APPENDIX D: ANSWERS TO SELF-REVIEW

CHAPTER 1

1–1 **a.** Inferential statistics, because a sample was used to draw a conclusion about how all consumers in the population would react if the chicken dinner were marketed.

b. On the basis of the sample of 1,960 consumers, we estimate that, if it is marketed, 60% of all consumers will purchase the chicken dinner: (1,176/1,960) × 100 = 60%.

1–2 **a.** Age is a ratio-scale variable. A 40-year-old is twice as old as someone 20 years old.

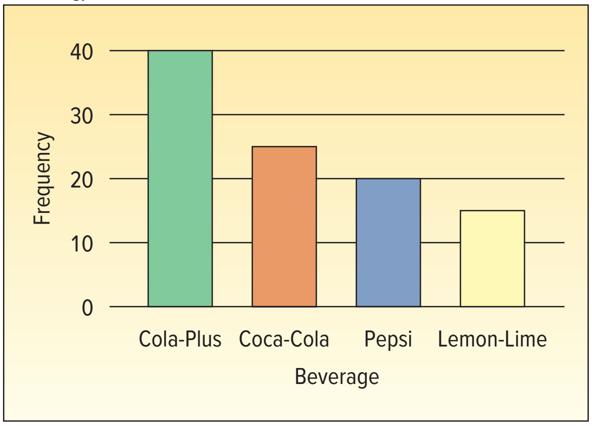
b. The two variables are: (1) if a person owns a luxury car, and (2) the state of residence. Both are measured on a nominal scale.

CHAPTER 2

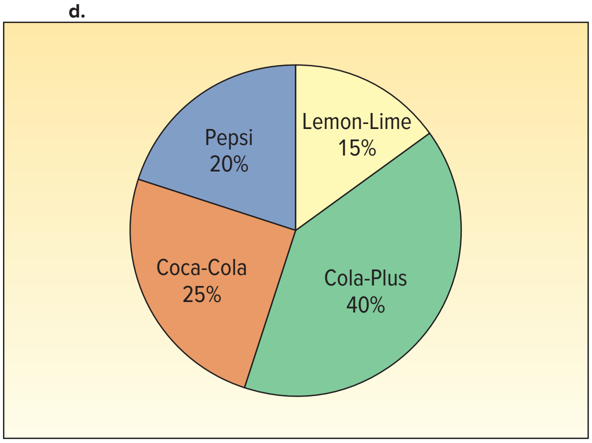
2–1 **a.** Qualitative data, because the customers' response to the taste test is the name of a beverage.

b. Frequency table. It shows the number of people who prefer each beverage.

c.



d.



2–2 **a.** The raw data or ungrouped data.

b.

Commission	Number of Salespeople
$1,400 up to $1,500	2
1,500 up to 1,600	5
1,600 up to 1,700	3
1,700 up to 1,800	1
Total	11

c. Class frequencies.

d. The largest concentration of commissions is $1,500 up to $1,600. The smallest commission is about $1,400 and the largest is about $1,800. The typical amount earned is $1,550.

2–3 **a.** $2^6 = 64 < 73 < 128 = 2^7$, so seven classes are recommended.

b. The interval width should be at least (488 − 320)/7 = 24. Class intervals of either 25 or 30 are reasonable.

c. Assuming a class interval of 25 and beginning with a lower limit of 300, eight classes are required. If we use an interval of 30 and begin with a lower limit of 300, only 7 classes are required. Seven classes is the better alternative.

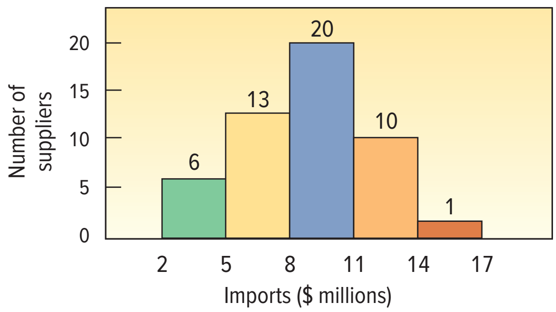
Distance Classes	Frequency	Percent
300 up to 330	2	2.7%
330 up to 360	2	2.7
360 up to 390	17	23.3
390 up to 420	27	37.0
420 up to 450	22	30.1
450 up to 480	1	1.4
480 up to 510	2	2.7
Grand Total	73	100.00

d. 17

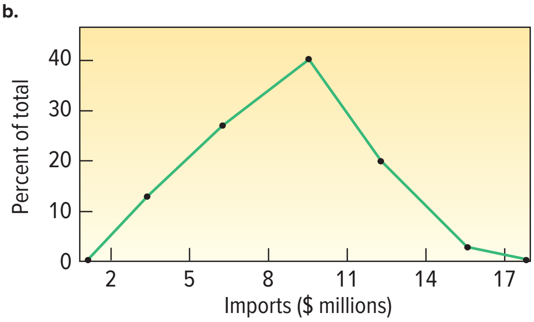
e. 23.3%, found by 17/73

f. 71.2%, found by (27 + 22 + 1 + 2)/73

2–4 **a.**



b.



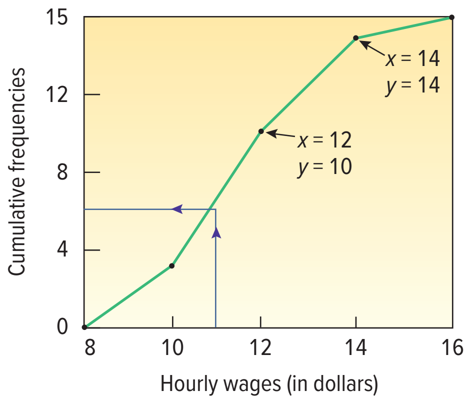
The plots are: (3.5, 12), (6.5, 26), (9.5, 40), (12.5, 20), and (15.5, 2).

c. The smallest annual volume of imports by a supplier is about $2 million, the largest about $17 million. The highest frequency is between $8 million and $11 million.

2–5 **a.** A frequency distribution.

b.

Hourly Wages	Cumulative Number
Less than $8	0
Less than $10	3
Less than $12	10
Less than $14	14
Less than $16	15



c. About seven employees earn $11.00 or less.

CHAPTER 3

3–1 **1.** **a.** $\bar{x} = \frac{\Sigma x}{n}$

b. $\bar{x} = \frac{\$267{,}100}{4} = \$66{,}775$

c. Statistic, because it is a sample value.

d. $66,775. The sample mean is our best estimate of the population mean.

2. **a.** $\mu = \frac{\Sigma x}{N}$

b. $\mu = \frac{498}{6} = 83$

c. Parameter, because it was computed using all the population values.

3–2 **1.** **a.** $878

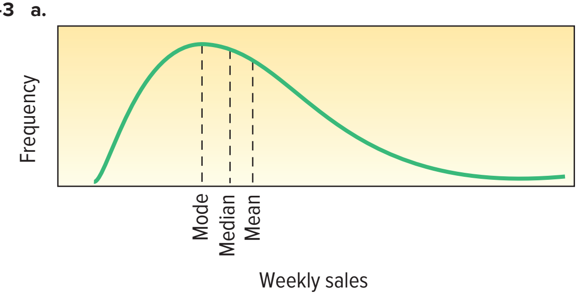
b. 3, 3

2. **a.** 17, found by (15 + 19)/2 = 17

b. 5, 5

c. There are 3 values that occur twice: 11, 15, and 19. There are three modes.

3–3 **a.**



b. Positively skewed, because the mean is the largest average and the mode is the smallest.

3–4 **a.** $237, found by:

$$\frac{(95 \times \$400) + (126 \times \$200) + (79 \times \$100)}{95 + 126 + 79} = \$237.00$$

b. The profit per suit is $12, found by $237 − $200 cost − $25 commission. The total profit for the 300 suits is $3,600, found by 300 × $12.

3–5 **a.** 22 thousands of pounds, found by 112 − 90

b. $\bar{x} = \frac{824}{8} = 103$ thousands of pounds

c. Variance $= \frac{373}{8} = 46.625$

3–6 **a.** $\mu = \frac{\$16{,}900}{5} = \$3{,}380$

b. $\sigma^2 = \frac{(3{,}536 - 3{,}380)^2 + \ldots + (3{,}622 - 3{,}380)^2}{5}$

$$= \frac{(156)^2 + (-207)^2 + (68)^2 + (-259)^2 + (242)^2}{5}$$

$$= \frac{197{,}454}{5} = 39{,}490.8$$

c. $\sigma = \sqrt{39{,}490.8} = 198.72$

d. There is more variation in the Pittsburgh office because the standard deviation is larger. The mean is also larger in the Pittsburgh office.

3–7 2.33, found by:

$$\bar{x} = \frac{\Sigma x}{n} = \frac{28}{7} = 4$$

$$s^2 = \frac{\Sigma(x - \bar{x})^2}{n - 1}$$

$$= \frac{14}{7 - 1}$$

$$= 2.33$$

$$s = \sqrt{2.33} = 1.53$$

3–8 **a.** $k = \frac{14.15 - 14.00}{.10} = 1.5$

$$k = \frac{13.85 - 14.0}{.10} = -1.5$$

$$1 - \frac{1}{(1.5)^2} = 1 - .44 = .56$$

b. 13.8 and 14.2

CHAPTER 4

4–1 **1.** **a.** 79, 105

b. 15

c. From 88 to 97; 75% of the stores are in this range.

4–2 **a.** 7.9

b. $Q_1 = 7.76$, $Q_3 = 8.015$

4–3 The smallest value is 10 and the largest 85; the first quartile is 25 and the third 60. About 50% of the values are between 25 and 60. The median value is 40. The distribution is positively skewed. There are no outliers.

4–4 **a.** $\bar{x} = \frac{407}{5} = 81.4$,

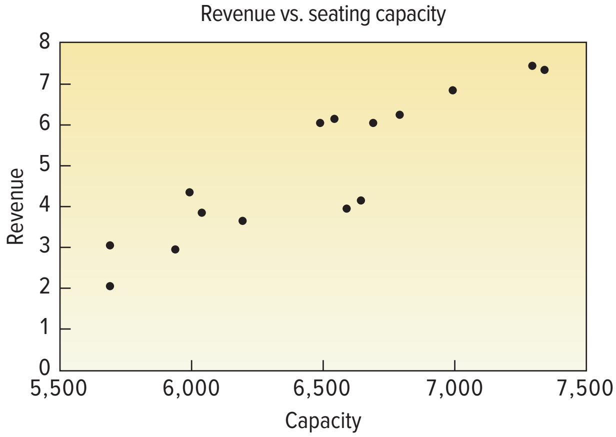
$$s = \sqrt{\frac{923.2}{5 - 1}} = 15.19, \text{ Median} = 84$$

b. $sk = \frac{3(81.4 - 84.0)}{15.19} = -0.51$

c. $sk = \frac{5}{(4)(3)}[-1.3154] = -0.5481$

d. The distribution is somewhat negatively skewed.

4–5 a.



b. The correlation coefficient is 0.90.
c. $7,500
d. Strong and positive. Revenue is positively related to seating capacity.

CHAPTER 5

5–1 a. Count the number who think the new game is playable.
b. Seventy-three players found the game playable. Many other answers are possible.
c. No. Probability cannot be greater than 1. The probability that the game, if put on the market, will be successful is 65/80, or .8125.
d. Cannot be less than 0. Perhaps a mistake in arithmetic.
e. More than half of the players testing the game liked it. (Of course, other answers are possible.)

5–2 1. $\dfrac{\text{4 queens in deck}}{\text{52 cards total}} = \dfrac{4}{52} = .0769$

Classical.

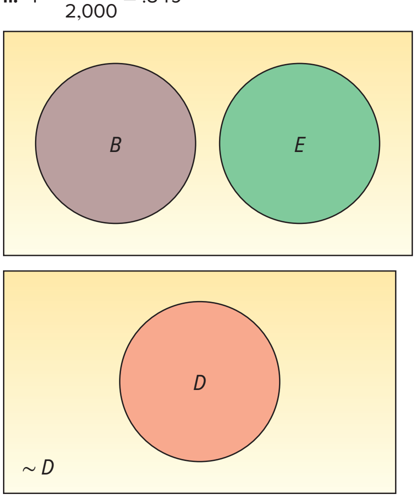
2. $\dfrac{182}{539} = .338$ Empirical.

3. The probability of the outcome is estimated by applying the subjective approach to estimating a probability. If you think that it is likely that you will save $1 million, then your probability should be between .5 and 1.0.

5–3 a. i. $\dfrac{(50 + 68)}{2{,}000} = .059$

ii. $1 - \dfrac{302}{2{,}000} = .849$

b.

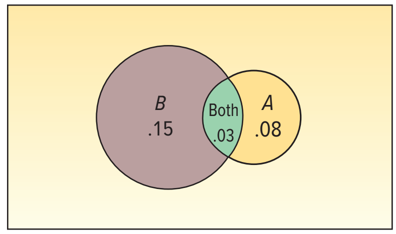


c. They are not complementary, but are mutually exclusive.

5–4 a. Need for corrective shoes is event A. Need for major dental work is event B.

$$\begin{aligned} P(A \text{ or } B) &= P(A) + P(B) - P(A \text{ and } B) \\ &= .08 + .15 - .03 \\ &= .20 \end{aligned}$$

b. One possibility is:



5–5 (.95)(.95)(.95)(.95) = .8145

5–6 a. .002, found by:

$$\left(\frac{4}{12}\right)\left(\frac{3}{11}\right)\left(\frac{2}{10}\right)\left(\frac{1}{9}\right) = \frac{24}{11{,}880} = .002$$

b. .14, found by:

$$\left(\frac{8}{12}\right)\left(\frac{7}{11}\right)\left(\frac{6}{10}\right)\left(\frac{5}{9}\right) = \frac{1{,}680}{11{,}880} = .1414$$

c. No, because there are other possibilities, such as three women and one man.

5–7 a. $P(B_2) = \dfrac{225}{500} = .45$

b. The two events are mutually exclusive, so apply the special rule of addition.

$$P(B_1 \text{ or } B_2) = P(B_1) + P(B_2) = \frac{100}{500} + \frac{225}{500} = .65$$

c. The two events are not mutually exclusive, so apply the general rule of addition.

$$\begin{aligned} P(B_1 \text{ or } A_1) &= P(B_1) + P(A_1) - P(B_1 \text{ and } A_1) \\ &= \frac{100}{500} + \frac{75}{500} - \frac{15}{500} = .32 \end{aligned}$$

d. As shown in the example/solution, movies attended per month and age are not independent, so apply the general rule of multiplication.

$$\begin{aligned} P(B_1 \text{ and } A_1) &= P(B_1)P(A_1|B_1) \\ &= \left(\frac{100}{500}\right)\left(\frac{15}{100}\right) = .03 \end{aligned}$$

5–8 a. $P(\text{visited often}) = \dfrac{80}{195} = .41$

b. $P(\text{visited a store in an enclosed mall}) = \dfrac{90}{195} = .46$

c. The two events are not mutually exclusive, so apply the general rule of addition.

P(visited often or visited a Kohl's in an enclosed mall)
$= P(\text{often}) + P(\text{enclosed mall}) - P(\text{often and enclosed mall})$
$= \dfrac{80}{195} + \dfrac{90}{195} - \dfrac{60}{195} = .56$

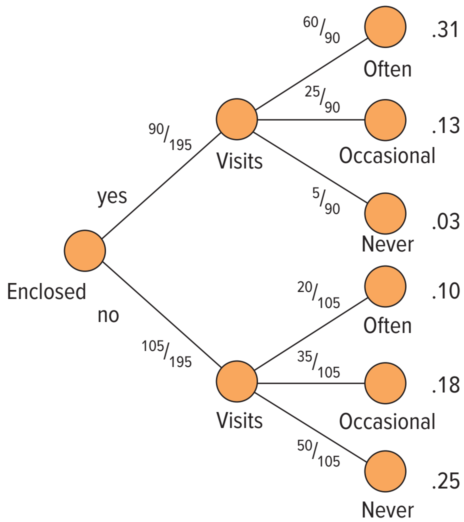
d. P(visited often | went to a Kohl's in an enclosed mall)
$= \dfrac{60}{90} = .67$

e. Independence requires that $P(A|B) = P(A)$. One possibility is: P(visit often | visited an enclosed mall) = P(visit often). Does 60/90 = 80/195? No, the two variables are not independent. Therefore, any joint probability in the table must be computed by using the general rule of multiplication.

f. As shown in part (e), visits often and enclosed mall are not independent, so apply the general rule of multiplication.

$$\begin{aligned} P(\text{often and enclosed mall}) &= P(\text{often})P(\text{enclosed}\,|\,\text{often}) \\ &= \left(\frac{80}{195}\right)\left(\frac{60}{80}\right) = .31 \end{aligned}$$

g.



5–9 **1.** $(5)(4) = 20$

2. $(3)(2)(4)(3) = 72$

5–10 **1.** **a.** 60, found by $(5)(4)(3)$

b. 60, found by:

$$\frac{5!}{(5-3)!} = \frac{5 \cdot 4 \cdot 3 \cdot \cancel{2 \cdot 1}}{\cancel{2 \cdot 1}}$$

2. 5,040, found by:

$$\frac{10!}{(10-4)!} = \frac{10 \cdot 9 \cdot 8 \cdot 7 \cdot \cancel{6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}}{\cancel{6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}}$$

3. **a.** 35 is correct, found by:

$${}_7C_3 = \frac{n!}{r!(n-r)!} = \frac{7!}{3!(7-3)!} = 35$$

b. Yes. There are 21 combinations, found by:

$${}_7C_5 = \frac{n!}{r!(n-r)!} = \frac{7!}{5!(7-5)!} = 21$$

4. **a.** $${}_{50}P_3 = \frac{50!}{(50-3)!} = 117{,}600$$

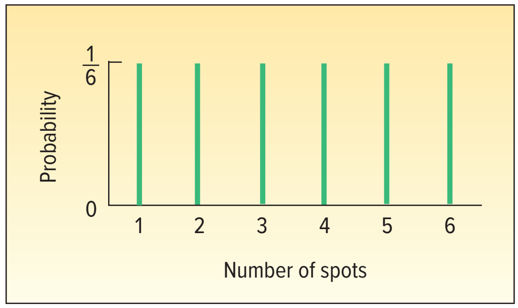
b. $${}_{50}C_3 = \frac{50!}{3!(50-3)!} = 19{,}600$$

CHAPTER 6

6–1 **a.**

Number of Spots	Probability
1	$\frac{1}{6}$
2	$\frac{1}{6}$
3	$\frac{1}{6}$
4	$\frac{1}{6}$
5	$\frac{1}{6}$
6	$\frac{1}{6}$
Total	$\frac{6}{6} = 1.00$

b.



c. $\frac{6}{6}$ or 1.

6–2 **a.** It is discrete because the values \$1.99, \$2.49, and \$2.89 are clearly separated from each other. Also the sum of the probabilities is 1.00, and the outcomes are mutually exclusive.

b.

x	$P(x)$	$xP(x)$
1.99	.30	0.597
2.49	.50	1.245
2.89	.20	0.578
		Sum is 2.42

Mean is 2.42

c.

x	$P(x)$	$(x - \mu)$	$(x - \mu)^2P(x)$
1.99	.30	−0.43	0.05547
2.49	.50	0.07	0.00245
2.89	.20	0.47	0.04418
			0.10210

The variance is 0.10208, and the standard deviation is 31.95 cents.

6–3 **a.** It is reasonable because each employee either uses direct deposit or does not; employees are independent; the probability of using direct deposit is 0.95 for all; and we count the number using the service out of 7.

b. $P(7) = {}_7C_7\,(.95)^7\,(.05)^0 = .6983$

c. $P(4) = {}_7C_4\,(.95)^4\,(.05)^3 = .0036$

d. Answers are in agreement.

6–4 **a.** $n = 8$, $\pi = .40$

b. $P(x = 3) = .2787$

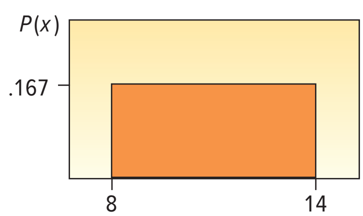
c. $P(x > 0) = 1 - P(x = 0) = 1 - .0168 = .9832$

6–6 $\mu = 4{,}000(.0002) = 0.8$

$$P(1) = \frac{0.8^1 e^{-0.8}}{1!} = .3595$$

CHAPTER 7

7–1 **a.**



b. $P(x) = \text{(height)(base)}$

$$= \left(\frac{1}{14-8}\right)\left(14-8\right)$$

$$= \left(\frac{1}{6}\right)\left(6\right) = 1.00$$

c. $\mu = \frac{a+b}{2} = \frac{14+8}{2} = \frac{22}{2} = 11$

$$\sigma = \sqrt{\frac{(b-a)^2}{12}} = \sqrt{\frac{(14-8)^2}{12}} = \sqrt{\frac{36}{12}} = \sqrt{3}$$

$$= 1.73$$

d. $P(10 < x < 14) = \text{(height)(base)}$

$$= \left(\frac{1}{14-8}\right)\left(14-10\right)$$

$$= \frac{1}{6}\left(4\right)$$

$$= .667$$

e. $P(x < 9) = \text{(height)(base)}$

$$= \left(\frac{1}{14-8}\right)\left(9-8\right)$$

$$= 0.167$$

7–2 **a.** $z = (64 - 48)/12.8 = 1.25$. This person's difference of 16 ounces more than average is 1.25 standard deviations above the average.

b. $z = (32 - 48)/12.8 = -1.25$. This person's difference of 16 ounces less than average is 1.25 standard deviations below the average.

7–3 **a.** \$46,400 and \$48,000, found by \$47,200 ± 1(\$800)

b. \$45,600 and \$48,800, found by \$47,200 ± 2(\$800)

c. \$44,800 and \$49,600, found by \$47,200 ± 3(\$800)

d. \$47,200. The mean, median, and mode are equal for a normal distribution.

e. Yes, a normal distribution is symmetrical.

7–4 **a.** Computing z:

$$z = \frac{154-150}{5} = 0.80$$

Referring to Appendix B.3, the area is .2881. So $P(150 < \text{temp} < 154) = .2881$.

b. Computing z:

$$z = \frac{164-150}{5} = 2.80$$

Referring to Appendix B.3, the area is .4974. So $P(164 > \text{temp}) = .5000 - .4974 = .0026$

7–5 **a.** Computing the z-values:

$$z = \frac{146-150}{5} = -0.80 \quad \text{and} \quad z = \frac{156-150}{5} = 1.20$$

$$P(146 < \text{temp} < 156) = P(-0.80 < z < 1.20)$$
$$= .2881 + .3849 = .6730$$

b. Computing the z-values:

$$z = \frac{162-150}{5} = 2.40 \quad \text{and} \quad z = \frac{156-150}{5} = 1.20$$

$$P(156 < \text{temp} < 162) = P(1.20 < z < 2.40)$$
$$= .4918 - .3849 = .1069$$

7–6 85.24 (instructor would no doubt make it 85). The closest area to .4000 is .3997; z is 1.28. Then:

$$1.28 = \frac{x-75}{8}$$

$$10.24 = x - 75$$
$$x = 85.24$$

CHAPTER 8

8–1 **a.** Students selected are Lehmann, Edinger, Nickens, Chontos, St. John, and Kemp.

b. Answers will vary.

c. Skip it and move to the next random number.

8–2 The students selected are Berry, Francis, Kopp, Poteau, and Swetye.

8–3 **a.** 10, found by:

$$_5C_2 = \frac{5}{2(5-2)}$$

b.

	Service	Sample Mean
Snow, Tolson	20, 22	21
Snow, Kraft	20, 26	23
Snow, Irwin	20, 24	22
Snow, Jones	20, 28	24
Tolson, Kraft	22, 26	24
Tolson, Irwin	22, 24	23
Tolson, Jones	22, 28	25
Kraft, Irwin	26, 24	25
Kraft, Jones	26, 28	27
Irwin, Jones	24, 28	26

c.

Mean	Number	Probability
21	1	.10
22	1	.10
23	2	.20
24	2	.20
25	2	.20
26	1	.10
27	1	.10
	10	1.00

d. Identical: population mean, μ, is 24, and mean of sample means, is also 24.

e. Sample means range from 21 to 27. Population values go from 20 to 28.

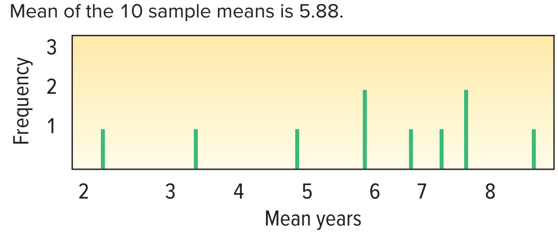
f. No, the population is uniformly distributed.

g. Yes.

8–4 The answers will vary. Here is one solution.

	Sample Number									
	1	2	3	4	5	6	7	8	9	10
	8	2	2	19	3	4	0	4	1	2
	19	1	14	9	2	5	8	2	14	4
	8	3	4	2	4	4	1	14	4	1
	0	3	2	3	1	2	16	1	2	3
	2	1	7	2	19	18	18	16	3	7
Total	37	10	29	35	29	33	43	37	24	17
$\bar{x}$	7.4	2	5.8	7.0	5.8	6.6	8.6	7.4	4.8	3.4

Mean of the 10 sample means is 5.88.



8–5 $z = \dfrac{31.08 - 31.20}{0.4/\sqrt{16}} = -1.20$

The probability that z is greater than -1.20 is $.5000 + .3849 = .8849$. There is more than an 88% chance the filling operation will produce bottles with at least 31.08 ounces.

CHAPTER 9

9–1 **a.** Unknown. This is the value we wish to estimate.

b. The sample mean of \$20,000 is the point estimate of the population mean daily franchise sales.

c. $\$20{,}000 \pm 1.960\dfrac{\$3{,}000}{\sqrt{40}} = \$20{,}000 \pm \$930$

d. The estimate of the population mean daily sales for the Bun-and-Run franchises is between \$19,070 and \$20,930. About 95% all possible samples of 40 Bun-and-Run franchises would include the population mean.

9–2 **a.** $\bar{x} = \dfrac{18}{10} = 1.8 \qquad s = \sqrt{\dfrac{11.6}{10-1}} = 1.1353$

b. The population mean is not known. The best estimate is the sample mean, 1.8 days.

c. $1.80 \pm 2.262\dfrac{1.1353}{\sqrt{10}} = 1.80 \pm 0.81$

The endpoints are 0.99 and 2.61.

d. t is used because the population standard deviation is unknown.

e. The value of 0 is not in the interval. It is unreasonable to conclude that the mean number of days of work missed is 0 per employee.

9–3 **a.** $p = \dfrac{420}{1{,}400} = .30$

b. $.30 \pm 2.576\,(.0122) = .30 \pm .03$

c. The interval is between .27 and .33. About 99% of the similarly constructed intervals would include the population mean.

9–4 $n = \left(\dfrac{2.576(.279)}{.05}\right)^2 = 206.6$. The sample should be rounded to 207.

CHAPTER 10

10–1 **a.** H_0: $\mu = 16.0$; H_1: $\mu \neq 16.0$

b. .05

c. $z = \dfrac{\bar{x} - \mu}{\sigma/\sqrt{n}}$

d. Reject H_0 if $z < -1.96$ or $z > 1.96$.

e. $z = \dfrac{16.017 - 16.0}{0.15/\sqrt{50}} = \dfrac{0.0170}{0.0212} = 0.80$

f. Do not reject H_0.

g. We cannot conclude the mean amount dispensed is different from 16.0 ounces.

10–2 **a.** H_0: $\mu \le 16.0$; H_1: $\mu > 16.0$

b. Reject H_0 if $z > 1.645$.

c. The sampling error is $16.04 - 16.00 = 0.04$ ounce.

d. $z = \dfrac{16.040 - 16.0}{0.15/\sqrt{50}} = \dfrac{.0400}{.0212} = 1.89$

e. Reject H_0.

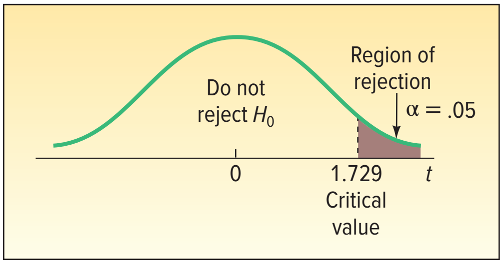
f. The mean amount dispensed is more than 16.0 ounces.

g. p-value $= .5000 - .4706 = .0294$. The p-value is less than $\alpha(.05)$, so H_0 is rejected. It is the same conclusion as in part (d).

10–3 **a.** H_0: $\mu \le 305$; H_1: $\mu > 305$

b. $df = n - 1 = 20 - 1 = 19$

The decision rule is to reject H_0 if $t > 1.729$.



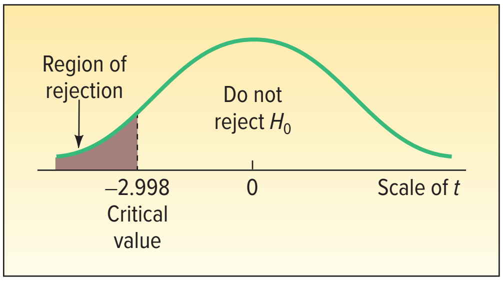
c. $t = \dfrac{\bar{X} - \mu}{s/\sqrt{n}} = \dfrac{311 - 305}{12/\sqrt{20}} = 2.236$

Reject H_0 because 2.236>1.729. The modification increased the mean battery life to more than 305 days.

10–4 **a.** H_0: $\mu \ge 9.0$; H_1: $\mu < 9.0$

b. 7, found by $n - 1 = 8 - 1 = 7$

c. Reject H_0 if $t < -2.998$.



d. $t = -2.494$, found by:

$$s = \sqrt{\frac{0.36}{8-1}} = 0.2268$$

$$\bar{x} = \frac{70.4}{8} = 8.8$$

Then

$$t = \frac{8.8 - 9.0}{0.2268/\sqrt{8}} = -2.494$$

Since -2.494 lies to the right of -2.998, H_0 is not rejected. We have not shown that the mean is less than 9.0.

e. The p-value is between .025 and .010.

CHAPTER 11

11–1 **a.** H_0: $\mu_W \le \mu_M \qquad H_1$: $\mu_W > \mu_M$

The subscript W refers to the women and M to the men.

b. Reject H_0 if $z > 1.645$.

c. $z = \dfrac{\$1{,}500 - \$1{,}400}{\sqrt{\dfrac{(\$250)^2}{50} + \dfrac{(\$200)^2}{40}}} = 2.11$

d. Reject the null hypothesis.

e. p-value $= .5000 - .4826 = .0174$

f. The mean amount sold per day is larger for women.

11–2 **a.** H_0: $\mu_d = \mu_a \qquad H_1$: $\mu_d \neq \mu_a$

b. $df = 6 + 8 - 2 = 12$

Reject H_0 if $t < -2.179$ or $t > 2.179$.

c. $\bar{x}_1 = \dfrac{42}{6} = 7.00 \quad s_1 = \sqrt{\dfrac{10}{6-1}} = 1.4142$

$\bar{x}_2 = \dfrac{80}{8} = 10.00 \quad s_2 = \sqrt{\dfrac{36}{8-1}} = 2.2678$

$$s_p^2 = \frac{(6-1)(1.4142)^2 + (8-1)(2.2678)^2}{6+8-2}$$
$$= 3.8333$$
$$t = \frac{7.00 - 10.00}{\sqrt{3.8333\left(\dfrac{1}{6} + \dfrac{1}{8}\right)}} = -2.837$$

d. Reject H_0 because -2.837 is less than the critical value.
e. The p-value is less than .02.
f. The mean number of defects is not the same on the two shifts.
g. Independent populations, populations follow the normal distribution, populations have equal standard deviations.

11–3 **a.** H_0: $\mu_c \geq \mu_a \qquad H_1$: $\mu_c < \mu_a$
b. $df = \dfrac{[(356^2/10) + (857^2/8)]^2}{\dfrac{(356^2/10)^2}{10-1} + \dfrac{(857^2/8)^2}{8-1}} = 8.93$

so $df = 8$

c. Reject H_0 if $t < -1.860$.
d. $t = \dfrac{\$1{,}568 - \$1{,}967}{\sqrt{\dfrac{356^2}{10} + \dfrac{857^2}{8}}} = \dfrac{-399.00}{323.23} = -1.234$
e. Do not reject H_0.
f. There is no difference in the mean account balance of those who applied for their card or were contacted by a telemarketer.

11–4 **a.** H_0: $\mu_d \geq 0, \qquad H_1$: $\mu_d > 0$
b. Reject H_0 if $t > 2.998$.
c.

Name	Before	After	d	$(d - \bar{d})$	$(d - \bar{d})^2$
Hunter	155	154	1	−7.875	62.0156
Cashman	228	207	21	12.125	147.0156
Mervine	141	147	−6	−14.875	221.2656
Massa	162	157	5	−3.875	15.0156
Creola	211	196	15	6.125	37.5156
Peterson	164	150	14	5.125	26.2656
Redding	184	170	14	5.125	26.2656
Poust	172	165	7	−1.875	3.5156
			71		538.8750

$$\bar{d} = \frac{71}{8} = 8.875$$
$$s_d = \sqrt{\frac{538.875}{8-1}} = 8.774$$
$$t = \frac{8.875}{8.774/\sqrt{8}} = 2.861$$

d. p-value = .0122
e. Do not reject H_0. We cannot conclude that the students lost weight.
f. The distribution of the differences must be approximately normal.

CHAPTER 12

12–1 Let Mark's assemblies be population 1, then H_0: $\sigma_1^2 \leq \sigma_2^2$; H_1: $\sigma_1^2 \geq \sigma_2^2$; $df_1 = 10 - 1 = 9$; and df_2 also equals 9. H_0 is rejected if $F > 3.18$.

$$F = \frac{(2.0)^2}{(1.5)^2} = 1.78$$

H_0 is not rejected. The variation is the same for both employees.

12–2 **a.** H_0: $\mu_1 = \mu_2 = \mu_3$
H_1: At least one treatment mean is different.
b. Reject H_0 if $F > 4.26$.
c. $\bar{x} = \dfrac{240}{12} = 20$

SS total $= (18-20)^2 + \ldots + (32-20)^2$
$= 578$
SSE $= (18-17)^2 + (14-17)^2 + \ldots + (32-29)^2$
$= 74$
SST $= 578 - 74 = 504$

d.

Source	Sum of Squares	Degrees of Freedom	Mean Square	F
Treatment	504	2	252	30.65
Error	74	9	8.22	
Total	578	11		

The F-test statistic, 30.65.
e. H_0 is rejected. There is a difference in the mean number of bottles sold at the various locations.

12–3 **a.** H_0: $\mu_1 = \mu_2 = \mu_3$
H_1: Not all means are equal.
b. H_0 is rejected if $F > 3.98$.
c. The F test statistic is 25.43493

ANOVA: Single Factor

Groups	Count	Sum	Average	Variance
Northeast	5	205	41	1
Southeast	4	155	38.75	0.916667
West	5	184	36.8	0.7

ANOVA

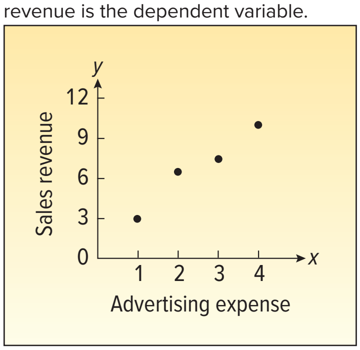
Source of Variation	SS	df	MS	F	p-Value
Between Groups	44.16429	2	22.08214	25.43493	7.49E-05
Within Groups	9.55	11	0.868182		
Total	53.71429	13			

d. H_0 is rejected. The treatment means differ.
e. $(41 - 36.8) \pm 2.201\sqrt{0.8682\left(\frac{1}{5} + \frac{1}{5}\right)} = 4.2 \pm 1.3 = 2.9$ *and* 5.50. The means are significantly different. Zero is not in the interval.

These treatment means differ because both endpoints of the confidence interval are of the same sign.

CHAPTER 13

13–1 **a.** Advertising expense is the independent variable, and sales revenue is the dependent variable.
b.



c.

x	y	$(x-\bar{x})$	$(x-\bar{x})^2$	$(y-\bar{y})$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
2	7	−0.5	.25	0	0	0
1	3	−1.5	2.25	−4	16	6
3	8	0.5	.25	1	1	0.5
4	10	1.5	2.25	3	9	4.5
10	28		5.00		26	11.0

$$\bar{x} = \frac{10}{4} = 2.5 \qquad \bar{y} = \frac{28}{4} = 7$$

$$s_x = \sqrt{\frac{5}{3}} = 1.2910$$

$$s_y = \sqrt{\frac{26}{3}} = 2.9439$$

$$r = \frac{\Sigma(X-\bar{X}(y-y)}{(n-1)s_x s_y} = \frac{11}{(4-1(1.2910)(2.9439)}$$

$$= 0.9648$$

d. There is a strong correlation between the advertising expense and sales.

13–2 H_0: $\rho \le 0$, H_1: $\rho > 0$. H_0 is rejected if $t > 1.714$.

$$t = \frac{.43\sqrt{25-2}}{\sqrt{1-(.43)^2}} = 2.284$$

H_0 is rejected. There is a positive correlation between the percent of the vote received and the amount spent on the campaign.

13–3 **a.** See the calculations in Self-Review 13–1, part (c).

$$b = \frac{rs_y}{s_x} = \frac{(0.9648)(2.9439)}{1.2910} = 2.2$$

$$a = \frac{28}{4} - 2.2\left(\frac{10}{4}\right) = 7 - 5.5 = 1.5$$

b. The slope is 2.2. This indicates that an increase of \$1 million in advertising will result in an increase of \$2.2 million in sales. The intercept is 1.5. If there was no expenditure for advertising, sales would be \$1.5 million.

c. $\hat{y} = 1.5 + 2.2(3) = 8.1$

13–4 H_0: $\beta_1 \le 0$; H_1: $\beta > 0$. Reject H_0 if $t > 3.182$.

$$t = \frac{2.2-0}{0.4243} = 5.1850$$

Reject H_0. The slope of the line is greater than 0.

13–5 **a.**

y	$\hat{y}$	$(y-\hat{y})$	$(y-\hat{y})^2$
7	5.9	1.1	1.21
3	3.7	−0.7	.49
8	8.1	−0.1	.01
10	10.3	−0.3	.09
			1.80

$$s_{y \cdot x} = \sqrt{\frac{\Sigma(y-\hat{y})^2}{n-2}}$$

$$= \sqrt{\frac{1.80}{4-2}} = .9487$$

b. $r^2 = (.9648)^2 = .9308$

c. Ninety-three percent of the variation in sales is accounted for by advertising expense.

13–6 6.58 and 9.62, since for an x of 3 is 8.1, found by $\hat{y} = 1.5 + 2.2(3) = 8.1$, then $\bar{x} = 2.5$ and $\Sigma(x-\bar{x})^2 = 5$. t from Appendix B.5 for $4 - 2 = 2$ degrees of freedom at the .10 level is 2.920.

$$\hat{y} \pm t(s_{y \cdot x})\sqrt{\frac{1}{n} + \frac{(x-\bar{x})^2}{\Sigma(x-\bar{x})^2}}$$

$$= 8.1 \pm 2.920(0.9487)\sqrt{\frac{1}{4} + \frac{(3-2.5)^2}{5}}$$

$$= 8.1 \pm 2.920(0.9487)(0.5477)$$

$$= 6.58 \text{ and } 9.62 \text{ (in \$ millions)}$$

CHAPTER 14

14–1 **a.** \$389,500 or 389.5 (in \$000); found by $2.5 + 3(40) + 4(72) - 3(10) + .2(20) + 1(5) = 3{,}895$

b. The b_2 of 4 shows profit will go up \$4,000 for each extra hour the restaurant is open (if none of the other variables change). The b_3 of −3 implies profit will fall \$3,000 for each added mile away from the central area (if none of the other variables change).

14–2 **a.** The total degrees of freedom ($n - 1$) is 25. So the sample size is 26.

b. There are 5 independent variables.

c. There is only 1 dependent variable (profit).

d. $S_{Y.12345} = 1.414$, found by $\sqrt{2}$. Ninety-five percent of the residuals will be between −2.828 and 2.828, found by $\pm 2(1.414)$.

e. $R^2 = .714$, found by 100/140. 71.4% of the deviation in profit is accounted for by these five variables.

f. $R^2_{\text{adj}} = .643$, found by

$$1 - \left[\frac{40}{(26-(5+1))}\right] \Big/ \left[\frac{140}{(26-1)}\right]$$

14–3 **a.** H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
H_1: Not all of the βs are 0.
The decision rule is to reject H_0 if $F > 2.71$. The computed value of F is 10, found by 20/2. So, you reject H_0, which indicates at least one of the regression coefficients is different from zero.

Based on p-values, the decision rule is to reject the null hypothesis if the p-value is less than .05. The computed value of F is 10, found by 20/2, and has a p-value of .000. Thus, we reject the null hypothesis, which indicates that at least one of the regression coefficients is different from zero.

b. For variable 1: H_0: $\beta_1 = 0$ and H_1: $\beta_1 \ne 0$
The decision rule is to reject H_0 if $t < -2.086$ or $t > 2.086$. Since 2.000 does not go beyond either of those limits, we fail to reject the null hypothesis. This regression coefficient could be zero. We can consider dropping this variable. By parallel logic, the null hypothesis is rejected for variables 3 and 4.

For variable 1, the decision rule is to reject H_0: $\beta_1 = 0$ if the p-value is less than .05. Because the p-value is .056, we cannot reject the null hypothesis. This regression coefficient could be zero. Therefore, we can consider dropping this variable. By parallel logic, we reject the null hypothesis for variables 3 and 4.

c. We should consider dropping variables 1, 2, and 5. Variable 5 has the smallest absolute value of t or largest p-value. So delete it first and compute the regression equation again.

14–4 **a.** $\hat{y} = 15.7625 + 0.4415x_1 + 3.8598x_2$

$\hat{y} = 15.7625 + 0.4415(30) + 3.8598(1)$
$= 32.87$

b. Female agents make \$3,860 more than male agents.

c. H_0: $\beta_3 = 0$
H_1: $\beta_3 \ne 0$
$df = 17$; reject H_0 if $t < -2.110$ or $t > 2.110$

$$t = \frac{3.8598-0}{1.4724} = 2.621$$

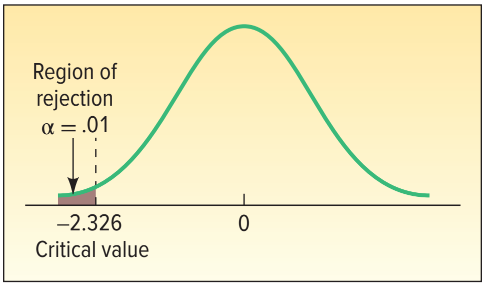
The t-statistic exceeds the critical value of 2.110. Also, the p-value = .0179 and is less than .05. Reject H_0. Gender should be included in the regression equation.

CHAPTER 15

15–1 **a.** Yes, because both $n\pi$ and $n(1 - \pi)$ exceed 5: $n\pi = 200(.40) = 80$, and $n(1 - \pi) = 200(.60) = 120$.

b. H_0: $\pi \ge .40$
H_1: $\pi < .40$

c. Reject H_0 if $z < -2.326$.



d. $z = -0.87$, found by:

$$z = \frac{.37 - .40}{\sqrt{\frac{.40(1-.40)}{200}}} = \frac{-.03}{\sqrt{.0012}} = -0.87$$

Do not reject H_0.

e. The p-value is .1922, found by .5000 − .3078.

15–2 **a.** $H_0: \pi_a = \pi_{ch}$

$H_1: \pi_a \neq \pi_{ch}$

b. .10

c. Two-tailed

d. Reject H_0 if $z < -1.645$ or $z > 1.645$.

e. $$p_c = \frac{87 + 123}{150 + 200} = \frac{210}{350} = .60$$

$$p_a = \frac{87}{150} = .58 \qquad p_{ch} = \frac{123}{200} = .615$$

$$z = \frac{.58 - .615}{\sqrt{\frac{.60(.40)}{150} + \frac{.60(.40)}{200}}} = -0.66$$

f. Do not reject H_0.

g. p-value = 2(.5000 − .2454) = .5092

There is no difference in the proportion of adults and children that liked the proposed flavor.

15–3 **a.** Observed frequencies

b. Six (six days of the week)

c. 10. Total observed frequencies ÷ 6 = 60/6 = 10.

d. 5; $k - 1 = 6 - 1 = 5$

e. 15.086 (from the chi-square table in Appendix B.7).

f. $$\chi^2 = \Sigma\left[\frac{(f_o - f_e)^2}{f_e}\right] = \frac{(12-10)^2}{10} + \ldots + \frac{(9-10)^2}{10} = 0.8$$

g. Do not reject H_0.

h. Evidence fails to show a difference in the proportion of absences by day of the week.

15–4 H_0: $P_C = .60$, $P_L = .30$,and $P_U = .10$.

H_1: Distribution is not as above.

Reject H_0 if $\chi^2 > 5.991$.

Category	f_o	f_e	$\frac{(f_o - f_e)^2}{f_e}$
Current	320	300	1.33
Late	120	150	6.00
Uncollectible	60	50	2.00
	500	500	9.33

Reject H_0. The accounts receivable data do not reflect the national average.

15–5 **a.** Contingency table

b. H_0: There is no relationship between income and whether the person played the lottery. H_1: There is a relationship between income and whether the person played the lottery.

c. Reject H_0 if $\chi^2 > 5.991$.

d. $$\chi^2 = \frac{(46-40.71)^2}{40.71} + \frac{(28-27.14)^2}{27.14} + \frac{(21-27.14)^2}{27.14} + \frac{(14-19.29)^2}{19.29} + \frac{(12-12.86)^2}{12.86} + \frac{(19-12.86)^2}{12.86}$$
$$= 6.544$$

e. Reject H_0. There is a relationship between income level and playing the lottery.