Answer Key

Chapter 1

Section 1.1

1. P: All Americans; S: Readers who mail in their ballots

3. P: All shoppers at the large discount store; S: 100 shoppers chosen

5. P: All Energy Bolt soda cans; parameter

7. P: All Americans aged 18–25; S: 1045 adults surveyed; statistic

9. P: All 520 treated plants in the greenhouse; S: 60 plants measured; statistic

11. P: All children aged 10–12; S: 250 children surveyed; statistic

13. P: All registered voters in the state; S: 565 constituents surveyed; statistic

15. P: All residents of the Northeast; S: 984 households that returned surveys; statistic

17. Population: All coffee consumers; Sample: 6195 customers who complete the survey; Parameter: 77%; Statistics: 45%, 32%, and 23%

19. Descriptive

21. Descriptive

23. Inferential

25. a. All Americans who wish to be employed (includes those who have a job as well as those who do not)

b. Those who have given up looking for a job, those who are employed part-time but seek to be full-time, and so forth.

c. Meaningful comparisons can easily be made when data collection methods are the same. However, when data collection methods change, direct comparisons should not be made without adjustments for change in methods.

27. a. American drivers between the ages of 20 and 39

b. Possible answers: Use targeted survey ads on social media; survey current customers by mail, email or phone

Section 1.2

1. a. Quantitative

b. Discrete

c. Ratio

3. a. Quantitative

b. Continuous

c. Interval

5. a. Quantitative

b. Continuous

c. Ratio

7. a. Quantitative

b. Continuous

c. Ratio

9. a. Quantitative

b. Discrete

c. Ratio

11. a. Quantitative

b. Continuous

c. Ratio

13. a. Quantitative

b. Continuous

c. Ratio

15. a. Qualitative

b. Neither

c. Nominal

17. a. Qualitative

b. Neither

c. Ordinal

19. a. Qualitative

b. Neither

c. Ordinal

21. a. Quantitative

b. Discrete

c. Ratio

23. a. Quantitative

b. Discrete

c. Interval

25. a. Categorical

b. Measurement

c. T-shirt sizes can be ordered, but no numerical value is assigned to these values.

27. Discrete and continuous data both describe quantities being measured, thus by definition, they cannot be qualitative.

Section 1.3

1. True; before collecting data, a researcher must first state the question to be answered in a statistical study.

3. False; if a researcher wishes to determine a cause-and-effect relationship, she should use an experimental study.

5. True; an Institutional Review Board (IRB) reviews the design of a study to ensure that no unnecessary harm will come to the subjects involved, so an IRB will require researchers to get the informed consent of participants.

7. False; participants in an experiment should be assigned to groups by researchers to ensure that similar characteristics are represented in both the treatment group and the control group.

9. Subject or participant

11. Treatment

13. Single-blind

15. Participant

17. Observational study

19. Observational study

21. Experiment

23. Cluster

25. Stratified

27. Convenience

29. Systematic

31. Simple random

33. Cross-sectional

35. Longitudinal

37. Cross-sectional

39. Case study

41. Case study

43. The population would be restricted from all adults at risk for heart attacks to just African-American women over the age of 50 who are at risk for heart attacks. No, this would not apply to an uncle regardless of his ethnicity because he is not a woman and therefore not part of the population of the study.

45. To get a sample with no errors, choose every 4th label and start with any label without an error. If you choose every 5th label, there will be labels with errors and without, but the sample may not be representative of the population. If you choose every 16th label, you will have the same situation as when choosing every 4th label since 16 is a multiple of 4.

Section 1.4

1. Processing error

3. Bias

5. Nonadherent

7. Variables: amount of rain, air quality level; Possible ways to measure air quality: temperature, humidity, visibility, dust levels, oxygen levels, nitrogen levels, ozone levels, particle pollution, pollen levels; Terms that need more precise definition: quality of air, more rain

9. Answers will vary. Group discussions could lead to students in varying fields of study taking the question to other forums for discussion. Nevertheless, instructors are encouraged to help students realize the difficult process of both defining and measuring such abstract and often controversial ideas.

11. Answers may include: self-selected sample; sample is only based on subscribers, not all Americans; non-Americans might be subscribers; subscription holders might have stronger opinions on celebrities than the general public

13. Answers may include: survey omits people not living in the largest cities; length of study might omit some programs

15. Answers should include a method of sampling the state's voters (not just a convenient area), possible survey questions, and evidence of avoiding potential biases.

Chapter 1 Exercises

1. a. Statistic

b. Inferential

3. a. Qualitative; ordinal

b. Quantitative; interval

c. Quantitative; ratio

5. No; yes

7. a. All shoppers

b. Convenience sampling

c. If the population is only the customers of that store, then it is representative.

9. The clusters are naturally the gas stations within a mile of rental car returns; randomly select a number of airports and survey all gas stations within that cluster.

11. a. Population: All adults; Study: Experiment

b. Answers should include a way to measure "optimal"; method for recruiting participants and how data will be collected.

13. a. Stratified

b. Possible answers: Sampling bias by only choosing large cities; participation bias; researcher bias due to the governor's staff conducting the study.

15. a. Americans over the age of 18.

b. 3297 adults surveyed

c. 73%

d. Possible answers: participation bias; nonresponse bias; sampling bias

Chapter 2

Section 2.1

1. a. 0.03

Class	b. Class Boundaries	c. Midpoint	d. Relative Frequency	e. Cumulative Frequency
0.05–0.07	0.045–0.075	0.06	$\frac{12}{70} \approx 17\%$	12
0.08–0.10	0.075–0.105	0.09	$\frac{15}{70} \approx 21\%$	27
0.11–0.13	0.105–0.135	0.12	$\frac{14}{70} = 20\%$	41
0.14–0.16	0.135–0.165	0.15	$\frac{15}{70} \approx 21\%$	56
0.17–0.19	0.165–0.195	0.18	$\frac{14}{70} = 20\%$	70

3. a. 4

Class	b. Class Boundaries	c. Midpoint	d. Relative Frequency	e. Cumulative Frequency
15–18	14.5–18.5	16.5	$\frac{2}{20} = 10\%$	2
19–22	18.5–22.5	20.5	$\frac{5}{20} = 25\%$	7
23–26	22.5–26.5	24.5	$\frac{4}{20} = 20\%$	11
27–30	26.5–30.5	28.5	$\frac{5}{20} = 25\%$	16
31–34	30.5–34.5	32.5	$\frac{4}{20} = 20\%$	20

5. a. 0.25

Class	b. Class Boundaries	c. Midpoint	d. Relative Frequency	e. Cumulative Frequency
0.25–0.49	0.245–0.495	0.37	$\frac{2}{43} \approx 5\%$	2
0.50–0.74	0.495–0.745	0.62	$\frac{15}{43} \approx 35\%$	17
0.75–0.99	0.745–0.995	0.87	$\frac{12}{43} \approx 28\%$	29
1.00–1.24	0.995–1.245	1.12	$\frac{5}{43} \approx 12\%$	34
1.25–1.49	1.245–1.495	1.37	$\frac{9}{43} \approx 21\%$	43

7. a. 7

Class	b. Class Boundaries	c. Midpoint	d. Relative Frequency	e. Cumulative Frequency
18–24	17.5–24.5	21	$\frac{2}{31} \approx 6\%$	2
25–31	24.5–31.5	28	$\frac{7}{31} \approx 23\%$	9
32–38	31.5–38.5	35	$\frac{4}{31} \approx 13\%$	13
39–45	38.5–45.5	42	$\frac{15}{31} \approx 48\%$	28
46–52	45.5–52.5	49	$\frac{3}{31} \approx 10\%$	31

9. a. 4

Class	b. Class Boundaries	c. Midpoint	d. Relative Frequency	e. Cumulative Frequency
16–19	15.5–19.5	17.5	$\frac{12}{56} \approx 21\%$	12
20–23	19.5–23.5	21.5	$\frac{8}{56} \approx 14\%$	20
24–27	23.5–27.5	25.5	$\frac{15}{56} \approx 27\%$	35
28–31	27.5–31.5	29.5	$\frac{12}{56} \approx 21\%$	47
32–35	31.5–35.5	33.5	$\frac{9}{56} \approx 16\%$	56

11.

Heights of Volunteers (in Inches)

Class	Frequency
69.0–69.9	3
70.0–70.9	4
71.0–71.9	5
72.0–72.9	9
73.0–73.9	3
74.0–74.9	3
75.0–75.9	3

13.

Number of Marbles in the Jar

Class	Frequency
1100–1199	1
1200–1299	3
1300–1399	4
1400–1499	4
1500–1599	4
1600–1699	4

15.

Class	f	Class Boundaries	Mid	Rel f	Cumulative f
15–19	1	14.5–19.5	17	$\frac{1}{16} \approx 6\%$	1
20–24	1	19.5–24.5	22	$\frac{1}{16} \approx 6\%$	2
25–29	5	24.5–29.5	27	$\frac{5}{16} \approx 31\%$	7
30–34	5	29.5–34.5	32	$\frac{5}{16} \approx 31\%$	12
35–39	2	34.5–39.5	37	$\frac{2}{16} \approx 13\%$	14
40–44	2	39.5–44.5	42	$\frac{2}{16} \approx 13\%$	16

17.

Class	f	Class Boundaries	Mid	Rel f	Cumulative f
1800–2199	1	1799.5–2199.5	1999.5	$\frac{1}{15} \approx 7\%$	1
2200–2599	4	2199.5–2599.5	2399.5	$\frac{4}{15} \approx 27\%$	5
2600–2999	6	2599.5–2999.5	2799.5	$\frac{6}{15} = 40\%$	11
3000–3399	3	2999.5–3399.5	3199.5	$\frac{3}{15} = 20\%$	14
3400–3799	1	3399.5–3799.5	3599.5	$\frac{1}{15} \approx 7\%$	15

19.

Class	f	Class Boundaries	Mid	Rel f	Cumulative f
0–4	7	–0.5–4.5	2	$\frac{7}{24} \approx 29\%$	7
5–9	6	4.5–9.5	7	$\frac{6}{24} = 25\%$	13
10–14	5	9.5–14.5	12	$\frac{5}{24} \approx 21\%$	18
15–19	3	14.5–19.5	17	$\frac{3}{24} \approx 13\%$	21
20–24	2	19.5–24.5	22	$\frac{2}{24} \approx 8\%$	23
25–29	1	24.5–29.5	27	$\frac{1}{24} \approx 4\%$	24

21. a. 27

b. 11–15 pounds

c. 14.8%

d. There is not enough information given to know this.

e. 16 pounds

f. 3 pounds

g. Answers will vary. Possible answer could be "Most People on Low Carb Diets Lose 11-15 Pounds."

23. a. $\frac{1}{3} \approx 33\%$

b. 16

c. 15.5

d. 3

e. $51.\overline{51}\%$

f. 33

g. The exact age is not known from this table; it could be 10, 11, or 12.

25. a. 936

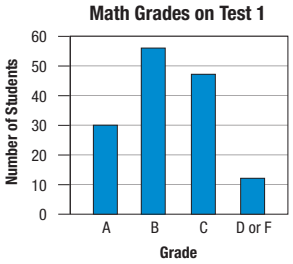
b. 0.4%

c. 50.9%

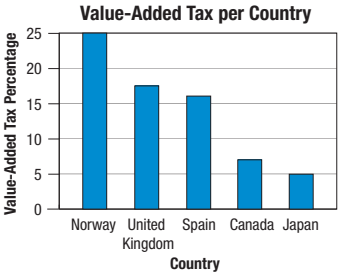
d. Answers will vary. 50% of the population is not white, with over 20% being Hispanic.

Section 2.2

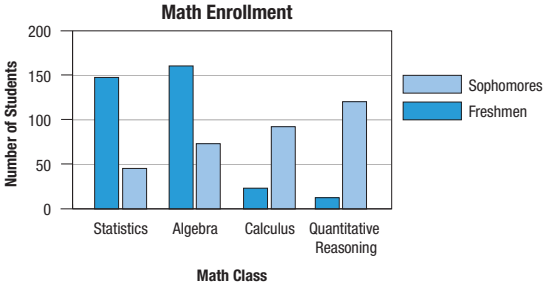
1. Bar graph



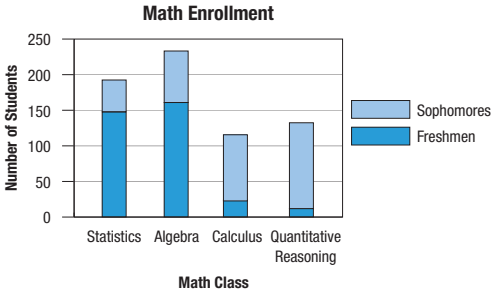
3. Pareto chart



5. Side-by-side bar graph



Stacked bar graph



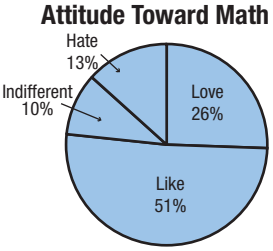
a. Algebra; stacked bar graph

b. Quantitative reasoning; side-by-side bar graph

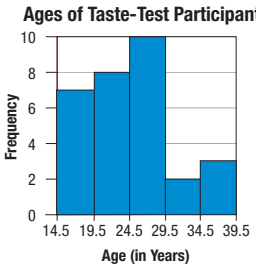
c. Algebra; side-by-side bar graph

d. Calculus; stacked bar graph

7.



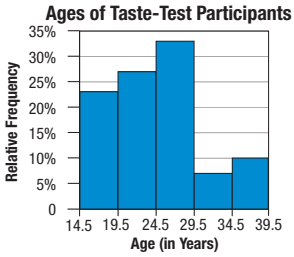
9. a.



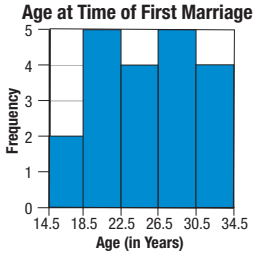
b.

Class	Relative Frequency
15–19	$\frac{7}{30} \approx 23\%$
20–24	$\frac{8}{30} \approx 27\%$
25–29	$\frac{10}{30} \approx 33\%$
30–34	$\frac{2}{30} \approx 7\%$
35–39	$\frac{3}{30} = 10\%$

c.



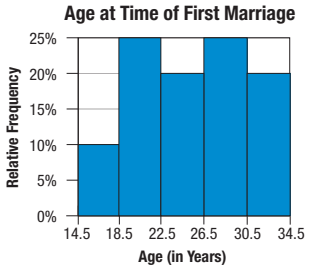
11. a.



b.

Class	Relative Frequency
15–18	$\frac{2}{20} = 10\%$
19–22	$\frac{5}{20} = 25\%$
23–26	$\frac{4}{20} = 20\%$
27–30	$\frac{5}{20} = 25\%$
31–34	$\frac{4}{20} = 20\%$

c.



13. Number of Sit-Ups in 60 Seconds for Children

Stem	Leaves
1	8
2	7 9 8 2 6 8
3	1 4 6 3 1 4 6
4	1 2

Key: 1 | 8 = 18

30-39

15. Time in Minutes for Teenagers to Complete a One Mile Run

Stem	Leaves
8	2
9	3 3 3 4 5 5 7
10	1 2 4 6 7 8 9
11	1 2 6 9
12	1 3 4 5 9

Key: 8 | 2 = 8.2

17. Saline Concentration (in Terms of Specific Gravity)

Stem	Leaves
101	7 8 9 9
102	0 1 1 1 2 2 2 2 2 3 3 3 4 5

Key: 101 | 7 = 1.017

19.

21. a. 26

b. 4.6 ounces

c. The average weight is closer to 5 ounces since more than half of the burgers weigh more than 4.5 ounces.

d. Yes; a quarter pound is exactly 4 ounces and every burger in the sample weighed more than 4 ounces.

23. a. College Algebra

b. Music Appreciation

c. Psychology I, as it has years that are gray and years that are orange.

d. 2014 and 2015

25. a. Housing

b. Cell phone

c. 36%

d. 23%

e. 20%

27. a. 12

b. 34

c. 18

d. 29

29. a. $N = 85$

b. Smallest: 1.82 mm; largest: 3.76 mm

c. 2.99 mm and 3.08 mm

d. Longer

31. Answers will vary. Encourage thoughtful answers that point out the difficulty of displaying the wide range of data points as well as the outliers, although students have yet to be introduced formally to the concepts of "range" and "outliers."

33. Line graph

35. Stacked or side-by-side bar graph

Section 2.3

1. Cross-sectional

3. Time-series

5. a. $11.7 - 6.1 = 5.6$; $\frac{5.6}{6.1} \approx 0.918$; an increase of approximately 92%

b. No. The scholarship fund nearly doubled, but the graphic for 2010 has an area considerably more than double that of the 2005 graphic.

c. Answers will vary.

7. Answers will vary. A possible answer is that the scale

in Graph A is more accurate since it covers 0% to 100%. According to Graph A, hospital satisfaction is very low despite small increases in the last few months. Graph B tends to imply a high level of satisfaction with a large recent increase; however, the scale is incorrect.

9. Answers will vary. Some possible answers are: The dots represent 1, 2, or 3 counts, which can be misleading; the number of counts should be standardized. The column on the right is not labeled. There is no key provided. There is no title. The graph is not really a stem-and-leaf plot; it is a dot plot. The dollar amounts in the left column are not labeled, so there is no way to know what they represent.

11. Uniform

13. Uniform

15. Skewed to the right

17. Symmetric

Chapter 2 Exercises

1.

Class	*f*	CB	Mid	Rel *f*	Cumul *f*
13.0 – 15.9	2	12.95 – 15.95	14.45	$\frac{2}{21}=0.095$	2
16.0 – 18.9	4	15.95 – 18.95	17.45	$\frac{4}{21}=0.190$	6
19.0 – 21.9	9	18.95 – 21.95	20.45	$\frac{9}{21}=0.429$	15
22.0 – 24.9	3	21.95 – 24.95	23.45	$\frac{3}{21}=0.143$	18
25.0 – 27.9	2	24.95 – 27.95	26.45	$\frac{2}{21}=0.095$	20
28.0 – 30.9	1	27.95 – 30.95	29.45	$\frac{1}{21}=0.048$	21

a. The 3rd class; 19.0-21.9

b. Yes, it is a reasonable statement because the cumulative frequency of the 3rd class contains more than half of the 21 schools.

c. Answers will vary.

3.

32	1 5
33	4
34	5
35	4
36	3
37	1
38	9 0
39	7 7 8 7 7 2
40	
41	3

Key: 41 | 3 = 4.13 million or 4,130,000

5. Line graph

7. Stacked or side-by-side bar graph

9. 11/108 ≈ 10.2%

11. 299.995

13. 23.1%

15. $299.99 because the cumulative frequency of this class (55) is more than half of her total sales for the month.

17. a. Europe

b. Africa

c. 18.3%

d. 73.7%

19. a. California, New York, Wisconsin

b. fewer than 50

c. 14,217

d. More states are colored orange, thus between 100 and 499 organic farms.

21. a. Nonresident Alien

b. Doctorates

c. No, because it only provides the percentage of total degrees for each race, not actual counts.

Chapter 3

Section 3.1

1. Mean = 5; Median = 4.5; Unimodal at 1

3. Mean = 5; Median = 5; No mode

5. Mean ≈ 4.883; Median = 4.9; No mode

7. Mean ≈ –17.9; Median = –42; Unimodal at –42

9. Mean = \$40.71; Median = \$16.00; No mode

11. Mean ≈ 16.56 Tweets; Median = 14.9 Tweets; Unimodal at 14.9 Tweets

13. Mean = 87.5 °F; Median = 88.5 °F; Multimodal at 85 °F, 88 °F, 89 °F, 90 °F, 91 °F, and 92 °F

15. \$2.37

17. 3.02

19. \$2068.836 ≈ \$2068.84 (rounded for currency)

21. 81.6

23. 79.2

25. \$10.201 ≈ \$10.20 (rounded for currency)

27. Mode

29. Mean

31. Mode = B

33. Mean = B; Median = B; Mode = B

35. Since the mean is much smaller than the median and the mode, the distribution is probably skewed to the left.

Section 3.2

1. Range = 5; $\sigma \approx 1.9$; $\sigma^2 \approx 3.7$

3. Range = 0; $\sigma \approx 0$; $\sigma^2 \approx 0$

5. Range = 8; $\sigma \approx 2.4$; $\sigma^2 \approx 5.7$

7. Range = 5; $s \approx 2.1$; $s^2 = 4.3$

9. Range = 0; $s = 0$; $s^2 = 0$

11. Range = 1.5; $s \approx 0.47$; $s^2 \approx 0.22$;

13. 1.14 pounds

15. 4.7 °F

17. False; if the standard deviation is zero, then all of the data values are equal to **the mean**.

19. False; since the standard deviation is an average *distance* and is defined as a square root, it **cannot be negative**.

21. A: CV ≈ 20.7%; B: CV ≈ 35.3%; Larger spread: B

23. A: CV ≈ 3.4%; B: CV ≈ 21.3%; Smaller spread: A

25. 68%

27. 84%

29. 84%

31. 88.9%

33. 75%

35. 8.4 points

37. 70.6 points

Section 3.3

1. **a.** 7.4 pounds

b. 73rd

3. **a.** 6.55 Tweets per day

b. 44th

5. **a.** 148.5 pounds

b. 67th

7. 140.5 mmHg

9. 38 years

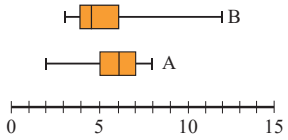
11. 6450, 11,201, 14,788, 15,692.5, 18,865

13. 1.2, 1.6, 1.75, 2.8, 4.1

15. 5.4, 7.15, 8.4, 9.2, 10.1

17. –12, –10, –5, 1, 4

19.

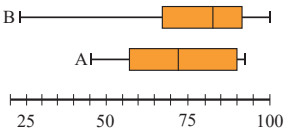


a. A

b. A

c. Neither; both data sets have IQR = 2

21.



a. B

b. B

c. A

23. **a.** 2.5

b. 9.0 knots

25. 0.67

27. –3.00

29. ACT

31. Charity tournament

33. c. 1.7

35. b. 0

Chapter 3 Exercises

1. $10.92

3. **a.** False

b. True

5. 83

7. True

9. At least 88.9%

11. $s \approx \$17.710 \approx \$17.71$ (rounded for currency); $s^2 \approx 313.655$

13. 15.0

15. Yes, because if you put them back in numerical order from smallest to largest, you get the five-number summary, 8, 12.5, 14, 17.5, 21, so the first quartile is 12.5.

Chapter 4

Section 4.1

1. {HH, HT, TH, TT}

3. T-shirt and jeans, T-shirt and slacks, button-down and jeans, button-down and slacks, sweater and jeans, sweater and slacks.

5. {RSunL, RSunC, RNoL, RNoC, BSunL, BSunC, BNoL, BNoC, SSunL, SSunC, SNoL, SNoC}

7. {1A, 1N, 2A, 2N, 3A, 3N}

9. Experimental

11. Classical

13. Subjective

15. **a.** $\frac{17}{107} \approx 0.1589$

b. $\frac{38}{107} \approx 0.3551$

c. $\frac{23+38}{107} = \frac{52}{107} \approx 0.4860$

17. $\frac{3}{17} \approx 0.1765$

19. $\frac{5}{10} = \frac{1}{2} = 0.5$

21. $\frac{6}{22} = \frac{3}{11} \approx 0.2727$

23. $\frac{5}{27} \approx 0.1852$

25. $\frac{1}{26} \approx 0.0385$

27. $\frac{21}{36} = \frac{7}{12} \approx 0.5833$

Section 4.2

1. Complement: The 211 apple trees that are not ready for harvesting

3. Complement: The 17 players who are not left-handed

5. Complement: The 30% of viewers who are 30 years old or younger

7. 98% or 0.98

9. $\frac{5}{6} \approx 0.8333$

11. Not mutually exclusive

13. Not mutually exclusive

15. Mutually exclusive

17. $\frac{4}{15} + \frac{11}{15} - \frac{2}{15} = \frac{13}{15} \approx 0.8667$

19. $\frac{125}{200+100+125+200} + \frac{100}{200+100+125+200} = \frac{9}{25} = 0.36$

21. $1 - \frac{3}{36} = \frac{33}{36} = \frac{11}{12} \approx 0.9167$

23. $\frac{9}{36} + \frac{18}{36} = \frac{3}{4} = 0.75$ or $1 - \frac{9}{36} = \frac{3}{4} = 0.75$

25. $\frac{3}{14} + \frac{11}{14} - \frac{1}{14} = \frac{13}{14} \approx 0.9286$

27. $\left(1 - \frac{12}{20}\right) + \left(1 - \frac{13}{20}\right) - \frac{4}{20} = \frac{11}{20} = 0.55$

Section 4.3

1. Independent

3. Dependent

5. Independent

7. $\frac{1}{4}\cdot\frac{1}{4}\cdot\frac{1}{4}=\frac{1}{64}\approx 0.0156$

9. $\frac{1}{15}\cdot\frac{1}{14}=\frac{1}{210}\approx 0.0048$

11. $(1-0.15)^5\approx 0.4437$

13. $0.85\cdot\frac{4}{5}=0.68$

15. $\frac{4}{8}=0.5$

17. $\frac{1}{3}\approx 0.3333$

19. a. $\frac{4}{4+5}=\frac{4}{9}\approx 0.4444$

b. $\frac{2}{13+5+2+3}=\frac{2}{23}\approx 0.0870$

c. $\frac{2}{4+2}=\frac{1}{3}\approx 0.3333$

21. $\frac{16}{26+19+11+16}\cdot\frac{19}{26+19+11+16-1}=\frac{38}{639}\approx 0.0595$

23. a. $\frac{5}{3768}\cdot\frac{4}{3767}\approx 0.000001$

b. $\frac{2001}{3768}\cdot\frac{1762}{3767}\approx 0.2484$

25. $10\cdot 10\cdot 10\cdot 10\cdot 10=100{,}000$

27. $3\cdot 3\cdot 4\cdot 3\cdot 2\cdot 1=216$

29. $10\cdot 10\cdot 10\cdot 10\cdot 10\cdot 5=500{,}000$

31. $\frac{1}{6\cdot 9\cdot 9}=\frac{1}{486}\approx 0.0021$

33.

Section 4.4

1. 720

3. 30

5. 15

7. 15

9. 1

11. 10

13. 1

15. 12

17. 60

19. 8

21. 1

23. 56

25. $\frac{n!}{n!(n-n)!}=1$

27. $\frac{n!}{(n-1)!}=n$

29. $\frac{n!}{[n-(n-1)]!}=n!$

31. ${}_9C_3=84$

33. ${}_{12}P_2=132$

35. ${}_{18}C_4=3060$

37. ${}_8P_3=336$

39. ${}_{15}C_{10}=3003$

41. ${}_{12}C_4=495$

43. ${}_{15}P_4=32{,}760$

45. $\frac{11!}{1!\,1!\,1!\,2!\,1!\,2!\,1!\,1!\,1!}=9{,}979{,}200$

47. a. $\frac{7!}{3!\,1!\,2!\,1!}=420$;
No, he will be 89 codes short.

b. $\frac{10!}{4!\,2!\,1!\,1!\,2!}=37{,}800$;
Yes, there would be plenty!

49. $\frac{5\cdot 5\cdot 5\cdot 5\cdot 5}{10\cdot 10\cdot 10\cdot 10\cdot 10}=\frac{3125}{100{,}000}=\frac{1}{32}\approx 0.0313$

51. $\frac{1}{{}_{24}C_2}=\frac{1}{276}\approx 0.0036$

53. $\frac{1}{{}_{26}P_3}=\frac{1}{15{,}600}\approx 0.00006$

Section 4.5

1. a. $4 \cdot 25 \cdot 24 \cdot 10 \cdot 9 \cdot 8 = 1,728,000$

b. $\dfrac{1 \cdot 25 \cdot 24 \cdot 10 \cdot 9 \cdot 8}{4 \cdot 25 \cdot 24 \cdot 10 \cdot 9 \cdot 8} = \dfrac{1}{4} = 0.25$

3. a. $5 \cdot 4 \cdot 8 \cdot 7 = 1120$

b. $\dfrac{1 \cdot 4 \cdot 8 \cdot 7}{5 \cdot 4 \cdot 8 \cdot 7} = \dfrac{1}{5} = 0.2$

5. a. ${}_{13}C_2 \cdot {}_{19}C_4 = 302,328$

b. $\dfrac{1}{302,328} \approx 0.0000033$

7. $5 \cdot {}_{10}C_6 \cdot {}_6C_2 = 15,750$

9. a. ${}_{20}C_2 \cdot {}_8C_3 \cdot {}_5C_2 = 106,400$

b. $\dfrac{{}_1C_1 \cdot {}_{19}C_1 \cdot {}_8C_3 \cdot {}_5C_2}{{}_{20}C_2 \cdot {}_8C_3 \cdot {}_5C_2} + \dfrac{{}_1C_1 \cdot {}_{19}C_1 \cdot {}_8C_3 \cdot {}_5C_2}{{}_{20}C_2 \cdot {}_8C_3 \cdot {}_5C_2}$
$- \dfrac{1 \cdot {}_8C_3 \cdot {}_5C_2}{{}_{20}C_2 \cdot {}_8C_3 \cdot {}_5C_2} = \dfrac{{}_1C_1 \cdot {}_{19}C_1 + {}_1C_1 \cdot {}_{19}C_1 - 1}{{}_{20}C_2}$
$= \dfrac{37}{190} \approx 0.1947$

11. ${}_7C_7 \cdot {}_{(6+6+8)}C_4 = 4845$

13. a. ${}_{41}C_4 \cdot {}_{104}C_4 \cdot {}_8C_4 \cdot {}_{12}P_{12}$
$= 15,613,371,090,319,242,240,000 \approx 1.56 \times 10^{22}$

b. $\dfrac{{}_{41}C_{12}}{{}_{(41+104+8)}C_{12}} = \dfrac{7,898,654,920}{220,667,975,965,944,780}$
$= \dfrac{2542}{71,016,901,053} \approx 3.58 \cdot 10^{-8} \approx 0.00000004$

Chapter 4 Exercises

1. ${}_{12}C_5 = 792$

3. ${}_6C_2 \cdot {}_5C_2 \cdot {}_7C_2 = 3150$

5. a. $7 \cdot 10 \cdot 10 \cdot 5 = 3500$

b. $6 \cdot 10 \cdot 10 \cdot 5 - 1 = 2999$

c. $5 \cdot 10 \cdot 10 \cdot 5 = 2500$

7. ${}_{10}C_4 = 210$

9. $({}_{12}C_3 \cdot {}_4C_1) \cdot ({}_9C_3 \cdot {}_3C_1) \cdot ({}_6C_3 \cdot {}_2C_1) \cdot ({}_3C_3 \cdot {}_1C_1)$
$= 8,870,400$

11. $1 - (0.56 + 0.46 - 0.39) = 0.37$ or 37%

13. $\dfrac{1}{1319} \approx 0.0008$

15. $1 - [(1 - 0.47) + (1 - 0.56) - 0.23] = 0.26$ or 26%

17. $\dfrac{2}{\frac{10!}{5!5!}} = \dfrac{2}{252} = \dfrac{1}{126} \approx 0.0079$

19. $\dfrac{1}{{}_4C_0 + {}_4C_1 + {}_4C_2 + {}_4C_3 + {}_4C_4} = \dfrac{1}{16} = 0.0625$

21. $1 - \dfrac{1}{{}_{52}C_4} = \dfrac{270,724}{270,725} \approx 0.999996 \approx 1.0000$

23. $\dfrac{(10 \cdot 10 \cdot 5) + (3 \cdot 10 \cdot 10) - (3 \cdot 10 \cdot 5)}{10 \cdot 10 \cdot 10} = \dfrac{650}{1000} = \dfrac{13}{20} = 0.65$

25. $\dfrac{1}{28} \cdot \dfrac{1}{28} \approx 0.0013$

Chapter 5

Section 5.1

1. Valid

3. Not valid; $P(X = x)$ cannot have a negative value.

5.

x	$P(X = x)$
0	$\frac{1}{16} = 0.0625$
1	$\frac{4}{16} = \frac{1}{4} = 0.25$
2	$\frac{6}{16} = \frac{3}{8} = 0.375$
3	$\frac{4}{16} = \frac{1}{4} = 0.25$
4	$\frac{1}{16} = 0.0625$

7.

x	$P(X = x)$
0	$\frac{6}{36} = \frac{1}{6}$
1	$\frac{10}{36} = \frac{5}{18}$
2	$\frac{8}{36} = \frac{2}{9}$
3	$\frac{6}{36} = \frac{1}{6}$
4	$\frac{4}{36} = \frac{1}{9}$
5	$\frac{2}{36} = \frac{1}{18}$

9. $\mu = E(X) = 17.8$; $\sigma \approx 3.4$

11. $\mu = E(X) = 12.2$; $\sigma \approx 9.80$

13. a. –\$10

b. –\$150

c. \$2,105,900

15. a. \$43.20

b. \$432,000

17. a. –\$1.20

b. –\$12.00

19. a. $\frac{175}{6} \approx \$29.17$

b. \$21,000

21. a. \$516.97

b. \$389.02

c. The standard deviations of textbook costs for liberal arts majors and business majors are \$153.68 and \$9.06, respectively. Business majors are more likely to feel that their textbooks are priced fairly since the expected value and standard deviation of their textbook costs are both lower than the expected value and standard deviation, respectively, of textbook costs for liberal arts majors. The low standard deviation of textbook costs for business majors means that regardless of their specific majors, students in the College of Business pay roughly the same amount for textbooks. Whereas, the high standard deviation of costs for liberal arts majors means that their textbook costs are much more variable.

Section 5.2

1. No; more than two possible outcomes for each trial, no fixed number of trials

3. Yes; it can be modeled using a binomial distribution.

5. 0.2304

7. 1.0000 (From table: 1.0000 or 0.9999)

9. 0.3743 (From table: 0.3743 or 0.3742)

11. 0.4096

13. 0.0004 (From table: 0.0004 or 0.0003)

15. a. 0.4199 (From table: 0.4199 or 0.4200)

b. 0.028

c. 4 (4.2 is the mean)

17. a. 0.1574

b. 0.3075 (From table: 0.3075 or 0.3076)

c. Standard deviation is 1.8, mean is 5.6. Thus, the inspector might get between 3.8 and 7.4. or between 3 and 7 bars containing almonds.

19. a. 0.0256

b. 0.5904

c. 0.4096

21. a. 1.0000

b. 0.6733

c. 0.00000000000005 (From table: 0.0000)

23. a. 0.7824

b. 0.2176

c. 0.00003

Section 5.3

1. 12

3. 187.5

5. $\frac{35}{3} \approx 11.67$

7. 0.2678

9. 0.0089

11. 0.2689

13. 0.0346

15. 0.8667

17. a. 0.0993

b. 0.1841

19. a. 0.3563 (From table: 0.3564 or 0.3562)

b. 0.2794 (From table: 0.2795 or 0.2793)

21. a. 0.2851

b. 0.2240

23. a. 0.3033

b. 0.6321

25. a. 0.0233

b. 0.0000

Section 5.4

1. a. $\frac{9139}{33,320} \approx 0.2743$

b. $\frac{33}{66,640} \approx 0.0005$

c. 1.25

3. a. $\frac{4312}{20,995} \approx 0.2054$

b. $\frac{7}{1938} \approx 0.0036$

c. 0.9

5. a. $\frac{3}{13} \approx 0.2308$

b. $\frac{1}{2} \approx 0.5$

7. a. $\frac{33}{646} \approx 0.0511$

b. $\frac{231}{646} \approx 0.3576$

9. a. $\frac{77}{260} \approx 0.2962$

b. $\frac{153}{703} \approx 0.2176$

11. $\frac{1}{5} = 0.2$

13. Poisson; 0.0177

15. Binomial; 0.1172

17. Hypergeometric; $\frac{3}{10} = 0.3$

Chapter 5 Exercises

1. It is possible for this to be part of a probability distribution. Although the probabilities on the poster only add up to 95%, the remaining 5% could be the probability of "losing your shirt." The casino just chose not to advertise that particular part of the distribution. However, we cannot say for certain that it is a probability distribution without more information. As it stands, it is not a probability distribution.

3. For this probability distribution, $E(X) = 0.1725$ and $\sigma \approx 0.069776$. So, the managers in the sixth state can expect approximately 17.3% of their employees to be downsized with a standard deviation of about 7.0%.

5.

x	$P(X = x)$
0	$\frac{1}{32} = 0.03125$
1	$\frac{5}{32} = 0.15625$
2	$\frac{10}{32} = \frac{5}{16} = 0.3125$
3	$\frac{10}{32} = \frac{5}{16} = 0.3125$
4	$\frac{5}{32} = 0.15625$
5	$\frac{1}{32} = 0.03125$

a. There are a fixed number of trials, namely five. Each trial is independent because the outcome of one coin toss does not influence the probability of either outcome in any other coin toss. For each trial there are only two outcomes, heads or tails. Assuming a fair coin is used, the probability of obtaining heads on any single coin toss is 0.5.

b. $E(X) = 0 \cdot \frac{1}{32} + 1 \cdot \frac{5}{32} + 2 \cdot \frac{5}{16} + 3 \cdot \frac{5}{16} + 4 \cdot \frac{5}{32} + 6 \cdot \frac{1}{32}$

$= \frac{5}{2} = 2.5$

c. $\mu = np = 5 \cdot 0.5 = 2.5$

d. Yes; since it is a binomial distribution, either method should give you the same answer.

7. Poisson; 0.2084 (From table: 0.2084 or 0.2085)

9. Hypergeometric; $\frac{1}{66} \approx 0.0152$

11. Hypergeometric; $\frac{55}{204} \approx 0.2696$

13. Poisson; 0.0483

Chapter 6

Section 6.1

1. False; There are an **unlimited** number of normal distributions with different means and standard deviations.

3. False; The mean of the **standard** normal distribution is always 0.

5. True; $P(X \le x)$ is equal to the area under the curve to the left of x. Similarly, $P(X > x)$ is equal to the area under the curve to the right of x.

7. True; A normal distribution is symmetric about its mean, so the line of symmetry is the vertical line $x = \mu$.

9. True; The distance along the x-axis from one inflection point to the mean is equal to the value of the standard deviation of the particular normal distribution.

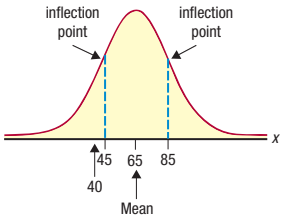
11. a. $\mu \approx 18.5$

b. $\sigma \approx 2.5$

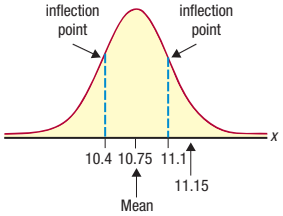
13. a. Curve A has a standard deviation of approximately 5 and curve B has a standard deviation of approximately 1, so curve A has the larger standard deviation.

b. Curve A is centered over 10 and curve B is centered over 5, so curve A has the larger mean.

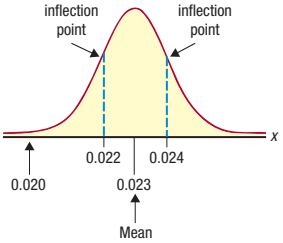
15.



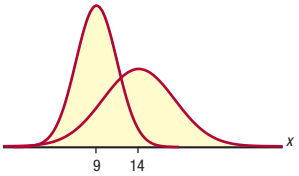
17.



19.



21. Answers will vary. The peaks of the curves should be 5 units apart on the x-axis. For example:

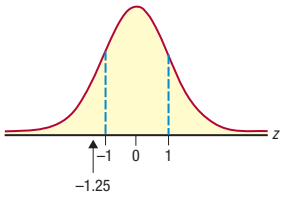


23. It is possible this data is normally distributed based on the fact that length is continuous. Although the distances are likely to be larger than the average person can jump, these distances will likely still be clustered around a mean with some extremes on both ends.

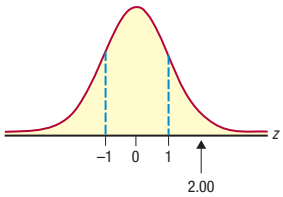
25. It is not possible for this data to be normally distributed since it is discrete in nature.

Section 6.2

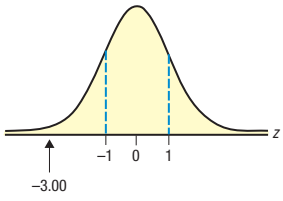
1.



3.



5.



7. a. −1.25

b. 7.4

c. 2.78

d. 20

9. $x = z \cdot \sigma + \mu$

11. 0.9625

13. 0.4247

15. 0.9032

17. 0.00002 (From table: ≈ 0.0000)

19. 0.0446

21. 0.6517

23. 0.0001 (From table: ≈ 0.0000)

25. 0.8790

27. 0.4167 (From table: 0.4166)

29. 0.0610

31. 0.9545 − 0.95 = 0.0045 (From table: 0.9544 − 0.95 = 0.0044); 0.9973 − 0.997 = 0.0003 (From table: 0.9974 − 0.997 = 0.0004)

33. 0.0349 (From table: 0.0348)

35. 0.0579

37. 0.1814 (From table: 0.1815)

39. 0.9317

41. 0.9630 (From table: 0.9629)

43. 0.9390

45. 0.9236

47. 0.7910

49. 0.2136

51. 0.1247 (From table: 0.1246)

53. 0.0168

55. 0.0455 (From table: 0.0456)

57. 0.8664

59. 0.9999 (From table: ≈ 1.0000)

Section 6.3

1. a. 0.7421 (From table: 0.7422)

b. 0.4363 (From table: 0.4364)

c. 0.6465 (From table: 0.6471)

d. 0.0505 (From table: 0.0507)

3. a. 59.35% (From table: 59.48%)

b. 80.14% (From table: 80.23%)

c. 40.15% (From table: 40.40%)

d. 59.85% (From table: 59.60%)

5. a. 0.9234 (From table: 0.9236)

b. 0.0008

c. 0.3867 (From table: 0.3851)

7. a. 4.44% (From table: 4.46%)

b. 0.53% (From table: 0.54%)

c. 28.74% (From table: 28.92%)

9. a. 0.0228

b. 0.0228

c. It is possible to find people who weigh more than 186 lb (two standard deviations) above the mean, that is, 365.8 lb. But a weight of 186 lb below the mean is impossible since that would be a weight of less than 0 lb. Hence, if the weights really have a mean of 179.8 lb and a standard deviation of 93 lb, then the distribution is not symmetric about the mean, and it would be inappropriate to assume that the weights are normally distributed.

11. b

Section 6.4

1. −2.67

3. 1.94

5. 1.64 (From table: 1.645)

7. −0.67

9. 1.38

11. −1.89

13. 2.58 (From table: 2.575)

15. 2.33

17. 0.57

19. 2.19

21. 0.67

23. 109.3

25. 58.3

27. 99.36 °F

29. 948.0 pounds

31. 36,490 feet (From table: 36,487 feet)

33. 155.387 mph (From table: 155.416 mph)

35. a. 0.8844 (From table: 0.8849)

b. 15.7 oz

Section 6.5

1. Area to the right of 39.5

3. Area to the right of 500.5

5. Area to the left of 30.5

7. Area to the left of 11.5

9. Area between 34.5 and 35.5

11. Conditions are met

13. Conditions are not met; $np = 1.5 < 10$

15. 0.2222 (From table: 0.2236)

17. ≈ 1.0000

19. 0.9937 (From table: 0.9938)

21. 0.9976

23. 0.8788 (From table: 0.8790)

25. 0.0732 (From table: 0.0735)

27. 0.0243 (From table: 0.0244)

29. 0.0449 (From table: 0.0453)

Chapter 6 Exercises

1. 1

3. Bell

5. 1

7. 47.72%

9. 0.1573 (From table: 0.1574)

11. 25%

13. 2.28%

15. b

17. a. $Q_1 \approx 13.6$, $Q_3 \approx 16.4$

b. $\mu = 3435$ (From table: $\mu = 3434$), $Q_3 = 3570$ (From table: $Q_3 = 3568$)

c. $\mu = 70$, $\sigma \approx 22.2$ (From table: $\sigma \approx 22.4$)

d. $\sigma \approx 0.6$, $Q_1 \approx 1.4$

19. Answers will vary. Students are encouraged to think about the level of measurement of the data and the shape the distribution might have.

21. 98.81% of women, 99.87% of men

23. 0.9882 (From table: 0.9881)

Chapter 7

Section 7.1

1. False; A sampling distribution refers to **groups** rather than **individuals**.

3. True; According to the Central Limit Theorem, the standard deviation of a sampling distribution of sample means, $\sigma_{\bar{x}}$, equals the population standard deviation divided by the square root of the sample size.

5. $\mu_{\bar{x}} = 35$, $\sigma_{\bar{x}} \approx 1.1$

7. $\mu_{\bar{x}} = 12.0$, $\sigma_{\bar{x}} \approx 0.38$

9. $\mu_{\bar{x}} = 9.5$, $\sigma_{\bar{x}} \approx 1.60$

11. $\mu_{\bar{x}} = \$2.88$ per gallon

13. $\mu_{\bar{x}} = 7$ days

15. $\sigma_{\bar{x}} \approx \$1.10$

17. $\sigma_{\bar{x}} = 0.58$ pounds

19. Yes, because the population is bell-shaped, it can be considered approximately normal.

21. No, the population is not normally distributed and $25 < 30$.

23. a. skewed right

b. No; the population is not normally distributed and $15 < 30$.

c. Yes, the CLT applies because $80 > 30$.

Section 7.2

1. 0.44

3. 3.16

5. –1.33

7. a. 0.1587

b. 0.000000003 (From table: ≈ 0.0000)

c. 0.0260 (From table: 0.0262)

d. 0.2435 (From table: 0.2420)

9. a. 0.3694 (From table: 0.3707)

b. 0.0092 (From table: 0.0091)

c. 0.9908 (From table: 0.9909)

d. 0.0092 (From table: 0.0091)

e. 0.0184 (From table: 0.0182)

11. a. 0.2881

b. 0.0057

c. 0.0090 (From table: 0.0089)

d. 0.0833 (From table: 0.0836)

13. 0.9505 (From table: 0.9500)

15. 0.00004 (From table: ≈ 0.0000)

17. 0.7248 (From table: 0.7258)

19. 0.0372 (From table: 0.0376)

21. 0.0402 (From table: 0.0401)

23. 0.9923

25. 0.0040

27. 0.9487 (From table: 0.9490)

29. 0.9886

Section 7.3

1. $\hat{p} = 0.35, z \approx 0.21$

3. $\hat{p} = \frac{24}{29} \approx 0.827586, \ z \approx 0.37$

5. $\hat{p} = 0.09216, z \approx -18.11$

7. 0.1367 (From table: 0.1357)

9. 0.6865 (From table: 0.6879)

11. 0.0432 (From table: 0.0436)

13. 0.6726 (From table: 0.6744)

15. 0.2227 (From table: 0.2206)

Chapter 7 Exercises

1. 0.1483 years

3. 0.7084 (From table: 0.7088)

5. 39.0 grams

7. 0.9493 (From table: 0.9488)

9. 0.0741 (From table: 0.0734)

11. 0.0014

13. 0.3050 (From table: 0.3030)

15. The group of 15 employees would be more likely to have a mean closer to $27,500 since the sampling distribution of sample means for samples of size 15 has a smaller standard deviation than the sampling distribution for samples of size 8.

Chapter 8

Section 8.1

1. $18

3. $(16.30, 19.70)$

5. 0.690181 (From table: 0.690242)

7. 0.254048 (From table: 0.254053)

9. $(44.58, 45.42)$

11. $(18.25, 18.65)$

13. 424

15. 67

17. $(14.6, 15.4)$; The professor can be 90% confident that the mean amount of time that her students spend studying is between 14.6 and 15.4 hours per week.

19. $(18.6, 19.8)$; The writer can be 95% confident that the mean computer usage time for American households is between 18.6 and 19.8 hours per week.

21. $(691, 749)$; We can be 98% confident that the mean amount of money that homeowners spend on lawn service each year is between $691 and $749.

23. $(21.1, 24.1)$; The physical therapist can be 99% confident that the mean recovery time for patients using the new therapy after ACL surgery is between 21.1 and 24.1 days.

25. 58 Millennials

27. 97 students

29. Yes; add the endpoints together and divide by two to find the midpoint of the interval, which is the original point estimate of 1.49.

31. Answers will vary. Encourage students to consider that the interval contains values both above and below last quarter's sales. A more conservative view would not report an increase in sales because of the lower bound of the interval. A less conservative view would lean towards an estimate of gain because the majority of the interval is above last quarter's sales figure.

Section 8.2

1. 1.753

3. 2.779

5. 2.462

7. 1.833

9. 3.365

11. –1.812

13. –3.055

15. 3.012

17. 2.681

19. 2.101

21. 1.708

23. 1.708

25. These two exercises essentially ask for the same thing. The value of t for a given area of c between $-t$ and t and the critical t-value for a confidence interval with the level of confidence, c, are the same thing.

27. The numbers in the last row are the critical values of z from the standard normal distribution, which are used for confidence intervals for means when the population standard deviation, σ, is known.

Section 8.3

1. $(92.2, 97.8)$

3. $(5.5, 8.5)$

5. $(246.9, 443.3)$ or $(247.0, 443.3)$

7. $(32.9, 48.8)$

9. 1.7 miles

11. $(555, 645)$; Conservationists can be 98% confident that the mean weight of adult male grizzly bears in the United States is between 555 and 645 pounds.

13. $(78.70, 81.30)$; We can say with 95% confidence that the mean fastball pitching speed of all high school baseball pitchers in the county is between 78.70 and 81.30 mph.

15. $(3837.7, 4412.3)$ or $(3837.6, 4412.4)$; With 95% confidence, the university can say that the mean number of fans at men's basketball games is between 3837.7 and 4412.3 people.

17. (22,679, 22,861); The company can say with 90% confidence that the average amount of heat produced by all the newest model fireplaces manufactured is between 22,679 BTUs and 22,861 BTUs.

19. (194, 236); With 99% confidence the school district can say that the average weekly mileage for all school buses in the district is between 194 and 236.

21. Yes; Subtract the endpoints to find the range of the interval. Dividing by 2 gives the margin of error for the interval, $E = 1.70$.

23. Answers will vary. Encourage students to consider the level of confidence, the sample size, as well as the range of each interval in their answers.

25. a. The margin of error will increase.

b. The width will increase.

27. The margin of error will increase.

29. The level of confidence will decrease.

Section 8.4

1. yes

3. no

5. $\frac{41}{50} = 0.82$

7. $\frac{48}{112} = \frac{3}{7} \approx 0.428571$

9. $(0.731, 0.909)$

11. $(0.050, 0.127)$; With 90% confidence, we can say that the proportion of all faculty members at the community college who know sign language is between 0.050 and 0.127.

13. $(17.0\%, 28.7\%)$; We can say with 90% confidence that the percentage of all kindergartners who say pancakes are their favorite breakfast food is between 17.0% and 28.7%.

15. $(33.3\%, 46.7\%)$; With 90% confidence, the percentage of all students at that college who do not regularly

check their campus e-mail accounts is between 33.3% and 46.7%.

17. $(0.305, 0.442)$; We can say with 95% confidence that the proportion of all adults in the United States who exercise on a regular basis is between 0.305 and 0.442.

19. $(40.6\%, 47.8\%)$; The wireless phone company can be 95% confident that between 40.6% and 47.8% of its customers prefer paperless billing.

21. 372 college students in the state (From table: 373 college students in the state)

23. 1637 American consumers

25. The confidence interval for the stated index of 85.3 is actually $(80.92, 89.68)$. Since the claim was that the new index was 5.4 points higher than the prior month, we can calculate the prior month's index to be 85.3 – 5.4 = 79.9. Since the entire confidence interval is above 79.9 (the prior month's index), we can say with 95% confidence that the index did indeed rise.

27. Answers will vary since the algebraic steps may be done in various sequences. One possible solution is as follows.

Section 8.5

1. 3.5

3. 0.12

5. $\chi^2_{0.025} = 39.364, \chi^2_{0.975} = 12.401$

7. $\chi^2_{0.05} = 32.671, \chi^2_{0.95} = 11.591$

9. $(9.6, 55.3)$

11. $(6.1, 30.3)$

13. $(2.0, 3.2)$

15. $(5.5, 8.7)$

17. $(2.25, 8.10)$; The grocer can be 90% confident that the variance in weights of all packages of strawberries is between 2.25 and 8.10.

19. $(12.1, 46.6)$; With 98% confidence, the variance in speeds of all fastballs thrown by major league pitchers is between 12.1 and 46.6.

21. $(6.0, 10.2)$; The standard deviation of completion times for all circuits driven for the transit system at the theme park is between 6.0 and 10.2 minutes, with a 98% level of confidence.

23. $(0.02, 0.15)$; We are 99% confident that the population variance is between 0.02 and 0.15.

25. $(1.37, 1.84)$; The factory can say with 95% confidence that the population standard deviation of the weights of all new truck engines is between 1.37 and 1.84 pounds.

27. 212

29. 337

Chapter 8 Exercises

1. $(43.00, 47.00)$; The mean amount of money that accountants spend on lunch each week is between $43.00 and $47.00.

3. 0.015842

5. 0.35 minutes

7. $(38.1, 43.9)$; We can say with 98% confidence that the mean weight of all stray dogs in this area is between 38.1 and 43.9 pounds.

9. $(0.001, 0.003)$; We are 95% confident that the population variance for the volumes of soda in all the soda cans that come off that particular assembly line is between 0.001 and 0.003.

11. 198 soldiers

13. 135 applicants

15. Normal distribution because $n > 30$ and σ is known

17. Neither distribution is appropriate in this scenario because

$n < 30$, distribution is not normal, and

σ is unknown

Chapter 9

Section 9.1

1. 3

3. 0.20 minutes

5. 1.796537 °C

7. 1.166273

9. 0.246268

11. (–5, 1); We are 90% confident that the mean delivery time for the local pizza store is between 5 minutes less than and 1 minute more than the mean delivery time for the national chain store. Since the confidence interval contains 0, the data do not provide evidence that the two population means are unequal at this level of confidence.

13. (–6, 0); We are 95% confident that the mean exam score for third graders in the first school is between 0 and 6 points less than the mean exam score for the third graders in the second school.

15. (–13,719, 7119) or (–13,720, 7120); We are 90% confident that the mean home price for houses in the first area is between $13,719 less than and $7119 more than the mean home price for houses in the second area. Since the confidence interval contains 0, the data do not provide evidence that the two population means are unequal at this level of confidence.

Section 9.2

1. $t_{0.025} = 2.045$

3. $t_{0.05} = 1.796$

5. $t_{0.025} = 3.182$

7. $t_{0.01} = 2.539$

9. 5.878117

11. 12.914234

13. (4.0, 8.0) or (3.8, 8.2); We are 90% confident that the mean size of Coonhound litters is between 4.0 and 8.0 puppies larger than the mean size of Schnauzer litters for Wesley's dogs.

15. (–6.1, 9.1); We are 95% confident that the mean battery life for Steve's cell phone battery is between 6.1 hours less than and 9.1 hours more than the mean battery life for his wife's cell phone battery. Since the confidence interval contains 0, the data do not provide evidence that the two population means are unequal at this level of confidence.

17. (19.9, 36.7); We are 90% confident that the mean distance hit with the new model of baseball bat is between 19.9 and 36.7 feet greater than the mean distance hit with the older model of baseball bat.

19. (−33,039, −20,964) or (−33,246, −20,751); We are 90% confident that the mean annual salary for people with doctoral degrees in education is between $20,964 and $33,039 greater than the mean annual salary for people with undergraduate degrees in education.

21. (–0.16, 0.76); We are 90% confident that the mean amount of syrup in the old bottles is between 0.16 fl oz less than and 0.76 fl oz greater than the mean amount of syrup in the new bottles. Since the confidence interval contains 0, the data do not provide evidence that the two population means are unequal at this level of confidence.

23. (–4.9, –1.5); We are 90% confident that the mean number of tomatoes per plant for the old fertilizer is between 1.5 and 4.9 tomatoes less than the mean number of tomatoes per plant for the new fertilizer.

25. (0.0, 0.8); We are 90% confident that the mean number of books read per month by Millenials is between 0.0 and 0.8 books greater than the mean number of books read per month by GenXers.

Section 9.3

1. $\bar{d} \approx 1.888889;\ s_d \approx 1.615893$

3. $\bar{d} = 1.25;\ s_d \approx 5.994045$

5. (1.991, 2.469)

7. (–0.10, 2.38)

9. (0.1, 2.2); We are 99% confident that the mean difference between the durations of a cold for people who take the traditional cold medicine and those who take the new medicine is between 0.1 and 2.2 days for the population from which the participants in the study were sampled.

11. (1.8, 3.8); We are 95% confident that the mean difference between the amount of weight lost after jogging every day for 30 days and the amount of weight lost after walking every day for 30 days is between 1.8 and 3.2 pounds for the population from which the participants in the study were sampled.

13. (–12.3, 1.3); We are 99% confident that, after taking the new drug for three months, the mean change in the total cholesterol levels for the population from which the participants were sampled is between –12.3 and 1.3 mg/dL. Since the confidence interval contains 0, the data do not provide evidence that the population mean decreased at this level of confidence. Thus, the company cannot conclude that the new drug actually lowers cholesterol.

15. (14.9, 30.8); We are 95% confident that, after taking the speed-reading course, the mean increase in reading speeds is between 14.9 and 30.8 pages per hour for the population from which the participants in the study were sampled.

17. (–7.2, 0.5); We are 90% confident that the mean difference between the test scores for the class under Instructor B and Instructor A is between –7.2 and 0.5 points. Since the confidence interval contains 0, the data do not provide evidence that the population mean changed at this level of confidence. Thus, the chairman of the biology department cannot conclude that there is a significant difference in the performance of students under the different instructors.

19. (2.9, 10.1); We are 80% confident that, after completing the typing program, the mean increase in typing speeds is between 2.9 and 10.1 words per minute for the population from which the participants in the study were sampled.

Section 9.4

1. Conditions are met

3. Conditions are not met; $n_2\left(1-\hat{p}_2\right) = 4.004 < 10$

5. –0.175887

7. 0.019445

9. 0.085037

11. 0.199600

13. 0.058568

15. 0.045430

17. (–0.105, 0.281); We are 95% confident that the divorce rate for couples in which a head injury occurred is between 0.105 less than and 0.281 greater than the divorce rate for the general population. Since the confidence interval contains 0, the data do not provide evidence that the two population proportions are unequal at this level of confidence.

19. (–0.047, 0.300); We are 90% confident that the difference in the proportion of high school graduates and high school dropouts that participated in team sports as children is between –0.047 and 0.300. Because this interval contains 0, the data do not provide evidence of a significant difference between the proportions at this level of confidence.

21. (–0.295, 0.022); We are 90% confident that the proportion of Baby Boomers who will return a lost wallet is between 0.295 less than and 0.022 greater than the proportion of Millenials who will return a lost wallet. Since the confidence interval contains 0, the data do not provide evidence that the two population proportions are unequal at this level of confidence.

23. (–0.098, 0.405); We are 99% confident that the proportion of gerbera daisy plants that bloom after being treated with FertiGro fertilizer is between 0.098 less than and 0.405 greater than the proportion of gerbera daisies that bloom after being treated with regular fertilizer. Since the confidence interval contains 0, the data do not provide evidence that the two population proportions are unequal at this level of confidence.

25. (–0.070, 0.178); We are 95% confident that the proportion of customers who order water to drink at Restaurant A is between 0.070 less than and 0.178 greater than the proportion of customers who order water to drink at Restaurant B. Since the confidence interval contains 0, the data do not provide evidence that the two population proportions are unequal at this level of confidence.

27. (0.010, 0.355); We are 98% confident that the proportion of children who start reading by age 4 when read to at least three times per week is between 0.010 and 0.355 greater than the proportion of children who start reading by age 4 when read to less often. Since both endpoints of the interval are positive, there is sufficient evidence for the parents' group to conclude with 98% confidence that children who are read to at least three times per week are more likely to begin reading by age 4.

Section 9.5

1. 1.194282

3. 1.113022

5. $F_{0.025} = 2.4478$, $F_{0.975} = 0.3868$

7. $F_{0.025} = 4.4333$, $F_{0.975} = 0.2256$

9. $F_{0.005} = 4.9884$, $F_{0.995} = 0.1910$

11. (0.5021, 3.4589)

13. (0.3324, 3.7861)

15. (0.2165, 8.7358)

17. (1.0094, 8.6067)

19. (0.4836, 2.1496); We are 90% confident that the ratio of the population variances of systolic blood pressure levels for patients who do not take the new medication for high blood pressure and patients who take the new medication is between 0.4836 and 2.1496 for the populations of patients from which the participants in the study were sampled. Since the confidence interval contains 1, the data do not provide evidence that the two population variances are unequal at this level of confidence.

21. (0.1824, 6.9829); We are 99% confident that the ratio of the population variances of the weights of the bags of flour for Machines A and B is between 0.1824 and 6.9829. Since the value of 1 is in the interval, the data do not provide evidence that the two population variances are unequal at this level of confidence. Thus, it is not necessary to adjust the machines.

23. (1.0357, 3.2750); We are 90% confident that the ratio of the population variances of driving distances for the old brand and the new brand of golf balls is between 1.0357 and 3.2750. Since both endpoints of the confidence interval are greater than 1, there is sufficient evidence to conclude that the population variance of driving distances is greater for the old brand. Thus, the new brand of golf ball significantly increases precision.

25. (1.0025, 4.9195); We are 95% confident that the ratio of the population variances of prices of students' and professors' cars at this college is between 1.0025 and 4.9195. Since both endpoints of the confidence interval are greater than 1, the sample data provide evidence that the population variance of car prices is greater for professors' cars than for students' cars at this college.

27. (0.2512, 4.6427); We are 99% confident that the ratio of the population variances of the thicknesses of the painted coatings inside these two tankers is between 0.2512 and 4.6427. Since the confidence interval contains 1, there is not sufficient evidence to conclude that there was a significant difference in how consistently the equipment applied the coating in one tanker versus the other.

Chapter 9 Exercises

1. (0.5, 5.9); We are 95% confident that the mean exam score for Class A is between 0.5 and 5.9 points higher than the mean exam score for Class B.

3. (–3.65, –2.01); We are 99% confident that, 30 minutes after taking the new drug for a fever, the mean decrease in patients' temperatures is between 2.01 °F and 3.65 °F for the population from which the patients in the study were sampled.

5. (–1.4, 0.2); We are 95% confident that, after children eat an apple every day for six months, the true mean change in the number of doctor's visits during a six-month period is between –1.4 and 0.2 for the population from which the children in the study were sampled. Since the confidence interval contains 0, the data do not provide evidence that the population mean decreased at this level of confidence. Thus, there is not sufficient evidence to conclude that an apple a day keeps the doctor away.

7. (0.2, 0.6); We are 95% confident that the mean exercise rate for citizens of State B is between 0.2 and 0.6 times per week more than the mean exercise rate for citizens of State A for the populations of citizens in these two states from which the survey respondents were sampled.

9. (7.3, 9.7); We are 90% confident that the population mean of students' GRE verbal scores in 2010 was

between 7.3 and 9.7 points higher for the land grant university than for the State University.

11. (0.7, 7.3); We are 95% confident that, after using the engine-cleaning product, the mean improvement in gas mileage is between 0.7 and 7.3 miles per gallon for the population of vehicles from which the cars in the study were sampled.

13. (0.3701, 3.2841); We are 95% confident that the ratio of the population variances of the numbers of times per game that John and Mark get on base is between 0.3701 and 3.2841. Since the confidence interval contains 1, the data do not provide evidence that the two population variances are unequal at this level of confidence.

15. (0.4407, 2.8219); We are 90% confident that the ratio of the population variances of the annual salaries of full professors and associate professors is between 0.4407 and 2.8219. Since the confidence interval contains 1, the data do not provide evidence for a difference in the population variances at this level of confidence.

Chapter 10

Section 10.1

1. False; We can **never** prove **either** hypothesis to be true.

3. True; By definition, rejecting a true null hypothesis is called a Type I error.

5. False; The level of significance is the probability of making a **Type I** error.

7. H_0: $\mu = 7.5$

H_a: $\mu \neq 7.5$

9. H_0: $\mu = 320.0$

H_a: $\mu > 320.0$

11. H_0: $p = 0.5$

H_a: $p < 0.5$

13. H_0: $p = 0.42$

H_a: $p > 0.42$

15. H_0: $\mu = 3$

H_a: $\mu > 3$

17. The evidence supports the claim at the 0.05 level of significance that the percentage is less than 40%.

19. The evidence does not support the researcher's claim that the percentage of people with significant side effects is more than 4% with $\alpha = 0.01$.

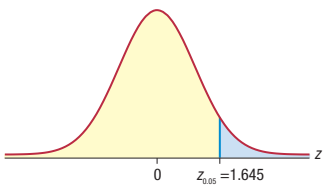
21. No; correct decision

23. Yes; Type I error

25. Yes; Type II error

Section 10.2

1.



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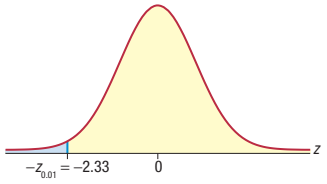

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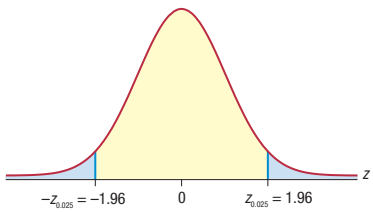


7. 0.0694

9. 0.0271 (From table: 0.0272)

11. 0.0537

13. Fail to reject H_0

15. Reject H_0

17. Fail to reject H_0

19. Reject H_0

21. Fail to reject H_0

23. Reject H_0

25. a. H_0: $\mu = 2.00$

H_a: $\mu \neq 2.00$

b. Normal distribution; $\alpha = 0.05$

c. $z = -2$

d. Reject H_0 if $|z| \geq 1.645$. p-value ≈ 0.0455 (From table: p-value $= 0.0456$); therefore reject H_0. At the 0.05 level of significance, the evidence supports the conclusion that the bolts are not 2.00 cm long and the manufacturer needs to recalibrate the machines.

27. a. H_0: $\mu = 25{,}764$

H_a: $\mu < 25{,}764$

b. Normal distribution; $\alpha = 0.10$

c. $z \approx -2.82$

d. Reject H_0 if $z < -1.28$; p-value ≈ 0.0024; therefore reject H_0. At the 0.10 level of significance, the evidence supports the bride's hope that the mean cost of a wedding is less than \$25,764.

29. a. H_0: $\mu = 3.00$

H_a: $\mu > 3.00$

b. Normal distribution; $\alpha = 0.02$

c. $z \approx 1.85$

d. p-value ≈ 0.0321 (From table: p-value $= 0.0322$); therefore fail to reject H_0. At the 0.02 level of significance, the evidence does not support the claim that the mean wait time is longer than 3.00 minutes.

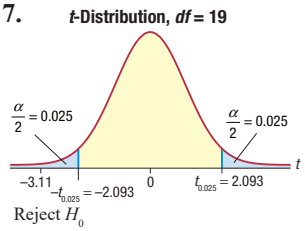
Section 10.3

1. Reject H_0 if $t \leq -1.761$.

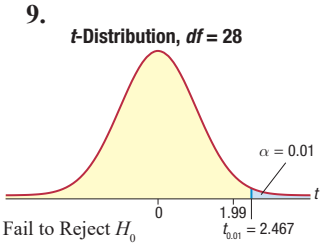
3. Reject H_0 if $|t| \geq 1.734$.

5. Reject H_0 if $|t| \geq 1.833$.

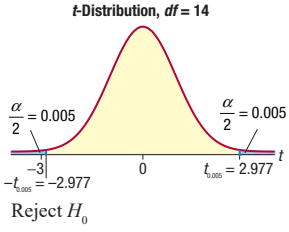
7.



9.



11.



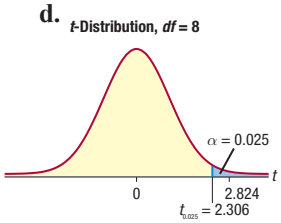
13. a. H_0: $\mu = 30$

H_a: $\mu > 30$

b. Student's t-distribution; $\alpha = 0.025$

c. $t \approx 2.824$

d.



p-value ≈ 0.0112; reject H_0. At the 0.025 level of significance, the evidence supports the customer's claim that the mean is more than 30 minutes.

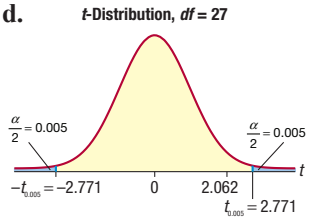
15. a. H_0: $\mu = 26$

H_a: $\mu \neq 26$

b. Student's t-distribution; $\alpha = 0.01$

c. $t \approx 2.062$

d.



p-value ≈ 0.0490; fail to reject H_0. At the 0.01 level of significance, the evidence does not support the claim that the machines need to be adjusted.

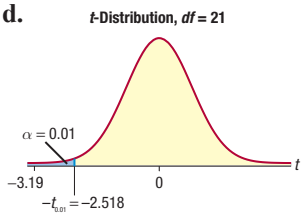
17. a. H_0: $\mu = 51{,}878$

H_a: $\mu < 51{,}878$

b. Student's t-distribution; $\alpha = 0.01$

c. $t \approx -3.19$

d.



***p*-value ≈ 0.0021; reject H_0. At the 0.01 level of significance, the evidence supports the claim that the mean salary for instructors in Mississippi is lower than the national mean.**

Section 10.4

1. Yes

3. No; $np < 10$

5. a. H_0: $p = 0.95$

H_a: $p < 0.95$

b. Normal distribution; $\alpha = 0.10$

c. $z \approx -2.84$

d. Reject H_0 if $z < -1.28$; p-value ≈ 0.0023; therefore reject H_0. At the 0.10 level of significance, the evidence does support the professor's claim that fewer than 95% of college students are procrastinators.

7. a. H_0: $p = 0.058$

H_a: $p \neq 0.058$

b. Normal distribution; $\alpha = 0.01$

c. $z \approx 2.22$

d. p-value ≈ 0.0265 (From table: p-value = 0.0264); therefore fail to reject H_0. At the 0.01 level of significance, the evidence does not support the claim that the percentage of commercial truck drivers with sleep apnea is not 5.8%.

9. a. H_0: $p = 0.15$

H_a: $p > 0.15$

b. Normal distribution; $\alpha = 0.05$

c. $z \approx 1.90$

d. Reject H_0 if $z > 1.645$; p-value ≈ 0.0288; therefore, fail to reject H_0. At the 0.05 level of significance, the evidence does support the group's claim that the true percentage of women who have PPD is greater than 15%.

Section 10.5

1. $\chi^2_{0.950} = 15.379$; reject H_0 if $\chi^2 \leq 15.379$.

3. $\chi^2_{0.050} = 27.587$; reject H_0 if $\chi^2 \geq 27.587$.

5. $\chi^2_{0.975} = 12.401$, $\chi^2_{0.025} = 39.364$; reject H_0 if $\chi^2 \leq 12.401$ or $\chi^2 \geq 39.364$.

7. a. H_0: $\sigma^2 = 4$

H_a: $\sigma^2 > 4$

b. Chi-square distribution; $\alpha = 0.01$

c. $\chi^2 = 37.5$

d. $\chi^2_{0.01} = 42.980$; reject H_0 if $\chi^2 \geq 42.980$.
$p = 0.0390 > \alpha$. Therefore fail to reject H_0. At the 0.01 level of significance, the evidence does not support the claim that the machine needs servicing.

9. a. H_0: $\sigma^2 = 0.33$

H_a: $\sigma^2 < 0.33$

b. Chi-square distribution; $\alpha = 0.10$

c. $\chi^2 \approx 9.788$

d. $\chi^2_{0.90} = 11.651$; reject H_0 if $\chi^2 \leq 11.651$.
$p = 0.0420 < 0.10$.Therefore reject H_0. At the 0.10 level of significance, the evidence does support the student's claim that the sight is off.

11. a. H_0: $\sigma^2 = 0.1$

H_a: $\sigma^2 < 0.1$

b. Chi-square distribution; $\alpha = 0.01$

c. $\chi^2 = 89.1$

d. $\chi^2_{0.99} = 70.065$; reject H_0 if $\chi^2 \leq 70.065$.
$p = 0.2480 > 0.01$. Therefore fail to reject H_0. At the 0.01 level of significance, the evidence does not support the claim that the variance of the amounts of active ingredient per dose is less than 0.1.

13. a. H_0: $\sigma^2 = 0.50$

H_a: $\sigma^2 \neq 0.50$

b. Chi-square distribution; $\alpha = 0.05$

c. $\chi^2 = 14.52$

d. $\chi^2_{0.975} = 12.401$, $\chi^2_{0.025} = 39.364$; reject H_0 if $\chi^2 \leq 12.401$ or $\chi^2 \geq 39.364$. Therefore fail to reject H_0. At the 0.05 level of significance, the evidence does not support the manager's claim that the variance of the temperatures in the chicken incubators is not 0.50.

15. a. H_0: $\sigma^2 = 2.25$

H_a: $\sigma^2 \neq 2.25$

b. Chi-square distribution; $\alpha = 0.10$

c. $\chi^2 \approx 23.707$

d. $\chi^2_{0.95} = 6.571$, $\chi^2_{0.05} = 23.685$; reject H_0 if $\chi^2 \le 6.571$ or $\chi^2 \ge 23.685$. Therefore reject H_0. At the 0.10 level of significance, the evidence supports the manager's claim that the variance in the water temperature is not 2.25.

Section 10.6

1. H_0: The proportions of prescriptions filled at the pharmacy do not vary by the day of the week.

H_a: The proportions of prescriptions filled at the pharmacy do vary by the day of the week.

3. H_0: The proportions of customers at the salon do not vary by the day of the week.

H_a: The proportions of customers at the salon do vary by the day of the week.

5. 34.471

7. 5.514

9. 0.905

11. $\chi^2_{0.100} = 63.167$

13. $\chi^2_{0.005} = 28.300$

15. $\chi^2_{0.005} = 31.319$; fail to reject H_0.

17. $\chi^2_{0.050} = 41.337$; reject H_0.

19. a. H_0: $p_1 = p_2 = p_3 = p_4 = p_5 = p_6 = p_7 = p_8 = p_9 = p_{10}$

H_a: There is some difference among the proportions.

b. Chi-square distribution; $\alpha = 0.05$

c. 12.5 for each month; $\chi^2 = 15.56$

d. $\chi^2_{0.05} = 16.919$; reject H_0 if $\chi^2 \ge 16.919$. p-value ≈ 0.0767; fail to reject H_0. At the 0.05 level of significance, the evidence does not support the teacher's claim that the numbers of tardy students vary by the month.

21. a. H_0: $p_1 = p_2 = p_3 = p_4$

H_a: There is some difference among the proportions.

b. Chi-square distribution; $\alpha = 0.10$

c. 79 for each phase; $\chi^2 \approx 8.228$

d. $\chi^2_{0.10} = 6.251$; reject H_0 if $\chi^2 \ge 6.251$. p-value ≈ 0.0415; reject H_0. At the 0.10 level of significance, the evidence supports the nurses' claim that the number of patients seen in the emergency room during the midnight shift varies by the phase of the moon.

23. a. H_0: $p_1 = p_2 = p_3 = p_4 = p_5$

H_a: There is some difference among the proportions.

b. Chi-square distribution; $\alpha = 0.01$

c. 48.6 for each weekday; $\chi^2 \approx 1.835$

d. $\chi^2_{0.01} = 13.277$; reject H_0 if $\chi^2 \ge 13.277$. p-value ≈ 0.7660; fail to reject H_0. At the 0.01 level of significance, the evidence does not support the manager's claim that the proportions of swimmers vary on weekdays. He does not need to hire extra lifeguards.

Section 10.7

1.

$\frac{2960}{146} \approx 20.273973$	$\frac{2400}{146} \approx 16.438356$	$\frac{1520}{146} \approx 10.410959$	$\frac{4800}{146} \approx 32.876712$
$\frac{2442}{146} \approx 16.726027$	$\frac{1980}{146} \approx 13.561644$	$\frac{1254}{146} \approx 8.589041$	$\frac{3960}{146} \approx 27.123288$

3.

$\frac{957}{119} \approx 8.042017$	$\frac{1584}{119} \approx 13.310924$	$\frac{561}{119} \approx 4.714286$	$\frac{825}{119} \approx 6.932773$
$\frac{1015}{119} \approx 8.529412$	$\frac{1680}{119} \approx 14.117647$	$\frac{595}{119} = 5$	$\frac{875}{119} \approx 7.352941$
$\frac{812}{119} \approx 6.823529$	$\frac{1344}{119} \approx 11.294118$	$\frac{476}{119} = 4$	$\frac{700}{119} \approx 5.882353$
$\frac{667}{119} \approx 5.605042$	$\frac{1104}{119} \approx 9.277311$	$\frac{391}{119} \approx 3.285714$	$\frac{575}{119} \approx 4.831933$

5. 0.005

7. 13.336

9. $\chi^2_{0.100} = 4.605$; reject H_0; not independent

11. $\chi^2_{0.005} = 45.559$; fail to reject H_0; independent

13. a. H_0: The grades and the sport student athletes play are independent.

H : The grades and the sport student athletes play are not independent.

b. Chi-square distribution; $\alpha = 0.005$

c.

10.75	33.75	38.75	20	6.75
10.75	33.75	38.75	20	6.75
10.75	33.75	38.75	20	6.75
10.75	33.75	38.75	20	6.75

$\chi^2 \approx 34.225$

d. $\chi^2_{0.005} = 28.299$; reject H_0 if $\chi^2 \ge 28.299$. p-value ≈ 0.00006; reject H_0. At the 0.005 level of significance, the evidence supports the claim that an association exists between the grades and the sport student athletes play.

15. a. H_0: Cola preference and age are independent.

H_a: Cola preference and age are not independent.

b. Chi-square distribution; $\alpha = 0.005$

c.

$\frac{78,561}{800} = 98.20125$	$\frac{81,872}{800} = 102.34$	$\frac{80,367}{800} = 100.45875$
$\frac{73,602}{800} = 92.0025$	$\frac{76,704}{800} = 95.88$	$\frac{75,294}{800} = 94.1175$
$\frac{56,637}{800} = 70.79625$	$\frac{59,024}{800} = 73.78$	$\frac{57,939}{800} = 72.42375$

$\chi^2 \approx 1.927$

d. $\chi^2_{0.005} = 14.860$; reject H_0 if $\chi^2 \geq 14.860$. p-value $\approx$ 0.7492; fail to reject H_0. At the 0.005 level of significance, the evidence does not support the claim that an association exists between cola preference and age.

17. a. H_0: Book preference and residential area are independent.

H_a: Book preference and residential area are not independent.

b. Chi-square distribution; $\alpha = 0.005$

c.

$\frac{7260}{266} \approx 27.293233$	$\frac{10,769}{266} \approx 40.484962$	$\frac{8349}{266} \approx 31.387218$	$\frac{5808}{266} \approx 21.834586$
$\frac{8700}{266} \approx 32.706767$	$\frac{12,905}{266} \approx 48.515038$	$\frac{10,005}{266} \approx 37.612782$	$\frac{6960}{266} \approx 26.165414$

$\chi^2 \approx 10.418$

d. $\chi^2_{0.005} = 12.838$; reject H_0 if $\chi^2 \geq 12.838$. p-value $\approx$ 0.0153; fail to reject H_0. At the 0.005 level of significance, the evidence does not support the claim that an association exists between book preference and residential area.

19. a. H_0: The commercial chosen and the combination of age and level of educational attainment are independent.

H_a: The commercial chosen and the combination of age and level of educational attainment are not independent.

b. Chi-square distribution; $\alpha = 0.10$

c.

10.25	9.75
10.25	9.75
10.25	9.75
10.25	9.75

$\chi^2 \approx 7.355$

d. $\chi^2_{0.10} = 6.251$; reject H_0 if $\chi^2 \geq 6.251$.

p-value ≈ 0.0614; reject H_0. At the 0.10 level of significance, there is enough evidence to conclude that an association exists between the commercial chosen and the combination of age and level of educational attainment.

Chapter 10 Exercises

1. a. H_0: $\mu = 55$

H_a: $\mu \neq 55$

b. Student's t-distribution; $\alpha = 0.01$

c. $t \approx -1.949$

d. $t_{0.005} = 2.779$; reject H_0 if $|t| \geq 2.779$.
p-value ≈ 0.0622; fail to reject H_0. Based on the sample chosen, the manufacturer can be 99% confident that the barrels meet the necessary standards.

3. a. H_0: $\mu = 6.83$

H_a: $\mu < 6.83$

b. Student's t-distribution; $\alpha = 0.10$

c. $t \approx -1.846$

d. $-t_{0.10} = -1.415$; reject H_0 if $t \leq -1.415$.
p-value ≈ 0.0537; reject H_0. Based on the sample chosen, there is enough evidence for the agency to be 90% confident that the new jumbo jet will decrease the mean transatlantic flight time from Newark to London Heathrow.

5. a. H_0: $\mu = 264$

H_a: $\mu > 264$

b. Normal distribution; $\alpha = 0.01$

c. $z \approx 2.93$

d. p-value ≈ 0.0017; reject H_0. At the 0.01 level of significance, the evidence supports the claim that the mean usable lifetime of the batteries is increased with the new process.

7. a. H_0: $p \leq 0.50$

H_a: $p > 0.50$

b. Normal distribution; $\alpha = 0.10$

c. $z \approx 0.26$

d. p-value ≈ 0.3958 (From table: p-value = 0.3974); fail to reject H_0. At the 0.10 level of significance, the evidence does not support Bren's claim that more than half of all sophomores live off-campus. Bren failed to reject a true null hypothesis, so she made the correct decision.

9. a. H_0: $p = 0.35$

H_a: $p \neq 0.35$

b. Normal distribution; $\alpha = 0.01$

c. $z \approx 1.26$

d. p-value ≈ 0.2078 (from table: p-value = 0.2076); fail to reject H_0. At the 0.01 level of significance,

the evidence does not support the organization's claim that the percentage of minority students is different from 35%. The organization failed to reject a false null hypothesis, so it made a Type II error.

11. a. H_0: $\sigma^2 = 15.5$

H_a: $\sigma^2 > 15.5$

b. Chi-square distribution; $\alpha = 0.05$

c. $\chi^2 \approx 26.787$

d. $\chi^2_{0.05} = 36.415$; reject H_0 if $\chi^2 \geq 36.415$. Fail to reject H_0. At the 0.10 level of significance, the evidence does not support the historian's claim that the variance in the hem lengths of skirts and dresses is more than 15.5.

13. a. H_0: $p_1 = p_2 = p_3 = p_4$

H_a: There is some difference among the proportions.

b. Chi-square distribution; $\alpha = 0.05$

c. $\chi^2 \approx 6.414$

d. $\chi^2_{0.05} = 7.815$; reject H_0 if $\chi^2 \geq 7.815$. p-value ≈ 0.0931; fail to reject H_0. At the 0.05 level of significance, the evidence does not support the claim that there is some difference between the numbers of calls for the four beats.

15. a. H_0: Education level and region in the United States are independent.

H_a: Education level and region in the United States are not independent.

b. Chi-square distribution; $\alpha = 0.05$

c. $\chi^2 \approx 4.997$

d. $\chi^2_{0.05} = 16.919$; reject H_0 if $\chi^2 \geq 16.919$. p-value ≈ 0.8346; fail to reject H_0. At the 0.05 level of significance, the evidence does not support the claim that education levels and regions in the United States are not independent.

Chapter 11

Section 11.1

1. $z \approx 1.16$

3. $z \approx -0.88$

5. H_0: $\mu_1 - \mu_2 = -30$

H_a: $\mu_1 - \mu_2 < -30$

7. H_0: $\mu_1 = \mu_2$

H_a: $\mu_1 > \mu_2$

9. H_0: $\mu_1 - \mu_2 = -3.6$

H_a: $\mu_1 - \mu_2 \neq -3.6$

11. a. H_0: $\mu_1 = \mu_2$

H_a: $\mu_1 > \mu_2$

b. Normal distribution; $\alpha = 0.05$

c. $z \approx 2.31$

d. p-value = 0.0104; therefore reject H_0. There is sufficient evidence at the 0.05 level to support the car company's claim that its new SUV has a better mean gas mileage than its competitor's SUV.

13. a. H_0: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

b. Normal distribution; $\alpha = 0.05$

c. $z \approx 1.57$

d. p-value ≈ 0.1171 (From table: p-value = 0.1164); therefore fail to reject H_0. There is not sufficient evidence at the 0.05 level to say that there is a difference between the mean numbers of miles run each week by group runners and individual runners who are training for marathons.

15. a. H_0: $\mu_1 = \mu_2$

H_a: $\mu_1 > \mu_2$

b. Normal distribution; $\alpha = 0.05$

c. $z \approx 1.49$

d. p-value ≈ 0.0685 (From table: p-value = 0.0681) therefore fail to reject H_0. There is not sufficient evidence at the 0.05 level to say that, on average, clients lose more weight with the company's help than without it.

17. a. H_0: $\mu_1 - \mu_2 = -5$

H_a: $\mu_1 - \mu_2 < -5$

b. Normal distribution; $\alpha = 0.05$

c. $z \approx -1.67$

d. p-value ≈ 0.0470 (From table: p-value = 0.0475) therefore reject H_0. There is sufficient evidence at the 0.05 level of significance to say that the mean score for evening classes is more than 5 points lower than the mean score for morning classes on art history tests.

19. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 < \mu_2$

b. Normal distribution; $\alpha = 0.10$

c. $z \approx -0.80$

d. p-value ≈ 0.2121 (From table: p-value $= 0.2119$); therefore fail to reject H_0. There is not sufficient evidence at the 10% level of significance to say that the mean ACT score of first-born children is lower than the mean ACT score of second-born children.

21. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 < \mu_2$

b. Normal distribution; $\alpha = 0.15$

c. $z \approx -0.73$

d. p-value ≈ 0.2335 (From table: p-value $= 0.2327$) therefore fail to reject H_0. There is not sufficient evidence at the 0.15 level to say that the mean number of sets of wiper blades needed per year is lower for Brand A than for Brand B.

Section 11.2

1. $t \approx 1.192$; $df = 17$

3. $t \approx 2.452$; $df = 23$

5. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 \neq \mu_2$

b. Student's t-distribution; $\alpha = 0.01$

c. $t \approx 1.602$

d. $t_{0.005} = 3.012$; reject H_0 if $|t| \geq 3.012$.
p-value ≈ 0.1208; fail to reject H_0. At the 0.01 level, there is not sufficient evidence to say that the mean fill levels are different for the bottles of cola and diet cola.

7. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 > \mu_2$

b. Student's t-distribution; $\alpha = 0.01$

c. $t \approx 2.773$

d. $t_{0.010} = 3.365$; reject H_0 if $t \geq 3.365$.
p-value ≈ 0.0128; fail to reject H_0. At the 0.01 level, there is not sufficient evidence to say that the mean thickness of briquettes from Brand A is larger than the mean thickness of those from Brand B.

9. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 > \mu_2$

b. Student's t-distribution; $\alpha = 0.10$

c. $t \approx 0.797$

d. $t_{0.100} = 1.397$; reject H_0 if $t \geq 1.397$.
p-value ≈ 0.2242; fail to reject H_0. At the 0.10 level, there is not sufficient evidence to say that there is a reduction in Gary's mean time to paint a room using the new tool.

11. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 < \mu_2$

b. Student's t-distribution; $\alpha = 0.10$

c. $t \approx -0.455$

d. $-t_{0.100} = -1.345$; reject H_0 if $t \leq -1.345$.
p-value ≈ 0.3262; fail to reject H_0. At the 0.10 level, there is not sufficient evidence to say that the mean weight of bags from Line A is lower than the mean weight of bags from Line B.

13. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 > \mu_2$

b. Student's t-distribution; $\alpha = 0.01$

c. $t \approx 3.238$

d. $t_{0.010} = 2.492$; reject H_0 if $t \geq 2.492$.
p-value ≈ 0.0012; reject H_0. At the 0.01 level, there is sufficient evidence to say that the mean decrease in cholesterol level is greater for patients who take Praxor than for those who take a placebo. Thus, the evidence supports the company's claim that Praxor lowers cholesterol levels more effectively than a placebo.

15. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 < \mu_2$

b. Student's t-distribution; $\alpha = 0.01$

c. $t \approx -0.433$

d. $-t_{0.010} = -2.552$; reject H_0 if $t \leq -2.552$.
p-value ≈ 0.3350; fail to reject H_0. At the 0.01 level, there is not sufficient evidence to say that the mean monthly cost for car insurance is lower for customers of Company A than for customers of Company B.

17. a. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 \neq \mu_2$

b. Student's t-distribution; $\alpha = 0.05$

c. $t \approx -1.585$

d. $t_{0.025} = 2.080$; reject H_0 if $|t| \geq 2.080$.
p-value ≈ 0.1278; fail to reject H_0. At the 0.05 level, there is not sufficient evidence to say that the mean lengths of time spent to complete a piece of artwork are different for male and female artists.

Section 11.3

1. a. $H_0: \mu_d = 0$
$H_a: \mu_d < 0$

b. Student's t-distribution; $\alpha = 0.05$

c. $\bar{d} \approx -1.583333$; $s_d \approx 2.609714$; $t \approx -2.102$

d. $-t_{0.050} = -1.796$; reject H_0 if $t \le -1.796$.
p-value ≈ 0.0297; reject H_0. There is sufficient evidence, at the 0.05 level of significance, to support the claim that participants in the anger-management course will lose their temper less often during the two-week period after completing the course than during the two weeks prior to taking the course.

3. a. $H_0: \mu_d = 60$
$H_a: \mu_d > 60$

b. Student's t-distribution; $\alpha = 0.01$

c. $\bar{d} \approx 81.111111$; $s_d \approx 86.954650$; $t \approx 0.728$

d. $t_{0.010} = 2.896$; reject H_0 if $t \ge 2.896$.
p-value ≈ 0.2436; fail to reject H_0. There is not sufficient evidence, at the 0.01 level of significance, to support the claim that students' SAT scores increase by a mean of more than 60 points after completing the SAT prep course.

5. a. $H_0: \mu_d = 0$
$H_a: \mu_d \neq 0$

b. Student's t-distribution; $\alpha = 0.10$

c. $\bar{d} \approx 2.888889$; $s_d \approx 5.348936$; $t \approx 1.620$

d. $t_{0.050} = 1.860$; reject H_0 if $|t| \ge 1.860$.
p-value ≈ 0.1438; fail to reject H_0. There is not sufficient evidence, at the 0.10 level of significance, to say that the mean difference between the weights of two boys with the same parents is not 0. That is, the evidence does not support the claim that boys with the same parents do not have the same weight.

7. a. $H_0: \mu_d = 30$
$H_a: \mu_d > 30$

b. Student's t-distribution; $\alpha = 0.10$

c. $\bar{d} = 31.625$; $s_d \approx 1.505941$; $t \approx 3.052$

d. $t_{0.100} = 1.415$; reject H_0 if $t \ge 1.415$.
p-value ≈ 0.0093; reject H_0. There is sufficient evidence, at the 0.10 level of significance, to support the teacher's claim that after a year of lessons, 5-year-old students will increase their stamina for standing in the correct position by a mean of more than 30 minutes.

9. a. $H_0: \mu_d = 0$
$H_a: \mu_d \neq 0$

b. Student's t-distribution; $\alpha = 0.01$

c. $\bar{d} \approx -0.087778$; $s_d \approx 1.029062$; $t \approx -0.256$

d. $t_{0.005} = 3.355$; reject H_0 if $|t| \ge 3.355$.
p-value ≈ 0.8045; fail to reject H_0. There is not sufficient evidence, at the 0.01 level of significance, to say that the mean difference between the average residential retail prices of electricity for counties in 2018 and 2019 was not 0. Thus, the evidence does not support the economist's claim that the average price of electricity, adjusted for inflation, has changed between these two years.

Section 11.4

1. $z \approx -0.80$

3. $z \approx -0.86$

5. a. $H_0: p_1 = p_2$
$H_a: p_1 > p_2$

b. Normal distribution; $\alpha = 0.01$

c. $z \approx 2.35$

d. p-value ≈ 0.0095 (From table: p-value = 0.0094); therefore reject H_0. There is sufficient evidence at the 0.01 level to support the newspaper's claim that singles now purchase more houses than singles 5 years ago.

7. a. $H_0: p_1 = p_2$
$H_a: p_1 < p_2$

b. Normal distribution; $\alpha = 0.05$

c. $z \approx -1.64$

d. p-value ≈ 0.0505; therefore fail to reject H_0. There is not sufficient evidence at the 0.05 level to support the university's claim that the retention rate improved between 2010 and 2011.

9. a. $H_0: p_1 = p_2$
$H_a: p_1 > p_2$

b. Normal distribution; $\alpha = 0.01$

c. $z \approx 0.40$

d. p-value ≈ 0.3441 (From table: p-value = 0.3446); therefore fail to reject H_0. There is not sufficient evidence at the 0.01 level to support the old wives' tale that women who eat chocolate during pregnancy have happier babies.

11. a. $H_0: p_1 = p_2$
$H_a: p_1 \neq p_2$
b. Normal distribution; $\alpha = 0.05$
c. $z \approx 0.50$
d. p-value ≈ 0.6192 (From table: p-value = 0.6170); therefore fail to reject H_0. There is not sufficient evidence at the 0.05 level to say that women and men are unequally likely to get speeding tickets in the area from where the participants in the survey were sampled.

Section 11.5

1. $H_0: \sigma_1^2 = \sigma_2^2$
$H_a: \sigma_1^2 < \sigma_2^2$

3. $H_0: \sigma_1^2 = \sigma_2^2$
$H_a: \sigma_1^2 > \sigma_2^2$

5. $H_0: \sigma_1^2 = \sigma_2^2$
$H_a: \sigma_1^2 \neq \sigma_2^2$

7. $F \approx 1.0380$

9. $F \approx 0.8211$

11. $F_{0.950} = 0.4632$; reject H_0 if $F \leq 0.4632$; reject H_0.

13. $F_{0.990} = 0.2062$; reject H_0 if $F \leq 0.2062$; fail to reject H_0.

15. $F_{0.100} = 1.7675$; reject H_0 if $F \geq 1.7675$; reject H_0.

17. $F_{0.975} = 0.3629$, $F_{0.025} = 2.5731$; reject H_0 if $F \leq 0.3629$ or $F \geq 2.5731$; fail to reject H_0.

19. $F_{0.950} = 0.4550$, $F_{0.050} = 2.2429$; reject H_0 if $F \leq 0.4550$ or $F \geq 2.2429$; fail to reject H_0.

21. a. $H_0: \sigma_1^2 = \sigma_2^2$
$H_a: \sigma_1^2 < \sigma_2^2$
b. F-distribution; $\alpha = 0.05$
c. $F \approx 0.5531$
d. $F_{0.950} = 0.3146$; reject H_0 if $F \leq 0.3146$. p-value ≈ 0.1955; fail to reject H_0. At the 0.05 level of significance, there is not sufficient evidence to support the golf pro's claim that his driving distances have a smaller variance when he uses Titleist golf balls than when he uses the store brand.

23. a. $H_0: \sigma_1^2 = \sigma_2^2$
$H_a: \sigma_1^2 > \sigma_2^2$
b. F-distribution; $\alpha = 0.10$
c. $F \approx 3.1124$
d. $F_{0.100} = 3.0145$; reject H_0 if $F \geq 3.0145$. p-value ≈ 0.0939; reject H_0. At the 0.10 level of significance, there is sufficient evidence to support the researcher's belief that the variance of total cholesterol levels in men is greater than that for women.

25. a. $H_0: \sigma_1^2 = \sigma_2^2$
$H_a: \sigma_1^2 \neq \sigma_2^2$
b. F-distribution; $\alpha = 0.01$
c. $F \approx 5.2565$
d. $F_{0.995} = 0.0432$, $F_{0.005} = 23.1545$; reject H_0 if $F \leq 0.0432$ or $F \geq 23.1545$. p-value ≈ 0.1369; fail to reject H_0. At the 0.01 level of significance, there is not sufficient evidence to support the study's claim that the variance in resting heart rates of smokers is different than that of nonsmokers.

Section 11.6

1. $F_{0.05} = 2.7534$

3. $F_{0.10} = 2.6241$

5. $F_{0.10} = 4.0604$

7.

	SS	*df*	*MS*	*F*
Treatments (T)	4	5	0.8	0.4364
Error (E)	11	6	1.833333	
Total	15	11		

9.

	SS	*df*	*MS*	*F*
Treatments (T)	50	4	12.5	1.5625
Error (E)	24	3	8	
Total	74	7		

11. a.

	SS	*df*	*MS*	*F*	*P-value*	*F crit*
Treatments (T)	1.242181	2	0.621090	2.2949	0.1295	3.5546
Error (E)	4.871514	18	0.270640			
Total	6.113695	20				

b. The p-value is greater than 0.05; thus fail to reject the null hypothesis. There is not sufficient evidence, at the 0.05 level of significance, to support the claim that the mean drive-through wait times at the three stores are different.

c. There is not enough evidence to support the claim.

13. a.

	SS	*df*	*MS*	*F*	*P-value*	*F crit*
Treatments (T)	2.882	3	0.960667	7.6277	0.0005	2.8663
Error (E)	4.534	36	0.125944			
Total	7.416	39				

b. The p-value is less than 0.05; thus reject the null hypothesis. Therefore, there is enough evidence, at the 0.05 level of significance, to support the claim that there is a difference between the mean GPAs for these four sororities.

c. Although there is enough evidence to reject the null hypothesis and support the claim that at least one of the population means differs from the others, the ANOVA test never identifies which population mean is different.

15. a.

	SS	*df*	*MS*	*F*	*P-value*	*F crit*
Treatments (T)	21.9230769	2	10.9615385	1.50158061	0.26900185	7.55943216
Error (E)	73	10	7.3			
Total	94.9230769	12				

b. The p-value is greater than 0.01; thus fail to reject the null hypothesis. There is not sufficient evidence, at the 0.10 level of significance, to support the claim that the mean number of days for visible results for the three creams are different.

c. There is not enough evidence to support the claim.

Chapter 11 Exercises

1. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 < \mu_2$
$z = -3.05$; p-value ≈ 0.0012 (From table: p-value = 0.0011); reject H_0. Therefore, there is sufficient evidence at the 0.05 level of significance to support the psychologists' claim that the mean exam score of students with test anxiety is lower than the mean score of students without test anxiety.

3. $H_0: \mu_d = 0$
$H_a: \mu_d > 0$
$t \approx 2.951$; $t_{0.05} = 1.833$; reject H_0 if $t \geq 1.833$.
p-value ≈ 0.0081; reject H_0. At the 0.05 level of significance, there is sufficient evidence to support the claim that husbands gain more weight than wives during the first year of marriage.

5. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 < \mu_2$
$t \approx -2.818$; $-t_{0.01} = -2.624$; reject H_0 if $t \leq -2.624$.
p-value ≈ 0.0045; reject H_0. At the 0.01 level of significance, there is sufficient evidence to say that cuts treated with the new ointment have a faster mean healing time than those without medication.

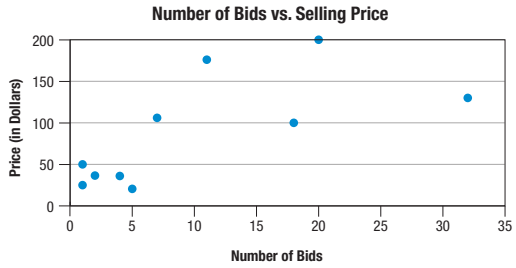
7. $H_0: \mu_d = 0$
$H_a: \mu_d \neq 0$
$t \approx 2.377$; $t_{0.005} = 3.250$; reject H_0 if $|t| \geq 3.250$.
p-value ≈ 0.0414; fail to reject H_0. At the 0.01 level of significance, there is not sufficient evidence to say that the mean difference between the numbers of times per month that each student is disciplined in the different teaching pedagogies is not 0. Thus, the evidence does not support the professor's claim that the new teaching pedagogy changes the number of disciplinary problems.

9. $H_0: \mu_1 = \mu_2$
$H_a: \mu_1 < \mu_2$
$z \approx -2.71$; p-value ≈ 0.0034; reject H_0. Therefore, there is sufficient evidence at the 0.05 level of significance to support the claim that the mean number of doctor's visits per year is lower for adults who attend church regularly than for those who do not.

Chapter 12

Section 12.1

1. Strong positive
3. Strong negative
5. None
7. No
9. Yes
11. No
13. **a.**

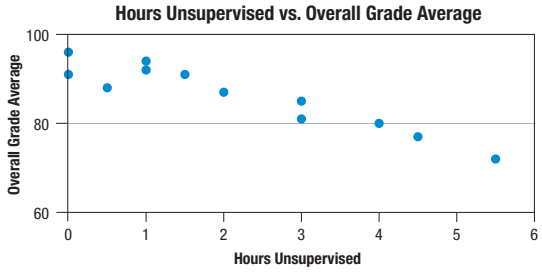


b. Positive

c. 0.693

d. No

15. **a.**

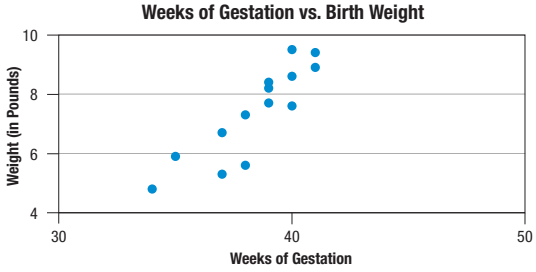


b. Negative

c. –0.944

d. No

17. **a.**



b. Positive

c. 0.881

d. Yes

19. **a.** –0.845

b. Yes

c. 0.715

d. 71.5% of the variation in the class averages can be associated with the variation in the numbers of absences.

21. **a.** 0.824

b. Yes

c. 0.678

d. 67.8% of the variation in the college GPAs can be associated with the variation in the ACT scores.

Section 12.2

1. **a.** A scatter plot of the data shows a linear pattern, and $r \approx 0.984 \geq 0.576$, so it is appropriate to create a regression line.

   $\hat{y} = 6.436 + 0.914x$

   b. 70.416

3. **a.** A scatter plot of the data shows a linear pattern, and $r \approx 0.927 \geq 0.707$, so it is appropriate to create a regression line.

   $\hat{y} = 6.204 - 0.097x$

   b. 4.163

5. **a.** A scatter plot of the data shows a linear pattern, and $r \approx 0.997 \geq 0.811$, so it is appropriate to create a regression line.

   $\hat{y} = 19121.201 + 0.373x$

   b. 47,096

7. **a.** A scatter plot of the data shows a linear pattern, and $r \approx 0.857 \geq 0.576$, so it is appropriate to create a regression line.

   $\hat{y} = 153.319 + 0.708x$

   b. 557

9. For each additional layoff, employee satisfaction rating goes down 0.097 points.

11. Since each additional paper results in an increase of 0.373 employees, an additional 10,000 papers would result in 10,000(0.373) = 3,730 more employees.

Section 12.3

1. **a.** 3.733
   b. 0.683
   c. $(12.334, 15.674)$ or $(12.328, 15.667)$
3. **a.** 479.905
   b. 6.076
   c. $(4.901, 32.023)$ or $(4.910, 32.031)$
5. **a.** 83.622
   b. 3.733
   c. $(6.914, 26.294)$ or $(6.887, 26.267)$
7. **a.** 3.208
   b. 0.731
   c. $(2.726, 6.522)$ or $(2.727, 6.523)$
9. **a.** 1,148,767.96
   b. 378.941
   c. $(496.446, 1319.694)$
   d. $(226.814, 401.146)$
11. **a.** 15.660
    b. 1.770
    c. $(87.609, 94.558)$
    d. $(-4.100, -2.958)$

Section 12.4

1. Yes, because $0.0000000005 \le 0.05$, that is, $p\text{-value} \le \alpha$.
3. No, because $0.0810 > 0.05$, that is, $p\text{-value} > \alpha$.
5. $\hat{y} = 63.880 - 1.416x_1 + 4.169x_2$

   x_1 = Absences

   x_2 = Hours studied per week

   Neither variable should be eliminated from the regression model.
7. $\hat{y} = -19.570 + 0.685x_1 + 0.063x_2$

   x_1 = Weeks of gestation

   x_2 = Number of prenatal visits

   The variable "Number of prenatal visits" could be eliminated from the regression model.
9. p-value ≈ 0.0259; thus, there is enough evidence to support the claim that a statistically significant linear relationship exists between the explanatory variables and the response variable.

   $\hat{y} = 5476.596 - 0.012x_1 - 29.124x_2 - 1045.990x_3$
11. p-value ≈ 0.0002; thus, there is enough evidence to support the claim that a statistically significant linear relationship exists between the explanatory variables and the response variable.

    $\hat{y} = 3010.562 + 4.621x_1 - 2.804x_2$
13. df for regression
15. It usually increases as the number of explanatory variables increases.

Chapter 12 Exercises

1. **a.** 0.182
   b. No; no
   c. No; the correlation coefficient is not significant.
3. **a.** Negative linear relationship
   b. $r \approx -0.862$; $r^2 \approx 0.743$
   c. Yes; yes
   d. 6 (The actual value is 6.79)
5. **a.** Because both the scatter plot is linear and value of r is significant at the 0.05 and 0.01 levels, yes.
   b. Yes, 339; no, 500 swimsuits is outside the range of the data.
   c. Seagulls flock to warmer climates and abundant food sources. Humans also "flock" to the beach during warmer months. Furthermore, humans bring food to the seagulls, even if it is in the form of trash they leave behind. However, seagulls also flock to the shrimp boats on the coast. Thus, though there is a significant linear relationship between these two variables, it is doubtful that it is a causal relationship.
7. **a.** Yes; yes
   b. \$19,680.11
   c. 80.5%
9. **a.** 16.724
   b. 1.670
   c. $(32.690, 41.894)$ or $(32.847, 42.051)$
   d. $(-8.593, 11.926)$
   e. $(0.069, 0.146)$
11. p-value ≈ 0.00001; thus, there is enough evidence to support the claim that a statistically significant linear relationship exists between the explanatory variables and the response variable.

    $\hat{y} = 0.325 + 0.097x_1 - 1.156x_2$