Appendix C: Answers

Answers to Odd-Numbered Chapter Exercises

CHAPTER 1

1. a. Interval
   b. Ratio
   c. Nominal
   d. Nominal
   e. Ordinal
   f. Ratio
3. Answers will vary.
5. Qualitative data is not numerical, whereas quantitative data is numerical. Examples will vary by student.
7. A discrete variable may assume only certain values. A continuous variable may assume an infinite number of values within a given range. The number of traffic citations issued each day during February in Garden City Beach, South Carolina, is a discrete variable. The weight of commercial trucks passing the weigh station at milepost 195 on Interstate 95 in North Carolina is a continuous variable.
9. a. Ordinal
   b. Interval
   c. The newer system provides information on the distance between exits.
11. If you were using this store as typical of all Barnes & Noble stores, then it would be sample data. However, if you were considering it as the only store of interest, then the data would represent the population.
13.

	Discrete Variable	Continuous Variable
Qualitative	b. Gender d. Soft drink preference	
Quantitative	f. SAT scores g. Student rank in class h. Rating of a finance professor i. Number of home computers	a. Salary c. Sales volume of MP3 players e. Temperature

	Discrete	Continuous
Nominal	b. Gender	
Ordinal	d. Soft drink preference g. Student rank in class h. Rating of a finance professor	
Interval	f. SAT scores	e. Temperature
Ratio	i. Number of home computers	a. Salary c. Sales volume of MP3 players

15. According to the sample information, 120/300 or 40% would accept a job transfer.
17. a. Total sales increased by 106,041, found by 1,255,337 − 1,149,296, which is a 9.2% increase.
    b. Market shares are:

	2010	2009
General Motors	22.9%	22.0%
Ford Motor	19.9%	16.2%
Chrysler	11.3%	12.7%
Toyota	15.8%	19.7%
American Honda	11.8%	12.4%
Nissan NA	10.6%	9.4%
Hyundai	5.1%	4.8%
Mazda	2.6%	2.8%

Ford has gained 3.7% and Toyota lost 3.9% of their market shares.

    c. Percentage changes are:

General Motors	increase of 13.7%
Ford Motor	increase of 34.3%
Chrysler	decrease of 3.2%
Toyota	decrease of 12.4%
American Honda	increase of 3.9%
Nissan NA	increase of 22.8%
Hyundai	increase of 17.0%
Mazda	increase of 2.9%

Ford and Nissan had increases of more than 20%. General Motors and Hyundai had increases of more than 10%. Meanwhile, Toyota had a decrease of over 10%.

19. Earnings increased each year over the previous year until a large peak in 2008. Then there was a rather large drop in 2009. Earnings increased again in 2010.
21. a. League is a qualitative variable; the others are quantitative.
    b. League is a nominal-level variable; the others are ratio-level variables.

CHAPTER 2

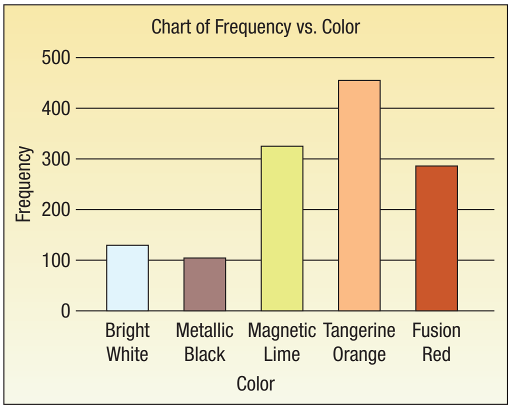
1. 25% market share.
3.

Season	Frequency	Relative Frequency
Winter	100	.10
Spring	300	.30
Summer	400	.40
Fall	200	.20
	1,000	1.00

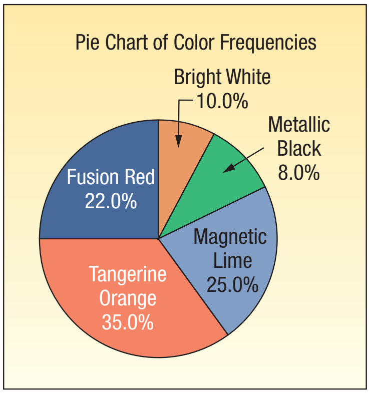
5. a. A frequency table.

Color	Frequency	Relative Frequency
Bright White	130	0.10
Metallic Black	104	0.08
Magnetic Lime	325	0.25
Tangerine Orange	455	0.35
Fusion Red	286	0.22
Total	1,300	1.00

b.



c.



d. 350,000 orange, 250,000 lime, 220,000 red, 100,000 white, and 80,000 black, found by multiplying relative frequency by 1,000,000 production.

7. $2^5 = 32$, $2^6 = 64$, therefore, 6 classes

9. $2^7 = 128$, $2^8 = 256$, suggests 8 classes

$i \geq \frac{\$567 - \$235}{8} = 41$ Class intervals of 45 or 50 would be acceptable.

11. **a.** $2^4 = 16$ Suggests 5 classes.

b. $i \geq \frac{31 - 25}{5} = 1.2$ Use interval of 1.5.

c. 24

d.

Units	*f*	Relative Frequency
24.0 up to 25.5	2	0.125
25.5 up to 27.0	4	0.250
27.0 up to 28.5	8	0.500
28.5 up to 30.0	0	0.000
30.0 up to 31.5	2	0.125
Total	16	1.000

e. The largest concentration is in the 27.0 up to 28.5 class (8).

13. **a.**

Number of Visits	*f*
0 up to 3	9
3 up to 6	21
6 up to 9	13
9 up to 12	4
12 up to 15	3
15 up to 18	1
Total	51

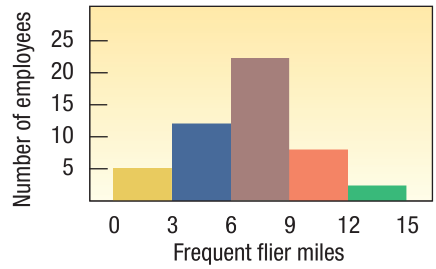
b. The largest group of shoppers (21) shop at the BiLo Supermarket 3, 4, or 5 times during a month period. Some customers visit the store only 1 time during the month, but others shop as many as 15 times.

c.

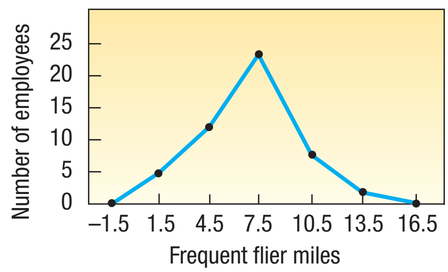
Number of Visits	Percent of Total
0 up to 3	17.65
3 up to 6	41.18
6 up to 9	25.49
9 up to 12	7.84
12 up to 15	5.88
15 up to 18	1.96
Total	100.00

15. **a.** Histogram
b. 100
c. 5
d. 28
e. 0.28
f. 12.5
g. 13

17. **a.** 50
b. 1.5 thousand miles, or 1,500 miles.
c.



d. $X = 1.5$, $Y = 5$
e.



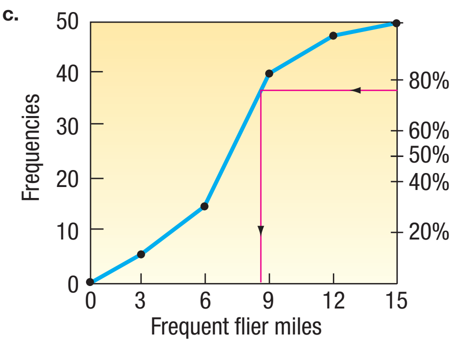
f. For the 50 employees, about half traveled between 6,000 and 9,000 miles. Five employees traveled less than 3,000 miles, and 2 traveled more than 12,000 miles.

19. **a.** 40
b. 5
c. 11 or 12
d. About \$20/hr
e. About \$9/hr
f. About 75%

21. **a.** 5
b.

Frequent Flier Miles	*f*	CF
0 up to 3	5	5
3 up to 6	12	17
6 up to 9	23	40
9 up to 12	8	48
12 up to 15	2	50

c.



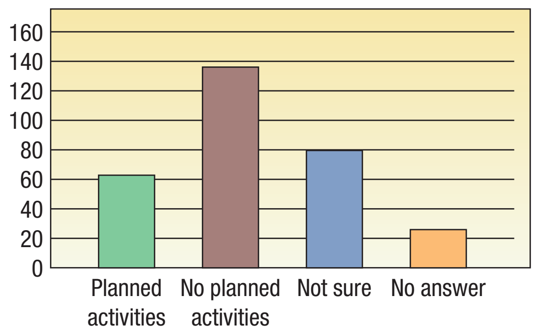
d. About 8.7 thousand miles

23. **a.** A qualitative variable uses either the nominal or ordinal scale of measurement. It is usually the result of counts. Quantitative variables are either discrete or continuous. There is a natural order to the results for a quantitative variable. Quantitative variables can use either the interval or ratio scale of measurement.

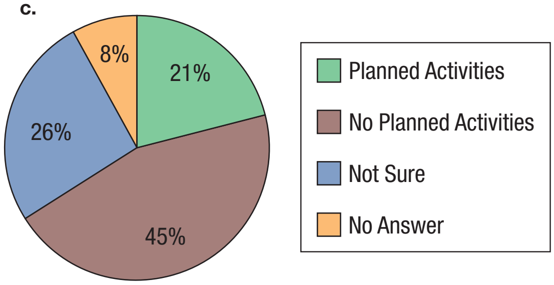
b. Both types of variables can be used for samples and populations.

25. **a.** Frequency table

b.



c.



d. A pie chart would be better because it clearly shows that nearly half of the customers prefer no planned activities.

27. $2^6 = 64$ and $2^7 = 128$, suggest 7 classes

29. **a.** 5, because $2^4 = 16 < 25$ and $2^5 = 32 > 25$

b. $i \geq \dfrac{48 - 16}{5} = 6.4$ Use interval of 7.

c. 15

d.

Class		Frequency
15 up to 22	III	3
22 up to 29	卌 III	8
29 up to 36	卌 II	7
36 up to 43	卌	5
43 up to 50	II	2
		25

e. It is fairly symmetric, with most of the values between 22 and 36.

31. **a.** $2^5 = 32$, $2^6 = 64$, 6 classes recommended.

b. $i = \dfrac{10 - 1}{6} = 1.5$, use an interval of 2.

c. 0

d.

Class	Frequency
0 up to 2	1
2 up to 4	5
4 up to 6	12
6 up to 8	17
8 up to 10	8

e. The distribution is fairly symmetric or bell-shaped with a large peak in the middle of the two classes of 4 up to 8.

33.

Class	Frequency
0 up to 200	19
200 up to 400	1
400 up to 600	4
600 up to 800	1
800 up to 1000	2

This distribution is positively skewed with a large "tail" to the right or positive values. Notice that the top 7 tunes account for 4,342 plays out of a total of 5,968 or about 73% of all plays.

35. **a.** 56 **c.** 55

b. 10 (found by 60 − 50) **d.** 17

37. **a.** \$30.50, found by (\$265 − \$82)/6

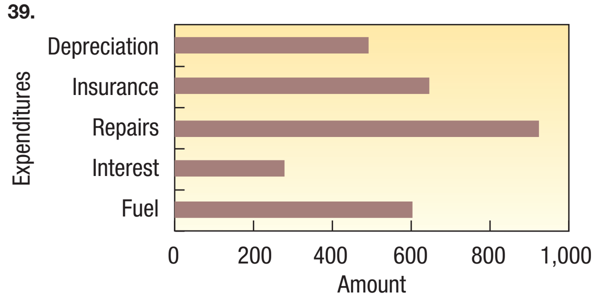
b. \$35

c.

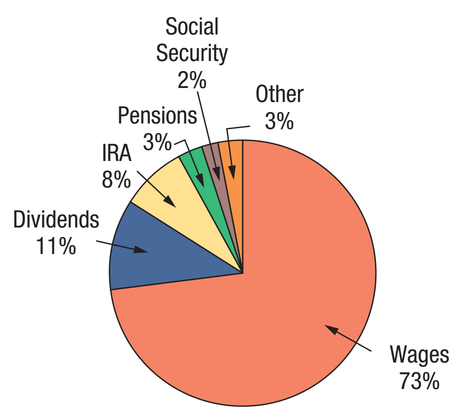
\$ 70 up to \$105	4
105 up to 140	17
140 up to 175	14
175 up to 210	2
210 up to 245	6
245 up to 280	1

d. The purchases range from a low of about \$70 to a high of about \$280. The concentration is in the \$105 up to \$140 and \$140 up to \$175 classes.

39.



41.



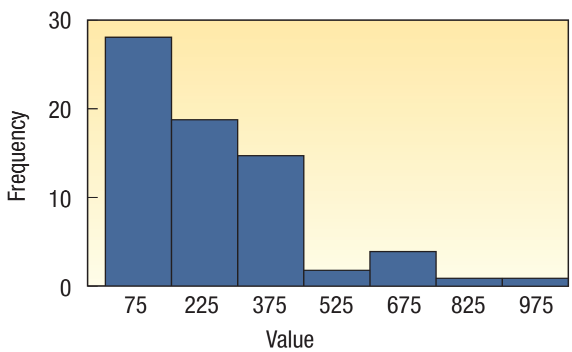
SC Income	Percent	Cumulative
Wages	73	73
Dividends	11	84
IRA	8	92
Pensions	3	95
Social Security	2	97
Other	3	100

By far the largest part of income in South Carolina is wages. Almost three-fourths of the adjusted gross income comes from wages. Dividends and IRAs each contribute roughly another 10%.

43. **a.** Since $2^6 = 64 < 70 < 128 = 2^7$, 7 classes are recommended. The interval should be at least $(1{,}002.2 - 3.3)/7 = 142.7$. Use 150 as a convenient value.

Frequency Distribution	
0 up to 150	28
150 up to 300	19
300 up to 450	15
450 up to 600	2
600 up to 750	4
750 up to 1050	1
Total	70

b.

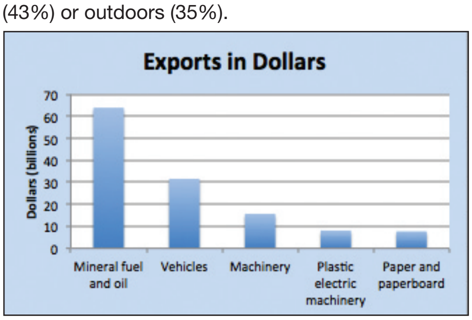


45. **a.** Pie chart

b. 215, found by 0.43×500

c. Seventy-eight percent are in either a house of worship (43%) or outdoors (35%).

47. **a.**

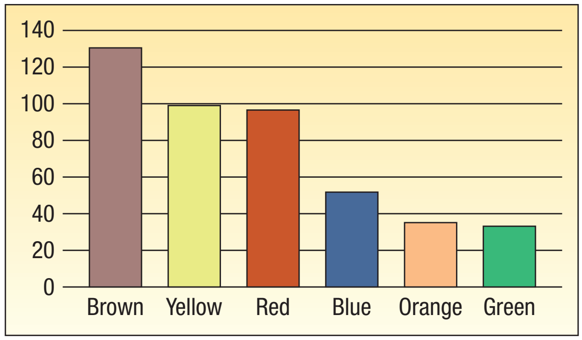


b. 0.42; $(63.9 + 31.6)/224.9$

c. 0.75; $(63.9 + 31.6)/127.0$

49.

Color	Frequency
Brown	130
Yellow	98
Red	96
Blue	52
Orange	35
Green	33
	444



Brown, yellow, and red M&M's make up almost 75 percent. The other 25 percent are blue, orange, and green.

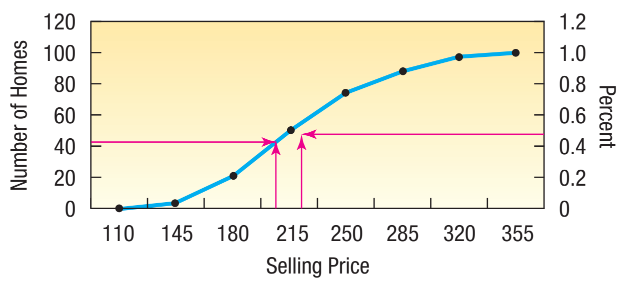
51. $i \geq \dfrac{345.3 - 125.0}{7} = 31.47$ Use interval of 35.

Selling Price	*f*	*CF*
110 up to 145	3	3
145 up to 180	19	22
180 up to 215	31	53
215 up to 250	25	78
250 up to 285	14	92
285 up to 320	10	102
320 up to 355	3	105

a. Most homes (53%) are in the 180 up to 250 range.

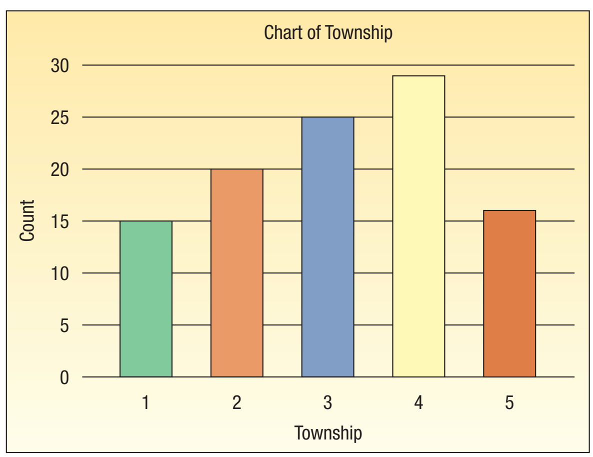
b. \$127.5 (110 + 17.5); \$337.5 (320 + 17.5)

c.



About 42 homes sold for less than 200.
About 55% of the homes sold for less than 220.
So 45% sold for more.
Less than 1% of the homes sold for less than 125.

d.



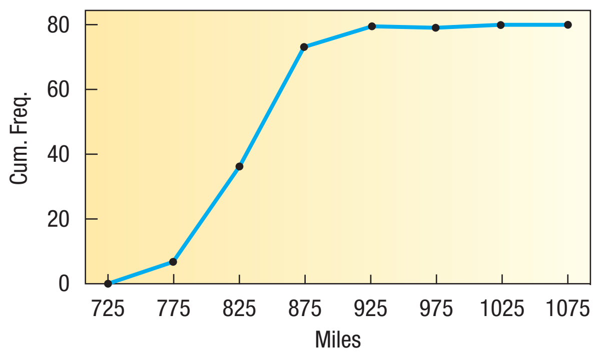
Townships 3 and 4 have more sales than the average and Townships 1 and 5 have somewhat less than the average.

53. Since $2^6 = 64 < 80 < 128 = 2^7$, use 7 classes. The interval should be at least $(1008 - 741)/7 = 38.14$ miles. Use 40. The resulting frequency distribution is:

Class	f
730 up to 770	5
770 up to 810	17
810 up to 850	37
850 up to 890	18
890 up to 930	1
930 up to 970	0
970 up to 1010	2

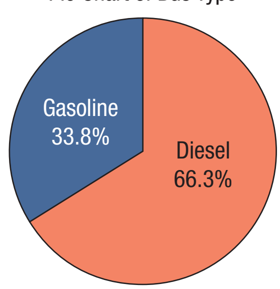
a. The typical amount driven is 830 miles. The range is from 730 up to 1010 miles.
b. The distribution is "bell shaped" around 830. However, there are two outliers up around 1000 miles.
c.

Cumulative Frequency of Miles Driven per Month

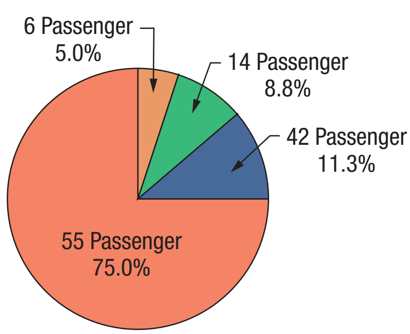


Forty percent of the buses were driven fewer than 820 miles.
Fifty-nine buses were driven less than 850 miles.

d. Pie Chart of Bus Type



Pie Chart of Seats



The first chart shows that about two-thirds of the buses are diesel. The second diagram shows that nearly three fourths of the buses have 55 seats.

CHAPTER 3

1. $\mu = 5.4$, found by 27/5
3. **a.** $\overline{X} = 7.0$, found by 28/4
b. $(5 - 7) + (9 - 7) + (4 - 7) + (10 - 7) = 0$
5. $\overline{X} = 14.58$, found by 43.74/3
7. **a.** 15.4, found by 154/10
b. Population parameter, since it includes all the salespeople at Midtown Ford
9. **a.** \$54.55, found by \$1,091/20
b. A sample statistic—assuming that the power company serves more than 20 customers
11. $\overline{X} = \frac{\Sigma X}{n}$ so
$\Sigma X = \overline{X} \cdot n = (\$5430)(30) = \$162{,}900$
13. \$22.91, found by $\frac{300(\$20) + 400(\$25) + 400(\$23)}{300 + 400 + 400}$
15. \$17.75, found by (\$400 + \$750 + \$2,400)/200
17. **a.** No mode
b. The given value would be the mode.
c. 3 and 4 bimodal
19. **a.** Mean = 3.33
b. Median = 5
c. Mode = 5
21. **a.** Median = 2.9
b. Mode = 2.9
23. $\overline{X} = \frac{647}{11} = 58.82$
Median = 58, Mode = 58
Any of the three measures would be satisfactory.
25. **a.** $\overline{X} = \frac{90.4}{12} = 7.53$
b. Median = 7.45. There are several modes: 6.5, 7.3, 7.8, and 8.7.
c. $\overline{X} = \frac{33.8}{4} = 8.45$,
Median = 8.7
About 1 percentage point higher in Winter
27. **a.** 7, found by 10 − 3.
b. 6, found by 30/5.
c. 2.4, found by 12/5.
d. The difference between the highest number sold (10) and the smallest number sold (3) is 7. On average, the number of HDTVs sold deviates by 2.4 from the mean of 6.
29. **a.** 30, found by 54 − 24.
b. 38, found by 380/10.
c. 7.2, found by 72/10.
d. The difference of 54 and 24 is 30. On average, the number of minutes required to install a door deviates 7.2 minutes from the mean of 38 minutes.
31.

State	Mean	Median	Range
California	33.10	34.0	32
Iowa	24.50	25.0	19

The mean and median ratings were higher for California, but there was also more variation in California.
33. **a.** 5
b. 4.4, found by
$$\frac{(8-5)^2 + (3-5)^2 + (7-5)^2 + (3-5)^2 + (4-5)^2}{5}$$
35. **a.** \$2.77
b. 1.26, found by
$$\frac{(2.68 - 2.77)^2 + (1.03 - 2.77)^2 + (2.26 - 2.77)^2 + (4.30 - 2.77)^2 + (3.58 - 2.77)^2}{5}$$

37. **a.** Range: 7.3, found by 11.6 − 4.3. Arithmetic mean: 6.94, found by 34.7/5. Variance: 6.5944, found by 32.972/5. Standard deviation: 2.568, found by $\sqrt{6.5944}$.
b. Dennis has a higher mean return (11.76 > 6.94). However, Dennis has greater spread in its returns on equity (16.89 > 6.59).

39. **a.** $\overline{X} = 4$

$$s^2 = \frac{(7-4)^2 + \cdots + (3-4)^2}{5-1} = \frac{22}{5-1} = 5.5$$

b. $s = 2.3452$

41. **a.** $\overline{X} = 38$

$$s^2 = \frac{(28-38)^2 + \cdots + (42-38)^2}{10-1} = 82.667$$

$$s^2 = \frac{744}{10-1} = 82.667$$

b. $s = 9.0921$

43. **a.** $\overline{X} = \frac{951}{10} = 95.1$

$$s^2 = \frac{(101-95.1)^2 + \cdots + (88-95.1)^2}{10-1}$$

$$= \frac{1{,}112.9}{9} = 123.66$$

b. $s = \sqrt{123.66} = 11.12$

45. About 69%, found by $1 - 1/(1.8)^2$

47. **a.** About 95%
b. 47.5%, 2.5%

49. **a.** Mean = 5, found by (6 + 4 + 3 + 7 + 5)/5. Median is 5, found by rearranging the values and selecting the middle value.
b. Population, because all partners were included
c. $\Sigma(X - \mu) = (6-5) + (4-5) + (3-5) + (7-5) + (5-5) = 0$

51. $\overline{X} = \frac{545}{16} = 34.06$

Median = 37.50

53. The mean is 35.675, found by 1427/40. The median is 36, found by sorting the data and averaging the 20th and 21st observations.

55. $\overline{X}_w = \frac{\$5.00(270) + \$6.50(300) + \$8.00(100)}{270 + 300 + 100} = \$6.12$

57. $\overline{X}_w = \frac{[15{,}300(4.5) + 10{,}400(3.0) + 150{,}600(10.2)]}{176{,}300} = 9.28$

59.
a. 55, found by 72 − 17
b. 14.4, found by 144/10, where $\overline{X} = 43.2$
c. 17.6245

61. **a.** There were 13 flights, so all items are considered.
b. $\mu = \frac{2{,}259}{13} = 173.77$

Median = 195

c. Range = 301 − 7 = 294

$$s = \sqrt{\frac{133{,}846}{13}} = 101.47$$

63. **a.** The mean is \$717.20, found by \$17,930/25. The median is \$717.00 and there are two modes, \$710 and \$722.
b. The range is \$90, found by \$771 − \$681, and the standard deviation is \$24.87, found by the square root of 14,850/24.
c. From \$667.46 up to \$766.94, found by \$717.20 ± 2(\$24.87).

65. **a.** Mean = 9.1, found by 273/30. Median is 9, found by averaging the 15th and 16th values.
b. Range = 14, found by 18 − 4. Standard deviation = 3.566, found by the square root of (368.7/29).

67. **a.** The mean team payroll is \$91,016,667, rounded to \$91.0 million. The median is \$84,300,000, rounded to \$84.3 million. Since the distribution is positively skewed, the median is a better measure of location.
b. The range is \$171,400,000, or \$171.4 million. The standard deviation is \$38,254,935, or \$38.3 million. Using the data rounded to the nearest \$0.1 million, 75% of the team payrolls are between \$14.4 million and \$167.6 million.
c. The AL mean and standard deviation are \$96,992,857, or \$98.0 million, and \$43,724,812, or \$43.7 million. The NL mean and standard deviation are \$85,787,500, or \$85.8 million, and \$33,314,739, or \$33.3 million. The AL team payroll has a larger mean and more dispersion.

CHAPTER 4

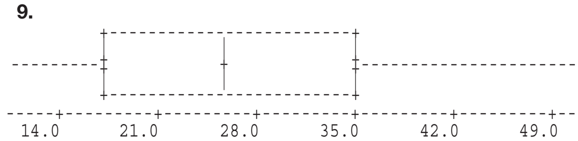
1. **a.** Dot plot **b.** 15
c. 1, 7 **d.** 2 and 3

3. Median = 53, found by $(11 + 1)(\frac{1}{2})$ ∴ 6th value in from lowest
$Q_1 = 49$, found by $(11 + 1)(\frac{1}{4})$ ∴ 3rd value in from lowest
$Q_3 = 55$, found by $(11 + 1)(\frac{3}{4})$ ∴ 9th value in from lowest

5. **a.** $Q_1 = 33.25$, $Q_3 = 50.25$
b. $D_2 = 27.8$, $D_8 = 52.6$
c. $P_{67} = 47$

7. **a.** 350
b. $Q_1 = 175$, $Q_3 = 930$
c. 930 − 175 = 755
d. Less than 0, or more than about 2,060
e. There are no outliers.
f. The distribution is positively skewed.

9.



The distribution is somewhat positively skewed. Note that the dashed line above 35 is longer than below 18.

11. **a.** The mean is 30.8, found by 154/5. The median is 31.0, and the standard deviation is 3.96, found by

$$s = \sqrt{\frac{62.8}{4}} = 3.96$$

b. −0.15, found by $\frac{3(30.8 - 31.0)}{3.96}$

c.

Salary	$\left(\frac{X - \overline{X}}{s}\right)$	$\left(\frac{X - \overline{X}}{s}\right)^3$
36	1.313131	2.264250504
26	−1.212121	−1.780894343
33	0.555556	0.171467764
28	−0.707071	−0.353499282
31	0.050505	0.000128826
		0.301453469

0.125, found by [5/(4 × 3)] × 0.301

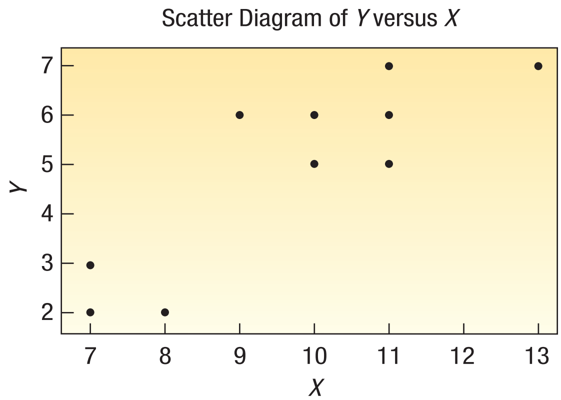
13. **a.** The mean is 21.93, found by 328.9/15. The median is 15.8, and the standard deviation is 21.18, found by

$$s = \sqrt{\frac{6283}{14}} = 21.18$$

b. 0.868, found by [3(21.93 − 15.8)]/21.18

c. 2.444, found by [15/(14 × 13)] × 29.658

15.



There is a positive relationship between the variables.

17. **a.** Both variables are nominal scale.

b. Contingency table

c. Men are about twice as likely to order a dessert. From the table, 32% of the men ordered dessert, but only 15% of the women.

19. **a.** Dot plot

b. 15

c. 5

21. **a.** $L_{50} = (20 + 1)\frac{50}{100} = 10.50$

$$\text{Median} = \frac{83.7 + 85.6}{2} = 84.65$$

$L_{25} = (21)(.25) = 5.25$

$Q_1 = 66.6 + .25(72.9 - 66.6) = 68.175$

$L_{75} = 21(.75) = 15.75$

$Q_3 = 87.1 + .75(90.2 - 87.1) = 89.425$

b. $L_{26} = 21(.26) = 5.46$

$P_{26} = 66.6 + .46(72.9 - 66.6) = 69.498$

$L_{83} = 21(.83) = 17.43$

$P_{83} = 93.3 + .43(98.6 - 93.3) = 95.579$

c.

```
                  -------------------------
     -------------I                  +    I---------------
                  -------------------------

   --------+---------+---------+---------+---------+--------C20
         64.0      72.0      80.0      88.0      96.0
```

23. **a.** $Q_1 = 26.25$, $Q_3 = 35.75$, Median = 31.50

```
                   -----------------------
      -------------I          +          I------------------
                   -----------------------

   ------+---------+---------+---------+---------+---------+
       24.5      28.0      31.5      35.0      38.5      42.0
```

b. $Q_1 = 33.25$, $Q_3 = 38.75$, Median = 37.50

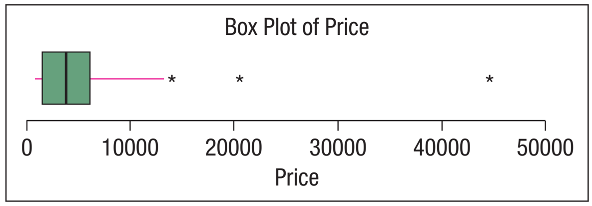
```
               ---------------------
        ------I                +   I---------------------
               ---------------------

   ------+---------+---------+---------+---------+---------+
       32.5      35.0      37.5      40.0      42.5      45.0
```

c. The median time for public transportation is about 6 minutes less. There is more variation in public transportation. The difference between Q_1 and Q_3 is 9.5 minutes for public transportation and 5.5 minutes for private transportation.

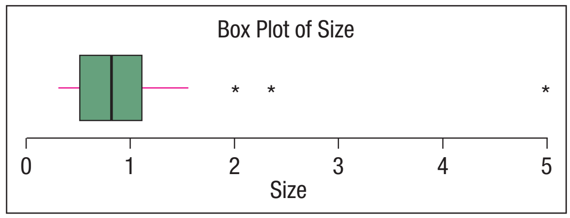
25. The distribution is positively skewed. The first quartile is about \$20 and the third quartile is about \$90. There is one outlier located at \$255. The median is about \$50.

27. **a.**



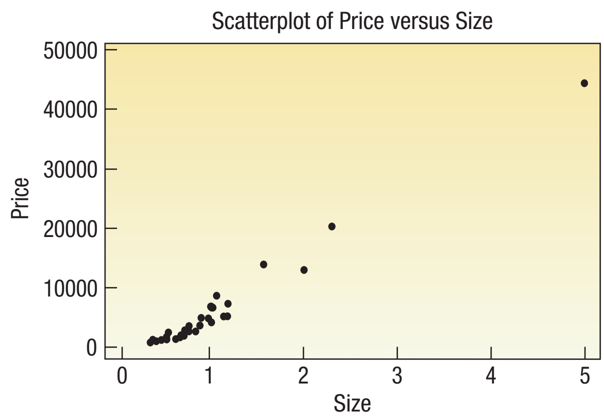
Median is 3733. First quartile is 1478. Third quartile is 6141. So prices over 13,135.5, found by 6141 + 1.5 (6141 − 1478), are outliers. There are three (13,925, 20,413, and 44,312).

b.



Median is 0.84. First quartile is 0.515. Third quartile is 1.12. So sizes over 2.0275, found by 1.12 + 1.5 (1.12 − 0.515), are outliers. There are three (2.03, 2.35, and 5.03).

c.



There is a direct association between them. The first observation is larger on both scales.

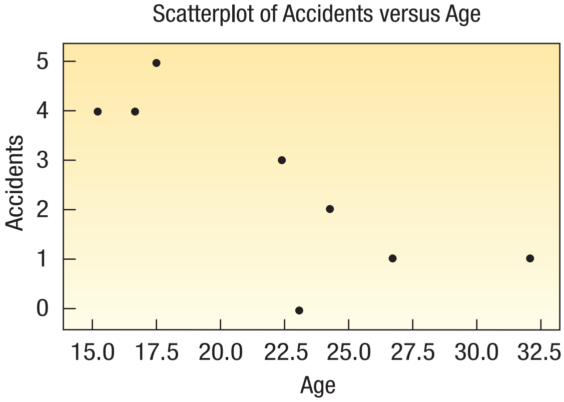
d.

Shape\ Cut	Average	Good	Ideal	Premium	Ultra Ideal	All
Emerald	0	0	1	0	0	1
Marquise	0	2	0	1	0	3
Oval	0	0	0	1	0	1
Princess	1	0	2	2	0	5
Round	1	3	3	13	3	23
Total	2	5	6	17	3	33

The majority of the diamonds are round (23). Premium cut is most common (17). The Round Premium combination occurs most often (13).

29. $sk = 0.065$ or $sk = \dfrac{3(7.7143 - 8.0)}{3.9036} = -0.22$

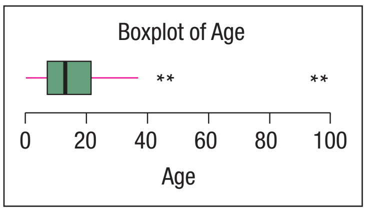
31.



As age increases, the number of accidents decreases.

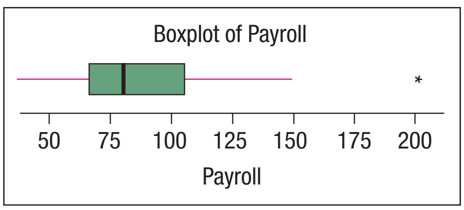
33. **a.** 139,340,000
b. 5.4% unemployed, found by (7523/139,340)100
c. Men = 5.64%
Women = 5.12%

35. **a.**



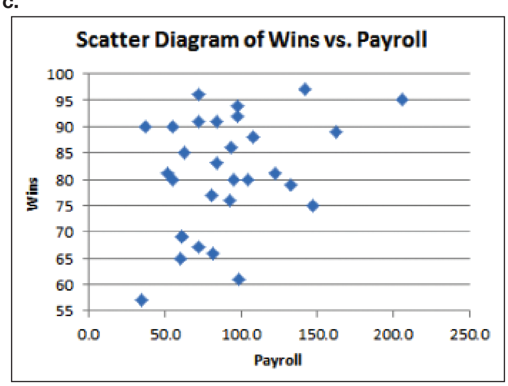
There are five outliers. There is a group of three around 50 years (Angels, Athletics, and Dodgers) and a group of two close to 100 years old (Cubs and Red Sox).

b.



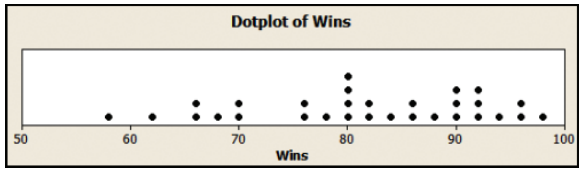
Using equation 4–1 (if using Excel, see software commands) and rounding to the nearest $0.1 million, the first quartile is $61.4 million, the third quartile is $105.8 million. The distribution is positively skewed, with the New York Yankees a definite outlier.

c.



Higher payrolls lead to more wins.

d.



The distribution is fairly uniform between 57 and 97.

CHAPTER 5

1.

	Person	
Outcome	**1**	**2**
1	A	A
2	A	F
3	F	A
4	F	F

3. **a.** .176, found by $\frac{6}{34}$ **b.** Empirical

5. **a.** Empirical
b. Classical
c. Classical
d. Empirical, based on seismological data

7. **a.** The survey of 40 people about environmental issues
b. 26 or more respond yes, for example.
c. 10/40 = .25
d. Empirical
e. The events are not equally likely, but they are mutually exclusive.

9. **a.** Answers will vary. Here are some possibilities: 123, 124, 125, 999
b. $(1/10)^3$
c. Classical

11. $P(A \text{ or } B) = P(A) + P(B) = .30 + .20 = .50$
$P(\text{neither}) = 1 - .50 = .50.$

13. **a.** 102/200 = .51
b. .49, found by 61/200 + 37/200 = .305 + .185. Special rule of addition.

15. $P(\text{above } C) = .25 + .50 = .75$

17. $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
$= .20 + .30 - .15 = .35$

19. When two events are mutually exclusive, it means that if one occurs, the other event cannot occur. Therefore, the probability of their joint occurrence is zero.

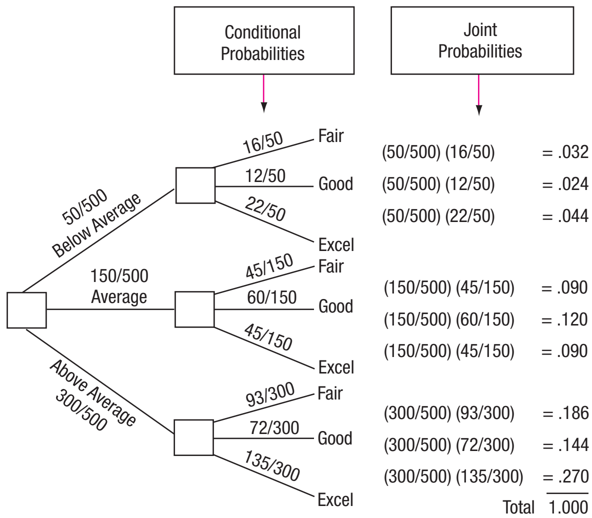
21. **a.** $P(P \text{ and } F) = 0.20$
b. $P(P \text{ and } D) = 0.30$
c. No
d. Joint probability
e. $P(P \text{ or } D \text{ or } F) = 1 - P(P \text{ and } D \text{ and } F)$
$= 1 - .10 = .90$

23. $P(A \text{ and } B) = P(A) \times P(B|A) = .40 \times .30 = .12$

25. .90, found by (.80 + .60) − .5.
.10, found by (1 − .90).

27. **a.** $P(A_1) = 3/10 = .30$
b. $P(B_1|A_2) = 1/3 = .33$
c. $P(B_2 \text{ and } A_3) = 1/10 = .10$

29. **a.** A contingency table
b. .27, found by 300/500 × 135/300
c. The tree diagram would appear as:



31. **a.** Contingency table
b. 0.842, found by 32/38
c. Independence requires that $P(A \mid B) = P(A)$. One possibility is: $P(\text{Good} \mid \text{20 up to 30 yards}) = P(\text{Good})$. Does $12/12 = 32/38$? No, the two variables are not independent.
d. 0.895, found by $12/38 + 32/38 - 10/38$
e. 0.026, found by 1/38

33. **a.** 78,960,960
b. 840, found by (7)(6)(5)(4). That is $7!/3!$
c. 10, found by $5!/3!2!$

35. 210, found by (10)(9)(8)(7)/(4)(3)(2)

37. 120, found by 5!

39. 10,897,286,400, found by $_{15}P_{10} = (15)(14)(13)(12)(11)(10)(9)(8)(7)(6)$

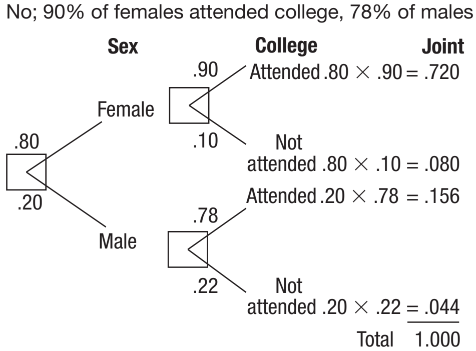
41. **a.** Asking teenagers to compare their reactions to a newly developed soft drink.
b. Answers will vary. One possibility is more than half of the respondents like it.

43. Subjective

45. **a.** 4/9, found by $(2/3) \cdot (2/3)$.
b. 3/4, because $(3/4) \cdot (2/3) = 0.5$.

47. **a.** .8145, found by $(.95)^4$
b. Special rule of multiplication
c. $P(A \text{ and } B \text{ and } C \text{ and } D) = P(A) \times P(B) \times P(C) \times P(D)$

49. **a.** .08, found by $.80 \times .10$
b. No; 90% of females attended college, 78% of males
c.



d. Yes, because all the possible outcomes are shown on the tree diagram.

51. **a.** 0.57, found by 57/100
b. 0.97, found by $(57/100) + (40/100)$
c. Yes, because an employee cannot be both.
d. 0.03, found by $1 - 0.97$

53. **a.** 1/2, found by (2/3)(3/4)
b. 1/12, found by (1/3)(1/4)
c. 11/12, found by $1 - 1/12$

55. **a.** 0.9039, found by $(0.98)^5$
b. 0.0961, found by $1 - 0.9039$

57. **a.** 0.0333, found by (4/10)(3/9)(2/8)
b. 0.1667, found by (6/10)(5/9)(4/8)
c. 0.8333, found by $1 - 0.1667$
d. Dependent

59. **a.** 0.3818, found by (9/12)(8/11)(7/10)
b. 0.6182, found by $1 - 0.3818$

61. **a.** $P(S) \cdot P(R \mid S) = .60(.85) = 0.51$
b. $P(S) \cdot P(PR \mid S) = .60(1 - .85) = 0.09$

63. **a.** $P(\text{not perfect}) = P(\text{bad sector}) + P(\text{defective})$
$$= \frac{112}{1{,}000} + \frac{31}{1{,}000} = .143$$
b. $P(\text{defective} \mid \text{not perfect}) = \dfrac{.031}{.143} = .217$

65. **a.** $P(\text{P or D}) = (1/50)(9/10) + (49/50)(1/10) = 0.116$
b. $P(\text{No}) = (49/50)(9/10) = 0.882$
c. $P(\text{No on 3}) = (0.882)^3 = 0.686$
d. $P(\text{at least one prize}) = 1 - 0.686 = 0.314$

67. Yes, 256 is found by 2^8.

69. .9744, found by $1 - (.40)^4$

71. **a.** .185, found by $(.15)(.95) + (.05)(.85)$
b. .0075, found by (.15)(.05)

73. **a.** $P(\text{F and} > 60) = .25$, found by solving with the general rule of multiplication: $P(\text{F}) \cdot P(>60 \mid \text{F}) = (.5)(.5)$
b. 0
c. .3333, found by 1/3

75. $26^4 = 456{,}976$

77. 0.512, found by $(0.8)^3$

79. .525, found by $1 - (.78)^3$

81. **a.**

Winning Season	Attendance Low	Moderate	High	Total
No	6	5	3	14
Yes	3	7	6	16
Total	9	12	9	30

1. 0.5333, found by 16/30
2. 0.6333, found by $16/30 + 9/30 - 6/30 = 19/30$
3. 0.6777, found by 6/9
4. 0.1000, found by 3/30

b.

	Losing Season	Winning Season	Total
New	7	8	15
Old	7	8	15
Total	14	16	30

1. 0.5333, found by 16/30
2. 0.2667, found by 8/30
3. 0.7667, found by $16/30 + 15/30 - 8/30$

CHAPTER 6

1. Mean = 1.3, variance = .81, found by:

$$\mu = 0(.20) + 1(.40) + 2(.30) + 3(.10) = 1.3$$
$$\sigma^2 = (0 - 1.3)^2(.2) + (1 - 1.3)^2(.4) + (2 - 1.3)^2(.3) + (3 - 1.3)^2(.1) = .81$$

3. Mean = 14.5, variance = 27.25, found by:

$$\mu = 5(.1) + 10(.3) + 15(.2) + 20(.4) = 14.5$$
$$\sigma^2 = (5 - 14.5)^2(.1) + (10 - 14.5)^2(.3) + (15 - 14.5)^2(.2) + (20 - 14.5)^2(.4) = 27.25$$

5. **a.**

Calls, x	Frequency	$P(x)$	$xP(x)$	$(x-\mu)^2 P(x)$
0	8	.16	0	.4624
1	10	.20	.20	.0980
2	22	.44	.88	.0396
3	9	.18	.54	.3042
4	1	.02	.08	.1058
	50		1.70	1.0100

b. Discrete distribution, because only certain outcomes are possible.
c. $\mu = \Sigma x \cdot P(x) = 1.70$
d. $\sigma = \sqrt{1.01} = 1.005$

7.

Amount	$P(x)$	$xP(x)$	$(x-\mu)^2 P(x)$
10	.50	5	60.50
25	.40	10	6.40
50	.08	4	67.28
100	.02	2	124.82
		21	259.00

a. $\mu = \Sigma xP(x) = 21$
b. $\sigma^2 = \Sigma(x - \mu)^2P(x) = 259$
$\sigma = \sqrt{259} = 16.093$

9. **a.** $P(2) = \frac{4!}{2!(4-2)!}(.25)^2(.75)^{4-2} = .2109$
b. $P(3) = \frac{4!}{3!(4-3)!}(.25)^3(.75)^{4-3} = .0469$

11. **a.**

X	$P(X)$
0	.064
1	.288
2	.432
3	.216

b. $\mu = 1.8$
$\sigma^2 = 0.72$
$\sigma = \sqrt{0.72} = .8485$

13. **a.** .2668, found by $P(2) = \frac{9!}{(9-2)!2!}(.3)^2(.7)^7$
b. .1715, found by $P(4) = \frac{9!}{(9-4)!4!}(.3)^4(.7)^5$
c. .0404, found by $P(0) = \frac{9!}{(9-0)!0!}(.3)^0(.7)^9$

15. **a.** .2824, found by $P(0) = \frac{12!}{(12-0)!0!}(.10)^0(.9)^{12}$
b. .3765, found by $P(1) = \frac{12!}{(12-1)!1!}(.10)^1(.9)^{11}$
c. .2301, found by $P(2) = \frac{12!}{(12-2)!2!}(.10)^2(.9)^{10}$
d. $\mu = 1.2$, found by 12(.10)
$\sigma = 1.0392$, found by $\sqrt{1.08}$

17. **a.** 0.1858, found by $\frac{15!}{2!13!}(0.23)^2(0.77)^{13}$
b. 0.1416, found by $\frac{15!}{5!10!}(0.23)^5(0.77)^{10}$
c. 3.45, found by (0.23)(15)

19. **a.** 0.296, found by using Appendix B.9 with n of 8, π of 0.30, and x of 2
b. $P(x \leq 2) = 0.058 + 0.198 + 0.296 = 0.552$
c. 0.448, found by $P(x \geq 3) = 1 - P(x \leq 2) = 1 - 0.552$

21. **a.** 0.387, found from Appendix B.9 with n of 9, π of 0.90, and x of 9
b. $P(X < 5) = 0.001$
c. 0.992, found by 1 − 0.008
d. 0.947, found by 1 − 0.053

23. **a.** $\mu = 10.5$, found by 15(0.7) and $\sigma = \sqrt{15(0.7)(0.3)} = 1.7748$
b. 0.2061, found by $\frac{15!}{10!5!}(0.7)^{10}(0.3)^5$
c. 0.4247, found by 0.2061 + 0.2186
d. 0.5154, found by
0.2186 + 0.1700 + 0.0916 + 0.0305 + 0.0047

25. **a.** .6703
b. .3297

27. **a.** .0613
b. .0803

29. $\mu = 6$
$P(X \geq 5) = 1 - (.0025 + .0149 + .0446 + .0892 + .1339) = .7149$

31. A random variable is a quantitative or qualitative outcome that results from a chance experiment. A probability distribution also includes the likelihood of each possible outcome.

33. μ = \$1,000(.25) + \$2,000(.60) + \$5,000(.15) = \$2,200
$\sigma^2 = (1{,}000 - 2{,}200)^2\,.25 + (\$2{,}000 - \$2{,}200)^2\,.60 + (5{,}000 - 2{,}200)^2\,.15 = 1{,}560{,}000$

35. $\mu = 12(.25) + \cdots + 15(.1) = 13.2$
$\sigma^2 = (12 - 13.2)^2.25 + \cdots + (15 - 13.2)^2.10 = 0.86$
$\sigma = \sqrt{0.86} = .927$

37. **a.** $\mu = 10(.35) = 3.5$
b. $P(X = 4) = {}_{10}C_4\,(.35)^4\,(.65)^6 = 210(.0150)\,(.0754) = .2375$
c. $P(X \geq 4) = {}_{10}C_x\,(.35)^X\,(.65)^{10-X} = .2375 + .1536 + \cdots + .0000 = .4862$

39. **a.** 6, found by 0.4 × 15
b. 0.0245, found by $\frac{15!}{10!5!}(0.4)^{10}(0.6)^5$
c. 0.0338, found by
0.0245 + 0.0074 + 0.0016 + 0.0003 + 0.0000
d. 0.0093, found by 0.0338 − 0.0245

41. **a.** $\mu = 20(0.075) = 1.5$
$\sigma = \sqrt{20(0.075)(0.925)} = 1.1779$
b. 0.2103, found by $\frac{20!}{0!20!}(0.075)^0(0.925)^{20}$
c. 0.7897, found by 1 − 0.2103

43. **a.** 0.1311, found by $\frac{16!}{4!12!}(0.15)^4(0.85)^{12}$
b. 2.4, found by (0.15)(16)
c. 0.2100, found by
1 − 0.0743 − 0.2097 − 0.2775 − 0.2285

45. 0.279

47. $\mu = 4.0$, from Appendix B.5
a. .0183
b. .1954
c. .6289
d. .5665

49. **a.** 0.1733, found by $\frac{(3.1)^4 e^{-3.1}}{4!}$

b. 0.0450, found by $\frac{(3.1)^0 e^{-3.1}}{0!}$

c. 0.9550, found by $1 - 0.0450$

51. $\mu = n\pi = 23\left(\frac{2}{113}\right) = .407$

$P(2) = \frac{(.407)^2 e^{-.407}}{2!} = 0.0551$

$P(0) = \frac{(.407)^0 e^{-.407}}{0!} = 0.6656$

53. **a.** $\mu = n\pi = 15(.67) = 10.05$

$\sigma = \sqrt{n\pi(1-\pi)} = \sqrt{15(.67)(.33)} = 1.8211$

b. $P(8) = {}_{15}C_8(.67)^8(.33)^7 = 6435(.0406)(.000426) = .1114$

c. $P(x \geq 8) = .1114 + .1759 + \cdots + .0025 = .9163$

55. The mean number of home runs per game is 1.89835, found by $4613/(15 \times 162)$.

a. $P(0) = \frac{1.89835^0 e^{-1.89835}}{0!} = 0.14982$

b. $P(2) = \frac{1.89835^2 e^{-1.89835}}{2!} = 0.26995$

c. $P(X >= 4) = 0.1250 = 1 - (0.1498 + 0.2844 + 0.2700 + 0.1708)$

CHAPTER 7

1. **a.** $b = 10, a = 6$

b. $\mu = \frac{6 + 10}{2} = 8$

c. $\sigma = \sqrt{\frac{(10-6)^2}{12}} = 1.1547$

d. $\text{Area} = \frac{1}{(10-6)} \cdot \frac{(10-6)}{1} = 1$

e. $P(X > 7) = \frac{1}{(10-6)} \cdot \frac{10-7}{1} = \frac{3}{4} = .75$

f. $P(7 \leq x \leq 9) = \frac{1}{(10-6)} \cdot \frac{(9-7)}{1} = \frac{2}{4} = .50$

3. **a.** 0.30, found by $(30 - 27)/(30 - 20)$

b. 0.40, found by $(24 - 20)/(30 - 20)$

5. **a.** $a = 0.5, b = 3.00$

b. $\mu = \frac{0.5 + 3.00}{2} = 1.75$

$\sigma = \sqrt{\frac{(3.00 - .50)^2}{12}} = .72$

c. $P(x < 1) = \frac{1}{(3.0 - 0.5)} \cdot \frac{1 - .5}{1} = \frac{.5}{2.5} = 0.2$

d. 0, found by $\frac{1}{(3.0 - 0.5)} \frac{(1.0 - 1.0)}{1}$

e. $P(x > 1.5) = \frac{1}{(3.0 - 0.5)} \cdot \frac{3.0 - 1.5}{1} = \frac{1.5}{2.5} = 0.6$

7. The actual shape of a normal distribution depends on its mean and standard deviation. Thus, there is a normal distribution, and an accompanying normal curve, for a mean of 7 and a standard deviation of 2. There is another normal curve for a mean of \$25,000 and a standard deviation of \$1,742, and so on.

9. **a.** 490 and 510, found by $500 \pm 1(10)$

b. 480 and 520, found by $500 \pm 2(10)$

c. 470 and 530, found by $500 \pm 3(10)$

11. $Z_{Rob} = \frac{\$50{,}000 - \$60{,}000}{\$5{,}000} = -2$

$Z_{Rachel} = \frac{\$50{,}000 - \$35{,}000}{\$8{,}000} = 1.875$

Adjusting for their industries, Rob is well below average and Rachel well above.

13. **a.** 1.25, found by $z = \frac{25 - 20}{4.0} = 1.25$

b. 0.3944, found in Appendix B.1

c. 0.3085, found by $z = \frac{18 - 20}{2.5} = -0.5$

Find 0.1915 in Appendix B.1 for $z = -0.5$, then $0.5000 - 0.1915 = 0.3085$

15. **a.** 0.3413, found by $z = \frac{\$24 - \$20.50}{\$3.50} = 1.00$, then find 0.3413 in Appendix B.1 for $z = 1$

b. 0.1587, found by $0.5000 - 0.3413 = 0.1587$

c. 0.3336, found by $z = \frac{\$19.00 - \$20.50}{\$3.50} = -0.43$

Find 0.1664 in Appendix B.1, for $z = -0.43$, then $0.5000 - 0.1664 = 0.3336$

17. **a.** 0.8276: First find $z = -1.5$, found by $(44 - 50)/4$ and $z = 1.25 = (55 - 50)/4$. The area between -1.5 and 0 is 0.4332 and the area between 0 and 1.25 is 0.3944, both from Appendix B.1. Then adding the two areas we find that $0.4332 + 0.3944 = 0.8276$.

b. 0.1056, found by $0.5000 - .3944$, where $z = 1.25$

c. 0.2029: Recall that the area for $z = 1.25$ is 0.3944, and the area for $z = 0.5$, found by $(52 - 50)/4$, is 0.1915. Then subtract 0.3944 − 0.1915 and find 0.2029.

19. **a.** 0.4052, where $z = [(3100 - 3000)/410] = 0.24$; leads to $0.5 - 0.0948 = 0.4052$.

b. 0.2940; the z value for \$3,500 is 1.22, found by $[(3500 - 3000)/410]$, and the corresponding area is 0.3888. Leads to $0.3888 - 0.0948 = 0.2940$

c. 0.8552; the z value for \$2,250 is -1.83, found by $[(2250 - 3000)/410]$, and the corresponding area is 0.4664. Then, $0.4664 + 0.3888 = 0.8552$

21. **a.** 0.0764, found by $z = (20 - 15)/3.5 = 1.43$, then $0.5000 - 0.4236 = 0.0764$

b. 0.9236, found by $0.5000 + 0.4236$, where $z = 1.43$

c. 0.1185, found by $z = (12 - 15)/3.5 = -0.86$. The area under the curve is 0.3051, then $z = (10 - 15)/3.5 = -1.43$. The area is 0.4236. Finally, $0.4236 - 0.3051 = 0.1185$.

23. $X = 56.60$, found by adding 0.5000 (the area left of the mean) and then finding a z value that forces 45% of the data to fall inside the curve. Solving for X: $1.65 = (X - 50)/4 = 56.60$.

25. \$1,630, found by \$2,100 − 1.88(\$250)

27. **a.** 214.8 hours: Find a z value where 0.4900 of area is between 0 and z. That value is $z = 2.33$. Then solve for X: $2.33 = (X - 195)/8.5$, so $X = 214.8$ hours.

b. 270.2 hours: Find a z value where 0.4900 of area is between 0 and $(-z)$. That value is $z = -2.33$. Then solve for X: $-2.33 = (X - 290)/8.5$, so $X = 270.2$ hours.

29. 41.7%, found by $12 + 1.65(18)$

31. **a.** $\mu = \frac{11.96 + 12.05}{2} = 12.005$

b. $\sigma = \sqrt{\frac{(12.05 - 11.96)^2}{12}} = .0260$

c. $P(X < 12) = \frac{1}{(12.05 - 11.96)} \frac{12.00 - 11.96}{1} = \frac{.04}{.09} = .44$

d. $P(X > 11.98) = \frac{1}{(12.05 - 11.96)}\left(\frac{12.05 - 11.98}{1}\right) = \frac{.07}{.09} = .78$

e. All cans have more than 11.00 ounces, so the probability is 100%.

33. a. $\mu = \frac{4 + 10}{2} = 7$

b. $\sigma = \sqrt{\frac{(10 - 4)^2}{12}} = 1.732$

c. $P(X < 6) = \frac{1}{(10 - 4)} \cdot \left(\frac{6 - 4}{1}\right) = \frac{2}{6} = .33$

d. $P(X > 5) = \frac{1}{(10 - 4)} \cdot \left(\frac{10 - 5}{1}\right) = \frac{5}{6} = .83$

35. a. −0.4 for net sales, found by (170 − 180)/25.
2.92 for employees, found by (1,850 − 1,500)/120.

b. Net sales are 0.4 standard deviations below the mean. Employees is 2.92 standard deviations above the mean.

c. 65.54 percent of the aluminum fabricators have greater net sales compared with Clarion, found by 0.1554 + 0.5000. Only 0.18% have more employees than Clarion, found by 0.5000 − 0.4982.

37. a. 0.5000, because $z = \frac{30 - 490}{90} = -5.11$

b. 0.2514, found by 0.5000 − 0.2486

c. 0.6374, found by 0.2486 + 0.3888

d. 0.3450, found by 0.3888 − 0.0438

39. a. 0.3015, found by 0.5000 − 0.1985

b. 0.2579, found by 0.4564 − 0.1985

c. 0.0011, found by 0.5000 − 0.4989

d. 1,818, found by 1,280 + 1.28(420)

41. a. 90.82%: First find z = 1.33, found by (40 − 34)/4.5. The area between 0 and 1.33 is 0.4082. Then add 0.5000 and 0.4082 and find 0.9082 or 90.82%.

b. 78.23%: First find z = −0.78 found by (25 − 29)/5.1. The area between 0 and (−0.78) is 0.2823. Then add 0.5000 and 0.2823 and find 0.7823 or 78.23%.

c. 44.5 hours/week for women: Find a z value where 0.4900 of the area is between 0 and z. That value is 2.33. Then solve for X: 2.33 = (X − 34)/4.5, so X = 44.5 hours/week. 40.9 hours/week for men: 2.33 = (X − 29)/5.1, so X = 40.9 hours/week.

43. About 4,099 units, found by solving for X.
1.65 = (X − 4,000)/60

45. a. 15.39%, found by (8 − 10.3)/2.25 = −1.02, then 0.5000 − 0.3461 = 0.1539.

b. 17.31%, found by:
z = (12 − 10.3)/2.25 = 0.76. Area is 0.2764.
z = (14 − 10.3)/2.25 = 1.64. Area is 0.4495.
The area between 12 and 14 is 0.1731, found by 0.4495 − 0.2764.

c. Yes, but it is rather remote. Reasoning:
On 99.73% of the days, returns are between 3.55 and 17.05, found by 10.3 ± 3(2.25). Thus, the chance of less than 3.55 returns is rather remote.

47. a. 21.19% found by z = (9.00 − 9.20)/0.25 = −0.80, so 0.5000 − 0.2881 = 0.2119

b. Increase the mean. z = (9.00 − 9.25)/0.25 = −1.00, P = 0.5000 − 0.3413 = 0.1587.
Reduce the standard deviation. z = (9.00 − 9.20)/0.15 = −1.33; P = 0.5000 − 0.4082 = 0.0918.
Reducing the standard deviation is better because a smaller percent of the hams will be below the limit.

49. a. z = (60 − 52)/5 = 1.60, so 0.5000 − 0.4452 = 0.0548

b. Let z = 0.67, so 0.67 = (X − 52)/5 and X = 55.35, set mileage at 55,350

c. z = (45 − 52)/5 = −1.40, so 0.5000 − 0.4192 = 0.0808

51. $\frac{470 - \mu}{\sigma} = 0.25$ $\quad \frac{500 - \mu}{\sigma} = 1.28$ $\quad \sigma = 29{,}126$ and $\mu = 462{,}718$

53. a. 1.65 = (45 − μ)/5 $\quad \mu$ = 36.75

b. 1.65 = (45 − μ)/10 $\quad \mu$ = 28.5

c. z = (30 − 28.5)/10 = 0.15, then 0.5000 + 0.0596 = 0.5596

55. a. Estimate is 2.043, rounding up to 3; z = (3.5 − 2.436)/0.713 = 1.49; leads to 0.5000 − 0.4319 = 0.0681. 2.043 teams is (30)(0.0681), rounding up to 3. There were actually 3 teams that exceeded 3.5 million. Estimate is fairly accurate.

b. Estimate is 25.7, or 26 teams. z = (50 − 91.020)/38.258 = −1.07; leads to 0.3577 + 0.5000 = 0.8577. 25.7 teams is 0.8577(30). There were actually 28 teams that exceeded $50 million in payroll. Estimate is fairly accurate.

CHAPTER 8

1. a. 303 Louisiana, 5155 S. Main, 3501 Monroe, 2652 W. Central

b. Answers will vary.

c. 630 Dixie Hwy, 835 S. McCord Rd, 4624 Woodville Rd

d. Answers will vary.

3. a. Bob Schmidt Chevrolet
Great Lakes Ford Nissan
Grogan Towne Chrysler
Southside Lincoln Mercury
Rouen Chrysler Jeep Eagle

b. Answers will vary.

c. Yark Automotive
Thayer Chevrolet Toyota
Franklin Park Lincoln Mercury
Mathews Ford Oregon Inc.
Valiton Chrysler

5. a.

Sample	Values	Sum	Mean
1	12, 12	24	12
2	12, 14	26	13
3	12, 16	28	14
4	12, 14	26	13
5	12, 16	28	14
6	14, 16	30	15

b. $\mu_{\bar{X}}$ = (12 + 13 + 14 + 13 + 14 + 15)/6 = 13.5
μ = (12 + 12 + 14 + 16)/4 = 13.5

c. More dispersion with population data compared to the sample means. The sample means vary from 12 to 15, whereas the population varies from 12 to 16.

7. a.

Sample	Values	Sum	Mean
1	12, 12, 14	38	12.66
2	12, 12, 15	39	13.00
3	12, 12, 20	44	14.66
4	14, 15, 20	49	16.33
5	12, 14, 15	41	13.66
6	12, 14, 15	41	13.66
7	12, 15, 20	47	15.66
8	12, 15, 20	47	15.66
9	12, 14, 20	46	15.33
10	12, 14, 20	46	15.33

b. $\mu_{\bar{X}} = \frac{(12.66 + \cdots + 15.33 + 15.33)}{10} = 14.6$
μ = (12 + 12 + 14 + 15 + 20)/5 = 14.6

c. The dispersion of the population is greater than that of the sample means. The sample means vary from 12.66 to 16.33, whereas the population varies from 12 to 20.

9. a. 20, found by ${}_6C_3$

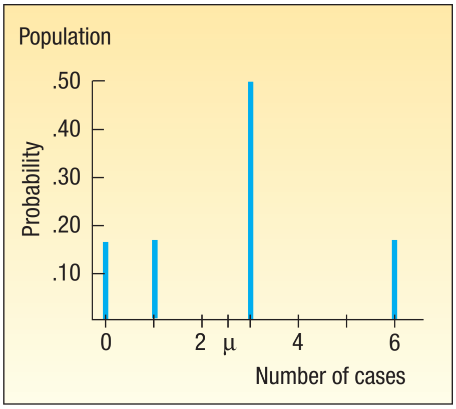
b.

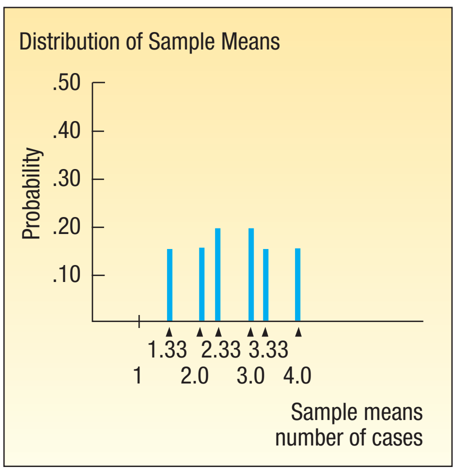
Sample	Cases	Sum	Mean
Ruud, Wu, Sass	3, 6, 3	12	4.00
Ruud, Sass, Flores	3, 3, 3	9	3.00
⋮	⋮	⋮	⋮
Sass, Flores, Schueller	3, 3, 1	7	2.33

c. $\mu_{\bar{X}} = 2.67$, found by $\frac{53.33}{20}$.

$\mu = 2.67$, found by $(3 + 6 + 3 + 3 + 0 + 1)/6$.
They are equal.

d.

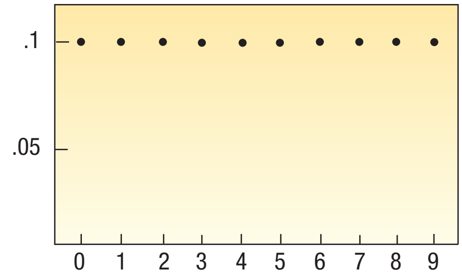




Sample Mean	Number of Means	Probability
1.33	3	.1500
2.00	3	.1500
2.33	4	.2000
3.00	4	.2000
3.33	3	.1500
4.00	3	.1500
	20	1.0000

The population has more dispersion than the sample means. The sample means vary from 1.33 to 4.0. The population varies from 0 to 6.

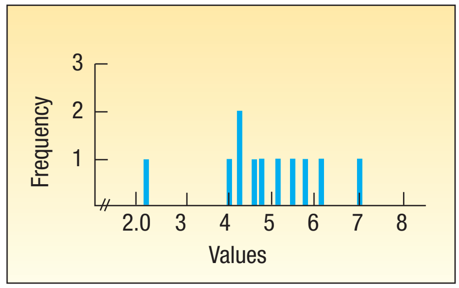
11. a.



$$\mu = \frac{0 + 1 + \cdots + 9}{10} = 4.5$$

b.

Sample	Sum	$\bar{X}$	Sample	Sum	$\bar{X}$
1	11	2.2	6	20	4.0
2	31	6.2	7	23	4.6
3	21	4.2	8	29	5.8
4	24	4.8	9	35	7.0
5	21	4.2	10	27	5.4



The mean of the 10 sample means is 4.84, which is close to the population mean of 4.5. The sample means range from 2.2 to 7.0, whereas the population values range from 0 to 9. From the above graph, the sample means tend to cluster between 4 and 5.

13. a.–c. Answers will vary depending on the coins in your possession.

15. a. $z = \frac{63 - 60}{12/\sqrt{9}} = 0.75$

$P = .2266$, found by $.5000 - .2734$

b. $z = \frac{56 - 60}{12/\sqrt{9}} = -1.00$

$P = .1587$, found by $.5000 - .3413$

c. $P = .6147$, found by $0.3413 + 0.2734$

17. $z = \frac{1{,}950 - 2{,}200}{250/\sqrt{50}} = -7.07 \quad P = 1$, or virtually certain

19. a. Formal Man, Summit Stationers, Bootleggers, Leather Ltd, Petries

b. Answers may vary.

c. Elder-Beerman, Frederick's of Hollywood, Summit Stationers, Lion Store, Leather Ltd., Things Remembered, County Seat, Coach House Gifts, Regis Hairstylists

21. a.

Samples	Mean	Deviation from Mean	Square of Deviation
1, 1	1.0	−1.0	1.0
1, 2	1.5	−0.5	0.25
1, 3	2.0	0.0	0.0
2, 1	1.5	−0.5	0.25
2, 2	2.0	0.0	0.0
2, 3	2.5	0.5	0.25
3, 1	2.0	0.0	0.0
3, 2	2.5	0.5	0.25
3, 3	3.0	1.0	1.0

b. Mean of sample means is (1.0 + 1.5 + 2.0 + ⋯ + 3.0)/9 = 18/9 = 2.0. The population mean is (1 + 2 + 3)/3 = 6/3 = 2. They are the same value.
c. Variance of sample means is (1.0 + 0.25 + 0.0 + ⋯ + 1.0)/9 = 3/9 = 1/3. Variance of the population values is (1 + 0 + 1)/3 = 2/3. The variance of the population is twice as large as that of the sample means.
d. Sample means follow a triangular shape peaking at 2. The population is uniform between 1 and 3.

23. Larger samples provide narrower estimates of a population mean. So the company with 200 sampled customers can provide more precise estimates. In addition, they are selected consumers who are familiar with laptop computers and may be better able to evaluate the new computer.

25. **a.** We selected 60, 104, 75, 72, and 48. Answers will vary.
b. We selected the third observation. So the sample consists of 75, 72, 68, 82, 48. Answers will vary.
c. Number the first 20 motels from 00 to 19. Randomly select three numbers. Then number the last five numbers 20 to 24. Randomly select two numbers from that group.

27. **a.** 15, found by ${}_6C_2$
b.

Sample	Value	Sum	Mean
1	79, 64	143	71.5
2	79, 84	163	81.5
⋮	⋮	⋮	⋮
15	92, 77	169	84.5
			1,195.0

c. $\mu_{\bar{X}}$ = 79.67, found by 1,195/15.
μ = 79.67, found by 478/6.
They are equal.
d. No. The student is not graded on all available information. He/she is as likely to get a lower grade based on the sample as a higher grade.

29. **a.** 10, found by ${}_5C_2$
b.

Number of Shutdowns	Mean	Number of Shutdowns	Mean
4, 3	3.5	3, 3	3.0
4, 5	4.5	3, 2	2.5
4, 3	3.5	5, 3	4.0
4, 2	3.0	5, 2	3.5
3, 5	4.0	3, 2	2.5

Sample Mean	Frequency	Probability
2.5	2	.20
3.0	2	.20
3.5	3	.30
4.0	2	.20
4.5	1	.10
	10	1.00

c. $\mu_{\bar{X}} = (3.5 + 4.5 + \cdots + 2.5)/10 = 3.4$
$\mu = (4 + 3 + 5 + 3 + 2)/5 = 3.4$
The two means are equal.
d. The population values are relatively uniform in shape. The distribution of sample means tends toward normality.

31. **a.** The distribution will be normal.
b. $\sigma_{\bar{X}} = \dfrac{5.5}{\sqrt{25}} = 1.1$
c. $z = \dfrac{36 - 35}{5.5/\sqrt{25}} = 0.91$
P = 0.1814, found by 0.5000 − 0.3186
d. $z = \dfrac{34.5 - 35}{5.5/\sqrt{25}} = -0.45$
P = 0.6736, found by 0.5000 + 0.1736
e. 0.4922, found by 0.3186 + 0.1736

33. $z = \dfrac{\$335 - \$350}{\$45/\sqrt{40}} = -2.11$
P = 0.9826, found by 0.5000 + 0.4826

35. $z = \dfrac{25.1 - 24.8}{2.5/\sqrt{60}} = 0.93$
P = 0.8238, found by 0.5000 + 0.3238

37. Between 5,954 and 6,046, found by 6,000 ± 1.96 $(150/\sqrt{40})$

39. $z = \dfrac{900 - 947}{205/\sqrt{60}} = -1.78$
P = 0.0375, found by 0.5000 − 0.4625

41. **a.** Alaska, Connecticut, Georgia, Kansas, Nebraska, South Carolina, Virginia, Utah
b. Arizona, Florida, Iowa, Massachusetts, Nebraska, North Carolina, Rhode Island, Vermont

43. **a.** $z = \dfrac{600 - 510}{14.28/\sqrt{10}} = 19.9$, $P = 0.00$, or virtually never
b. $z = \dfrac{500 - 510}{14.28/\sqrt{10}} = -2.21$,
P = 0.4864 + 0.5000 = 0.9864
c. $z = \dfrac{500 - 510}{14.28/\sqrt{10}} = -2.21$,
P = 0.5000 − 0.4864 = 0.0136

45. **a.** $\sigma_{\bar{X}} = \dfrac{2.1}{\sqrt{81}} = 0.23$
b. $z = \dfrac{7.0 - 6.5}{2.1/\sqrt{81}} = 2.14$, $z = \dfrac{6.0 - 6.5}{2.1/\sqrt{81}} = -2.14$,
P = .4838 + .4838 = .9676
c. $z = \dfrac{6.75 - 6.5}{2.1/\sqrt{81}} = 1.07$, $z = \dfrac{6.25 - 6.5}{2.1/\sqrt{81}} = -1.07$,
P = .3577 + .3577 = .7154
d. .0162 found by .5000 − .4838

47. Mean 2010 attendance is 2.436 million. Likelihood of a sample mean this large or larger is 0.0721, found by 0.5000 − 0.4279. The z value is 1.46.

CHAPTER 9

1. 51.32 and 58.68, found by 55 ± 2.576$(10/\sqrt{49})$

3. **a.** 1.581, found by $\sigma_{\bar{x}} = 25/\sqrt{250}$
b. The population is normally distributed and the population variance is known.
c. 16.901 and 23.099, found by 20 ± 3.099

5. **a.** \$20. It is our best estimate of the population mean.
b. \$18.60 and \$21.40, found by \$20 ± 1.96$(\$5/\sqrt{49})$. About 95% of the intervals similarly constructed will include the population mean.

7. **a.** 8.60 gallons.
b. 7.84 and 9.36, found by 8.60 ± 2.576$(2.30/\sqrt{60})$
c. If 100 such intervals were determined, the population mean would be included in about 99 intervals.

9. **a.** 2.201
b. 1.729
c. 3.499

11. **a.** The population mean is unknown, but the best estimate is 20, the sample mean.
b. Use the t distribution since the standard deviation is unknown. However, assume the population is normally distributed.
c. 2.093
d. Between 19.06 and 20.94, found by $20 \pm 2.093(2/\sqrt{20})$
e. Neither value is reasonable, because they are not inside the interval.

13. Between 95.39 and 101.81, found by $98.6 \pm 1.833(5.54/\sqrt{10})$

15. **a.** 0.8, found by 80/100
b. Between 0.72 and 0.88, found by
$$0.8 \pm 1.96\left(\sqrt{\frac{0.8(1-0.8)}{100}}\right)$$
c. We are reasonably sure the population proportion is between 72% and 88%.

17. **a.** 0.625, found by 250/400
b. Between 0.563 and 0.687, found by
$$0.625 \pm 2.576\left(\sqrt{\frac{0.625(1-0.625)}{400}}\right)$$
c. We are reasonably sure the population proportion is between 56% and 69%.

19. 97, found by $n = \left(\frac{1.96 \times 10}{2}\right)^2 = 96.04$

21. 196, found by $n = 0.15(0.85)\left(\frac{1.96}{0.05}\right)^2 = 195.9216$

23. 554, found by $n = \left(\frac{1.96 \times 3}{0.25}\right)^2 = 553.19$

25. **a.** 577, found by $n = 0.60(0.40)\left(\frac{1.96}{0.04}\right)^2 = 576.24$
b. 601, found by $n = 0.50(0.50)\left(\frac{1.96}{0.04}\right)^2 = 600.25$

27. 6.13 years to 6.87 years, found by $6.5 \pm 1.989(1.7/\sqrt{85})$

29. **a.** Between \$313.41 and 332.59, found by
$$323 \pm 2.426\left(\frac{25}{\sqrt{40}}\right).$$
b. \$350 is not reasonable, because it is outside of the confidence interval.

31. **a.** The population mean is unknown.
b. Between 7.50 and 9.14, found by $8.32 \pm 1.685(3.07/\sqrt{40})$
c. 10 is not reasonable because it is outside the confidence interval.

33. **a.** 65.49 up to 71.71 hours, found by $68.6 \pm 2.680(8.2/\sqrt{50})$
b. The value suggested by the NCAA is included in the confidence interval. Therefore, it is reasonable.
c. Changing the confidence interval to 95 would reduce the width of the interval. The value of 2.680 would change to 2.010.

35. 61, found by $1.96(16/\sqrt{n}) = 4$

37. Between \$13,734 up to \$15,028, found by $14{,}381 \pm 1.711(1{,}892/\sqrt{25})$. 15,000 is reasonable because it is inside the confidence interval.

39. **a.** \$62.583, found by \$751/12
b. Between \$60.54 and \$64.63, found by $62.583 \pm 1.796(3.94/\sqrt{12})$
c. \$60 is not reasonable, because it is outside the confidence interval.

41. **a.** 89.4667, found by 1,342/15
b. Between 84.99 and 93.94, found by $89.4667 \pm 2.145(8.08/\sqrt{15})$
c. Yes, because even the lower limit of the confidence interval is above 80.

43. The confidence interval is between 0.011 and 0.059, found by $0.035 \pm 2.576\left(\sqrt{\frac{0.035(1-0.035)}{400}}\right)$. It would not be reasonable to conclude that fewer than 5% of the employees are now failing the test, because 0.05 is inside the confidence interval.

45. Between .65 and .75, found by $.7 \pm 2.576\sqrt{(.7)(.3)/500}$. Yes, she will be reelected. She will receive more than 50% of the vote.

47. 369, found by $n = 0.60(1-0.60)(1.96/0.05)^2$

49. 97, found by $[(1.96 \times 500)/100]^2$

51. **a.** Between 7,849 and 8,151, found by $8{,}000 \pm 2.756(300/\sqrt{30})$
b. 554, found by $n = \left(\frac{(1.96)(300)}{25}\right)^2$

53. **a.** Between 75.44 and 80.56, found by $78 \pm 2.010(9/\sqrt{50})$
b. 220, found by $n = \left(\frac{(1.645)(9)}{1.0}\right)^2$

55. **a.** 30, found by $180/\sqrt{36}$
b. \$355.10 and \$476.90, found by $\$416 \pm 2.030\left(\frac{\$180}{\sqrt{36}}\right)$
c. About 1,245, found by $\left(\frac{1.96(180)}{10}\right)^2$

57. **a.** 708.13, rounded up to 709, found by $0.21(1-0.21)(1.96/0.03)^2$
b. 1,068, found by $0.50(0.50)(1.96/0.03)^2$

59. **a.** Between 0.156 and 0.184, found by
$$0.17 \pm 1.96\sqrt{\frac{(0.17)(1-0.17)}{2700}}$$
b. Yes, because 18% is inside the confidence interval.
c. 21,682; found by $0.17(1-0.17)[1.96/0.005]^2$

61. Between 12.69 and 14.11, found by $13.4 \pm 1.96\,(6.8/\sqrt{352})$

63. **a.** For selling price: 211.99 up to 230.22, found by $221.1 \pm (1.983)(47.11/\sqrt{105}) = 221.1 \pm 9.12$
b. For distance: 13.685 up to 15.572, found by $14.629 \pm (1.983)(4.874/\sqrt{105}) = 14.629 \pm 0.943$
c. For garage: 0.5867 up to 0.7657, found by $0.6762 \pm (1.96)\sqrt{\frac{0.6762(1-0.6762)}{105}} = 0.6762 \pm 0.0895$
d. Answers may vary.

65. **a.** Between \$438.34 and 462.24, found by
$$450.29 \pm 1.99\left(\frac{53.69}{\sqrt{80}}\right)$$
b. Between 820.72 and 839.50, found by
$$830.11 \pm 1.99\left(\frac{42.19}{\sqrt{80}}\right)$$
c. Answers will vary.

CHAPTER 10

1. **a.** Two-tailed
b. Reject H_0 when z does not fall in the region between -1.96 and 1.96.
c. -1.2, found by $z = (49-50)/(5/\sqrt{36}) = -1.2$
d. Fail to reject H_0.
e. $p = .2302$, found by 2(.5000 − .3849). A 23.02% chance of finding a z value this large when H_0 is true.

3. **a.** One-tailed
b. Reject H_0 when $z > 1.645$.
c. 1.2, found by $z = (21-20)/(5/\sqrt{36}) = 1.2$
d. Fail to reject H_0 at the .05 significance level
e. $p = .1151$, found by .5000 − .3849. An 11.51% chance of finding a z value this large or larger when the null hypothesis is true.

5. **a.** H_0: $\mu = 60{,}000$ H_1: $\mu \neq 60{,}000$
b. Reject H_0 if $z < -1.96$ or $z > 1.96$.
c. -0.69, found by:

$$z = \frac{59{,}500 - 60{,}000}{(5{,}000/\sqrt{48})} = -0.69$$

d. Do not reject H_0.
e. $p = .4902$, found by $2(.5000 - .2549)$. Crosset's experience is not different from that claimed by the manufacturer. If H_0 is true, the probability of finding a value more extreme than this is .4902.

7. **a.** H_0: $\mu \geq 6.8$ H_1: $\mu < 6.8$
b. Reject H_0 if $z < -1.645$
c. $z = \dfrac{6.2 - 6.8}{0.5/\sqrt{36}} = -7.2$
d. H_0 is rejected.
e. $p = 0$. The mean number of DVDs watched is less than 6.8 per month. If H_0 is true, there is virtually no chance of getting a statistic this small.

9. **a.** Reject H_0 when $t > 1.833$.
b. $t = \dfrac{12 - 10}{(3/\sqrt{10})} = 2.108$
c. Reject H_0. The mean is greater than 10.

11. H_0: $\mu \leq 40$ H_1: $\mu > 40$

Reject H_0 if $t > 1.703$.

$$t = \frac{42 - 40}{(2.1/\sqrt{28})} = 5.040$$

Reject H_0 and conclude that the mean number of calls is greater than 40 per week.

13. H_0: $\mu \leq 40{,}000$ H_1: $\mu > 40{,}000$

Reject H_0 if $t > 1.833$.

$$t = \frac{50{,}000 - 40{,}000}{10{,}000/\sqrt{10}} = 3.16$$

Reject H_0 and conclude that the mean income in Wilmington is greater than \$40,000.

15. **a.** Reject H_0 if $t < -3.747$.
b. $\overline{X} = 17$ and $s = \sqrt{\dfrac{50}{5 - 1}} = 3.536$

$$t = \frac{17 - 20}{(3.536/\sqrt{5})} = -1.90$$

c. Do not reject H_0. We cannot conclude the population mean is less than 20.
d. Between .05 and .10, about .065

17. H_0: $\mu \leq 1.4$ H_1: $\mu > 1.4$

Reject H_0 if $t > 2.821$.

$$t = \frac{1.6 - 1.4}{0.216/\sqrt{10}} = 2.93$$

Reject H_0 and conclude that the drug has increased the amount of water consumption. The p-value is between 0.01 and 0.005.
There is a slight probability (between one chance in 100 and one chance in 200) this rise could have arisen by chance.

19. H_0: $\mu \leq 50$ H_1: $\mu > 50$

Reject H_0 if $t > 1.796$.

$$t = \frac{82.5 - 50}{59.5/\sqrt{12}} = 1.89$$

Reject H_0 and conclude that the mean number of text messages is greater than 50. The p-value is less than 0.05. There is a slight probability (less than one chance in 20) this could happen by chance.

21. **a.** H_0 is rejected if $z > 1.645$.
b. 1.09, found by $z = (0.75 - 0.70)/\sqrt{(0.70 \times 0.30)/100}$
c. H_0 is not rejected.

23. **a.** H_0: $\pi \leq 0.52$ H_1: $\pi > 0.52$
b. H_0 is rejected if $z > 2.326$.
c. 1.62, found by $z = (.5667 - .52)/\sqrt{(0.52 \times 0.48)/300}$
d. H_0 is not rejected. We cannot conclude that the proportion of men driving on the Ohio Turnpike is larger than 0.52.

25. **a.** H_0: $\pi \geq 0.90$ H_1: $\pi < 0.90$
b. H_0 is rejected if $z < -1.282$.
c. -2.67, found by $z = (0.82 - 0.90)/\sqrt{(0.90 \times 0.10)/100}$
d. H_0 is rejected. Fewer than 90% of the customers receive their orders in less than 10 minutes.

27. H_0: $\mu = \$45{,}000$ H_1: $\mu \neq \$45{,}000$
Reject H_0 if $z < -1.645$ or $z > 1.645$.

$$z = \frac{45{,}500 - 45{,}000}{\$3{,}000/\sqrt{120}} = 1.83$$

Reject H_0. We can conclude that the mean salary is not \$45,000. p-value 0.0672, found by $2(0.5000 - 0.4664)$.

29. H_0: $\mu \geq 10$ H_1: $\mu < 10$
Reject H_0 if $z < -1.645$.

$$z = \frac{9.0 - 10.0}{2.8/\sqrt{50}} = -2.53$$

Reject H_0. The mean weight loss is less than 10 pounds. p-value $= 0.5000 - 0.4943 = 0.0057$

31. H_0: $\mu \geq 7.0$ H_1: $\mu < 7.0$
Assuming a 5% significance level, reject H_0 if $t < -1.677$.

$$t = \frac{6.8 - 7.0}{0.9/\sqrt{50}} = -1.57$$

Do not reject H_0. West Virginia students are not sleeping less than 6 hours. p-value is between .05 and .10.

33. H_0: $\mu \geq 3.13$ H_1: $\mu < 3.13$
Reject H_0 if $t < -1.711$

$$t = \frac{2.86 - 3.13}{1.20/\sqrt{25}} = -1.13$$

We fail to reject H_0 and conclude that the mean number of residents is not necessarily less than 3.13.

35. H_0: $\mu \leq 14$ H_1: $\mu > 14$
Reject H_0 if $t > 2.821$.
$\overline{X} = 15.66$ $s = 1.544$

$$t = \frac{15.66 - 14.00}{1.544/\sqrt{10}} = 3.400$$

Reject H_0. The average rate is greater than 14%.

37. H_0: $\mu = 3.1$ H_1: $\mu \neq 3.1$ Assume a normal population.
Reject H_0 if $t < -2.201$ or $t > 2.201$.

$$\overline{X} = \frac{41.1}{12} = 3.425$$

$$s = \sqrt{\frac{4.0625}{12 - 1}} = .6077$$

$$t = \frac{3.425 - 3.1}{.6077/\sqrt{12}} = 1.853$$

Do not reject H_0. Cannot show a difference between senior citizens and the national average. p-value is about 0.09.

39. H_0: $\mu \geq 6.5$ H_1: $\mu < 6.5$ Assume a normal population.
Reject H_0 if $t < -2.718$.
$\overline{X} = 5.1667$ $s = 3.1575$

$$t = \frac{5.1667 - 6.5}{3.1575/\sqrt{12}} = -1.463$$

Do not reject H_0. The p-value is greater than 0.05.

41. H_0: $\mu = 0$ H_1: $\mu \neq 0$
Reject H_0 if $t < -2.110$ or $t > 2.110$.

$\overline{X} = -0.2322 \qquad s = 0.3120$

$$t = \frac{-0.2322 - 0}{0.3120/\sqrt{18}} = -3.158$$

Reject H_0. The mean gain or loss does not equal 0. The p-value is less than 0.01, but greater than 0.001.

43. H_0: $\mu \leq 100 \qquad H_1$: $\mu > 100$ Assume a normal population.
Reject H_0 if $t > 1.761$.

$$\overline{X} = \frac{1{,}641}{15} = 109.4$$

$$s = \sqrt{\frac{1{,}389.6}{15 - 1}} = 9.9628$$

$$t = \frac{109.4 - 100}{9.9628/\sqrt{15}} = 3.654$$

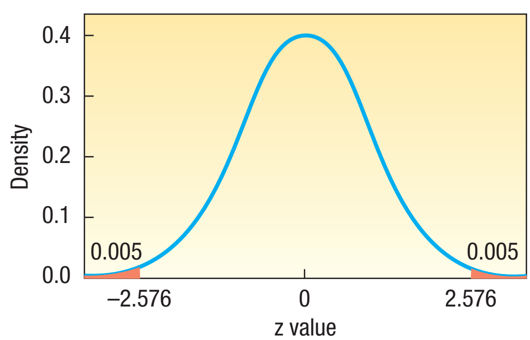
Reject H_0. The mean number with the scanner is greater than 100. p-value is 0.001.

45. H_0: $\mu = 1.5 \qquad H_1$: $\mu \neq 1.5$
Reject H_0 if $t > 3.250$ or $t < -3.250$.

$$t = \frac{1.3 - 1.5}{0.9/\sqrt{10}} = -0.703$$

Do not reject H_0.

47. **a.** This is a binomial situation with both the mean number of successes and failures equal to 22.5, found by 0.5×45.
b. H_0: $\pi = 0.50 \qquad H_1$: $\pi \neq 0.50$
c.



Reject H_0 if z is not between -2.576 and 2.576.

d. $$z = \frac{\left(\frac{31}{45}\right) - 0.50}{\sqrt{0.50(1 - 0.50)/45}} = 2.534$$ We do not reject the null hypothesis. These data do not prove the coin flip is biased.
e. The p-value is 0.0114, found by $2 \times (0.5000 - 0.4943)$. A value this extreme will happen about once out of fifty times with a fair coin.

49. H_0: $\pi \leq 0.60 \qquad H_1$: $\pi > 0.60$
H_0 is rejected if $z > 2.326$.

$$z = \frac{.70 - .60}{\sqrt{\frac{.60(.40)}{200}}} = 2.89$$

H_0 is rejected. Ms. Dennis is correct. More than 60% of the accounts are more than three months old.

51. H_0: $\pi \leq 0.44 \qquad H_1$: $\pi > 0.44$
H_0 is rejected if $z > 1.645$.

$$z = \frac{0.480 - 0.44}{\sqrt{(0.44 \times 0.56)/1{,}000}} = 2.55$$

H_0 is rejected. We conclude that there has been an increase in the proportion of people wanting to go to Europe.

53. H_0: $\pi \leq 0.20 \qquad H_1$: $\pi > 0.20$
H_0 is rejected if $z > 2.326$

$$z = \frac{(56/200) - 0.20}{\sqrt{(0.20 \times 0.80)/200}} = 2.83$$

H_0 is rejected. More than 20% of the owners move during a particular year. p-value $= 0.5000 - 0.4977 = 0.0023$.

55. H_0: $\pi \leq 0.40 \qquad H_1$: $\pi > 0.40$
Reject H_0 if z is greater than 2.326.

$$z = \frac{(16/30) - 0.40}{\sqrt{[0.40(1 - 0.40)/30]}} = 1.49$$

Do not reject the null hypothesis. These data do not show that college students are more likely to skip breakfast.

57. H_0: $\pi \geq 0.0008 \qquad H_1$: $\pi < 0.0008$
H_0 is rejected if $z < -1.645$.

$$z = \frac{0.0006 - 0.0008}{\sqrt{\frac{0.0008\,(0.9992)}{10{,}000}}} = -0.707 \quad H_0 \text{ is not rejected.}$$

These data do not prove there is a reduced fatality rate.

59. H_0: $\mu \geq 8 \qquad H_1$: $\mu < 8$
Reject H_0 if $t < -1.714$.

$$t = \frac{7.5 - 8}{3.2/\sqrt{24}} = -0.77$$

Do not reject the null hypothesis. The time is not less.

61. **a.** H_0: $\mu = 80 \qquad H_1$: $\mu \neq 80$
Reject H_0 if t is not between -2.045 and 2.045.

$$t = \frac{91.02 - 80}{38.26/\sqrt{30}} = 1.578 \qquad \text{Do not reject the null.}$$

The mean payroll could be \$80.0 million.
b. H_0: $\mu \leq 2{,}000{,}000 \qquad H_1$: $\mu > 2{,}000{,}000$
Reject H_0 if t is > 1.699.

$$t = \frac{2{,}436{,}000 - 2{,}000{,}000}{713{,}000/\sqrt{30}} = 3.349$$

Reject the null. The mean attendance was more than 2,000,000.

CHAPTER 11

1. **a.** Two-tailed test
b. Reject H_0 if $z < -2.05$ or $z > 2.05$
c. $$z = \frac{102 - 99}{\sqrt{\frac{5^2}{40} + \frac{6^2}{50}}} = 2.59$$
d. Reject H_0
e. p-value $= .0096$, found by $2(.5000 - .4952)$

3. **Step 1** H_0: $\mu_1 \geq \mu_2 \qquad H_1$: $\mu_1 < \mu_2$
Step 2 The .05 significance level was chosen.
Step 3 Reject H_0 if $z < -1.645$.
Step 4 -0.94, found by:

$$z = \frac{7.6 - 8.1}{\sqrt{\frac{(2.3)^2}{40} + \frac{(2.9)^2}{55}}} = -0.94$$

Step 5 Do not reject H_0. Babies using the Gibbs brand did not gain less weight. p-value $= .1736$, found by $.5000 - .3264$.

5. H_0: $\mu_1 \leq \mu_2 \qquad H_1$: $\mu_1 > \mu_2$
If $z > 1.645$, reject H_0.

$$z = \frac{61.4 - 60.6}{\sqrt{\frac{(1.2)^2}{45} + \frac{(1.1)^2}{39}}} = 3.187$$

Reject the null. It is reasonable to conclude that those who had a Caesarean section are shorter.
The p-value is virtually zero. That much of a difference could almost never be due to sampling error.

7. **a.** H_0 is rejected if $z > 1.645$.

b. 0.64, found by $p_c = \dfrac{70 + 90}{100 + 150}$

c. 1.61, found by

$$z = \frac{0.70 - 0.60}{\sqrt{[(0.64 \times 0.36)/100] + [(0.64 \times 0.36)/150]}}$$

d. H_0 is not rejected.

9. **a.** H_0: $\pi_1 = \pi_2$ $\quad H_1$: $\pi_1 \neq \pi_2$

b. H_0 is rejected if $z < -1.96$ or $z > 1.96$.

c. $p_c = \dfrac{24 + 40}{400 + 400} = 0.08$

d. -2.09, found by

$$z = \frac{0.06 - 0.10}{\sqrt{[(0.08 \times 0.92)/400] + [(0.08 \times 0.92)/400]}}$$

e. H_0 is rejected. The proportion infested is not the same in the two fields.

11. H_0: $\pi_d \leq \pi_r$ $\quad H_1$: $\pi_d > \pi_r$
H_0 is rejected if $z > 2.05$.

$$p_c = \frac{168 + 200}{800 + 1{,}000} = 0.2044$$

$$z = \frac{0.21 - 0.20}{\sqrt{\dfrac{(0.2044)(0.7956)}{800} + \dfrac{(0.2044)(0.7956)}{1{,}000}}} = 0.52$$

H_0 is not rejected. We cannot conclude that a larger proportion of Democrats favor lowering the standards.
p-value = 0.3015.

13. **a.** Reject H_0 if $t > 2.120$ or $t < -2.120$.
$df = 10 + 8 - 2 = 16$

b. $s_p^2 = \dfrac{(10 - 1)(4)^2 + (8 - 1)(5)^2}{10 + 8 - 2} = 19.9375$

c. $t = \dfrac{23 - 26}{\sqrt{19.9375\left(\dfrac{1}{10} + \dfrac{1}{8}\right)}} = -1.416$

d. Do not reject H_0.

e. p-value is greater than 0.10 and less than 0.20.

15. H_0: $\mu_1 = \mu_2$ $\quad H_1$: $\mu_1 \neq \mu_2$
$df = n_1 + n_2 - 2 = 16 + 14 - 2 = 28$
Reject H_0 if $t > 2.376$ or $t < -2.376$.

$$s_p^2 = \frac{(16 - 1)(9380.646)^2 + (14 - 1)(7547.931)^2}{16 + 14 - 2} = 73{,}591{,}939.53$$

$$t = \frac{5906 - 7500}{\sqrt{73{,}791{,}939.53\left(\dfrac{1}{16} + \dfrac{1}{14}\right)}} = -0.5075$$

Do not reject H_0. The data do not suggest any statistical difference between the average salaries of pitchers versus position players.

17. H_0: $\mu_s \leq \mu_a$ $\quad H_1$: $\mu_s > \mu_a$
$df = 6 + 7 - 2 = 11$
Reject H_0 if $t > 1.363$.

$$s_p^2 = \frac{(6 - 1)(12.2)^2 + (7 - 1)(15.8)^2}{6 + 7 - 2} = 203.82$$

$$t = \frac{142.5 - 130.3}{\sqrt{203.82\left(\dfrac{1}{6} + \dfrac{1}{7}\right)}} = 1.536$$

Reject H_0. The mean daily expenses are greater for the sales staff. The p-value is between 0.05 and 0.10.

19. **a.** Reject H_0 if $t > 2.353$.

b. $\bar{d} = \dfrac{12}{4} = 3.00 \qquad s_d = \sqrt{\dfrac{2}{3}} = 0.816$

c. $t = \dfrac{3.00}{0.816/\sqrt{4}} = 7.35$

d. Reject H_0. There are more defective parts produced on the day shift.

e. p-value is less than 0.005, but greater than 0.0005.

21. H_0: $\mu_d \leq 0$ $\quad H_1$: $\mu_d > 0$
$\bar{d} = 25.917$
$s_d = 40.791$
Reject H_0 if $t > 1.796$

$$t = \frac{25.917}{40.791/\sqrt{12}} = 2.20$$

Reject H_0. The incentive plan resulted in an increase in weekly income. The p-value is about .025.

23. H_0: $\mu_m = \mu_w$ $\quad H_1$: $\mu_m \neq \mu_w$
Reject H_0 if $z > 2.576$ or $t < -2.576$.

$$z = \frac{24.51 - 22.69}{\sqrt{\left(\dfrac{4.48^2}{35} + \dfrac{3.86^2}{40}\right)}} = 1.871$$

Do not reject H_0. The p-value is 0.0614, found by 2(0.5000 − 0.4693).

25. H_0: $\mu_1 = \mu_2$; $\quad H_1$: $\mu_1 \neq \mu_2$
Reject H_0 if $z < -1.96$ or $z > 1.96$.

$$z = \frac{4.77 - 5.02}{\sqrt{\dfrac{(1.05)^2}{40} + \dfrac{(1.23)^2}{50}}} = -1.04$$

H_0. is not rejected. There is no difference in the mean number of calls. p-value = 2(0.5000 − 0.3508) = 0.2984.

27. H_0: $\mu_B \leq \mu_A$ $\quad H_1$: $\mu_B > \mu_A$.
$df = n_B + n_A - 2 = 30 + 40 - 2 = 68$
Reject H_0 if $t > 1.668$

$$s_p^2 = \frac{(30 - 1)(7100)^2 + (40 - 1)(9200)^2}{30 + 40 - 2} = 70{,}041{,}911.76$$

$$t = \frac{61{,}000 - 57{,}000}{\sqrt{70{,}041{,}911.76\left(\dfrac{1}{30} + \dfrac{1}{40}\right)}} = 1.979$$

Reject H_0. The mean income of Plan B subscribers is greater than that of Plan A subscribers. The p-value is between 0.025 and 0.010.

29. H_0: $\pi_1 \leq \pi_2$ $\quad H_1$: $\pi_1 > \pi_2$
Reject H_0 if $z > 1.645$.

$$p_c = \frac{180 + 261}{200 + 300} = 0.882$$

$$z = \frac{0.90 - 0.87}{\sqrt{\dfrac{0.882(0.118)}{200} + \dfrac{0.882(0.118)}{300}}} = 1.019$$

H_0 is not rejected. There is no difference in the proportions that found relief with the new and the old drugs.

31. H_0: $\pi_1 \leq \pi_2$ $\quad H_1$: $\pi_1 > \pi_2$
If $z > 2.326$, reject H_0.

$$p_c = \frac{990 + 970}{1{,}500 + 1{,}600} = 0.63$$

$$z = \frac{.6600 - .60625}{\sqrt{\dfrac{.63(.37)}{1{,}500} + \dfrac{.63(.37)}{1{,}600}}} = 3.10$$

Reject the null hypothesis. We can conclude the proportion of men who believe the division is fair is greater. The p-value is less than 0.001.

33. H_0: $\pi_1 \le \pi_2$ H_1: $\pi_1 > \pi_2$ H_0 is rejected if $z > 1.645$.

$$p_c = \frac{.091 + .085}{2} = .088$$

$$z = \frac{0.091 - 0.085}{\sqrt{\frac{(0.088)(0.912)}{5000} + \frac{(0.088)(0.912)}{5000}}} = 1.059$$

H_0 is not rejected. There has not been an increase in the proportion calling conditions "good." The p-value is 0.1446, found by $0.5000 - 0.3554$. The increase in the percentages will happen by chance in one out of every seven cases.

35. H_0: $\pi_1 = \pi_2$ H_1: $\pi_1 \ne \pi_2$

H_0 is rejected if z is not between -1.96 and 1.96.

$$p_c = \frac{100 + 36}{300 + 200} = .272$$

$$z = \frac{\frac{100}{300} - \frac{36}{200}}{\sqrt{\frac{(0.272)(0.728)}{300} + \frac{(0.272)(0.728)}{200}}} = 3.775$$

H_0 is rejected. There is a difference in the replies of the sexes.

37. H_0: $\mu_1 \le \mu_2$ H_1: $\mu_1 > \mu_2$ Reject H_0 if $t > 2.650$.

$\bar{X}_1 = 125.125$ $s_1 = 15.094$

$\bar{X}_2 = 117.714$ $s_2 = 19.914$

$$s_p^2 = \frac{(8 - 1)(15.094)^2 + (7 - 1)(19.914)^2}{8 + 7 - 2} = 305.708$$

$$t = \frac{125.125 - 117.714}{\sqrt{305.708\left(\frac{1}{8} + \frac{1}{7}\right)}} = 0.819$$

H_0 is not rejected. There is no difference in the mean number sold at the regular price and the mean number sold at the reduced price.

39. H_0: $\mu_d \le 0$ H_1: $\mu_d > 0$ Reject H_0 if $t > 1.895$.

$\bar{d} = 1.75$ $s_d = 2.9155$

$$t = \frac{1.75}{2.9155/\sqrt{8}} = 1.698$$

Do not reject H_0. There is no difference in the mean number of absences. The p-value is greater than 0.05 but less than .10.

41. H_0: $\mu_1 = \mu_2$ H_1: $\mu_1 \ne \mu_2$

Reject H_0 if $t < -2.024$ or $t > 2.204$.

$$s_p^2 = \frac{(15 - 1)(40)^2 + (25 - 1)(30)^2}{15 + 25 - 2} = 1157.89$$

$$t = \frac{150 - 180}{\sqrt{1157.89\left(\frac{1}{15} + \frac{1}{25}\right)}} = -2.699$$

Reject the null hypothesis. The population means are different.

43. H_0: $\mu_d \le 0$ H_1: $\mu_d > 0$

Reject H_0 if $t > 1.895$.

$\bar{d} = 3.11$ $s_d = 2.91$

$$t = \frac{3.11}{2.91/\sqrt{8}} = 3.02$$

Reject H_0. The mean is lower.

45. H_0: $\mu_O = \mu_R$ H_1: $\mu_O \ne \mu_R$

$df = 25 + 28 - 2 = 51$

Reject H_0 if $t < -2.008$ or $t > 2.008$.

$\bar{X}_O = 86.24$, $s_O = 23.43$

$X_R = 92.04$, $s_R = 24.12$

$$s_p^2 = \frac{(25 - 1)(23.43)^2 + (28 - 1)(24.12)^2}{25 + 28 - 2} = 566.335$$

$$t = \frac{86.24 - 92.04}{\sqrt{566.335\left(\frac{1}{25} + \frac{1}{28}\right)}} = -0.886$$

Do not reject H_0. There is no difference in the mean number of cars in the two lots.

47. Defining d = (Count at US 17 − Count at SC 707)

H_0: $\mu_d \le 0$ H_1:$\mu_d > 0$ $df = n - 1 = 25 - 1 = 24$

Reject H_0 if $t > 1.711$.

$$\bar{d} = 2.8; \quad S_d = 6.589$$

$$t = \frac{2.8}{6.589/\sqrt{25}} = 2.125$$

Reject H_0; p-value = 0.022. Based on automobile counts, the US 17 store has more business volume than the SC 707 store.

49. **a.** μ_1 = without pool μ_2 = with pool

H_0: $\mu_1 = \mu_2$ H_1: $\mu_1 \ne \mu_2$

Reject H_0 if $t > 1.983$ or $t < -1.983$.

$\bar{X}_1 = 202.8$ $s_1 = 33.7$ $n_1 = 38$

$\bar{X}_2 = 231.5$ $s_2 = 50.46$ $n_2 = 67$

$$s_p^2 = \frac{(38 - 1)(33.7)^2 + (67 - 1)(50.46)^2}{38 + 67 - 2} = 2{,}041.05$$

$$t = \frac{202.8 - 231.5}{\sqrt{2{,}041.05\left(\frac{1}{38} + \frac{1}{67}\right)}} = -3.12$$

Reject H_0. There is a difference in mean selling price for homes with and without a pool.

b. μ_1 = without attached garage μ_2 = with garage

H_0: $\mu_1 = \mu_2$ H_1: $\mu_1 \ne \mu_2$

Reject H_0 if $t > 1.983$ or $t < -1.983$.

$\alpha = 0.05$ $df = 34 + 71 - 2 = 103$

$\bar{X}_1 = 185.45$ $s_1 = 28.00$

$\bar{X}_2 = 238.18$ $s_2 = 44.88$

$$s_p^2 = \frac{(34 - 1)(28.00)^2 + (71 - 1)(44.88)^2}{103} = 1{,}620.07$$

$$t = \frac{185.45 - 238.18}{\sqrt{1{,}620.07\left(\frac{1}{34} + \frac{1}{71}\right)}} = -6.28$$

Reject H_0. There is a difference in mean selling price for homes with and without an attached garage.

c. H_0: $\mu_1 = \mu_2$ H_1: $\mu_1 \ne \mu_2$

Reject H_0 if $t > 2.036$ or $t < -2.036$.

$\bar{X}_1 = 196.91$ $s_1 = 35.78$ $n_1 = 15$

$\bar{X}_2 = 227.45$ $s_2 = 44.19$ $n_2 = 20$

$$s_p^2 = \frac{(15 - 1)(35.78)^2 + (20 - 1)(44.19)^2}{15 + 20 - 2} = 1{,}667.43$$

$$t = \frac{196.91 - 227.45}{\sqrt{1{,}667.43\left(\frac{1}{15} + \frac{1}{20}\right)}} = -2.19$$

Reject H_0. There is a difference in mean selling price for homes in Township 1 and Township 2.

d. H_0: $\pi_1 = \pi_2$ H_1: $\pi_1 \ne \pi_2$

If z is not between -1.96 and 1.96, reject H_0.

$$p_c = \frac{24 + 43}{52 + 53} = 0.64$$

$$z = \frac{0.462 - 0.811}{\sqrt{0.64 \times 0.36/52 + 0.64 \times 0.36/53}} = -3.73$$

Reject the null hypothesis. There is a difference.

51. H_0: $\mu_1 = \mu_2$ H_1: $\mu_1 \ne \mu_2$

If t is not between -1.991 and 1.991, reject H_0.

$$s_p^2 = \frac{(53 - 1)(52.9)^2 + (27 - 1)(55.1)^2}{53 + 27 - 2} = 2878$$

$$t = \frac{454.8 - 441.5}{\sqrt{2878\left(\frac{1}{53} + \frac{1}{27}\right)}} = 1.05$$

Do not reject H_0. There may be no difference in the mean maintenance cost for the two types of buses.

CHAPTER 12

1. 9.01, from Appendix B.4

3. Reject H_0 if $F > 10.5$, where degrees of freedom in the numerator are 7 and 5 in the denominator. Computed $F = 2.04$, found by:

$$F = \frac{s_1^2}{s_2^2} = \frac{(10)^2}{(7)^2} = 2.04$$

Do not reject H_0. There is no difference in the variations of the two populations.

5. H_0: $\sigma_1^2 = \sigma_2^2$ H_1: $\sigma_1^2 \neq \sigma_2^2$
Reject H_0 where $F > 3.10$. (3.10 is about halfway between 3.14 and 3.07.) Computed $F = 1.44$, found by:

$$F = \frac{(12)^2}{(10)^2} = 1.44$$

Do not reject H_0. There is no difference in the variations of the two populations.

7. **a.** H_0: $\mu_1 = \mu_2 = \mu_3$; H_1: Treatment means are not all the same.
b. Reject H_0 if $F > 4.26$.
c & d.

Source	SS	*df*	MS	*F*
Treatment	62.17	2	31.08	21.94
Error	12.75	9	1.42	
Total	74.92	11		

e. Reject H_0. The treatment means are not all the same.

9. H_0: $\mu_1 = \mu_2 = \mu_3$; H_1: Treatment means are not all the same. Reject H_0 if $F > 4.26$.

Source	SS	*df*	MS	*F*
Treatment	276.50	2	138.25	14.18
Error	87.75	9	9.75	

Reject H_0. The treatment means are not all the same.

11. **a.** H_0: $\mu_1 = \mu_2 = \mu_3$; H_1: Not all means are the same.
b. Reject H_0 if $F > 4.26$.
c. SST = 107.20, SSE = 9.47, SS total = 116.67.
d.

Source	SS	*df*	MS	*F*
Treatment	107.20	2	53.600	50.96
Error	9.47	9	1.052	
Total	116.67	11		

e. Since $50.96 > 4.26$, H_0 is rejected. At least one of the means differs.
f. $(\bar{X}_1 - \bar{X}_2) \pm t\sqrt{MSE(1/n_1 + 1/n_2)}$
$= (9.667 - 2.20) \pm 2.262\ \sqrt{1.052(1/3 + 1/5)}$
$= 7.467 \pm 1.69$
$= [5.777, 9.157]$
Yes, we can conclude that treatments 1 and 2 have different means.

13. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$; H_1: Not all means are equal. H_0 is rejected if $F > 3.71$.

Source	SS	*df*	MS	*F*
Treatment	32.33	3	10.77	2.36
Error	45.67	10	4.567	
Total	78.00	13		

Because 2.36 is less than 3.71, H_0 is not rejected. There is no difference in the mean number of weeks.

15. H_0: $\sigma_1^2 \leq \sigma_2^2$; H_1: $\sigma_1^2 > \sigma_2^2$. $df_1 = 21 - 1 = 20$; $df_2 = 18 - 1 = 17$. H_0 is rejected if $F > 3.16$.

$$F = \frac{(45{,}600)^2}{(21{,}330)^2} = 4.57$$

Reject H_0. There is more variation in the selling price of oceanfront homes.

17. Sharkey: $n = 7$ $s_s = 14.79$
White: $n = 8$ $s_w = 22.95$
H_0: $\sigma_w^2 \leq \sigma_s^2$; H_1: $\sigma_w^2 > \sigma_s^2$. $df_s = 7 - 1 = 6$; $df_w = 8 - 1 = 7$. Reject H_0 if $F > 8.26$.

$$F = \frac{(22.95)^2}{(14.79)^2} = 2.41$$

Cannot reject H_0. There is no difference in the variation of the monthly sales.

19. **a.** H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$
H_1: Treatment means are not all equal.
b. $\alpha = .05$ Reject H_0 if $F > 3.10$.
c.

Source	SS	*df*	MS	*F*
Treatment	50	4 − 1 = 3	50/3	1.67
Error	200	24 − 4 = 20	10	
Total	250	24 − 1 = 23		

d. Do not reject H_0.

21. H_0: $\mu_1 = \mu_2 = \mu_3$; H_1: Not all treatment means are equal. H_0 is rejected if $F > 3.89$.

Source	SS	*df*	MS	*F*
Treatment	63.33	2	31.667	13.38
Error	28.40	12	2.367	
Total	91.73	14		

H_0 is rejected. There is a difference in the treatment means.

23. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$; H_1: Not all means are equal. H_0 is rejected if $F > 3.10$.

Source	SS	*df*	MS	*F*
Factor	87.79	3	29.26	9.12
Error	64.17	20	3.21	
Total	151.96	23		

Because the computed F of $9.12 > 3.10$, the null hypothesis of no difference is rejected at the .05 level.

25. **a.** H_0: $\mu_1 = \mu_2$; H_1: $\mu_1 \neq \mu_2$. Critical value of $F = 4.75$.

Source	SS	*df*	MS	*F*
Treatment	219.43	1	219.43	23.10
Error	114.00	12	9.5	
Total	333.43	13		

b. $$t = \frac{19 - 27}{\sqrt{9.5\left(\frac{1}{6} + \frac{1}{8}\right)}} = -4.806$$

Then $t^2 = F$. That is $(-4.806)^2 = 23.10$.
c. H_0 is rejected. There is a difference in the mean scores.

27. The null hypothesis is rejected because the F statistic (8.26) is greater than the critical value (5.61) at the .01 significance level. The p-value (.0019) is also less than the significance level. The mean gasoline mileages are not the same.

29. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$. H_1: At least one mean is different. Reject H_0 if $F > 2.7395$. Since 2.72 is less than 2.7395, H_0 is not rejected. You can also see this conclusion from the p-value of 0.051, which is greater than 0.05. There is no difference in the means for the different types of first-class mail.

31. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$; H_1: The treatment means are not equal. Reject H_0: if $F > 2.76$.

Source	*df*	SS	MS	*F*
Treatment	3	1,552	517	1.84
Error	60	16,846	281	
Total	63	18,399		

Because the computed F of $1.84 < 2.76$, do not reject the null hypothesis of no difference at the 0.05 level. The mean proportions of stock investment could be the same for all age groups.

33. a. H_0: $\sigma^2_{np} = \sigma^2_p$ $\quad H_1$: $\sigma^2_{np} \neq \sigma^2_p$

Reject H_0 if $F > 2.05$ (estimated).
$df_1 = 67 - 1 = 66$; $df_2 = 38 - 1 = 37$

$$F = \frac{(50.57)^2}{(33.71)^2} = 2.25$$

Reject H_0. There is a difference in the variance of the two selling prices.

b. H_0: $\sigma^2_g = \sigma^2_{ng}$; H_1: $\sigma^2_g \neq \sigma^2_{ng}$.

Reject H_0 if $F > 2.21$ (estimated).

$$F = \frac{(44.88)^2}{(28.00)^2} = 2.57$$

Reject H_0. There is a difference in the variance of the two selling prices.

c.

Source	SS	*df*	MS	*F*
Township	13,263	4	3,316	1.52
Error	217,505	100	2,175	
Total	230,768	104		

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$; H_1: Not all treatment means are equal. Reject H_0 if $F > 2.46$.
Do not reject H_0. There is no difference in the mean selling prices in the five townships.

35. a. H_0: $\mu_1 = \mu_2 = \mu_3$ $\quad H_1$: Not all treatment means are equal.
Reject H_0 if $F > 4.89$.

Source	SS	*df*	MS	*F*
Treatment	28,996	2	14,498	5.62
Error	198,696	77	2,580	
Total	227,692	79		

Reject H_0. The mean maintenance costs are different.

b. H_0: $\mu_1 = \mu_2 = \mu_3$ $\quad H_1$: Not all treatment means are equal.
Reject H_0 if $F > 3.12$.

Source	SS	*df*	MS	*F*
Treatment	5,095	2	2,547	1.45
Error	135,513	77	1,760	
Total	140,608	79		

Do not reject H_0. The mean miles traveled are not different.

c. $(441.81 - 506.75) \pm 1.991\sqrt{2580\left(\frac{1}{47} + \frac{1}{8}\right)}$

This reduces to -64.94 ± 38.68, so the difference is between -103.62 and -26.26. To put it another way, Bluebird is less costly than Thompson by an amount between \$26.26 and \$103.62.

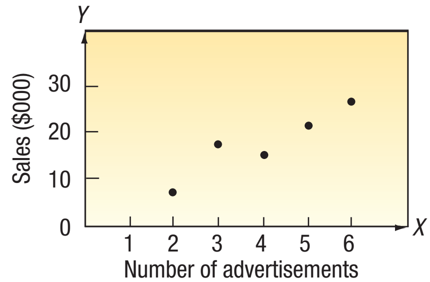
CHAPTER 13

1. $\Sigma(X - \overline{X})(Y - \overline{Y}) = 10.6$, $s_x = 2.7019$, $s_y = 1.3038$

$$r = \frac{10.6}{(5 - 1)(2.7019)(1.3038)} = 0.7522$$

3. a. Sales.

b.



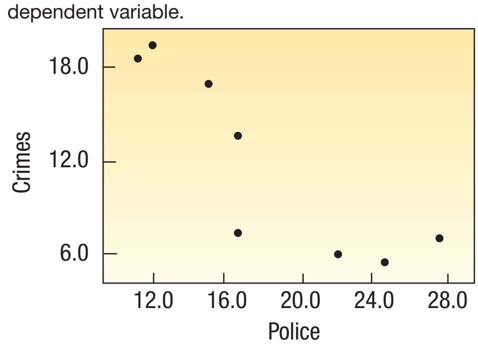
c. $\Sigma(X - \overline{X})(Y - \overline{Y}) = 36$, $n = 5$, $s_x = 1.5811$, $s_y = 6.1237$

$$r = \frac{36}{(5 - 1)(1.5811)(6.1237)} = 0.9295$$

d. There is a strong positive association between the variables.

5. a. Police is the independent variable, and crime is the dependent variable.

b.



c. $n = 8$, $\Sigma(X - \overline{X})(Y - \overline{Y}) = -231.75$, $s_x = 5.8737$, $s_y = 6.4462$

$$r = \frac{-231.75}{(8 - 1)(5.8737)(6.4462)} = -0.8744$$

d. Strong inverse relationship. As the number of police increases, the crime decreases.

7. Reject H_0 if $t > 1.812$.

$$t = \frac{.32\sqrt{12 - 2}}{\sqrt{1 - (.32)^2}} = 1.068$$

Do not reject H_0.

9. H_0: $\rho \leq 0$; H_1: $\rho > 0$. Reject H_0 if $t > 2.552$. $df = 18$.

$$t = \frac{.78\sqrt{20 - 2}}{\sqrt{1 - (.78)^2}} = 5.288$$

Reject H_0. There is a positive correlation between gallons sold and the pump price.

11. H_0: $\rho \leq 0$ $\quad H_1$: $\rho > 0$
Reject H_0 if $t > 2.650$.

$$t = \frac{0.667\sqrt{15 - 2}}{\sqrt{1 - 0.667^2}} = 3.228$$

Reject H_0. There is a positive correlation between the number of passengers and plane weight.

13. **a.** $\hat{Y} = 3.7778 + 0.3630X$

$$b = 0.7522\left(\frac{1.3038}{2.7019}\right) = 0.3630$$

$$a = 5.8 - 0.3630(5.6) = 3.7671$$

b. 6.3081, found by $\hat{Y} = 3.7671 + 0.3630(7)$

15. **a.** $\Sigma(X - \bar{X})(Y - \bar{Y}) = 44.6$, $s_x = 2.726$, $s_y = 2.011$

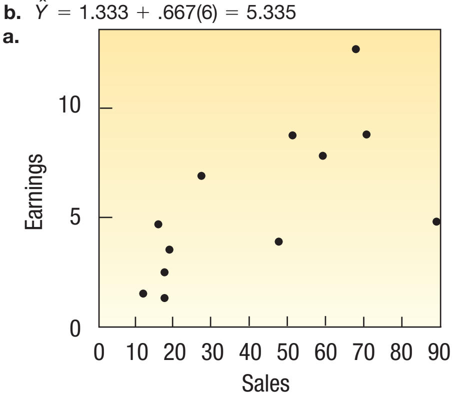
$$r = \frac{44.6}{(10 - 1)(2.726)(2.011)} = .904$$

$$b = .904\left(\frac{2.011}{2.726}\right) = 0.667$$

$$a = 7.4 - .677(9.1) = 1.333$$

b. $\hat{Y} = 1.333 + .667(6) = 5.335$

17. **a.**



b. $\Sigma(X - \bar{X})(Y - \bar{Y}) = 629.64$, $s_x = 26.17$, $s_y = 3.248$

$$r = \frac{629.64}{(12 - 1)(26.17)(3.248)} = .6734$$

c. $b = .6734\left(\frac{3.248}{26.170}\right) = 0.0836$

$$a = \frac{64.1}{12} - 0.0836\left(\frac{501.10}{12}\right) = 1.8507$$

d. $\hat{Y} = 1.8507 + 0.0836(50.0) = 6.0307$ (\$ millions)

19. **a.** $b = -.8744\left(\frac{6.4462}{5.8737}\right) = -0.9596$

$$a = \frac{95}{8} - (-0.9596)\left(\frac{146}{8}\right) = 29.3877$$

b. 10.1957, found by $29.3877 - 0.9596(20)$

c. For each policeman added, crime goes down by almost one.

21. H_0: $\beta \geq 0$ $\quad H_1$: $\beta < 0$ $\quad df = n - 2 = 8 - 2 = 6$

Reject H_0 if $t < -1.943$.

$$t = -0.96/0.22 = -4.364$$

Reject H_0 and conclude the slope is less than zero.

23. H_0: $\beta = 0$ $\quad H_1$: $\beta \neq 0$ $\quad df = n - 2 = 12 - 2 = 10$

Reject H_0 if t not between -2.228 and 2.228

$$t = 0.08/0.03 = 2.667$$

Reject H_0 and conclude the slope is different from zero.

25. The standard error of estimate is 3.379, found by $\sqrt{\frac{68.4877}{8 - 2}}$.

The coefficient of determination is 0.76, found by $(-0.874)^2$. Seventy-six percent of the variation in crimes can be explained by the variation in police.

27. The standard error of estimate is 0.913, found by $\sqrt{\frac{6.667}{10 - 2}}$.

The coefficient of determination is 0.82, found by 29.733/36.4.

Eighty-two percent of the variation in kilowatt hours can be explained by the variation in the number of rooms.

29. **a.** $r^2 = \frac{1000}{1500} = .6667$

b. $r = \sqrt{.6667} = .8165$

c. $s_{y \cdot x} = \sqrt{\frac{500}{13}} = 6.2017$

31. **a.** $6.308 \pm (3.182)(.993)\sqrt{.2 + \frac{(7 - 5.6)^2}{29.2}}$

$= 6.308 \pm 1.633$

$= [4.675, 7.941]$

b. $6.308 \pm (3.182)(.993)\sqrt{1 + 1/5 + .0671}$

$= [2.751, 9.865]$

33. **a.** 4.2939, 6.3721

b. 2.9854, 7.6806

35. No, relationship is nonlinear. Correlation coefficient is 0.298. The correlation is 0.298 Yes, transformed relationship is linear. Correlation coefficient is 0.99.

37. H_0: $\rho \leq 0$; H_1: $\rho > 0$. Reject H_0 if $t > 1.714$.

$$t = \frac{.94\sqrt{25 - 2}}{\sqrt{1 - (.94)^2}} = 13.213$$

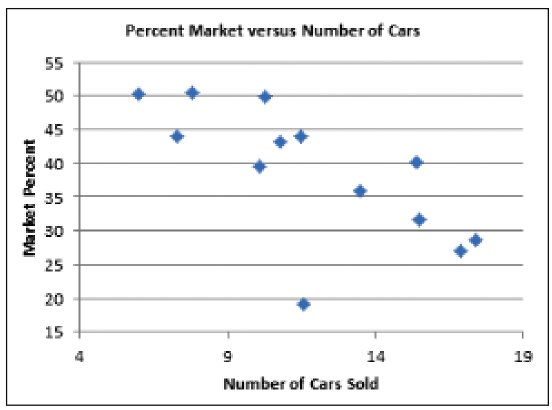
Reject H_0. There is a positive correlation between passengers and weight of luggage.

39. H_0: $\rho \leq 0$; H_1: $\rho > 0$. Reject H_0 if $t > 2.764$.

$$t = \frac{.47\sqrt{12 - 2}}{\sqrt{1 - (.47)^2}} = 1.684$$

Do not reject H_0. There is not a positive correlation between engine size and performance. p-value is greater than .05, but less than .10.

41. **a.**



The sales volume is inversely related to their market share.

b. $\bar{X} = \frac{154.1}{13} = 11.854 \qquad \bar{Y} = \frac{503.5}{13} = 38.7308$

$$s_x = \sqrt{\frac{163.032}{12}} = 3.686 \qquad s_y = \sqrt{\frac{1154.41}{12}} = 9.808$$

$$r = \frac{-299.792}{(13 - 1)(3.686)(9.808)} = -0.691$$

c. H_0: $\rho \geq 0$ $\quad H_1$: $\rho < 0$

Reject H_0 if $t < -2.718$.

$df = 11 \qquad t = \frac{-0.691\sqrt{13 - 2}}{\sqrt{1 - (-0.691)^2}} = -3.17$

Reject H_0. There is a negative correlation between cars sold and market share.

d. 47.7%, found by $(-0.691)^2$, of the variation in market share is accounted for by variation in cars sold.

43. **a.** $r = -0.241$

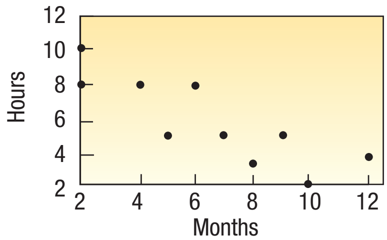
b. $R^2 = (-0.241)^2 = 0.0581$; relationship is very weak

c. H_0: $\rho \geq 0$; H_1: $\rho < 0$. Reject H_0 if $t < -1.697$

$$t = \frac{-0.241\sqrt{32 - 2}}{\sqrt{1 - (-0.241)^2}} = -1.36$$

Do not reject H_0. There is not enough evidence to suggest that points scored and points allowed per game are negatively or inversely related.

45. a.



There is an inverse relationship between the variables. As the months owned increase, the number of hours exercised decreases.

b. $r = -0.827$

c. H_0: $\rho \geq 0$; H_1: $\rho < 0$. Reject H_0 if $t < -2.896$.

$$t = \frac{-0.827\sqrt{10 - 2}}{\sqrt{1 - (-0.827)^2}} = -4.16$$

Reject H_0. There is a negative association between months owned and hours exercised.

47. a. Median age and population are directly related.

b. $r = \dfrac{11.93418}{(10 - 1)(2.207)(1.330)} = 0.452$

c. The slope of 0.272 indicates that for each increase of 1 million in the population, the median age increases on average by 0.272 years.

d. The median age is 32.08 years, found by $31.4 + 0.272(2.5)$.

e. The p-value (0.190) for the population variable is greater than, say, 0.05. A test for significance of that coefficient would fail to be rejected. In other words, it is possible the population coefficient is zero.

f. H_0: $\rho = 0$ H_1: $\rho \neq 0$ Reject H_0 if t is not between -2.306 and 2.306.

$$df = 8 \qquad t = \frac{0.452\sqrt{10 - 2}}{\sqrt{1 - (0.452)^2}} = 1.433$$

Do not reject H_0.
There may be no relationship between age and population.

49. a. $b = -0.4667$, $a = 11.2358$

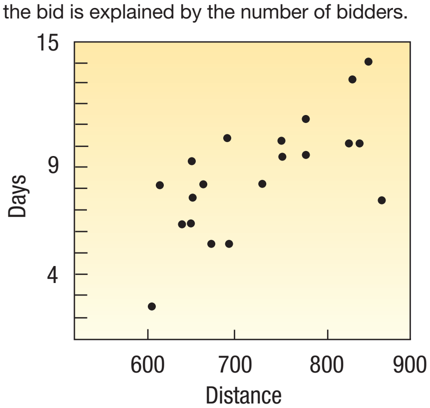
b. $\hat{Y} = 11.2358 - 0.4667(7.0) = 7.9689$

c. $7.9689 \pm (2.160)(1.114)\sqrt{1 + \dfrac{1}{15} + \dfrac{(7 - 7.1333)^2}{73.7333}}$

$= 7.9689 \pm 2.4854$
$= [5.4835, 10.4543]$

d. $r^2 = 0.499$. Nearly 50% of the variation in the amount of the bid is explained by the number of bidders.

51. a.



There appears to be a relationship between the two variables. As the distance increases, so does the shipping time.

b. $r = 2.004$
H_0: $\rho \leq 0$; H_1: $\rho > 0$. Reject H_0 if $t > 1.734$.

$$t = \frac{0.692\sqrt{20 - 2}}{\sqrt{1 - (0.692)^2}} = 4.067$$

H_0 is rejected. There is a positive association between shipping distance and shipping time.

c. $r^2 = 0.479$. Nearly half of the variation in shipping time is explained by shipping distance.

d. $s_{y \cdot x} = 2.004$

53. a. $b = 2.41$
$a = 26.8$
The regression equation is: Price $= 26.8 + 2.41 \times$ Dividend. For each additional dollar of dividend, the price increases by \$2.41.

b. $r^2 = \dfrac{5{,}057.6}{7{,}682.7} = 0.658$ Thus, 65.8% of the variation in price is explained by the dividend.

c. $r = \sqrt{.658} = 0.811$ H_0: $\rho \leq 0$ H_1: $\rho > 0$
At the 5% level, reject H_0 when $t > 1.701$.

$$t = \frac{0.811\sqrt{30 - 2}}{\sqrt{1 - (0.811)^2}} = 7.34$$

Thus, H_0 is rejected. The population correlation is positive.

55. a. 35

b. $s_{y \cdot x} = \sqrt{29{,}778{,}406} = 5{,}456.96$

c. $r^2 = \dfrac{13{,}548{,}662{,}082}{14{,}531{,}349{,}474} = 0.932$

d. $r = \sqrt{0.932} = 0.966$

e. H_0: $\rho \leq 0$, H_1: $\rho > 0$; reject H_0 if $t > 1.692$.

$$t = \frac{.966\sqrt{35 - 2}}{\sqrt{1 - (.966)^2}} = 21.46$$

Reject H_0. There is a direct relationship between size of the house and its market value.

57. a. The regression equation is Price $= -773 + 1{,}408$ Speed.

b. The second laptop (1.6, 922) with a residual of -557.60, is priced \$557.60 below the predicted price. That is a noticeable "bargain."

c. The correlation of Speed and Price is 0.835.
H_0: $\rho \leq 0$ H_1: $\rho > 0$ Reject H_0 if $t > 1.8125$.

$$t = \frac{0.835\sqrt{12 - 2}}{\sqrt{1 - (0.835)^2}} = 4.799$$

Reject H_0. It is reasonable to say the population correlation is positive.

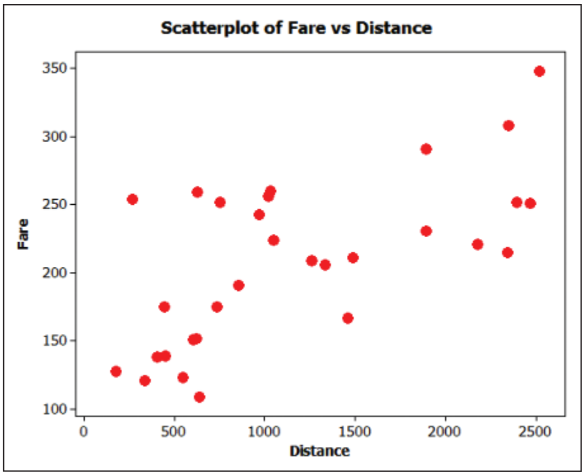
59. a. $r = .987$, H_0: $\rho \leq 0$, H_1: $\rho > 0$. Reject H_0 if $t > 1.746$.

$$t = \frac{.987\sqrt{18 - 2}}{\sqrt{1 - (.987)^2}} = 24.564$$

b. $\hat{Y} = -29.7 + 22.93X$; an additional cup increases the dog's weight by almost 23 pounds.

c. Dog number 4 is an overeater.

61. **a.**



The relationship is direct. Fares increase for longer flights.

b. The correlation of *Distance* and *Fare* is 0.656.

H_0: $\rho \leq 0$ $\quad$ H_1: $\rho > 0$

Reject H_0 if $t > 1.701$ $\quad$ $df = 28$

$$t = \frac{0.656\sqrt{30-2}}{\sqrt{1-(0.656)^2}} = 4.599$$

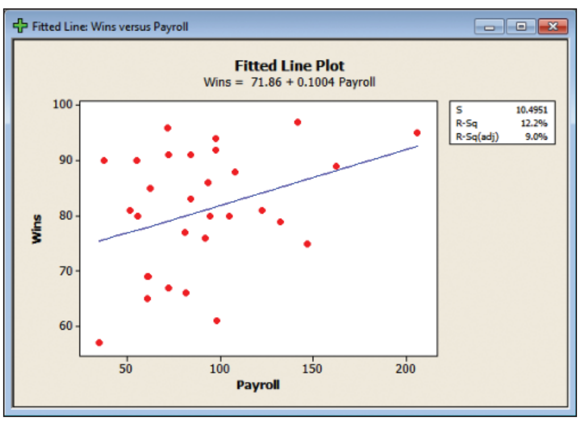
Reject H_0. There is a significant positive correlation between fares and distances.

c. 43%, found by $(0.656)^2$, of the variation in fares is explained by the variation in distance.

d. The regression equation is *Fare* = 147.08 + 0.05265 *Distance*. Each additional mile adds \$0.05265 to the fare. A 1,500-mile flight would cost \$226.06, found by \$147.08 + 0.05265(1500).

e. A flight of 4,218 miles is outside the range of the sampled data. So the regression equation may not be useful.

63. **a.** There does seem to be a direct relationship between the variables.



b. (71.86 + .1004 (100)) = 81.90 wins

c. $(.1004 \times 5) = .5020$ wins

d. H_0: $\beta \leq 0$; H_1: $\beta > 0$. $df = n - 2 = 30 - 2 = 28$

Reject H_0 if $t > 1.701$. $t = 0.1004/0.05094 = 1.97$

Reject H_0 and conclude the slope is positive.

e. 0.1218, or 12.18%, found by 427.86/3512.00

f. The correlation between wins and batting average is 0.461; the correlation between wins and ERA is −0.681. The relationship between wins and ERA is stronger.

For batting average: H_0: $\rho \leq 0$; H_1: $\rho > 0$.

Reject H_0 if $t > 1.701$.

$$t = \frac{0.461\sqrt{30-2}}{\sqrt{1-(0.461)^2}} = 2.749$$

Rejected H_0. Team wins and team batting average are positively related.

For ERA, H_0: $\rho \geq 0$; H_1: $\rho < 0$.

Reject H_0 if $t < -1.701$.

$$t = \frac{-0.681\sqrt{30-2}}{\sqrt{1-(-0.681)^2}} = -4.921$$

Rejected H_0. Team wins and ERA are inversely related.

CHAPTER 14

1. **a.** Multiple regression equation

b. The *Y*-intercept

c. $\hat{Y} = 64{,}100 + 0.394(796{,}000) + 9.6(6{,}940) - 11{,}600(6.0) = \$374{,}748$

3. **a.** 497.736, found by

$$\hat{Y} = 16.24 + 0.017(18) + 0.0028(26{,}500) + 42(3) + 0.0012(156{,}000) + 0.19(141) + 26.8(2.5)$$

b. Two more social activities. Income added only 28 to the index; social activities added 53.6.

5. **a.** $s_{Y\cdot 12} = \sqrt{\dfrac{SSE}{n-(k+1)}} = \sqrt{\dfrac{583.693}{65-(2+1)}} = \sqrt{9.414} = 3.068$

95% of the residuals will be between ±6.136, found by 2(3.068).

b. $R^2 = \dfrac{SSR}{SS\ total} = \dfrac{77.907}{661.6} = .118$

The independent variables explain 11.8% of the variation.

c. $$R^2_{adj} = 1 - \frac{\dfrac{SSE}{n-(k+1)}}{\dfrac{SS\ total}{n-1}} = 1 - \frac{\dfrac{583.693}{65-(2+1)}}{\dfrac{661.6}{65-1}} = 1 - \frac{9.414}{10.3375} = 1 - .911 = .089$$

7. **a.** $\hat{Y} = 84.998 + 2.391X_1 - 0.4086X_2$

b. 90.0674, found by $\hat{Y} = 84.998 + 2.391(4) - 0.4086(11)$

c. $n = 65$ and $k = 2$

d. H_0: $\beta_1 = \beta_2 = 0$ $\quad$ H_1: Not all β's are 0

Reject H_0 if $F > 3.15$.

$F = 4.14$, reject H_0. Not all net regression coefficients equal zero.

e.

For X_1	For X_2
H_0: $\beta_1 = 0$	H_0: $\beta_2 = 0$
H_1: $\beta_1 \neq 0$	H_1: $\beta_2 \neq 0$
$t = 1.99$	$t = -2.38$

Reject H_0 if $t > 2.0$ or $t < -2.0$.

Delete variable 1 and keep 2.

f. The regression analysis should be repeated with only X_2 as the independent variable.

9. **a.** The regression equation is: Performance = 29.3 + 5.22 Aptitude + 22.1 Union

Predictor	Coef	SE Coef	T	P
Constant	29.28	12.77	2.29	0.041
Aptitude	5.222	1.702	3.07	0.010
Union	22.135	8.852	2.50	0.028

```
S = 16.9166 R-Sq = 53.3% R-Sq (adj) = 45.5%
Analysis of Variance
Source          DF      SS      MS     F      P
Regression       2  3919.3  1959.6  6.85  0.010
Residual Error  12  3434.0   286.2
Total           14  7353.3
```

b. These variables are effective in predicting performance. They explain 45.5% of the variation in performance. In particular, union membership increases the typical performance by 22.1.

c. H_0: $\beta_2 = 0$ $\quad H_1$: $\beta_2 \neq 0$
Reject H_0 if $t < -2.179$ or $t > 2.179$.
Since 2.50 is greater than 2.179, we reject the null hypothesis and conclude that union membership is significant and should be included.

11. a. $n = 40$
b. 4
c. $R^2 = \frac{750}{1250} = .60$
d. $s_{y \cdot 1234} = \sqrt{500/35} = 3.7796$
e. H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$
H_1: Not all the βs equal zero.
H_0 is rejected if $F > 2.65$.

$$F = \frac{750/4}{500/35} = 13.125$$

H_0 is rejected. At least one β_i does not equal zero.

13. a. $n = 26$
b. $R^2 = 100/140 = .7143$
c. 1.4142, found by $\sqrt{2}$
d. H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
H_1: Not all the βs are 0.
H_0 is rejected if $F > 2.71$.
Computed $F = 10.0$. Reject H_0. At least one regression coefficient is not zero.
e. H_0 is rejected in each case if $t < -2.086$ or $t > 2.086$. X_1 and X_5 should be dropped.

15. a. $28,000
b. $R^2 = \frac{\text{SSR}}{\text{SS total}} = \frac{3{,}050}{5{,}250} = .5809$
c. 9.199, found by $\sqrt{84.62}$
d. H_0 is rejected if $F > 2.97$ (approximately)

$$\text{Computed } F = \frac{1{,}016.67}{84.62} = 12.01$$

H_0 is rejected. At least one regression coefficient is not zero.
e. If computed t is to the left of -2.056 or to the right of 2.056, the null hypothesis in each of these cases is rejected. Computed t for X_2 and X_3 exceed the critical value. Thus, "population" and "advertising expenses" should be retained and "number of competitors," X_1, dropped.

17. a. The strongest correlation is between GPA and legal. No problem with multicollinearity.
b. $R^2 = \frac{4.3595}{5.0631} = .8610$
c. H_0 is rejected if $F > 5.41$.

$$F = \frac{1.4532}{0.1407} = 10.328$$

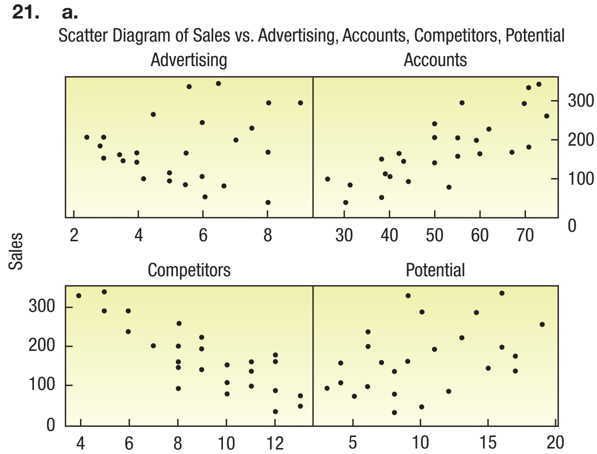
At least one coefficient is not zero.
d. Any H_0 is rejected if $t < -2.571$ or $t > 2.571$. It appears that only GPA is significant. Verbal and math could be eliminated.
e. $R^2 = \frac{4.2061}{5.0631} = .8307$
R^2 has only been reduced .0303.
f. The residuals appear slightly skewed (positive), but acceptable.
g. There does not seem to be a problem with the plot.

19. a. The correlation of Screen and Price is 0.893. So there does appear to be a linear relationship between the two.
b. Price is the "dependent" variable.
c. The regression equation is Price $= -2484 + 101$ Screen. For each inch increase in screen size, the price increases $101 on average.
d. Using "dummy" indicator variables for Sharp and Sony, the regression equation is Price $= -2308 + 94.1$ Screen $+ 15$ Manufacturer Sharp $+ 381$ Manufacturer Sony. Sharp can obtain on average $15 more than Samsung and Sony can collect an additional benefit of $381 more than Samsung.
e. Here is some of the output.

Predictor	Coef	SE Coef	T	P
Constant	-2308.2	492.0	-4.69	0.000
Screen	94.12	10.83	8.69	0.000
Manufacturer_Sharp	15.1	171.6	0.09	0.931
Manufacturer_Sony	381.4	168.8	2.26	0.036

The p-value for Sharp is relatively large. A test of their coefficient would not be rejected. That means they may not have any real advantage over Samsung. On the other hand, the p-value for the Sony coefficient is quite small. That indicates that it did not happen by chance and there is some real advantage to Sony over Samsung.
f. A histogram of the residuals indicates they follow a normal distribution.
g. The residual variation may be increasing for larger fitted values.

21. a.



Sales seem to fall with the number of competitors and rise with the number of accounts and potential.
b. Pearson correlations

	Sales	Advertising	Accounts	Competitors
Advertising	0.159			
Accounts	0.783	0.173		
Competitors	−0.833	−0.038	−0.324	
Potential	0.407	−0.071	0.468	−0.202

The number of accounts and the market potential are moderately correlated.

c. The regression equation is:
Sales = 178 + 1.81 Advertising + 3.32 Accounts − 21.2 Competitors + 0.325 Potential

Predictor	Coef	SE Coef	T	P
Constant	178.32	12.96	13.76	0.000
Advertising	1.807	1.081	1.67	0.109
Accounts	3.3178	0.1629	20.37	0.000
Competitors	−21.1850	0.7879	−26.89	0.000
Potential	0.3245	0.4678	0.69	0.495

S = 9.60441 R-Sq = 98.9% R-Sq(adj) = 98.7%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	176777	44194	479.10	0.000
Residual Error	21	1937	92		
Total	25	178714			

The computed *F* value is quite large. So we can reject the null hypothesis that all of the regression coefficients are zero. We conclude that some of the independent variables are effective in explaining sales.

d. Market potential and advertising have large *p*-values (0.495 and 0.109, respectively). You would probably drop them.

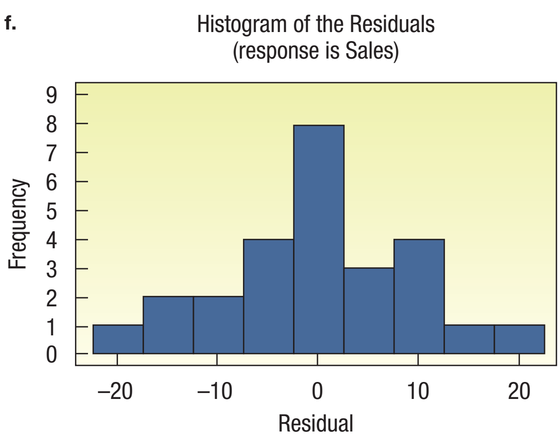
e. If you omit potential, the regression equation is:
Sales = 180 + 1.68 Advertising + 3.37 Accounts − 21.2 Competitors

Predictor	Coef	SE Coef	T	P
Constant	179.84	12.62	14.25	0.000
Advertising	1.677	1.052	1.59	0.125
Accounts	3.3694	0.1432	23.52	0.000
Competitors	−21.2165	0.7773	−27.30	0.000

Now advertising is not significant. That would also lead you to cut out the advertising variable and report that the polished regression equation is:
Sales = 187 + 3.41 Accounts − 21.2 Competitors

Predictor	Coef	SE Coef	T	P
Constant	186.69	12.26	15.23	0.000
Accounts	3.4081	0.1458	23.37	0.000
Competitors	−21.1930	0.8028	−26.40	0.000

f.



The histogram looks to be normal. There are no problems shown in this plot.

g. The variance inflation factor for both variables is 1.1. They are less than 10. There are no troubles as this value indicates the independent variables are not strongly correlated with each other.

23. The computer output is:

Predictor	*Coef*	*StDev*	*t-ratio*	*p*
Constant	651.9	345.3	1.89	0.071
Service	13.422	5.125	2.62	0.015
Age	−6.710	6.349	−1.06	0.301
Gender	205.65	90.27	2.28	0.032
Job	−33.45	89.55	−0.37	0.712

Analysis of Variance

SOURCE	*DF*	*SS*	*MS*	*F*	*p*
Regression	4	1066830	266708	4.77	0.005
Error	25	1398651	55946		
Total	29	2465481			

a. $\hat{Y} = 651.9 + 13.422X_1 - 6.710X_2 + 205.65X_3 - 33.45X_4$

b. $R^2 = .433$, which is somewhat low for this type of study.

c. H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$; H_1: not all βs equal zero. Reject H_0 if $F > 2.76$.

$$F = \frac{1{,}066{,}830/4}{1{,}398{,}651/25} = 4.77$$

H_0 is rejected. Not all the β_i's equal 0.

d. Using the .05 significance level, reject the hypothesis that the regression coefficient is 0 if $t < -2.060$ or $t > 2.060$. Service and gender should remain in the analyses; age and job should be dropped.

e. Following is the computer output using the independent variables service and gender.

Predictor	*Coef*	*StDev*	*t-ratio*	*p*
Constant	784.2	316.8	2.48	0.020
Service	9.021	3.106	2.90	0.007
Gender	224.41	87.35	2.57	0.016

Analysis of Variance

SOURCE	*DF*	*SS*	*MS*	*F*	*p*
Regression	2	998779	499389	9.19	0.001
Error	27	1466703	54322		
Total	29	2465481			

A man earns $224 more per month than a woman. The difference between technical and clerical jobs is not significant.

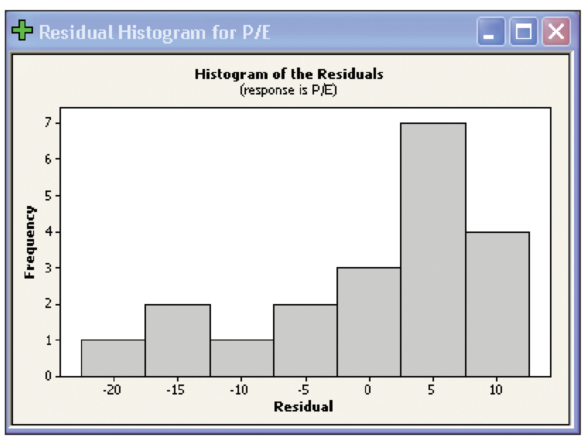
25. **a.** $\hat{Y} = 29.913 - 5.324X_1 + 1.449X_2$

b. EPS is ($t = -3.26$, p-value = .005). Yield is not ($t = 0.81$, p-value = .431).

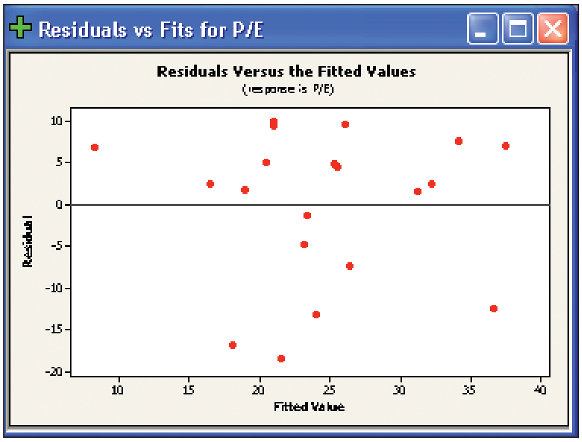
c. An increase of 1 in EPS results in a decline of 5.324 in P/E. When yield increases by one, P/E increases by 1.449.

d. Stock number 2 is undervalued.

e. Below is a residual plot. It does *not* appear to follow the normal distribution.



f. There does not seem to be a problem with the plot of the residuals versus the fitted values.



g. The correlation between yield and EPS is not a problem. No problem with multicollinearity.

	P/E	EPS
EPS	−0.602	
Yield	.054	.162

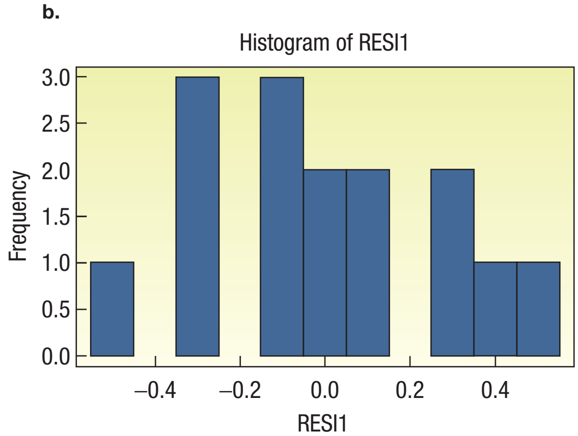
27. a. The regression equation is
Sales (000) = 1.02 + 0.0829 Infomercials

```
Predictor           Coef   SE Coef      T      P
Constant          1.0188    0.3105   3.28  0.006
Infomercials     0.08291   0.01680   4.94  0.000

Analysis  of  Variance
Source           DF       SS       MS      F      P
Regression        1   2.3214   2.3214  24.36  0.000
Residual  Error  13   1.2386   0.0953
Total            14   3.5600
```

The global test demonstrates there is a relationship between sales and the number of infomercials.

b.



The residuals appear to follow the normal distribution.

29. The computer output is as follows:

```
Predictor        Coef    SE Coef        T        P
Constant        38.71      39.02      .99     .324
Bedrooms        7.118      2.551     2.79    0.006
Size          0.03800    0.01468     2.59    0.011
Pool           18.321      6.999     2.62    0.010
Distance      −0.9295     0.7279    −1.28    0.205
Garage         35.810      7.638     4.69    0.000
Baths          23.315      9.025     2.58    0.011

S  =  33.21  R-Sq  =  53.2%  R-Sq (adj)  =  50.3%

Analysis  of  Variance
SOURCE            DF     SS     MS     F      P
Regression         6 122676  20446 18.54  0.000
Residual  Error   98 108092   1103
Total            104 230768
```

a. Each additional bedroom adds about $7,000 to the selling price, each additional square foot adds $38, a pool adds $18,300 to the value, an attached garage increases the value by $35,800, and each mile the home is from the center of the city reduces the selling price by $929.

b. The *R*-square value is 0.532.

c. The correlation matrix is as follows:

	Price	Bedrooms	Size	Pool	Distance	Garage
Bedrooms	0.467					
Size	0.371	0.383				
Pool	0.294	0.005	0.201			
Distance	−0.347	−0.153	−0.117	−0.139		
Garage	0.526	0.234	0.083	0.114	−0.359	
Baths	0.382	0.329	0.024	0.055	−0.195	0.221

The independent variable *garage* has the strongest correlation with price. Distance is inversely related, as expected, and there does not seem to be a problem with correlation among the independent variables.

d. The results of the global test suggest that some of the independent variables have net regression coefficients different from zero.

e. We can delete *distance*.

f. The new regression output follows.

```
Predictor        Coef    SE Coef        T        P
Constant        17.01      35.24      .48     .630
Bedrooms        7.169      2.559     2.80    0.006
Size          0.03919    0.01470    −2.67    0.009
Pool           19.110      6.994     2.73    0.007
Garage         38.847      7.281     5.34    0.000
Baths          24.624      8.995     2.74    0.007

S  =  33.32  R-Sq  =  52.4%  R-Sq(adj)  =  50.0%

Analysis  of  Variance
SOURCE            DF     SS     MS     F      P
Regression         5 120877  24175 21.78  0.000
Residual  Error   99 109890   1110
Total            104 230768
```

In reviewing the *p*-values for the various regression coefficients, all are less than .05. We leave all the independent variables.

g. & h. Analysis of the residuals, not shown, indicates the normality assumption is reasonable. In addition, there is no pattern to the plots of the residuals and the fitted values of *Y*.

31. **a.** The regression equation is

Maintenance = 102 + 5.94 Age + 0.374 Miles − 11.8 GasolineIndicator

Each additional year of age adds \$5.94 to upkeep cost. Every extra mile adds \$0.374 to maintenance total. Gasoline buses are cheaper to maintain than diesel by \$11.80 per year.

b. The coefficient of determination is 0.286, found by 65135/227692. Twenty-nine percent of the variation in maintenance cost is explained by these variables.

c. The correlation matrix is:

	Maintenance	Age	Miles
Age	0.465		
Miles	0.450	0.522	
GasolineIndicato	−0.118	−0.068	0.025

Age and Miles both have moderately strong correlations with maintenance cost. The highest correlation among the independent variables is 0.522 between Age and Miles. That is smaller than 0.70 so multicollinearity may not be a problem.

d.

```
Analysis of Variance
Source          DF      SS     MS      F      P
Regression       3   65135  21712  10.15  0.000
Residual Error  76  162558   2139
Total           79  227692
```

The *p*-value is zero. Reject the null hypothesis of all coefficients being zero and say at least one is important.

e.

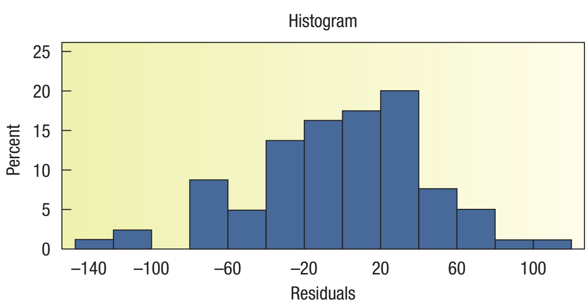
```
Predictor              Coef  SE Coef      T      P
Constant              102.3    112.9   0.91  0.368
Age                   5.939    2.227   2.67  0.009
Miles                0.3740   0.1450   2.58  0.012
GasolineIndicator    -11.80    10.99  -1.07  0.286
```

The *p*-value of the gasoline indicator is bigger than 0.10. Consider deleting it.

f. The condensed regression equation is

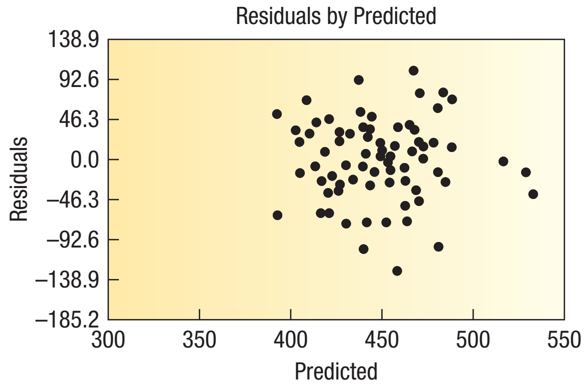
Maintenance = 106 + 6.17 Age + 0.363 Miles

g.



The normality conjecture appears realistic.

h.



This plot appears to be random and to have a constant variance.

CHAPTER 15

1. **a.** 3

b. 7.815

3. **a.** Reject H_0 if $\chi^2 > 5.991$

b. $\chi^2 = \frac{(10-20)^2}{20} + \frac{(20-20)^2}{20} + \frac{(30-20)^2}{20} = 10.0$

c. Reject H_0. The proportions are not equal.

5. H_0: The outcomes are the same; H_1: The outcomes are not the same. Reject H_0 if $\chi^2 > 9.236$.

$$\chi^2 = \frac{(3-5)^2}{5} + \cdots + \frac{(7-5)^2}{5} = 7.60$$

Do not reject H_0. Cannot reject H_0 since outcomes are the same.

7. H_0: There is no difference in the proportions.
H_1: There is a difference in the proportions.
Reject H_0 if $\chi^2 > 15.086$.

$$\chi^2 = \frac{(47-40)^2}{40} + \cdots + \frac{(34-40)^2}{40} = 3.400$$

Do not reject H_0. There is no difference in the proportions.

9. **a.** Reject H_0 if $\chi^2 > 9.210$.

b. $\chi^2 = \frac{(30-24)^2}{24} + \frac{(20-24)^2}{24} + \frac{(10-12)^2}{12} = 2.50$

c. Do not reject H_0.

11. H_0: Proportions are as stated; H_1: Proportions are not as stated. Reject H_0 if $\chi^2 > 11.345$.

$$\chi^2 = \frac{(50-25)^2}{25} + \cdots + \frac{(160-275)^2}{275} = 115.22$$

Reject H_0. The proportions are not as stated.

13. H_0: The population of clients follows a normal distribution.
H_1: The population of clients does not follow a normal distribution.
Reject the null if chi-square is greater than 5.991.

Number of Clients	*z*-values	Area	Found by	f_e
Under 30	Under −1.58	0.0571	0.5000 − 0.4429	2.855
30 up to 40	−1.58 up to −0.51	0.2479	0.4429 − 0.1950	12.395
40 up to 50	−0.51 up to 0.55	0.4038	0.1950 + 0.2088	20.19
50 up to 60	0.55 up to 1.62	0.2386	0.4474 − 0.2088	11.93
60 or more	1.62 or more	0.0526	0.5000 − 0.4474	2.63

The first and last class both have expected frequencies smaller than 5. They are combined with adjacent classes.

Number of Clients	Area	f_e	f_o	$f_e - f_o$	$(f_o - f_e)^2$	$[(f_o - f_e)^2]/f_e$
Under 40	0.3050	15.25	16	−0.75	0.5625	0.0369
40 up to 50	0.4038	20.19	22	−1.81	3.2761	0.1623
50 or more	0.2912	14.56	12	2.56	6.5536	0.4501
Total	1.0000	50.00	50	0		0.6493

Since 0.6493 is not greater than 5.991, we fail to reject the null hypothesis. These data could be from a normal distribution.

15. The p-value of 0.746 is greater than 0.05 and the plotted values are close to the line. Thus it is reasonable to say the readings are normally distributed.

17. H_0: There is no relationship between community size and section read. H_1: There is a relationship. Reject H_0 if $\chi^2 > 9.488$.

$$\chi^2 = \frac{(170 - 157.50)^2}{157.50} + \cdots + \frac{(88 - 83.62)^2}{83.62} = 7.340$$

Do not reject H_0. There is no relationship between community size and section read.

19. H_0: No relationship between error rates and item type. H_1: There is a relationship between error rates and item type. Reject H_0 if $\chi^2 > 9.21$.

$$\chi^2 = \frac{(20 - 14.1)^2}{14.1} + \cdots + \frac{(225 - 225.25)^2}{225.25} = 8.033$$

Do not reject H_0. There is not a relationship between error rates and item type.

21. H_0: $\pi_s = 0.50$, $\pi_r = \pi_e = 0.25$
H_1: Distribution is not as given above.
$df = 2$. Reject H_0 if $\chi^2 > 4.605$.

Turn	f_o	f_e	$f_o - f_e$	$(f_o - f_e)^2/f_e$
Straight	112	100	12	1.44
Right	48	50	−2	0.08
Left	40	50	−10	2.00
Total	200	200		3.52

H_0 is not rejected. The proportions are as given in the null hypothesis.

23. H_0: There is no preference with respect to TV stations.
H_1: There is a preference with respect to TV stations.
$df = 3 - 1 = 2$. H_0 is rejected if $\chi^2 > 5.991$.

TV Station	f_o	f_e	$f_o - f_e$	$(f_o - f_e)^2$	$(f_o - f_e)^2/f_e$
WNAE	53	50	3	9	0.18
WRRN	64	50	14	196	3.92
WSPD	33	50	−17	289	5.78
	150	150	0		9.88

H_0 is rejected. There is a preference for TV stations.

25. H_0: $\pi_n = 0.21$, $\pi_m = 0.24$, $\pi_s = 0.35$, $\pi_w = 0.20$
H_1: The distribution is not as given.
Reject H_0 if $\chi^2 > 11.345$.

Region	f_o	f_e	$f_o - f_e$	$(f_o - f_e)^2/f_e$
Northeast	68	84	−16	3.0476
Midwest	104	96	8	0.6667
South	155	140	15	1.6071
West	73	80	−7	0.6125
Total	400	400	0	5.9339

H_0 is not rejected. The distribution of order destinations reflects the population.

27. H_0: The proportions are the same.
H_1: The proportions are not the same.
Reject H_0 if $\chi^2 > 16.919$.

f_o	f_e	$f_o - f_e$	$(f_o - f_e)^2$	$(f_o - f_e)^2/f_e$
44	28	16	256	9.143
32	28	4	16	0.571
23	28	−5	25	0.893
27	28	−1	1	0.036
23	28	−5	25	0.893
24	28	−4	16	0.571
31	28	3	9	0.321
27	28	−1	1	0.036
28	28	0	0	0.000
21	28	−7	49	1.750
				14.214

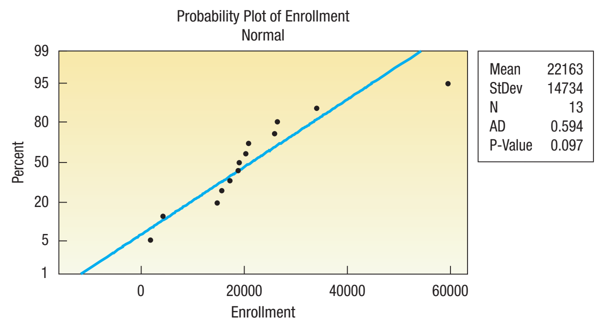
Do not reject H_0. The digits are evenly distributed.

29. H_0: The population of wages follows a normal distribution.
H_1: The population of hourly wages does not follow a normal distribution.
Reject the null if chi-square is greater than 7.779.

Wage	z-values	Area	Found by	f_e	f_o	$f_e - f_o$	$(f_o - f_e)^2$	$[(f_o - f_e)^2]/f_e$
Under \$6.50	Under −1.72	0.0427	0.5000 − 0.4573	11.529	20	−8.471	71.7578	6.2241
6.50 up to 7.50	−1.72 up to −0.72	0.1931	0.4573 − 0.2642	52.137	24	28.137	791.6908	15.1848
7.50 up to 8.50	−0.72 up to 0.28	0.3745	0.2642 + 0.1103	101.115	130	−28.885	834.3432	8.2514
8.50 up to 9.50	0.28 up to 1.27	0.2877	0.3980 − 0.1103	77.679	68	9.679	93.6830	1.2060
9.50 or more	1.27 or more	0.1020	0.5000 − 0.3980	27.54	28	−0.46	0.2116	0.0077
Total		1.0000		270	270	0		30.874

Since 30.874 is greater than 7.779, we reject the null hypothesis; wages do not follow a normal distribution.

31.



The p-value (0.097) is greater than 0.05. Do not reject the null hypothesis. The data could be normally distributed.

33. H_0: Gender and attitude toward the deficit are not related.
H_1: Gender and attitude toward the deficit are related.
Reject H_0 if $\chi^2 > 5.991$.

$$\chi^2 = \frac{(244 - 292.41)^2}{292.41} + \frac{(194 - 164.05)^2}{164.05} + \frac{(68 - 49.53)^2}{49.53} + \frac{(305 - 256.59)^2}{256.59} + \frac{(114 - 143.95)^2}{143.95} + \frac{(25 - 43.47)^2}{43.47} = 43.578$$

Since $43.578 > 5.991$, you reject H_0. A person's position on the deficit is influenced by his or her gender.

35. H_0: Whether a claim is filed and age are not related.
H_1: Whether a claim is filed and age are related.
Reject H_0 if $\chi^2 > 7.815$.

$$\chi^2 = \frac{(170 - 203.33)^2}{203.33} + \cdots + \frac{(24 - 35.67)^2}{35.67} = 53.639$$

Reject H_0. Age is related to whether a claim is filed.

37. H_0: $\pi_{BL} = \pi_O = .23$, $\pi_Y = \pi_G = .15$, $\pi_{BR} = \pi_R = .12$. H_1: The proportions are not as given. Reject H_0 if $\chi^2 > 15.086$.

Color	f_o	f_e	$(f_o - f_e)^2/f_e$
Blue	12	16.56	1.256
Brown	14	8.64	3.325
Yellow	13	10.80	0.448
Red	14	8.64	3.325
Orange	7	16.56	5.519
Green	12	10.80	0.133
Total	72		14.006

Do not reject H_0. The color distribution agrees with the manufacturer's information.

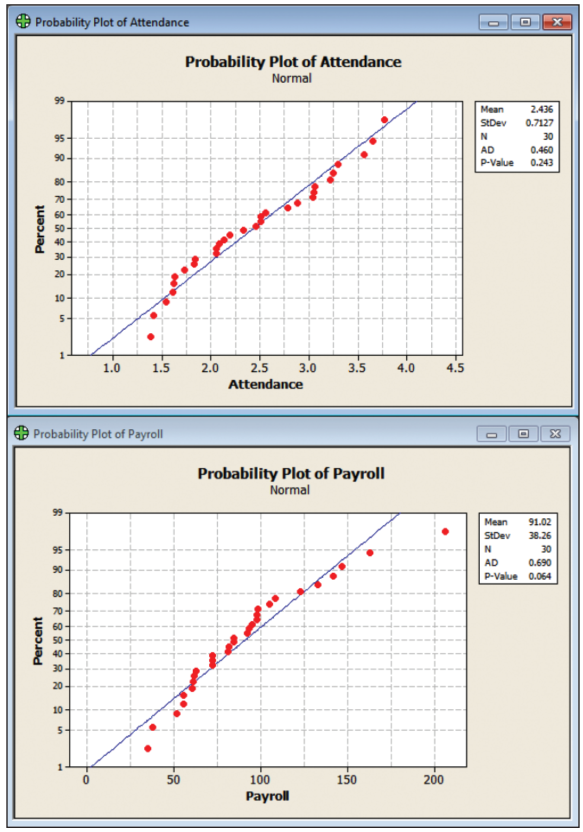
39. **a.** H_0: Payroll and winning are not related.
H_1: Payroll and winning are related.
Reject H_0 if $\chi^2 > 3.84$.

	Payroll		
Winning	Lower Half	Top Half	Total
No	8	6	14
Yes	7	9	16
Total	15	15	

$$\chi^2 = \frac{(8 - 7)^2}{7} + \frac{(6 - 7)^2}{7} + \frac{(7 - 8)^2}{8} + \frac{(9 - 8)^2}{8} = 0.5357$$

Do not reject H_0. Conclude that payroll and winning may not be related.

b.



The attendance p-value is 0.243, which is greater than 0.05. Do not reject the null hypothesis. Attendance could be normally distributed. The payroll p-value is 0.064, which is greater than 0.05. Do not reject the null hypothesis. Payroll could be normally distributed.

Solutions to Practice Tests

PRACTICE TEST—CHAPTER 1

Part I

1. Statistics
2. Descriptive statistics
3. Statistical inference
4. Sample
5. Population
6. Nominal
7. Ratio
8. Ordinal
9. Interval
10. Discrete
11. Nominal
12. Nominal

Part II

1. **a.** 11.1
   b. About 3 to 1
   c. 65
2. **a.** Ordinal
   b. 67.7%

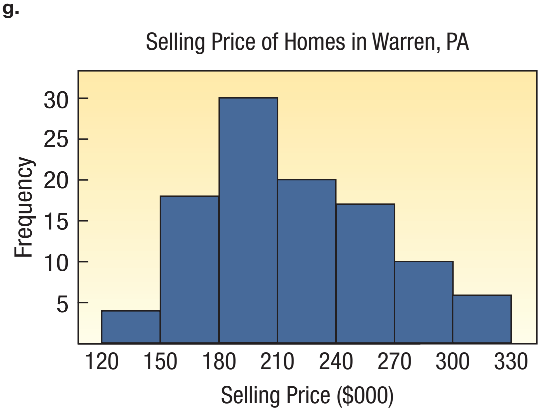
PRACTICE TEST—CHAPTER 2

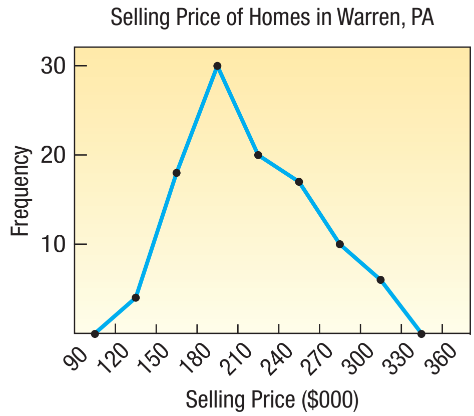
Part I

1. Frequency table
2. Frequency distribution
3. Bar chart
4. Pie chart
5. Histogram or frequency polygon
6. 7
7. Class interval
8. Midpoint
9. Total number of observations
10. Upper class limits

Part II

1. **a.** \$30
   b. 105
   c. 52
   d. .19
   e. \$165
   f. \$120, \$330
   g.





PRACTICE TEST—CHAPTER 3

Part I

1. Parameter
2. Statistic
3. Zero
4. Median
5. 50%
6. Mode
7. Range
8. Variance
9. Variance
10. Never
11. Median
12. Normal rule or empirical rule

Part II

1. **a.** $\bar{X} = \frac{560}{8} = 70$
   b. Median = 71.5
   c. Range = 80 − 52 = 28
   d. $s = \sqrt{\frac{610.0}{8 - 1}} = 9.335$
2. $\bar{X}_w = \frac{200(\$36) + 300(\$40) + 500(\$50)}{200 + 300 + 500} = \$44.20$
3. $-0.88 \pm 2(1.41)$
   -0.88 ± 2.82
   $-3.70, 1.94$

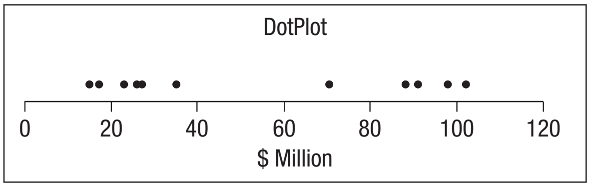
PRACTICE TEST—CHAPTER 4

Part I

1. Dot plot
2. Box plot
3. Scatter diagram
4. Contingency table
5. Quartile
6. Percentile
7. Skewness
8. First quartile
9. Inter quartile range

Part II

1. a.



b. $L_{50} = (11 + 1)\dfrac{50}{100} = 6$

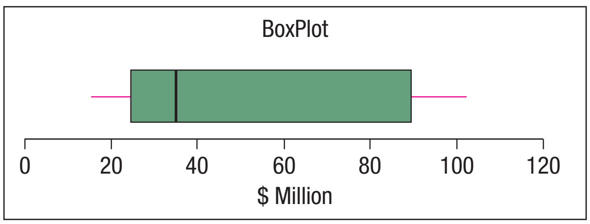
median = 35

c. $L_{25} = (11 + 1)\dfrac{25}{100} = 3$

$Q_1 = 23$

d. $L_{75} = (11 + 1)\dfrac{75}{100} = 9$

$Q_3 = 91$



2. a. $P(H) = \dfrac{144}{449} = 0.32$

b. $P(H|< 30) = \dfrac{21}{89} = 0.24$

c. $P(H|> 60) = \dfrac{75}{203} = 0.37$. Age is related to high blood pressure, because $P(H|> 60)$ is greater than $P(H|< 30)$.

PRACTICE TEST—CHAPTER 5

Part I

1. Probability
2. Experiment
3. Event
4. Relative frequency
5. Subjective
6. Classical
7. Mutually exclusive
8. Exhaustive
9. Mutually exclusive
10. Complement rule
11. Joint probability
12. Independent

Part II

1. a. $P(\text{Both}) = P(B_1) \cdot P(B_2|B_1)$

$$= \left(\frac{5}{20}\right)\left(\frac{4}{19}\right) = .0526$$

b. $P(\text{at least 1}) = 1 - P(\text{neither})$

$$= 1 - \left(\frac{15}{20}\right)\left(\frac{14}{19}\right) = 1 - .5526 = .4474$$

2. $P(\text{At least 1}) = P(\text{Jogs}) + P(\text{Bike}) - P(\text{Both})$

$= .30 + .20 - 12 = .38$

3. $X = 5! = 120$

PRACTICE TEST—CHAPTER 6

Part I

1. Probability distribution
2. Probability
3. One
4. Mean
5. Two
6. Never
7. Equal
8. π
9. .075
10. .183

Part II

1. a. Binomial

b. $P(x = 1) = {}_{16}C_1(.15)^1(.85)^{15} = (16)(.15)(.0874) = .210$

c. $P(x \geq 1) = 1 - P(x = 0) = 1 - {}_{16}C_0(.15)^0(.85)^{16} = .9257$

2. a. Poisson

b. $P(x = 3) = \dfrac{3^3e^{-3}}{3!} = \dfrac{27}{(6)(20.0855)} = .224$

c. $P(x = 0) = \dfrac{3^0e^{-3}}{0!} = .050$

d. $P(x \geq 1) = 1 - P(x = 0) = 1 - .050 = .950$

3.

Exemptions x	Probability $P(x)$	$X \cdot P(x)$	$(x-2.2)^2 \cdot P(x)$
1	0.2	0.2	0.288
2	0.5	1	0.02
3	0.2	0.6	0.128
4	0.1	0.4	0.324
		2.2	0.76

a. $\mu = 1(.2) + 2(.5) + 3(.2) + 4(.1) = 2.2$

b. $\sigma^2 = (1 - 2.2)^2(.2) + \cdots + (4 - 2.2)^2(.1) = 0.76$

PRACTICE TEST—CHAPTER 7

Part I

1. One
2. Infinite
3. Discrete
4. Always equal
5. Infinite
6. One
7. Any of these values
8. .2764
9. .9396
10. .0450

Part II

1. a. $z = \dfrac{2000 - 1600}{850} = .47$

$P(0 \leq z < .47) = .1808$

b. $z = \dfrac{900 - 1600}{850} = -0.82$

$P(-0.82 \leq z \leq .47) = .2939 + .1808 = .4747$

c. $z = \dfrac{1800 - 1600}{850} = 0.24$

$P(0.24 \leq z \leq .47) = .1808 - .0948 = -.0860$

d. $1.65 = \dfrac{X - 1600}{850}$

$X = 1600 + 1.65(850) = \$3002.50$

PRACTICE TEST—CHAPTER 8

Part I

1. Random sample
2. No size restriction
3. Strata
4. Sampling error
5. Sampling distribution of sample means
6. 120
7. Standard error of the mean
8. Always equal
9. Decrease
10. Normal distribution

Part II

1. $z = \frac{11 - 12.2}{2.3/\sqrt{12}} = -1.81$

   $P(z < -1.81) = .5000 - .4649 = .0351$

PRACTICE TEST—CHAPTER 9

Part I

1. Point estimate
2. Confidence interval
3. Narrower
4. Proportion
5. 95
6. Standard deviation
7. Binomial
8. z distribution
9. Population median
10. Population mean

Part II

1. **a.** Unknown

   b. 9.3 years

   c. $s_{\bar{x}} = \frac{2.0}{\sqrt{26}} = 0.392$

   d. $9.3 \pm (1.708)\frac{2.0}{\sqrt{26}}$

   9.3 ± 0.67

   $(8.63, 9.97)$

2. $n = (.27)(.73)\left(\frac{2.326}{.02}\right)^2 = 2.666$

3. $.64 \pm 1.96\sqrt{\frac{.64(.36)}{100}}$

   $.64 \pm .094$

   $[.546, .734]$

PRACTICE TEST—CHAPTER 10

Part I

1. Null hypothesis
2. Accept
3. Significant level
4. Test statistic
5. Critical value
6. Two
7. Standard deviation (or variance)
8. p-value
9. Binomial
10. Five

Part II

1. $H_0: \mu \le 90$, $H_1: \mu > 90$

   $df = 18 - 1 = 17$

   Reject H_0 if $t > 2.567$

   $t = \frac{96 - 90}{12/\sqrt{18}} = 2.121$

   Do not reject H_0. We cannot conclude that the mean time in the park is more than 90 minutes.

2. $H_0: \mu \le 9.75$ $\quad H_1: \mu > 9.75$

   Reject H_0 if $z > 1.645$

   note σ is known, so z is used and we assume a .05 significance level.

   $z = \frac{9.85 - 9.75}{0.27/\sqrt{25}} = 1.852$

   Reject H_0. The mean weight is more than 9.75 ounces.

3. $H_0: \pi \ge 0.67$, $H_1: \pi < 0.67$

   Reject H_0 if $z < -1.645$.

   $$z = \frac{\frac{180}{300} - 0.67}{\sqrt{\frac{0.67(1 - 0.67)}{300}}} = -2.578$$

   Reject H_0. Less than .67 of the couples seek their mate's approval.

PRACTICE TEST—CHAPTER 11

Part I

1. Zero
2. z
3. Proportions
4. Population standard deviation
5. Difference
6. t distribution
7. $n - 2$
8. Paired
9. Independent
10. Dependent sample

Part II

1. $H_0: \mu_y = \mu_h$; $H_1: \mu_y \ne \mu_h$

   $df = 14 + 12 - 2 = 24$

   Reject H_0 if $t < -2.064$ or $t > 2.064$

   $$s_p^2 = \frac{(14 - 1)30^2 + (12 - 1)(40)^2}{14 + 12 - 2} = 1220.83$$

   $$t = \frac{837 - 797}{\sqrt{1220.83\left(\frac{1}{14} + \frac{1}{12}\right)}} = \frac{40.0}{13.7455} = 2.910$$

   Reject H_0. There is a difference in the mean miles traveled.

2. $H_0: \pi_E = \pi_T$ $\quad H_1: \pi_E \ne \pi_T$

   Reject H_0 if $z < -1.96$ or $z > 1.96$

   $$P_C = \frac{128 + 149}{300 + 400} = \frac{277}{700} = .396$$

   $$z = \frac{\frac{128}{300} - \frac{149}{400}}{\sqrt{\frac{.396(1 - .396)}{300} + \frac{.396(1 - .396)}{400}}} = \frac{.054}{.037} = 1.459$$

   Do not reject H_0. There is no difference on the proportion that liked the soap in the two cities.

PRACTICE TEST—CHAPTER 12

Part I

1. F distribution
2. Positively skewed
3. Variances
4. Means
5. Population standard deviations
6. Error or Residual
7. Equal
8. Degrees of freedom
9. Variances
10. Independent

Part II

1. $H_0: \sigma_h^2 = \sigma_y^2$; $H_1: \sigma_h^2 \neq \sigma_y^2$

   $df_y = 12 - 1 = 11 \qquad df_h = 14 - 1 = 13$

   Reject H_0 if $F > 2.635$.

   $$F = \frac{(40)^2}{(30)^2} = 1.78$$

   Do not reject H_0. Cannot conclude there is a difference in the variation of the miles traveled.

2. **a.** 3
   b. 21
   c. 3.55
   d. $H_0: \mu_1 = \mu_2 = \mu_3$
   H_1: not all treatment means are the same
   e. Reject H_0
   f. The treatment means are not the same.

PRACTICE TEST—CHAPTER 13

Part I

1. Scatter diagram
2. -1 and 1
3. Less than zero
4. Coefficient of determination
5. t
6. Predicted or fitted
7. Sign
8. Larger
9. Error
10. Independent

Part II

1. **a.** 25
   b. Shares of stock
   c. $\hat{Y} = 197.9229 + 24.9145X$
   d. Direct
   e. $r = \sqrt{\dfrac{152{,}399.0211}{208{,}333.1400}} = 0.855$
   f. $\hat{Y} = 197.9229 + 24.9145(10) = 447.0679$, or 447
   g. Increase almost 25
   h. $H_0: \beta \leq 0$
   $H_1: \beta > 0$
   Reject H_0 if $t > 1.71$
   $$t = \frac{24.9145}{3.1473} = 7.916$$
   Reject H_0. There is a positive relationship between years and shares.

PRACTICE TEST—CHAPTER 14

Part I

1. Independent variables
2. Least squares
3. Mean square error
4. Independent variables
5. Independent variable
6. Different from zero
7. F distribution
8. t distribution
9. Linearity
10. Correlated
11. Multicollinearity
12. Dummy variable

Part II

1. **a.** Four
   b. $\hat{Y} = 70.06 + 0.42x_1 + 0.27x_2 + 0.75x_3 + 0.42x_4$
   c. $R^2 = \dfrac{1050.8}{1134.6} = 0.926$
   d. $s_{y.1234} = \sqrt{4.19} = 2.05$
   e. $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$
   H_1: not all $\beta_i = 0$
   Reject H_0 if $F > 2.87$.
   $$F = \frac{262.70}{4.19} = 62.70$$
   Reject H_0. Not all the regression coefficients equal zero.
   d. $H_0: \beta_i = 0$, $H_1: \beta_i \neq 0$
   Reject H_0 if $t < -2.086$ or $t > 2.086$.

$\beta_1 = 0$	$\beta_2 = 0$	$\beta_3 = 0$	$\beta_4 = 0$
$\beta_1 \neq 0$	$\beta_2 \neq 0$	$\beta_3 \neq 0$	$\beta_4 \neq 0$
$t = 2.47$	$t = 1.29$	$t = 2.50$	$t = 6.00$
Reject H_0	Do not reject H_0	Reject H_0	Reject H_0

   Conclusion. Drop variable 2 and retain the others.

PRACTICE TEST—CHAPTER 15

Part I

1. Nominal
2. No assumption
3. Can have negative values
4. 2
5. 6
6. Independent
7. 4
8. The same
9. 9.488
10. Degrees of freedom

Part II

1. H_0: There is no difference between the school district and census data.
   H_1: There is a difference between the school district and census data.
   Reject H_0 if $\chi^2 > 7.815$.
   $$\chi^2 = \frac{(120-130)^2}{130} + \frac{(40-40)^2}{40} + \frac{(30-20)^2}{20} + \frac{(10-10)^2}{10} = 5.77$$
   Do not reject H_0. There is no difference between the census and school district data.

2. H_0: Gender and book type are independent.
   H_1: Gender and book type are related.
   Reject H_0 if $\chi^2 > 5.991$.
   $$\chi^2 = \frac{(250-197.31)^2}{197.31} + \cdots + \frac{(200-187.5)^2}{187.5} = 54.842$$
   Reject H_0. Men and women read different types of books.