equal to 4.3 miles per gallon.

17. H_0: $\sigma^2 = 40$; H_1: $\sigma^2 \neq 40$ (claim); C.V. $= 2.700$ and 19.023; test statistic $\chi^2 = 9.68$; do not reject H_0. There is insufficient evidence to conclude that the variance in the number of games played differs from 40.

19. H_0: $\mu = 4$ and H_1: $\mu \neq 4$ (claim); C.V. $= \pm 2.58$; $z = 1.49$; $3.85 < \mu < 4.55$; do not reject. There is not enough evidence to support the claim that the growth has changed.

Chapter Quiz

1. True
2. True
3. False
4. True
5. False
6. *b*
7. *d*
8. *c*
9. *b*
10. Type I
11. β
12. Statistical hypothesis
13. Right
14. $n - 1$

15. H_0: $\mu = 28.6$ (claim) and H_1: $\mu \neq 28.6$; $z = 2.15$; C.V. $= \pm 1.96$; reject. There is enough evidence to reject the claim that the average age of the mothers is 28.6 years.

16. H_0: $\mu = \$6500$ (claim) and H_1: $\mu \neq \$6500$; $z = 5.27$; C.V. $= \pm 1.96$; reject. There is enough evidence to reject the agent's claim.

17. H_0: $\mu = 8$ and H_1: $\mu > 8$ (claim); $z = 6$; C.V. $= 1.65$; reject. There is enough evidence to support the claim that the average is greater than 8.

18. H_0: $\mu = 500$ (claim) and H_1: $\mu \neq 500$; d.f. $= 6$; $t = -0.571$; C.V. $= \pm 3.707$; do not reject. There is not enough evidence to reject the claim that the mean is 500.

19. H_0: $\mu = 67$ and H_1: $\mu < 67$ (claim); $t = -3.1568$; P-value < 0.005 (0.003); since P-value < 0.05, reject. There is enough evidence to support the claim that the average height is less than 67 inches.

20. H_0: $\mu = 12.4$ and H_1: $\mu < 12.4$ (claim); $t = -2.324$; C.V. $= -1.345$; reject. There is enough evidence to support the claim that the average is less than the company claimed.

21. H_0: $\mu = 63.5$ and H_1: $\mu > 63.5$ (claim); $t = 0.47075$; P-value > 0.25 (0.322); since P-value > 0.05, do not reject. There is not enough evidence to support the claim that the average is greater than 63.5.

22. H_0: $\mu = 26$ (claim) and H_1: $\mu \neq 26$; $t = -1.5$; C.V. $= \pm 2.492$; do not reject. There is not enough evidence to reject the claim that the average is 26.

23. H_0: $p = 0.39$ (claim) and H_1: $p \neq 0.39$; C.V. $= \pm 1.96$; $z = -0.62$; do not reject. There is not enough evidence to reject the claim that 39% took supplements. The study supports the results of the previous study.

24. H_0: $p = 0.55$ (claim) and H_1: $p < 0.55$; $z = -0.8989$; C.V. $= -1.28$; do not reject. There is not enough evidence to reject the survey's claim.

25. H_0: $p = 0.35$ (claim) and H_1: $p \neq 0.35$; C.V. $= \pm 2.33$; $z = 0.666$; do not reject. There is not enough evidence to reject the claim that the proportion is 35%.

26. H_0: $p = 0.75$ (claim) and H_1: $p \neq 0.75$; $z = 2.6833$; C.V. $= \pm 2.58$; reject. There is enough evidence to reject the claim.

27. P-value $= 0.0324$

28. P-value < 0.0001

29. H_0: $\sigma = 6$ and H_1: $\sigma > 6$ (claim); $\chi^2 = 54$; C.V. $= 36.415$; reject. There is enough evidence to support the claim.

30. H_0: $\sigma = 8$ (claim) and H_1: $\sigma \neq 8$; $\chi^2 = 33.2$; C.V. $= 27.991, 79.490$; do not reject. There is not enough evidence to reject the claim that $\sigma = 8$.

31. H_0: $\sigma = 2.3$ and H_1: $\sigma < 2.3$ (claim); $\chi^2 = 13$; C.V. $= 10.117$; do not reject. There is not enough evidence to support the claim that the standard deviation is less than 2.3.

32. H_0: $\sigma = 9$ (claim) and H_1: $\sigma \neq 9$; $\chi^2 = 13.4$; P-value > 0.20 (0.291); since P-value > 0.05, do not reject. There is not enough evidence to reject the claim that $\sigma = 9$.

33. $28.9 < \mu < 31.2$; no

34. $\$6562.81 < \mu < \$6637.19$; no

Chapter 9

Exercises 9–1

1. Testing a single mean involves comparing a sample mean to a specific value such as $\mu = 100$; testing the difference between two means involves comparing the means of two samples, such as $\mu_1 = \mu_2$.

3. The populations must be independent of each other, and they must be normally distributed; s_1 and s_2 can be used in place of σ_1 and σ_2 when σ_1 and σ_2 are unknown, but a t test must be used.

5. H_0: $\mu_1 = \mu_2$ (claim) and H_1: $\mu_1 \neq \mu_2$; C.V. $= \pm 2.58$; $z = -0.88$; do not reject. There is not enough evidence to reject the claim that the average lengths of the major rivers are the same. (TI: $z = -0.856$)

7. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$ (claim); C.V. $= \pm 1.96$; $z = -3.65$; reject. There is sufficient evidence at $\alpha = 0.05$ to conclude that the commuting times differ in the winter.

9. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 > \mu_2$ (claim); C.V. $= 2.33$; $z = 3.75$; reject. There is sufficient evidence at $\alpha = 0.01$ to conclude that the average hospital stay for men is longer.

11. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 < \mu_2$ (claim); C.V. $= -1.65$; $z = -2.01$; reject. There is enough evidence to support the claim that the stayers had a higher grade point average.

13. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$ (claim); C.V. $= \pm 1.96$; $z = 0.66$; do not reject. There is not enough evidence to support the claim that there is a difference in the means.

15. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 \neq \mu_2$ (claim); $z = 1.01$; P-value $= 0.3124$; do not reject. There is not enough evidence to support the claim that there is a difference in self-esteem scores. (TI: P-value $= 0.3131$)

17. $2.8 < \mu_1 - \mu_2 < 6.0$

19. $10.48 < \mu_1 - \mu_2 < 59.52$. The interval provides evidence to reject the claim that there is no difference in mean scores because the interval for the difference is entirely positive. That is, 0 is not in the interval.

21. H_0: $\mu_1 - \mu_2 = 8$ (claim) and H_1: $\mu_1 - \mu_2 > 8$; C.V. $= +1.65$; $z = -0.73$; do not reject. There is not enough evidence to reject the claim that private school students have exam scores that are at most 8 points higher than those of students in public schools.

23. H_0: $\mu_1 - \mu_2 = \$30{,}000$; H_1: $\mu_1 - \mu_2 \neq \$30{,}000$ (claim); C.V. $= \pm 2.58$; $z = 1.22$; do not reject. There is not enough evidence to support the claim that the difference in income is not $30,000.

Exercises 9–2

1. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$ (claim); C.V. $= \pm 1.761$; d.f. $= 14$; $t = -1.595$; do not reject. There is not enough evidence to support the claim that the means are different.

3. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$ (claim); C.V. $= \pm 2.093$; d.f. $= 19$; $t = 3.811$; reject. There is enough evidence to support the claim that the mean noise levels are different.

5. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$ (claim); C.V. $= \pm 1.812$; d.f. $= 10$; $t = -1.220$; do not reject. There is not enough evidence to support the claim that the means are not equal.

7. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$ (claim); d.f. $= 9$; $t = 5.103$; the P-value for the t test is P-value < 0.0001; reject. There is enough evidence to support the claim that the means are different.

9. $3.066 < \mu_1 - \mu_2 < 10.534$
(TI: Interval $3.18 < \mu_1 - \mu_2 < 10.42$)

11. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$ (claim); C.V. $= \pm 2.977$; d.f. $= 14$; $t = 2.60$; do not reject. There is insufficient evidence to conclude a difference in viewing times.

13. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 > \mu_2$ (claim); C.V. $= 3.365$; d.f. $= 5$; $t = 1.057$; do not reject. There is not enough evidence to support the claim that the average number of students attending cyber charter schools in Allegheny County is greater that the average number of students attending cyber charter schools in surrounding counties. One reason why caution should be used is that cyber charter schools are a relatively new concept.

15. H_0: $\mu_1 = \mu_2$ (claim) and H_1: $\mu_1 \neq \mu_2$; d.f. $= 15$; $t = 2.385$. The P-value for the t test is $0.02 < P$-value < 0.05 (0.026). Do not reject since P-value > 0.01. There is not enough evidence to reject the claim that the means are equal. $-0.09 < \mu_1 - \mu_2 < 0.89$
(TI: Interval $-0.07 < \mu_1 - \mu_2 < 0.87$)

17. $9.87 < \mu_1 - \mu_2 < 219.6$
(TI: Interval $13.23 < \mu_1 - \mu_2 < 216.24$)

Exercises 9–3

1. *a.* Dependent
b. Dependent
c. Independent
d. Dependent
e. Independent

3. H_0: $\mu_D = 0$ and H_1: $\mu_D < 0$ (claim); C.V. $= -1.397$; d.f. $= 8$; $t = -2.8$; reject. There is enough evidence to support the claim that the seminar increased the number of hours students studied.

5. H_0: $\mu_D = 0$ and H_1: $\mu_D \neq 0$ (claim); C.V. $= \pm 2.365$; d.f. $= 7$; $t = 1.6583$; do not reject. There is not enough evidence to support the claim that the means are different.

7. H_0: $\mu_D = 0$ and H_1: $\mu_D > 0$ (claim); C.V. $= 2.571$; d.f. $= 5$; $t = 2.24$; do not reject. There is not enough evidence to support the claim that the errors have been reduced.

9. H_0: $\mu_D = 0$ and H_1: $\mu_D \neq 0$ (claim); d.f. $= 7$; $t = 0.978$; $0.20 < P$-value < 0.50 (0.361). Do not reject since P-value > 0.01. There is not enough evidence to support the claim that there is a difference in the pulse rates.
$-3.23 < \mu_D < 5.73$

11.
$$\overline{X_1 - X_2} = \Sigma \frac{X_1 - X_2}{n} = \Sigma\left(\frac{X_1}{n} - \frac{X_2}{n}\right)$$
$$= \Sigma \frac{X_1}{n} - \Sigma \frac{X_2}{n} = \overline{X}_1 - \overline{X}_2$$

Exercises 9–4

1a. *a.* $\hat{p} = \frac{34}{48}$, $\hat{q} = \frac{14}{48}$
b. $\hat{p} = \frac{28}{75}$, $\hat{q} = \frac{47}{75}$
c. $\hat{p} = \frac{50}{100}$, $\hat{q} = \frac{50}{100}$
d. $\hat{p} = \frac{6}{24}$, $\hat{q} = \frac{18}{24}$
e. $\hat{p} = \frac{12}{144}$, $\hat{q} = \frac{132}{144}$

1b. *a.* 16 *b.* 4 *c.* 48
d. 104 *e.* 30

3. $\hat{p}_1 = 0.593$; $\hat{p}_2 = 0.463$; $\overline{p} = 0.528$; $\overline{q} = 0.472$; H_0: $p_1 = p_2$; H_1: $p_1 > p_2$ (claim); C.V. = 1.65; $z = 3.19$; reject. There is enough evidence to support the claim that the proportion of married men is greater than the proportion of married women.

5. $\hat{p}_1 = 0.817$; $\hat{p}_2 = 0.783$; $\overline{p} = 0.8$; $\overline{q} = 0.2$; H_0: $p_1 = p_2$; H_1: $p_1 \neq p_2$ (claim); C.V. = ± 1.96; $z = 2.04$; reject. There is enough evidence to support the claim that the proportions are different.

7. $\hat{p}_1 = 0.83$; $\hat{p}_2 = 0.75$; $\overline{p} = 0.79$; $\overline{q} = 0.21$; H_0: $p_1 = p_2$ (claim) and H_1: $p_1 \neq p_2$; C.V. = ± 1.96; $z = 1.39$; do not reject. There is not enough evidence to reject the claim that the proportions are equal. $-0.032 < p_1 - p_2 < 0.192$

9. $\hat{p}_1 = 0.55$; $\hat{p}_2 = 0.45$; $\overline{p} = 0.5$; $\overline{q} = 0.5$; H_0: $p_1 = p_2$ and H_1: $p_1 \neq p_2$ (claim); C.V. = ± 2.58; $z = 1.23$; do not reject. There is not enough evidence to support the claim that the proportions are different. $(-0.103 < p_1 - p_2 < 0.291)$

11. $\hat{p}_1 = 0.347$; $\hat{p}_2 = 0.433$; $\overline{p} = 0.385$; $\overline{q} = 0.615$; H_0: $p_1 = p_2$ and H_1: $p_1 \neq p_2$ (claim); C.V. = ± 1.96; $z = -1.03$; do not reject. There is not enough evidence to say that the proportion of dog owners has changed $(-0.252 < p_1 - p_2 < 0.079)$. Yes, the confidence interval contains 0. This is another way to conclude that there is no difference in the proportions.

13. $\hat{p}_1 = 0.25$; $\hat{p}_2 = 0.31$; $\overline{p} = 0.286$; $\overline{q} = 0.714$; H_0: $p_1 = p_2$ and H_1: $p_1 \neq p_2$ (claim); C.V. = ± 2.58; $z = -1.45$; do not reject. There is not enough evidence to support the claim that the proportions are different. $-0.165 < p_1 - p_2 < 0.045$

15. $0.077 < p_1 - p_2 < 0.323$

17. $\hat{p}_1 = 0.4$; $\hat{p}_2 = 0.295$; $\overline{p} = 0.3475$; $\overline{q} = 0.6525$; H_0: $p_1 = p_2$; H_1: $p_1 \neq p_2$ (claim); C.V. = ± 2.58; $z = 2.21$; do not reject. There is not enough evidence to support the claim that the proportions are different.

19. $-0.0631 < p_1 - p_2 < 0.0667$. It does agree with the *Almanac* statistics stating a difference of -0.042 since -0.042 is contained in the interval.

Exercises 9–5

1. The variance in the numerator should be the larger of the two variances.

3. One degree of freedom is used for the variance associated with the numerator, and one is used for the variance associated with the denominator.

5. *a.* d.f.N. = 15, d.f.D. = 22; C.V. = 3.36
b. d.f.N. = 24, d.f.D. = 13; C.V. = 3.59
c. d.f.N. = 45, d.f.D. = 29; C.V. = 2.03
d. d.f.N. = 20, d.f.D. = 16; C.V. = 2.28
e. d.f.N. = 10, d.f.D. = 10; C.V. = 2.98

6. Specific *P*-values are in parentheses.
a. $0.025 < P\text{-value} < 0.05$ (0.033)
b. $0.05 < P\text{-value} < 0.10$ (0.072)
c. $P\text{-value} = 0.05$
d. $0.005 < P\text{-value} < 0.01$ (0.006)
e. $P\text{-value} = 0.05$
f. $P\text{-value} > 0.10$ (0.112)
g. $0.05 < P\text{-value} < 0.10$ (0.068)
h. $0.01 < P\text{-value} < 0.02$ (0.015)

7. H_0: $\sigma_1^2 = \sigma_2^2$; H_1: $\sigma_1^2 \neq \sigma_2^2$ (claim); C.V. = ± 1.88; d.f.N. = 59; d.f.D. = 59; $F = 1.981$; reject. There is enough evidence to support the claim that the variances are not equal.

9. H_0: $\sigma_1^2 = \sigma_2^2$; H_1: $\sigma_1^2 \neq \sigma_2^2$ (claim); C.V. = 3.430; d.f.N. = 12; d.f.D. = 11; $F = 2.085$; do not reject. There is not enough evidence to support the claim that the variances are different.

11. H_0: $\sigma_1^2 = \sigma_2^2$ and H_1: $\sigma_1^2 \neq \sigma_2^2$ (claim); C.V. = 4.99; d.f.N. = 7; d.f.D. = 7; $F = 1$; do not reject. There is not enough evidence to support the claim that there is a difference in the variances.

13. H_0: $\sigma_1^2 = \sigma_2^2$; H_1: $\sigma_1^2 > \sigma_2^2$ (claim); C.V. = 4.950; $F = 9.801$; reject. There is sufficient evidence at $\alpha = 0.05$ to conclude that the variance in area is greater for Eastern cities. C.V. = 10.67; do not reject. There is insufficient evidence to conclude the variance is greater at $\alpha = 0.01$.

15. H_0: $\sigma_1^2 = \sigma_2^2$ and H_1: $\sigma_1^2 \neq \sigma_2^2$ (claim); C.V. = 4.03; d.f.N. = 9; d.f.D. = 9; $F = 1.1026$; do not reject. There is not enough evidence to support the claim that the variances are not equal.

17. H_0: $\sigma_1^2 = \sigma_2^2$ (claim) and H_1: $\sigma_1^2 \neq \sigma_2^2$; C.V. = 3.87; d.f.N. = 6; d.f.D. = 7; $F = 3.18$; do not reject. There is not enough evidence to reject the claim that the variances of the heights are equal.

19. H_0: $\sigma_1^2 = \sigma_2^2$ (claim) and H_1: $\sigma_1^2 \neq \sigma_2^2$; $F = 5.32$; d.f.N. = 14; d.f.D. = 14; $P\text{-value} < 0.01$ (0.004); reject. There is enough evidence to reject the claim that the variances of the weights are equal. The variance for men is 2.363 and the variance for women is 0.444.

Review Exercises

1. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 > \mu_2$ (claim); C.V. = 2.33; $z = 0.59$; do not reject. There is not enough evidence to support the claim that single drivers do more pleasure driving than married drivers.

3. H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 > \mu_2$ (claim); C.V. = 1.729; $t = 4.595$; reject. There is sufficient evidence to conclude that single persons spend a greater time communicating.

5. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 \neq \mu_2$ (claim); C.V. = ± 2.624; d.f. = 14; $t = 6.54$; reject. Yes, there is enough evidence to support the claim that there is a difference in the teachers' salaries. $\$3494.80 < \mu_1 - \mu_2 < \$8021.20$

7. H_0: $\mu_D = 10$; H_1: $\mu_D > 10$ (claim); C.V. = 2.821; $t = 3.249$; reject. There is sufficient evidence to conclude that the difference in temperature is greater than 10 degrees.
9. H_0: $p_1 = p_2$; H_1: $p_1 \neq p_2$ (claim); C.V. = ± 1.96; $z = -1.45$; do not reject. There is not enough evidence to support the claim that the proportions are different.
11. H_0: $\sigma_1 = \sigma_2$ and H_1: $\sigma_1 \neq \sigma_2$ (claim); C.V. = 2.77; $\alpha = 0.10$; d.f.N. = 23; d.f.D. = 10; $F = 10.365$; reject. There is enough evidence to support the claim that there is a difference in the standard deviations.
13. H_0: $\sigma_1^2 = \sigma_2^2$; H_1: $\sigma_1^2 \neq \sigma_2^2$ (claim); C.V. = 2.45; d.f.N. = 24; d.f.D. = 19; $F = 1.631$; do not reject. There is not enough evidence to support the claim that the standard deviations are different. Store Z's paint would have to have a standard deviation of \$3.33.

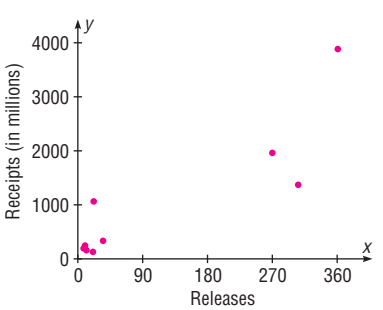
Chapter Quiz

1. False
2. False
3. True
4. False
5. *d*
6. *a*
7. *c*
8. *a*
9. $\mu_1 = \mu_2$
10. *t*
11. Normal
12. Negative
13. $\frac{s_1^2}{s_2^2}$
14. H_0: $\mu_1 = \mu_2$ and H_1: $\mu \neq \mu_2$ (claim); $z = -3.69$; C.V. = ± 2.58; reject. There is enough evidence to support the claim that there is a difference in the cholesterol levels of the two groups. $-10.2 < \mu_1 - \mu_2 < -1.8$
15. H_0: $\mu_1 = \mu_2$ and H_1: $\mu > \mu_2$ (claim); C.V. = 1.28; $z = 1.60$; reject. There is enough evidence to support the claim that the average rental fees for the apartments in the East are greater than the average rental fees for the apartments in the West.
16. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 \neq \mu_2$ (claim); $t = 11.094$; C.V. = ± 2.779; reject. There is enough evidence to support the claim that the average prices are different. $0.298 < \mu_1 - \mu_2 < 0.502$ (TI: Interval $0.2995 < \mu_1 - \mu_2 < 0.5005$)
17. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 < \mu_2$ (claim); C.V. = -1.860; d.f. = 8; $t = -4.05$; reject. There is enough evidence to support the claim that accidents have increased.
18. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 \neq \mu_2$ (claim); $t = 9.807$; C.V. = ± 2.718; reject. There is enough evidence to support the claim that the salaries are different. \$6653 $< \mu_1 - \mu_2 <$ \$11,757 (TI: Interval \$6619 $< \mu_1 - \mu_2 <$ \$11,491)
19. H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 > \mu_2$ (claim); d.f. = 10; $t = 0.874$; $0.10 < P$-value < 0.25 (0.198); do not reject since P-value > 0.05. There is not enough evidence to support the claim that the incomes of city residents are greater than the incomes of rural residents.
20. H_0: $\mu_D = 0$ and H_1: $\mu_D < 0$ (claim); $t = -4.17$; C.V. = -2.821; reject. There is enough evidence to support the claim that the sessions improved math skills.
21. H_0: $\mu_D = 0$ and H_1: $\mu_D < 0$ (claim); $t = -1.71$; C.V. = -1.833; do not reject. There is not enough evidence to support the claim that egg production was increased.
22. H_0: $p_1 = p_2$ and H_1: $p_1 \neq p_2$ (claim); $z = -0.69$; C.V. = ± 1.65; do not reject. There is not enough evidence to support the claim that the proportions are different. $-0.105 < p_1 - p_2 < 0.045$
23. H_0: $p_1 = p_2$ and H_1: $p_1 \neq p_2$ (claim); C.V. = ± 1.96; $z = 0.544$; do not reject. There is not enough evidence to support the claim that the proportions have changed. $-0.026 < p_1 - p_2 < 0.0460$. Yes, the confidence interval contains 0; hence, the null hypothesis is not rejected.
24. H_0: $\sigma_1^2 = \sigma_2^2$ and H_1: $\sigma_1^2 \neq \sigma_2^2$ (claim); $F = 1.637$; d.f.N. = 17; d.f.D. = 14; P-value > 0.20 (0.357). Do not reject since P-value > 0.05. There is not enough evidence to support the claim that the variances are different.
25. H_0: $\sigma_1^2 = \sigma_2^2$ and H_1: $\sigma_1^2 \neq \sigma_2^2$ (claim); $F = 1.296$; C.V. = 1.90; do not reject. There is not enough evidence to support the claim that the variances are different.

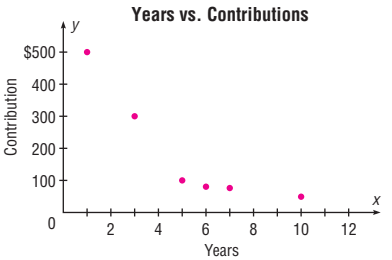
Chapter 10

Exercises 10–1

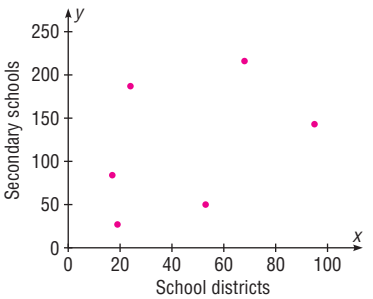
1. Two variables are related when a discernible pattern exists between them.
3. r, ρ (rho)
5. A positive relationship means that as x increases, y increases. A negative relationship means that as x increases, y decreases.
7. Answers will vary.
9. Pearson product moment correlation coefficient
11. There are many other possibilities, such as chance or relationship to a third variable.
13. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.880$; C.V. = ± 0.666; reject. There is sufficient evidence to conclude that a significant relationship exists between the number of releases and gross receipts.



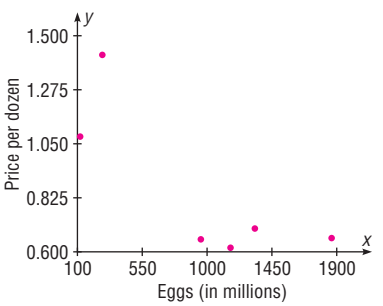
15. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = -0.883$; C.V. $= \pm 0.811$; reject. There is a significant relationship between the number of years a person has been out of school and his or her contribution.



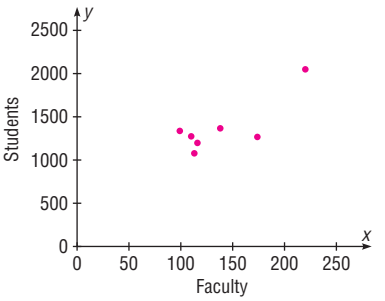
17. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.401$; C.V. $= \pm 0.811$; do not reject. There is not a significant linear relationship between the number of local school districts and the corresponding number of secondary schools.



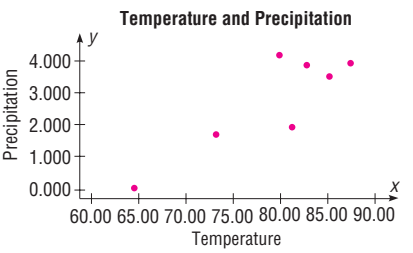
19. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = -0.833$; C.V. $= \pm 0.811$; reject. There is sufficient evidence to conclude a relationship exists between the number of eggs produced and the price per dozen.



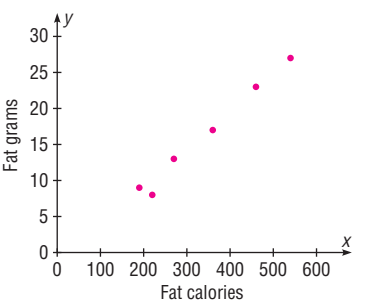
21. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.812$; C.V. $= \pm 0.754$; reject. There is a significant linear relationship between the number of faculty and the number of students at small colleges. When the values for x and y are switched, the results are identical. The independent variable is most likely the number of students.



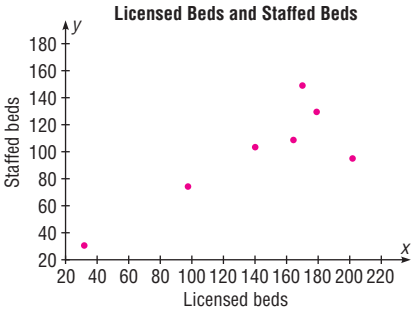
23. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.883$; C.V. $= \pm 0.754$; reject. There is a significant linear relationship between the average daily temperature and the average monthly precipitation.



25. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.993$; C.V. $= \pm 0.811$; reject. There is a significant linear relationship between the fat calories and the amount of saturated fat in the breakfast foods.



27. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.831$; C.V. $= \pm 0.754$; reject. There is a significant linear relationship between the number of licensed beds in a hospital and the number of staffed beds.



29. $r = 1.00$: All values fall in a straight line. $r = 1.00$: The value of r between x and y is the same when x and y are interchanged.

Exercises 10–2

1. A scatter plot should be drawn, and the value of the correlation coefficient should be tested to see whether it is significant.

3. $y' = a + bx$

5. It is the line that is drawn through the points on the scatter plot such that the sum of the squares of the vertical distances from each point to the line is a minimum.

7. When r is positive, b will be positive. When r is negative, b will be negative.

9. The closer r is to $+1$ or -1, the more accurate the predicted value will be.

11. When r is not significant, the mean of the y values should be used to predict y.

13. $y' = 181.661 + 7.319x$; $y' = 1645.5$ (million \$)

15. $y' = 453.176 - 50.439x$; 251.42

17. Since r is not significant, no regression should be done.

19. $y' = 1.252 - 0.000398x$; $y' = 0.615$ per dozen

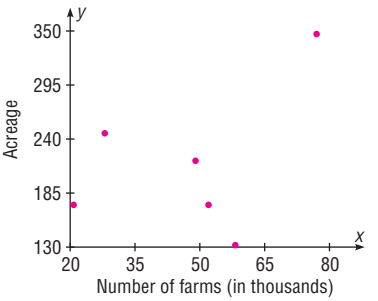
21. $y' = -14.974 + 0.111x$

23. $y' = -8.994 + 0.1448x$; 1.1

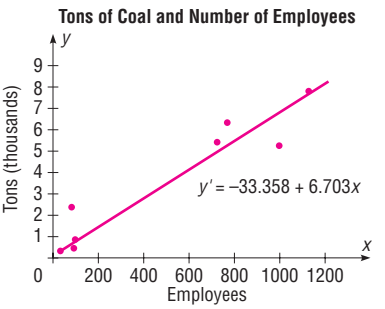
25. $y' = -2.417 + 0.055x$; 19.6 grams

27. $y' = 22.659 + 0.582x$; 48.267

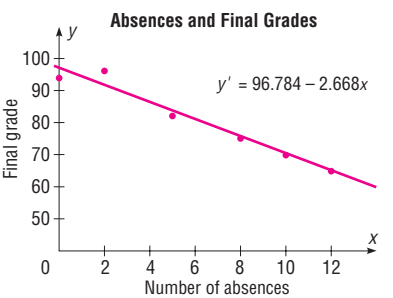
29. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.429$; C.V. $= \pm 0.811$; do not reject. There is insufficient evidence to conclude a relationship exists between number of farms and acreage.



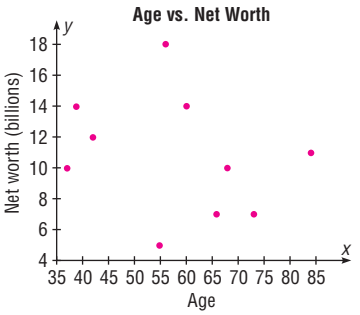
31. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.970$; C.V. $= \pm 0.707$; reject; $y' = -33.358 + 6.703x$; when $x = 500$, $y' = 3318.142$. There is a significant relationship between number of employees and tons of coal produced.



33. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = -0.981$; C.V. $= \pm 0.811$; reject. There is a significant relationship between the number of absences and the final grade; $y' = 96.784 - 2.668x$.



35. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = -0.265$; P-value > 0.05 (0.459); do not reject. There is no significant linear relationship between the ages of billionaires and their net worth. No regression should be done.



37. 453.173; regression should not be done

Exercises 10–3

1. Explained variation is the variation due to the relationship. It is computed by $\Sigma(y' - \bar{y})^2$.

3. Total variation is the sum of the squares of the vertical distances of the points from the mean. It is computed by $\Sigma(y - \bar{y})^2$.

5. The coefficient of determination is found by squaring the value of the correlation coefficient.

7. The coefficient of nondetermination is found by subtracting r^2 from 1.

9. $R^2 = 0.5625$; 56.25% of the variation of y is due to the variation of x; 43.75% is due to chance.

11. $R^2 = 0.1764$; 17.64% of the variation of y is due to the variation of x; 82.36% is due to chance.

13. $R^2 = 0.8281$; 82.81% of the variation of y is due to the variation of x; 17.19% is due to chance.

15. 629.4862

17. 94.22*

19. $365.88 < y' < 2925.04$*

21. $\$30.46 < y < \$472.38$*

*Answers may vary due to rounding.

Exercises 10–4

1. Simple regression has one dependent variable and one independent variable. Multiple regression has one dependent variable and two or more independent variables.

3. The relationship would include all variables in one equation.

5. They will all be smaller.

7. 3.48 or 3

9. 85.75 (grade) or 86

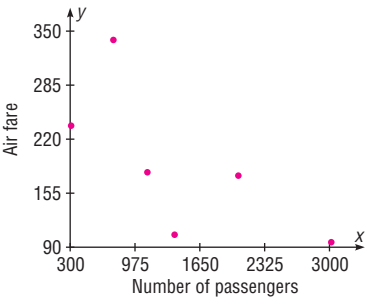
11. R is the strength of the relationship between the dependent variable and all the independent variables.

13. R^2 is the coefficient of multiple determination. R^2_{adj} is adjusted for sample size and number of predictors.

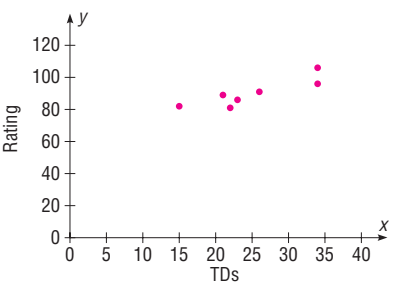
15. F test

Review Exercises

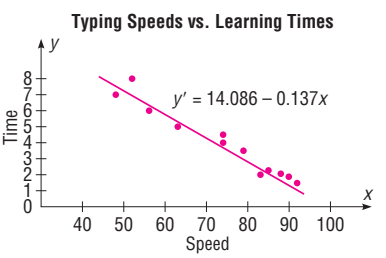
1. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = -0.686$; C.V. $= \pm 0.917$; do not reject. There is insufficient evidence to conclude that a relationship exists between number of passengers and one-way fare cost.



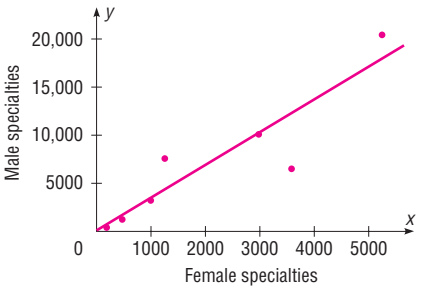
3. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.873$; C.V. $= \pm 0.875$; do not reject. There is not a significant linear relationship between the number of touchdowns and the quarterback's rating. No regression should be done.



5. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = -0.974$; C.V. $= \pm 0.708$; d.f. $= 10$; reject. There is a significant relationship between speed and time; $y' = 14.086 - 0.137x$; $y' = 4.222$.



7. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.907$; C.V. $= \pm 0.875$; reject. There is sufficient evidence to conclude a relationship exists between the numbers of female physicians and male physicians in a given field. $y' = 102.846 + 3.408x$; $y' = 6919$



9. 0.468* (TI value 0.513)

11. $3.34 < y < 5.10$*

13. 22.01*

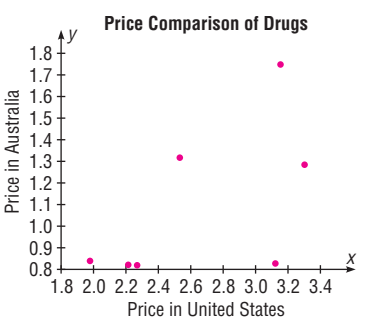
15. $R^2_{adj} = 0.643$*

*Answers may vary due to rounding.

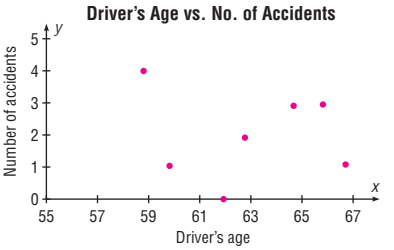
Chapter Quiz

1. False
2. True
3. True
4. False
5. False
6. False
7. *a*
8. *a*
9. *d*
10. *c*
11. *b*
12. Scatter plot
13. Independent
14. $-1, +1$
15. *b*
16. Line of best fit
17. $+1, -1$

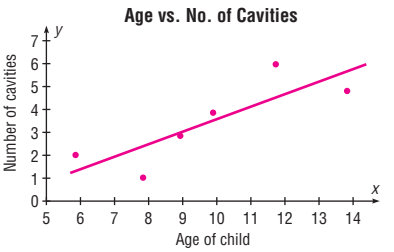
18. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.600$; C.V. $= \pm 0.754$; do not reject. There is no significant linear relationship between the price of the same drugs in the United States and in Australia. No regression should be done.



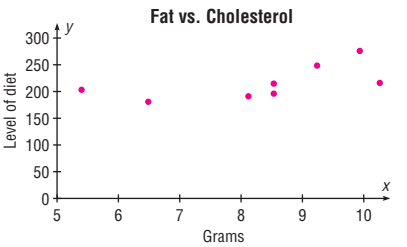
19. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = -0.078$; C.V. $= \pm 0.754$; do not reject. No regression should be done.



20. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.842$; C.V. $= \pm 0.811$; reject. $y' = -1.918 + 0.551x$; 4.14 or 4



21. H_0: $\rho = 0$; H_1: $\rho \neq 0$; $r = 0.602$; C.V. $= \pm 0.707$; do not reject. No regression should be done.



22. 1.129*

23. 29.5* For calculation purposes only. No regression should be done.

24. $0 < y < 5$*

25. 217.5 (average of y' values is used since there is no significant relationship)

26. 119.9*

27. $R = 0.729$*

28. $R^2_{adj} = 0.439$*

*These answers may vary due to the method of calculation or rounding.

Chapter 11

Exercises 11–1

1. The variance test compares a sample variance with a hypothesized population variance; the goodness-of-fit test compares a distribution obtained from a sample with a hypothesized distribution.

3. The expected values are computed on the basis of what the null hypothesis states about the distribution.

5. H_0: 82% of home-schooled students receive their education entirely at home, 12% attend school up to 9 hours per week, and 6% spend from 9 to 25 hours per week at school. H_1: The proportions differ from those stated in the null hypothesis (claim). C.V. = 5.991; $\chi^2 = 31.75$; reject. There is sufficient evidence to conclude that the proportions differ from those stated by the government.

7. H_0: The distribution of the recorded music sales were as follows: full-length CDs, 77.8%; digital downloads, 12.8%; singles, 3.8%; and other formats, 5.6%. H_1: The distribution is not the same as that stated in the null hypothesis (claim). C.V. = 7.815; $\chi^2 = 24.66$; reject. There is enough evidence to support the claim that the distribution is not the same as stated in the null hypothesis.

9. H_0: 35% feel that genetically modified food is safe to eat, 52% feel that genetically modified food is not safe to eat, and 13% have no opinion. H_1: The distribution is not the same as stated in the null hypothesis (claim). C.V. = 9.210; d.f. = 2; $\chi^2 = 1.4286$; do not reject. There is not enough evidence to support the claim that the proportions are different from those reported in the survey.

11. H_0: The distribution of students who use calculators on tests is as follows: never, 28%; sometimes, 51%; and always, 21%. H_1: The distribution is not the same as stated in the null hypothesis (claim). C.V. = 5.991; $\chi^2 = 2.999$; do not reject. There is not enough evidence to support the claim that the distribution is different from the one stated in the null hypothesis.

13. H_0: The methods of payments of adult shoppers for purchases are distributed as follows: 53% pay cash, 30% use checks, 16% use credit cards, and 1% have no preference (claim). H_1: The distribution is not the same as stated in the null hypothesis. C.V. = 11.345; d.f. = 3; $\chi^2 = 36.8897$; reject. There is enough evidence to reject the claim that the distribution at the large store is the same as in the survey.

15. H_0: The proportion of Internet users is the same for the groups. H_1: The proportion of Internet users is not the same for the groups (claim). C.V. = 5.991; $\chi^2 = 0.208$; do not reject. There is insufficient evidence to conclude that the proportions differ.

17. H_0: The distribution of the ways people pay for their prescriptions is as follows: 60% used personal funds, 25% used insurance, and 15% used Medicare (claim). H_1: The distribution is not the same as stated in the null hypothesis. The d.f. = 2; $\alpha = 0.05$; $\chi^2 = 0.667$; do not reject since P-value > 0.05. There is not enough evidence to reject the claim that the distribution is the same as stated in the null hypothesis. An implication of the results is that the majority of people are using their own money to pay for medications. Maybe the medication should be less expensive to help out these people. (TI: P-value = 0.7164)

19. Answers will vary.

Exercises 11–2

1. The independence test and the goodness-of-fit test both use the same formula for computing the test value. However, the independence test uses a contingency table, whereas the goodness-of-fit test does not.

3. H_0: The variables are independent (or not related). H_1: The variables are dependent (or related).

5. The expected values are computed as (row total $\times$ column total) $\div$ grand total.

7. H_0: $p_1 = p_2 = p_3 = p_4 = \cdots = p_n$. H_1: At least one proportion is different from the others.

9. H_0: The number of endangered species is independent of the number of threatened species. H_1: The number of endangered species is dependent upon the number of threatened species (claim). C.V. = 9.488; $\chi^2 = 45.315$; reject. There is sufficient evidence to conclude a relationship. The result is not different at $\alpha = 0.01$.

11. H_0: The composition of the legislature (House of Representatives) is independent of the state. H_1: The composition of the legislature is dependent upon the state (claim). C.V. = 7.815; d.f. = 3; $\chi^2 = 48.7521$; reject. There is enough evidence to support the claim that the composition of the legislature is dependent upon the state.

13. H_0: The type of Olympic medal won is independent of the country that won the medal. H_1: The type of medal won is dependent on the country that won the medal (claim). C.V. = 9.236; $\chi^2 = 6.651$; do not reject. There is not enough evidence to support the claim that the type of medal won is dependent on the country that won the medal.

15. H_0: The program of study of a student is independent of the type of institution. H_1: The program of study of a student is dependent upon the type of institution (claim). C.V. = 7.815; $\chi^2 = 13.702$; reject. There is sufficient evidence to conclude that there is a relationship between program of study and type of institution.

17. H_0: The type of furniture sold is independent of the store that sold the furniture. H_1: The type of furniture sold is dependent on the store that sold it (claim). C.V. = 9.488; $\chi^2 = 2.86$; do not reject. There is not enough evidence to support the claim that the type of furniture sold is dependent on the store that sold the furniture.

19. H_0: The choice of exercise equipment is independent of the gender of the individual using it. H_1: The choice of exercise equipment is dependent upon the gender of the individual using it (claim). C.V. = 5.991; $\chi^2 = 9.139$; reject. There is enough evidence to support the claim that the choice of exercise equipment is dependent upon the gender of the user.

21. H_0: The type of book purchased by an individual is independent of the gender of the individual (claim). H_1: The type of book purchased by an individual is dependent on the gender of the individual. The d.f. = 2; $\alpha = 0.05$; $\chi^2 = 19.43$; P-value < 0.05; reject since

P-value < 0.05. There is enough evidence to reject the claim that the type of book purchased by an individual is independent of the gender of the individual. (TI: P-value = 0.00006)

23. H_0: $p_1 = p_2 = p_3 = p_4$ (claim). H_1: At least one proportion is different. C.V. = 7.815; d.f. = 3; $\chi^2 = 5.317$; do not reject. There is not enough evidence to reject the claim that the proportions are equal.

25. H_0: $p_1 = p_2 = p_3 = p_4$ (claim). H_1: At least one of the proportions is different from the others. C.V. = 7.815; d.f. = 3; $\chi^2 = 1.172$; do not reject. There is not enough evidence to reject the claim that the proportions are equal. Since the survey was done in Pennsylvania, it is doubtful that it can be generalized to the population of the United States.

27. H_0: $p_1 = p_2 = p_3 = p_4 = p_5$. H_1: At least one proportion is different. C.V. = 9.488; $\chi^2 = 12.028$; reject. There is sufficient evidence to conclude that the proportions differ.

29. H_0: $p_1 = p_2 = p_3 = p_4$ (claim). H_1: At least one proportion is different. The d.f. = 3; $\chi^2 = 1.734$; $\alpha = 0.05$; P-value > 0.10 (0.629); do not reject since P-value > 0.05. There is not enough evidence to reject the claim that the proportions are equal. (TI: P-value = 0.6291)

31. H_0: $p_1 = p_2 = p_3$ (claim). H_1: At least one proportion is different. C.V. = 4.605; d.f. = 2; $\chi^2 = 2.401$; do not reject. There is not enough evidence to reject the claim that the proportions are equal.

33. $\chi^2 = 1.075$

Review Exercises

1. H_0: The distribution of traffic fatalities were as follows: used seat belt, 31.58%; did not use seat belt, 59.83%; status unknown, 8.59%. H_1: The distribution is not as stated in the null hypothesis (claim). C.V. = 5.991; $\chi^2 = 1.819$; do not reject. There is not enough evidence to support the claim that the distribution differs from the one stated in the null hypothesis.

3. H_0: Opinion is independent of gender. H_1: Opinion is dependent on gender (claim). C.V. = 4.605; d.f. = 2; $\chi^2 = 6.166$; reject. There is enough evidence to support the claim that opinion is dependent on gender.

5. H_0: The type of investment is independent of the age of the investor. H_1: The type of investment is dependent on the age of the investor (claim). C.V. = 9.488; d.f. = 4; $\chi^2 = 28.0$; reject. There is enough evidence to support the claim that the type of investment is dependent on the age of the investor.

7. H_0: $p_1 = p_2 = p_3$ (claim). H_1: At least one proportion is different. $\chi^2 = 4.912$; d.f. = 2; $\alpha = 0.01$; $0.05 < P$-value < 0.10 (0.086); do not reject since P-value > 0.01. There is not enough evidence to reject the claim that the proportions are equal.

9. H_0: Health care coverage is independent of the state of residence of the individual. H_1: Health care coverage is related to the state of residence of the individual (claim). C.V. = 11.345; $\chi^2 = 18.993$; reject. There is sufficient evidence to say that health care coverage is related to the state of residence of the individual.

Chapter Quiz

1. False

2. True

3. False

4. *c*

5. *b*

6. *d*

7. 6

8. Independent

9. Right

10. At least 5

11. H_0: The reasons why people lost their jobs are equally distributed (claim). H_1: The reasons why people lost their jobs are not equally distributed. C.V. = 5.991; d.f. = 2; $\chi^2 = 2.334$; do not reject. There is not enough evidence to reject the claim that the reasons why people lost their jobs are equally distributed. The results could have been different 10 years ago since different factors of the economy existed then.

12. H_0: Takeout food is consumed according to the following distribution: 53% at home, 19% in the car, 14% at work, and 14% at other places (claim). H_1: The distribution is different from that stated in the null hypothesis. C.V. = 11.345; d.f. = 3; $\chi^2 = 5.271$; do not reject. There is not enough evidence to reject the claim that the distribution is as stated. Fast-food restaurants may want to make their advertisements appeal to those who like to take their food home to eat.

13. H_0: College students show the same preference for shopping channels as those surveyed. H_1: College students show a different preference for shopping channels (claim). C.V. = 7.815; d.f. = 3; $\alpha = 0.05$; $\chi^2 = 21.789$; reject. There is enough evidence to support the claim that college students show a different preference for shopping channels.

14. H_0: The number of commuters is distributed as follows: 75.7%, alone; 12.2%, carpooling; 4.7%, public transportation; 2.9%, walking; 1.2%, other; and 3.3%, working at home. H_1: The proportion of workers using each type of transportation differs from the stated proportions. C.V. = 11.071; d.f. = 5; $\chi^2 = 41.269$; reject. There is enough evidence to support the claim that the distribution is different from the one stated in the null hypothesis.

15. H_0: Ice cream flavor is independent of the gender of the purchaser (claim). H_1: Ice cream flavor is dependent upon the gender of the purchaser. C.V. = 7.815; d.f. = 3; $\chi^2 = 7.198$; do not reject. There is not enough evidence to reject the claim that ice cream flavor is independent of the gender of the purchaser.

16. H_0: The type of pizza ordered is independent of the age of the individual who purchases it. H_1: The type of pizza ordered is dependent on the age of the individual who purchases it (claim). $\chi^2 = 107.3$; d.f. = 9; $\alpha = 0.10$; P-value < 0.005; reject since P-value < 0.10. There is enough evidence to support the claim that the pizza purchased is related to the age of the purchaser.

17. H_0: The color of the pennant purchased is independent of the gender of the purchaser (claim). H_1: The color of the pennant purchased is dependent on the gender of the purchaser. $\chi^2 = 5.632$; C.V. = 4.605; reject. There is enough evidence to reject the claim that the color of the pennant purchased is independent of the gender of the purchaser.

18. H_0: The opinion of the children on the use of the tax credit is independent of the gender of the children. H_1: The opinion of the children on the use of the tax credit is dependent upon the gender of the children (claim). C.V. = 4.605; d.f. = 2; $\chi^2 = 1.534$; do not reject. There is not enough evidence to support the claim that the opinion of the children on the use of the tax credit is dependent on their gender.

19. H_0: $p_1 = p_2 = p_3$ (claim). H_1: At least one proportion is different from the others. C.V. = 4.605; d.f. = 2; $\chi^2 = 6.711$; reject. There is enough evidence to reject the claim that the proportions are equal. It seems that more women are undecided about their jobs. Perhaps they want better income or greater chances of advancement.

Chapter 12

Exercises 12–1

1. The analysis of variance using the F test can be employed to compare three or more means.

3. The populations from which the samples were obtained must be normally distributed. The samples must be independent of each other. The variances of the populations must be equal.

5. $F = \frac{s_B^2}{s_W^2}$

7. One

9. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one of the means differs from the others. C.V. = 4.26; d.f.N. = 2; d.f.D. = 9; $F = 14.149$; reject. There is sufficient evidence to conclude at least one mean is different from the others.

11. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean is different from the others (claim). C.V. = 3.98; $\alpha = 0.05$; d.f.N. = 2; d.f.D. = 11; $F = 2.7313$; do not reject. There is not enough evidence to support the claim that at least one mean is different from the others.

13. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean is different from the others (claim). C.V. = 3.68; $\alpha = 0.05$; d.f.N. = 2; d.f.D. = 15; $F = 8.14$; reject. There is enough evidence to support the claim that at least one mean is different from the others.

15. H_0: $\mu_1 = \mu_2 = \mu_3$ (claim). H_1: At least one mean is different from the others. C.V. = 4.10; $\alpha = 0.05$; d.f.N. = 2; d.f.D. = 10; $F = 3.9487$; do not reject. There is not enough evidence to reject the claim that the means are equal.

17. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean is different from the others (claim). $F = 10.118$; P-value = 0.00102; reject. There is enough evidence to conclude that at least one mean is different from the others.

19. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean differs from the others (claim). C.V. = 2.57; d.f.N. = 2; d.f.D. = 21; $F = 3.497$; reject. There is sufficient evidence to conclude at least one mean is different from the others.

Exercises 12–2

1. The Scheffé and Tukey tests are used.

3. $F_{1\times2} = 2.059$; $F_{2\times3} = 17.640$; $F_{1\times3} = 27.929$. Scheffé test: C.V. = 8.52. There is sufficient evidence to conclude a difference in mean cost to drive 25 miles between hybrid cars and hybrid trucks and between hybrid SUVs and hybrid trucks.

5. Tukey test: C.V. = 3.29; $\overline{X}_1 = 7.0$; $\overline{X}_2 = 8.12$; $\overline{X}_3 = 5.23$; $\overline{X}_1$ versus $\overline{X}_2$, $q = -2.196$; $\overline{X}_1$ versus $\overline{X}_3$, $q = 3.47$; $\overline{X}_2$ versus $\overline{X}_3$, $q = -6.35$. There is a significant difference between $\overline{X}_1$ and $\overline{X}_3$, and $\overline{X}_2$ and $\overline{X}_3$. One reason for the difference might be that the students are enrolled in cyber schools with different fees.

7. Scheffé test: C.V. = 5.22; $\overline{X}_1$ versus $\overline{X}_2$, $F = 2.91$; $\overline{X}_1$ versus $\overline{X}_3$, $F = 19.3$; $\overline{X}_2$ versus $\overline{X}_3$, $F = 8.40$. There is a significant difference between $\overline{X}_1$ and $\overline{X}_3$, and $\overline{X}_2$ and $\overline{X}_3$.

9. Tukey test: C.V. = 3.08; $\overline{X}_1$ versus $\overline{X}_2$, $q = 3.262$; $\overline{X}_1$ versus $\overline{X}_3$, $q = 3.215$; $\overline{X}_2$ versus $\overline{X}_3$, $q = -0.047$. There is a significant difference between $\overline{X}_1$ and $\overline{X}_2$ and $\overline{X}_2$ and $\overline{X}_3$.

11. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean is different from the others (claim). C.V. = 3.47; $\alpha = 0.05$; d.f.N. = 2; d.f.D. = 21; $F = 1.9912$; do not reject. There is not enough evidence to support the claim that at least one mean is different from the others.

13. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean differs from the others (claim). C.V. = 3.68; d.f.N. = 2; d.f.D. = 16; $F = 17.172$; reject. There is enough evidence to support the claim that at least one mean differs from the others. Tukey test: C.V. = 3.67; $\overline{X}_1$ versus $\overline{X}_2$, $q = -8.17$; $\overline{X}_1$ versus $\overline{X}_3$, $q = -2.91$; $\overline{X}_2$ versus $\overline{X}_3$, $q = 5.269$. There is a significant difference between $\overline{X}_1$ and $\overline{X}_2$ and between $\overline{X}_2$ and $\overline{X}_3$.

Exercises 12–3

1. The two-way ANOVA allows the researcher to test the effects of two independent variables and a possible interaction effect. The one-way ANOVA can test the effects of only one independent variable.

3. The mean square values are computed by dividing the sum of squares by the corresponding degrees of freedom.

5. *a.* For factor A, d.f.$_A = 2$ *c.* d.f.$_{A\times B} = 2$
b. For factor B, d.f.$_B = 1$ *d.* d.f.$_{\text{within}} = 24$

7. The two types of interactions that can occur are ordinal and disordinal.

9. *a.* The lines will be parallel or approximately parallel. They may also coincide.
b. The lines will not intersect and they will not be parallel.
c. The lines will intersect.

11. *Interaction:* H_0: There is no interaction effect between the temperature and the level of humidity. H_1: There is an interactive effect between the temperature and the level of humidity. *Humidity:* H_0: There is no difference in mean length of effectiveness with respect to humidity. H_1: There is a difference in mean length of effectiveness with respect to humidity. *Temperature:* H_0: There is no difference in the mean length of effectiveness based on temperature. H_1: There is a difference in mean length of effectiveness based on temperature.

C.V. = 5.318; d.f.N. = 1; d.f.D. = 8; $F = 18.383$ for humidity. There is sufficient evidence to conclude a difference in mean length of effectiveness based on the humidity level. The temperature and interaction effects are not significant.

ANOVA Summary Table for Exercise 11

Source of variation	SS	d.f.	MS	*F*	*P*-value
Humidity	280.3333	1	280.3333	18.383	0.003
Temperature	3	1	3	0.197	0.669
Interaction	65.33333	1	65.33333	4.284	0.0722
Within	122	8	15.25		
Total	470.6667	11			

13. *Interaction:* H_0: There is no interaction effect on the durability rating between the dry additives and the solution-based additives. H_1: There is an interaction effect on the durability rating between the dry additives and the solution-based additives. *Solution-based additive:* H_0: There is no difference in the mean durability rating with respect to the solution-based additives. H_1: There is a difference in the mean durability rating with respect to the solution-based additives. *Dry additive:* H_0: There is no difference in the mean durability rating with respect to the dry additive. H_1: There is a difference in the mean durability rating with respect to the dry additive. C.V. = 4.75; d.f.N. = 1; d.f.D. = 12. There is not a significant interaction effect. Neither the solution additive nor the dry additive have a significant effect on mean durability.

ANOVA Summary Table for Exercise 13

Source	SS	d.f.	MS	*F*	*P*-value
Solution additive	1.563	1	1.563	0.497	0.494
Dry additive	0.063	1	0.063	0.020	0.898
Interaction	1.563	1	1.563	0.497	0.494
Within	37.750	12	3.146		
Total	40.939	15			

15. H_0: There is no interaction effect between the ages of the salespeople and the products they sell on the monthly sales. H_1: There is an interaction effect between the ages of the salespeople and the products they sell on the monthly sales.

H_0: There is no difference in the means of the monthly sales of the two age groups. H_1: There is a difference in the means of the monthly sales of the two age groups.

H_0: There is no difference among the means of the sales for the different products. H_1: There is a difference among the means of the sales for the different products.

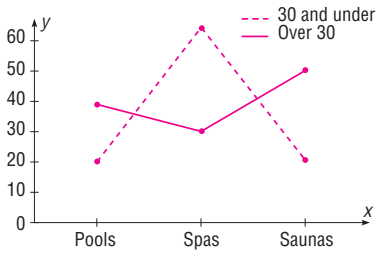
ANOVA Summary Table

Source	SS	d.f.	MS	*F*
Age	168.033	1	168.033	1.567
Product	1,762.067	2	881.034	8.215
Interaction	7,955.267	2	3,977.634	37.087
Within	2,574.000	24	107.250	
Total	12,459.367	29		

At $\alpha = 0.05$, the critical values are: for age, d.f.N. = 1, d.f.D. = 24, C.V. = 4.26; for product and interaction,

d.f.N. = 2 and d.f.D. = 24; C.V. = 3.40. There is a significant interaction between the age of the salesperson and the type of product sold, so no main effects should be interpreted without further study.

Product / Age	Pools	Spas	Saunas
Over 30	38.8	28.6	55.4
30 and under	21.2	68.6	18.8



Since the lines cross, there is a disordinal interaction; hence, there is an interaction effect between the ages of salespeople and the type of products sold.

Review Exercises

1. H_0: $\mu_1 = \mu_2 = \mu_3$ (claim). H_1: At least one mean is different from the others. C.V. = 5.39; d.f.N. = 2; d.f.D. = 33; $\alpha = 0.01$; $F = 6.94$; reject. Tukey test: C.V. = 4.45; $\overline{X}_1$ versus $\overline{X}_2$: $q = 0.342$; $\overline{X}_1$ versus $\overline{X}_3$: $q = 4.72$; $\overline{X}_2$ versus $\overline{X}_3$: $q = 4.38$. There is a significant difference between $\overline{X}_1$ and $\overline{X}_3$.

3. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean is different from the others (claim). C.V. = 3.55; $\alpha = 0.05$; d.f.N. = 2; d.f.D. = 18; $F = 0.0408$; do not reject. There is not enough evidence to support the claim that at least one mean is different from the others.

5. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean is different from the others (claim). C.V. = 2.61; $\alpha = 0.10$; d.f.N. = 2; d.f.D. = 19; $F = 0.4876$; do not reject. There is not enough evidence to support the claim that at least one mean is different from the others.

7. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$. H_1: At least one mean is different from the others (claim). C.V. = 3.59; $\alpha = 0.05$; d.f.N. = 3; d.f.D. = 11; $F = 0.182$; do not reject. There is not enough evidence to support the claim that at least one mean is different from the others.

9. H_0: There is no interaction effect between the type of exercise program and the type of diet on a person's glucose level. H_1: There is an interaction effect between type of exercise program and the type of diet on a person's glucose level.

H_0: There is no difference in the means for the glucose levels of the people in the two exercise programs. H_1: There is a difference in the means for the glucose levels of the people in the two exercise programs.

H_0: There is no difference in the means for the glucose levels of the people in the two diet programs. H_1: There is a difference in the means for the glucose levels of the people in the two diet programs.

ANOVA Summary Table

Source	SS	d.f.	MS	*F*
Exercise	816.750	1	816.750	60.50
Diet	102.083	1	102.083	7.56
Interaction	444.083	1	444.083	32.90
Within	108.000	8	13.500	
Total	1470.916	11		

At $\alpha = 0.05$, d.f.N. = 1, d.f.D. = 8, and the critical value is 5.32 for each F_A, F_B, and $F_{A\times B}$. Hence, all three null hypotheses are rejected. The cell means should be calculated.

Exercise / Diet	A	B
I	64.000	57.667
II	68.333	86.333

Since the means for exercise program I are both smaller than those for exercise program II and the vertical differences are not the same, the interaction is ordinal. Hence you can say that there is a difference for exercise and diet, and that an interaction effect is present.

Chapter Quiz

1. False **2.** False
3. False **4.** True
5. *d* **6.** *a*
7. *a* **8.** *c*
9. ANOVA **10.** Tukey
11. Two

12. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$. H_1: At least one mean is different from the others (claim). C.V. = 3.49; $\alpha = 0.05$; d.f.N. = 3; d.f.D. = 12; $F = 3.23$; do not reject. There is not enough evidence to support the claim that there is a difference in the means.

13. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean is different from the others (claim). C.V. = 6.93; $\alpha = 0.01$; d.f.N. = 2; d.f.D. = 12; $F = 3.49$. There is not enough evidence to support the claim that at least one mean is different from the others. Writers would want to target their material to the age group of the viewers.

14. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean differs from the others (claim). C.V. = 4.26; d.f.N. = 2; d.f.D. = 9; $F = 10.025$; reject. There is enough evidence to conclude that at least one mean differs from the others. Tukey test: C.V. = 3.95; $\overline{X}_1$ versus $\overline{X}_2$, $q = -1.28$; $\overline{X}_1$ versus $\overline{X}_3$,

$q = 4.74$; $\overline{X}_2$ versus $\overline{X}_3$, $q = 6.02$. There is a significant difference between $\overline{X}_1$ and $\overline{X}_3$ and between $\overline{X}_2$ and $\overline{X}_3$.

15. H_0: $\mu_1 = \mu_2 = \mu_3$. H_1: At least one mean differs from the others (claim). C.V. = 2.92; d.f.N. = 2; d.f.D. = 8; $F = 6.652$; reject. Scheffé test: C.V. = 8.918; $\overline{X}_1$ versus $\overline{X}_2$, $F_s = 9.32$; $\overline{X}_1$ versus $\overline{X}_3$, $F_s = 10.132$; $\overline{X}_2$ versus $\overline{X}_3$, $F_s = 0.1258$. There is a significant difference between $\overline{X}_1$ and $\overline{X}_2$ and between $\overline{X}_1$ and $\overline{X}_3$.

16. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$. H_1: At least one mean is different from the others (claim). C.V. = 3.07; $\alpha = 0.05$; d.f.N. = 3; d.f.D. = 21; $F = 0.4564$; do not reject. There is not enough evidence to support the claim that at least one mean is different from the others.

17. *a.* Two-way ANOVA

b. Diet and exercise program

c. 2

d. H_0: There is no interaction effect between the type of exercise program and the type of diet on a person's weight loss. H_1: There is an interaction effect between the type of exercise program and the type of diet on a person's weight loss.

H_0: There is no difference in the means of the weight losses of people in the exercise programs. H_1: There is a difference in the means of the weight losses of people in the exercise programs.

H_0: There is no difference in the means of the weight losses of people in the diet programs. H_1: There is a difference in the means of the weight losses of people in the diet programs.

e. Diet: $F = 21.0$, significant; exercise program: $F = 0.429$, not significant; interaction: $F = 0.429$, not significant

f. Reject the null hypothesis for the diets.

Chapter 13

Exercises 13–1

1. *Nonparametric* means hypotheses other than those using population parameters can be tested; *distribution-free* means no assumptions about the population distributions have to be satisfied.

3. Nonparametric methods have the following advantages:

a. They can be used to test population parameters when the variable is not normally distributed.

b. They can be used when data are nominal or ordinal.

c. They can be used to test hypotheses other than those involving population parameters.

d. The computations are easier in some cases than the computations of the parametric counterparts.

e. They are easier to understand.

The disadvantages are as follows:

a. They are less sensitive than their parametric counterparts.

b. They tend to use less information than their parametric counterparts.

c. They are less efficient than their parametric counterparts.

5.

Data	22	32	34	43	43	65	66	71
Rank	1	2	3	4.5	4.5	6	7	8

7.

Data	3.2	5.9	10.3	11.1	19.4	21.8	23.1
Rank	1	2	3	4	5	6	7

9.

Data	11	28	36	41	47	50	50	50	52	71	71	88
Rank	1	2	3	4	5	7	7	7	9	10.5	10.5	12

Exercises 13–2

1. The sign test uses only positive or negative signs.

3. The smaller number of positive or negative signs

5. H_0: median = 27.6 years and H_1: median $\neq$ 27.6 years (claim); test value = 5; C.V. = 3; do not reject. There is insufficient evidence to support the claim that the median is not 27.6 years.

7. H_0: median = 25 (claim) and H_1: median $\neq$ 25; test value = 7; C.V. = 4; do not reject. There is not enough evidence to reject the claim that the median is 25. School boards could use the median to plan for the costs of cyber school enrollments.

9. H_0: median = \$10.86 (claim) and H_1: median $\neq$ \$10.86; C.V. = ± 1.96; $z = -0.77$; do not reject. There is not enough evidence to reject the claim that the median is \$10.86. Home buyers could estimate the yearly cost of their gas bills.

11. H_0: the median number of faculty = 150 and H_1: the median $\neq$ 150; C.V. = ± 1.96; $z = -2.70$; reject. There is sufficient evidence at the 0.05 level of significance to reject the claim that the median number of faculty is 150.

13. H_0: median = 50 (claim) and H_1: median $\neq$ 50; $z = -2.3$; P-value = 0.0214; reject. There is enough evidence to reject the claim that 50% of the students are against extending the school year.

15. H_0: the medication has no effect on weight loss and H_1: the medication affects weight loss (claim); C.V. = 0; test value = 1; do not reject. There is not enough evidence to support the claim that the medication affects weight loss.

17. H_0: there is no difference in the test scores and H_1: there is an increase in the test scores (i.e., the program is effective) (claim); test value = 2; C.V. = 0; do not reject. There is insufficient evidence to support the claim that the program is effective.

19. H_0: the number of viewers is the same as last year (claim) and H_1: the number of viewers is not the same as last year; C.V. = 0; test value = 2; do not reject. There is not enough evidence to reject the claim that the number of viewers is the same as last year.

21. $6 \leq \text{median} \leq 22$

23. $4.7 \leq \text{median} \leq 9.3$

25. $17 \leq \text{median} \leq 33$

Exercises 13–3

1. n_1 and n_2 are each greater than or equal to 10.

3. The standard normal distribution

5. H_0: there is no difference in the test scores and H_1: there is a difference in the test scores (claim); C.V. $= \pm 1.96$; $z = -1.215$; do not reject. There is not enough evidence to support the claim that there is a difference in the test scores.

7. H_0: there is no difference between the stopping distances of the two types of automobiles (claim) and H_1: there is a difference between the stopping distances of the two types of automobiles; C.V. $= \pm 1.65$; $z = -2.72$; reject. There is not enough evidence to reject the claim that there is no difference in the stopping distances of the automobiles. In this case, midsize cars have a smaller stopping distance.

9. H_0: there is no difference in the number of hunting accidents in the two geographic areas and H_1: there is a difference in the number of hunting accidents (claim); C.V. $= \pm 1.96$; $z = 2.57$; reject. There is enough evidence to support the claim that there is a difference in the number of accidents in the two areas. The number of accidents may be related to the number of hunters in the areas.

11. H_0: there is no difference in the pain relief times of the drugs and H_1: there is a difference in the pain relief times of the drugs (claim); C.V. $= \pm 1.96$; $z = 2.91$; reject. There is enough evidence to support the claim that there is a difference in the pain relief times of the drugs.

Exercises 13–4

1. The t test for dependent samples

3. Sum of minus ranks is -6; sum of plus ranks is $+15$. The test value is 6.

5. C.V. $= 20$; reject

7. C.V. $= 102$; reject

9. H_0: the human dose is equal to the animal dose and H_1: the human dose is more than the animal dose (claim); C.V. $= 6$; $w_s = 2$; reject. There is enough evidence to support the claim that the human dose costs more than the equivalent animal dose. One reason is that some people might not be inclined to pay a lot of money for their pets' medication.

11. H_0: there is no difference in the weights of the subjects and H_1: there is a difference in the weights of the subjects (claim); C.V. $= 4$; $w_s = 5$; do not reject. There is insufficient evidence to support the claim that the weights have changed.

13. H_0: the prices of prescription drugs in the United States are equal to the prices in Canada and H_1: the drugs sold in Canada are cheaper; C.V. $= 11$; $w_s = 3$; reject. There is enough evidence to support the claim that the drugs are less expensive in Canada.

Exercises 13–5

1. H_0: there is no difference in the number of calories and H_1: there is a difference in the number of calories (claim); C.V. $= 7.815$; $H = 2.842$; do not reject. There is not enough evidence to support the claim that there is a difference in the number of calories.

3. H_0: there is no difference in the prices of the three types of lawnmowers and H_1: there is a difference in the prices of the three types of lawnmowers (claim); C.V. $= 4.605$; $H = 1.07$; do not reject. There is not enough evidence to support the claim that the prices are different. No, price is not a factor. Results are suspect since one sample is less than 5.

5. H_0: there is no difference in the amounts of the benefits for the areas and H_1: there is a difference in the amount of the benefits for the areas (claim); C.V. $= 5.991$; $H = 12.43$; reject. There is significant evidence to support the claim that there is a difference in the amount of the benefits for the areas. The benefits are probably not normally distributed.

7. H_0: there is no difference in spending between regions and H_1: there is a difference in spending between regions; $H = 0.74$; C.V. $= 5.991$; do not reject. There is insufficient evidence to conclude a difference in spending.

9. H_0: there is no difference in the number of crimes in the five precincts and H_1: there is a difference in the number of crimes in the five precincts (claim); C.V. $= 13.277$; $H = 20.753$; reject. There is enough evidence to support the claim that there is a difference in the number of crimes in the five precincts.

11. H_0: there is no difference in speeds and H_1: there is a difference in speeds; $H = 3.815$; C.V. $= 5.991$; do not reject. There is insufficient evidence to conclude a difference in speeds.

Exercises 13–6

1. 0.716

3. 0.648

5. $r_s = 0.929$; H_0: $\rho = 0$ and H_1: $\rho \neq 0$; C.V. $= \pm 0.786$; reject. There is enough evidence to say that there is a relationship between the grade 4 achievement tests and the grade 8 achievement tests.

7. $r_s = 0.817$; H_0: $\rho = 0$ and H_1: $\rho \neq 0$; C.V. $= \pm 0.700$; reject. There is a significant relationship between the number of new releases and the gross receipts.

9. $r_s = 0.048$; H_0: $\rho = 0$ and H_1: $\rho \neq 0$; C.V. $= \pm 0.738$; do not reject. There is not enough evidence to say that a significant correlation exists between calories and the cholesterol amounts in fast-food sandwiches.

11. $r_s = 0.624$; H_0: $\rho = 0$ and H_1: $\rho \neq 0$; C.V. $= \pm 0.700$; do not reject. There is no significant relationship between gasoline prices paid to the car rental agency and regular gasoline prices. One would wonder how the car rental agencies determine their prices.

13. $r_s = -0.10$; H_0: $\rho = 0$ and H_1: $\rho \neq 0$; C.V. $= \pm 0.900$; do not reject. There is no significant relationship between the number of cyber school students and the cost per pupil. In this case, the cost per pupil is different in each district.

15. H_0: the number of cavities in a person occurs at random and H_1: the null hypothesis is not true. There are 21 runs; the expected number of runs is between 10 and 22. Therefore, do not reject the null hypothesis; the number of cavities in a person occurs at random.

17. H_0: the purchases of soft drinks occur at random and H_1: the null hypothesis is not true. There are 16 runs, and the expected number of runs is between 9 and 22, so do not reject the null hypothesis. Hence the purchases of soft drinks occur at random.

19. H_0: the seating occurs at random and H_1: the null hypothesis is not true. There are 14 runs. Since the expected number of runs is between 10 and 23, do not reject. The seating occurs at random.

21. H_0: the number of absences of employees occurs at random over a 30-day period and H_1: the null hypothesis is not true. There are only 6 runs, and this value does not fall within the 9-to-21 range. Hence, the null hypothesis is rejected; the absences do not occur at random.

23. Answers will vary.

25. ± 0.479

27. ± 0.215

Review Exercises

1. H_0: median $= 36$ years and H_1: median $\neq 36$ years; $z = -0.548$; C.V. $= \pm 1.96$; do not reject. There is insufficient evidence to conclude that the median differs from 36.

3. H_0: there is no difference in prices and H_1: there is a difference in prices; test value $= 1$; C.V. $= 0$; do not reject. There is insufficient evidence to conclude a difference in prices. Comments: Examine what affects the result of this test.

5. H_0: there is no difference in the hours worked and H_1: there is a difference in the hours worked; $R = 85$; $\mu_R = 110$; $\sigma_R = 14.2009$; $z = -1.76$; C.V. $= \pm 1.645$; reject. There is sufficient evidence to conclude a difference in the hours worked. C.V. $= \pm 1.96$; do not reject.

7. H_0: there is no difference in the amount spent and H_1: there is a difference in the amount spent; $w_s = 1$; C.V. $= 2$; reject. There is sufficient evidence of a difference in amount spent at the 0.05 level of significance.

9. H_0: there is no difference in beach temperatures and H_1: there is a difference in temperatures; $H = 15.524$; C.V. $= 7.815$; reject. There is sufficient evidence to conclude a difference in beach temperatures. (Without the Southern Pacific: $H = 3.661$; C.V. $= 5.991$; do not reject.)

11. $r_s = 0.891$; H_0: $\rho = 0$ and H_1: $\rho \neq 0$; C.V. $= \pm 0.648$; reject. There is a significant relationship in the average number of people who are watching the television shows for both years.

13. H_0: the grades of students who finish the exam occur at random and H_1: the null hypothesis is not true. Since there are 8 runs and this value does not fall in the 9-to-21 interval, the null hypothesis is rejected. The grades do not occur at random.

Chapter Quiz

1. False **2.** False

3. True **4.** True

5. *a* **6.** *c*

7. *d* **8.** *b*

9. Nonparametric **10.** Nominal, ordinal

11. Sign **12.** Sensitive

13. H_0: median $= \$177{,}500$; H_1: median $\neq \$177{,}500$ (claim); C.V. $= 2$; test value $= 3$; do not reject. There is not enough evidence to say that the median is not $177,500.

14. H_0: median $= 1200$ (claim) and H_1: median $\neq 1200$. There are 10 minus signs. Do not reject since 10 is greater than the critical value 6. There is not enough evidence to reject the claim that the median is 1200.

15. H_0: there will be no change in the weight of the turkeys after the special diet and H_1: the turkeys will weigh more after the special diet (claim). There is 1 plus sign; hence, the null hypothesis is rejected. There is enough evidence to support the claim that the turkeys gained weight on the special diet.

16. H_0: there is no difference in the amounts of money received by the teams and H_1: there is a difference in the amounts of money each team received; C.V. $= \pm 1.96$; $z = -0.79$; do not reject. There is not enough evidence to say that the amounts differ.

17. H_0: the distributions are the same and H_1: the distributions are different (claim); $z = -0.14434$; C.V. $= \pm 1.65$; do not reject the null hypothesis. There is not enough evidence to support the claim that the distributions are different.

18. H_0: there is no difference in the GPA of the students before and after the workshop and H_1: there is a difference in the GPA of the students before and after the workshop (claim); test statistic $= 0$; C.V. $= 2$; reject the null hypothesis. There is enough evidence to support the claim that there is a difference in the GPAs of the students.

19. H_0: there is no difference in the amounts of sodium in the three sandwiches and H_1: there is a difference in the amounts of sodium in the sandwiches; C.V. = 5.991; $H = 11.795$; reject. There is enough evidence to conclude that there is a difference in the amounts of sodium in the sandwiches.

20. H_0: there is no difference in the reaction times of the monkeys and H_1: there is a difference in the reaction times of the monkeys (claim); $H = 6.9$; $0.025 < P\text{-value} < 0.05$ (0.032); reject the null hypothesis. There is enough evidence to support the claim that there is a difference in the reaction times of the monkeys.

21. $r_s = 0.683$; H_0: $\rho = 0$ and H_1: $\rho \neq 0$; C.V. = ± 0.600; reject. There is enough evidence to say that there is a significant relationship between the drug prices.

22. $r_s = 0.943$; H_0: $\rho = 0$ and H_1: $\rho \neq 0$; C.V. = ± 0.829; reject. There is a significant relationship between the amount of money spent on Head Start and the number of students enrolled in the program.

23. H_0: the births of babies occur at random according to gender and H_1: the null hypothesis is not true. There are 10 runs, and since this is between 8 and 19, the null hypothesis is not rejected. There is not enough evidence to reject the null hypothesis that the gender occurs at random.

24. H_0: there is no difference in the rpm of the motors before and after the reconditioning and H_1: there is a difference in the rpm of the motors before and after the reconditioning (claim); test statistic = 0; C.V. = 6; do not reject the null hypothesis. There is not enough evidence to support the claim that there is a difference in the rpm of the motors before and after reconditioning.

25. H_0: the numbers occur at random and H_1: the null hypothesis is not true. There are 16 runs, and since this is between 9 and 21, the null hypothesis is not rejected. There is not enough evidence to reject the null hypothesis that the numbers occur at random.

Chapter 14

Exercises 14–1

1. Random, systematic, stratified, cluster

3. A sample must be randomly selected.

5. Talking to people on the street, calling people on the phone, and asking your friends are three incorrect ways of obtaining a sample.

7. Random sampling has the advantage that each unit of the population has an equal chance of being selected. One disadvantage is that the units of the population must be numbered; if the population is large, this could be somewhat time-consuming.

9. An advantage of stratified sampling is that it ensures representation for the groups used in stratification; however, it is virtually impossible to stratify the population so that all groups are represented.

11–20. Answers will vary.

Exercises 14–2

1. Flaw—biased; it's confusing.

3. Flaw—the question is too broad.

5. Flaw—confusing words. How many hours did you study for this exam?

7. Flaw—confusing words. If a plane were to crash on the border of New York and New Jersey, where should the victims be buried?

9. Answers will vary.

Exercises 14–3

1. Simulation involves setting up probability experiments that mimic the behavior of real-life events.

3. John Von Neumann and Stanislaw Ulam

5. The steps are as follows:

a. List all possible outcomes.

b. Determine the probability of each outcome.

c. Set up a correspondence between the outcomes and the random numbers.

d. Conduct the experiment by using random numbers.

e. Repeat the experiment and tally the outcomes.

f. Compute any statistics and state the conclusions.

7. When the repetitions increase, there is a higher probability that the simulation will yield more precise answers.

9. Use three-digit random numbers; numbers 001 through 681 mean that the mother is in the labor force.

11. Select 100 two-digit random numbers. Numbers 00 to 34 mean the household has at least one set with premium cable service. Numbers 35 to 99 mean the household does not have the service.

13. Let an odd number represent heads and an even number represent tails. Then each person selects a digit at random.

14–24. Answers will vary.

Review Exercises

1–8. Answers will vary.

9. Use one-digit random numbers 1 through 4 for a strikeout and 5 through 9 and 0 represent anything other than a strikeout.

11. In this case, a one-digit random number is selected. Numbers 1 through 6 represent the numbers on the face. Ignore 7, 8, 9, and 0 and select another number.

13. Let the digits 1 through 3 represent rock, let 4 through 6 represent paper, let 7 through 9 represent scissors, and omit 0.

14–18. Answers will vary.

19. Flaw—asking a biased question. Have you ever driven through a red light?

21. Flaw—asking a double-barreled question. Do you think all automobiles should have heavy-duty bumpers?

Chapter Quiz

1. True
2. True
3. False
4. True
5. *a*
6. *c*
7. *c*
8. Larger
9. Biased
10. Cluster

11–14. Answers will vary.

15. Use two-digit random numbers: 01 through 45 means the player wins. Any other two-digit random number means the player loses.

16. Use two-digit random numbers: 01 through 05 means a cancellation. Any other two-digit random number means the person shows up.

17. The random numbers 01 through 10 represent the 10 cards in hearts. The random numbers 11 through 20 represent the 10 cards in diamonds. The random numbers 21 through 30 represent the 10 spades, and 31 through 40 represent the 10 clubs. Any number over 40 is ignored.

18. Use two-digit random numbers to represent the spots on the face of the dice. Ignore any two-digit random numbers with 7, 8, 9, or 0. For cards, use two-digit random numbers between 01 and 13.

19. Use two-digit random numbers. The first digit represents the first player, and the second digit represents the second player. If both numbers are odd or even, player 1 wins. If a digit is odd and the other digit is even, player 2 wins.

20–24. Answers will vary.

Appendix A

A–1. 362,880

A–3. 120

A–5. 1

A–7. 1320

A–9. 20

A–11. 126

A–13. 70

A–15. 1

A–17. 560

A–19. 2520

A–21. 121; 2181; 14,641; 716.9

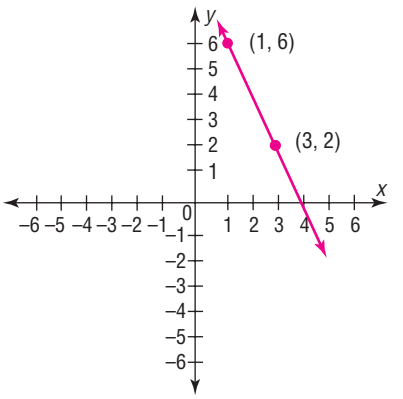
A–23. 32; 258; 1024; 53.2

A–25. 328; 22,678; 107,584; 1161.2

A–27. 693; 50,511; 480,249; 2486.1

A–29. 318; 20,150; 101,124; 3296

A–31.



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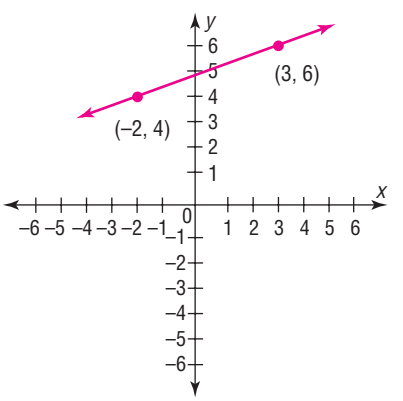

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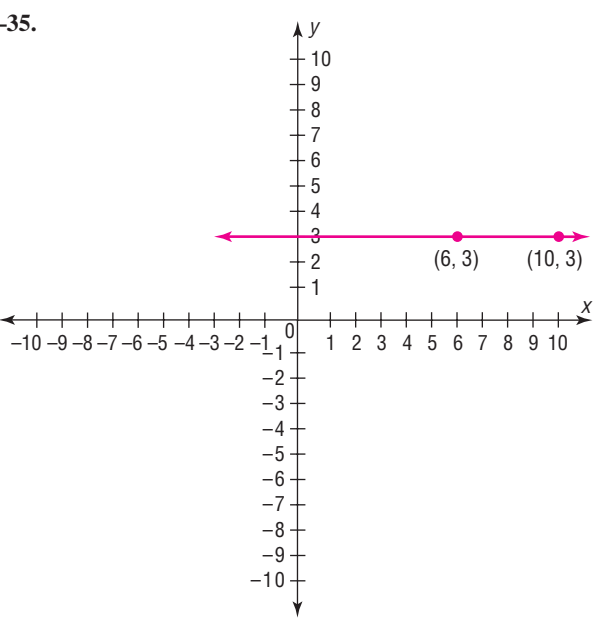

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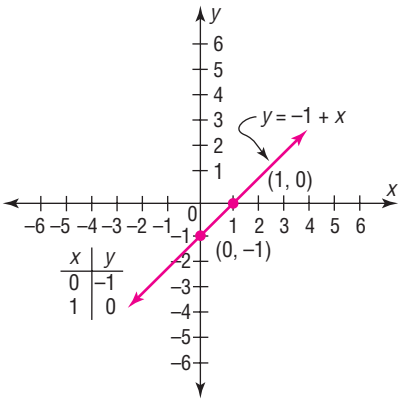

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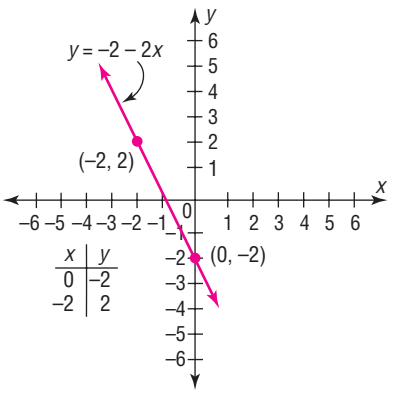

Appendix B–2

B–1. 0.65

B–3. 0.653

B–5. 0.379

B–7. $\frac{1}{4}$

B–9. 0.64

B–11. 0.857