5.67 **(a)** $p = 1/4 = 0.25$. **(b)** $P(X \geq 10) = 0.0139$. **(c)** $\mu = np = 5$ and $\sigma = \sqrt{3.75} = 1.9365$ successes. **(d)** No. The trials would not be independent.

5.69 **(a)** X, the count of successes, has the $B(900, 1/5)$ distribution, with mean $\mu = 180$ and $\sigma = 12$ successes. **(b)** For $\hat{p}$, the mean is $\mu_{\hat{p}} = p = 0.2$ and $\sigma_{\hat{p}} = 0.01333$. **(c)** $P(\hat{p} > 0.24) = 0.0013$. **(d)** 208 or more successes.

5.71 **(a)** 0.1788. **(b)** 0.0594. **(c)** 400. **(d)** Yes.

5.73 Y has possible values 1, 2, 3, . . . P(first ⚀ appears on toss k) $= (5/6)^{k-1}(1/6)$.

5.75 **(a)** $\mu = 50$. **(b)** The standard deviation is $\sigma = \sqrt{50} = 7.071$. $P(X > 60) = 0.0793$. Software gives 0.0786.

5.77 **(a)** $\bar{x}$ has (approximately) an $N(123 \text{ mg}, 0.04619 \text{ mg})$ distribution. **(b)** $P(\bar{x} \geq 124)$ is essentially 0.

5.79 **(a)** Approximately Normal with mean $\mu_{\bar{x}} = 2.13$ and standard deviation $\sigma_{\bar{x}} = 0.159$. **(b)** $P(\bar{x} < 2) = 0.2061$. Software gives 0.2068. **(c)** Yes, because $n = 140$ is large.

5.81 0.0034.

5.83 If the carton weighs between 755 and 830 g, then the average weight of the 12 eggs must be between $755/12 = 62.92$ and $830/12 = 69.17$ g. The distribution of the mean weight is $N(66, 6/\sqrt{12} = 1.732)$. $P(62.92 < \bar{x} < 69.17) = 0.9288$.

5.85 **(a)** He needs 14.857 (really 15) wins. **(b)** $\mu = 13.52$ and $\sigma = 3.629$. **(c)** Without the continuity correction, $P(X \geq 15) = 0.3409$. With the continuity correction, we have $P(X \geq 14.5) = 0.3936$. The continuity correction is much closer.

5.87 **(a)** $\hat{p}_F$ is approximately $N(0.82, 0.01921)$, and $\hat{p}_M$ is approximately $N(0.88, 0.01625)$. **(b)** When we subtract two independent Normal random variables, the difference is Normal. The new mean is the difference between the two means $(0.88 - 0.82 = 0.06)$, and the new variance is the sum of the variances $(0.000369 + 0.000264 = 0.000633)$, so $\hat{p}_M - \hat{p}_F$ is approximately $N(0.06, 0.02516)$. **(c)** 0.0087 (software: 0.0085).

5.89 $P(Y \geq 200) = P(Y/500 \geq 0.4) = P(Z \geq 4.56) = 0$.

CHAPTER 6

6.1 $\sigma_{\bar{x}} = \$0.40$.

6.3 \$0.80.

6.7 The margin of error will be halved.

6.9 $n = 285$.

6.11 The students who did not respond are (obviously) not represented in the results. They may be more (or less) likely to use credit cards.

6.13 Margins of error: 17.355, 12.272, 8.677, and 6.136; interval width decreases with increasing sample size.

6.15 **(a)** She did not divide the standard deviation by $\sqrt{500} = 22.361$. **(b)** Confidence intervals concern the *population* mean. **(c)** 0.95 is a confidence level, not a probability. **(d)** The large sample size affects the distribution of the sample mean (by the central limit theorem), not the individual ratings.

6.17 **(a)** The margin of error is 0.244; the interval is 5.156 to 5.644. **(b)** The margin of error is 0.321; the interval is 5.079 to 5.721.

6.19 Margin of error, 2.29 U/l. Interval, 10.91 to 15.49 U/l.

6.21 Scenario A has a smaller margin of error; less variability in a single class rank.

6.23 **(a)** ± 18.98. **(b)** ± 18.98.

6.25 No; this is a range of values for the mean rent, not for individual rents.

6.27 **(a)** 11.03 to 11.97 hours. **(b)** No; this is a range of values for the mean time spent, not for individual times. **(c)** The sample size is large ($n = 1200$ students surveyed).

6.29 **(a)** Not certain (only 95% confident). **(b)** We obtained the interval 86.5% to 88.5% by a method that gives a correct result 95% of the time. **(c)** About 0.51%. **(d)** No (only random sampling error).

6.31 $\bar{x} = 18.3515$ kpl; the margin of error is 0.6521 kpl.

6.33 $n = 73$.

6.35 No; confidence interval methods can be applied only to an SRS.

6.37 **(a)** 0.7738. **(b)** 0.9774.

6.39 H_0: $\mu = 1.4 \text{ g/cm}^2$; H_a: $\mu \neq 1.4 \text{ g/cm}^2$.

6.41 $P = 0.0702$ (Software gives 0.0703).

6.43 **(a)** 1.645. **(b)** $z > 1.645$.

6.45 **(a)** $z = 1.875$. **(b)** $P = 0.0301$ (Software gives 0.0304). **(c)** $P = 0.0602$ (Software gives 0.0608).

6.47 **(a)** No. **(b)** Yes.

6.49 **(a)** Yes. **(b)** No. **(c)** To reject, we need $P < \alpha$.

6.51 **(a)** $P = 0.031$ and $P = 0.969$. **(b)** We need to know whether the observed data (for example, $\bar{x}$) are consistent with H_a. (If so, use the smaller P-value.)

6.53 **(a)** Population mean, not sample mean. **(b)** H_0 should be that there is no change. **(c)** A small P-value is needed for significance. **(d)** Compare P, not z, with α.

6.55 **(a)** H_0: $\mu = 77$; H_a: $\mu \neq 77$. **(b)** H_0: $\mu = 20$ seconds; H_a: $\mu > 20$ seconds. **(c)** H_0: $\mu = 880 \text{ ft}^2$; H_a: $\mu < 880 \text{ ft}^2$.

6.57 (a) H_0: μ = \$42,800; H_a: μ > \$42,800. **(b)** H_0: μ = 0.4 hr; H_a: $\mu \neq$ 0.4 hr.

6.59 (a) $P = 0.9545$. **(b)** $P = 0.0455$. **(c)** $P = 0.0910$.

6.61 $P = 0.09$ means there is some evidence for the wage decrease, but it is not significant at the $\alpha = 0.05$ level.

6.63 The difference was large enough that it would rarely arise by chance. Health issues related to alcohol use are probably discussed in the health and safety class.

6.65 The report can be made for public school students but not for private school students. Not finding a significant increase is not the same as finding no difference.

6.67 $z = 4.14$, so $P = 0.00003$ (for a two-sided alternative).

6.69 H_0: μ = 100; H_a: $\mu \neq$ 100; $z = 5.75$; significant ($P < 0.0001$).

6.71 (a) $z = 2.13$, $P = 0.0166$. **(b)** The important assumption is that this is an SRS. We also assume a Normal distribution, but this is not crucial provided there are no outliers and little skewness.

6.73 (a) H_0: μ = 0 mpg; H_a: $\mu \neq$ 0 mpg, where μ is the mean difference. **(b)** $z = 4.07$, which gives a very small P-value.

6.75 (a) H_0: μ = 0.61 mg; H_a: μ > 0.61 mg. **(b)** Yes. **(c)** No.

6.77 $\bar{x} = 0.8$ is significant, but 0.7 is not. Smaller α means that $\bar{x}$ must be farther away.

6.79 $\bar{x} \geq 0.3$ will be statistically significant. With a larger sample size, $\bar{x}$ close to μ_0 will be significant.

6.81 Changing to the two-sided alternative multiplies each P-value by 2.

$\bar{x}$	P	$\bar{x}$	P
0.1	0.7518	0.6	0.0578
0.2	0.5271	0.7	0.0269
0.3	0.3428	0.8	0.0114
0.4	0.2059	0.9	0.0044
0.5	0.1139	1	0.0016

6.83 Something that occurs "fewer than 1 time in 100 repetitions" must also occur "fewer than 5 times in 100 repetitions."

6.85 Any z with $2.576 < |z| < 2.807$.

6.87 $P > 0.25$.

6.89 $0.05 < P < 0.10$; $P = 0.0602$.

6.91 To determine the effectiveness of alarm systems, we need to know the percent of all homes with alarm systems and the percent of burglarized homes with alarm systems.

6.93 The first test was barely significant at $\alpha = 0.05$, while the second was significant at any reasonable α.

6.95 A significance test answers only question (b).

6.97 (a) The differences observed might occur by chance even if SES had no effect. **(b)** This tells us that the statistically insignificant test result did not occur merely because of a small sample size.

6.99 (a) $P = 0.2843$. **(b)** $P = 0.1020$. **(c)** $P = 0.0023$.

6.101 With a larger sample, we might have significant results.

6.107 n should be about 100,000.

6.109 Reject the fifth ($P = 0.002$) and eleventh ($P < 0.002$), because the P-values are both less than $0.05/12 = 0.0042$.

6.111 Larger samples give more power.

6.113 Higher; larger differences are easier to detect.

6.115 (a) Power decreases. **(b)** Power decreases. **(c)** Power increases.

6.117 Power: about 0.99.

6.119 Power: 0.4641.

6.121 (a) Hypotheses: "subject should go to college" and "subject should join workforce." Errors: recommending college for someone who is better suited for the workforce, and recommending work for someone who should go to college.

6.123 (a) For example, if μ is the mean difference in scores, H_0: $\mu = 0$; H_a: $\mu \neq 0$. **(b)** No. **(c)** For example: Was this an experiment? What was the design? How big were the samples?

6.125 (a) For boys:

Energy (kJ)	2399.9 to 2496.1
Protein (g)	24.00 to 25.00
Calcium (mg)	315.33 to 332.87

(b) For girls:

Energy (kJ)	2130.7 to 2209.3
Protein (g)	21.66 to 22.54
Calcium (mg)	257.70 to 272.30

(c) The confidence interval for boys is entirely above the confidence interval for girls for each food intake.

6.129 (a) 4.61 to 6.05 mg/dl. **(b)** $z = 1.45$, $P = 0.0735$; not significant.

6.131 (b) 26.06 to 34.74 μg/l. **(c)** $z = 2.44$, $P = 0.0073$.

6.133 (a) Under H_0, $\bar{x}$ has an N(0%, 5.3932%) distribution. **(b)** $z = 1.28$, $P = 0.1003$. **(c)** Not significant.

6.135 It is essentially correct.

6.137 Find $\bar{x}$, then take $\bar{x} \pm 1.96(4/\sqrt{12}) = \bar{x} \pm 2.2632$.

6.139 Find $\bar{x}$, then compute $z = (\bar{x} - 23)/(4/\sqrt{12})$. Reject H_0 based on your chosen significance level.

CHAPTER 7

7.1 **(a)** \$13.75. **(b)** 15.

7.3 \$570.70 to \$629.30.

7.5 **(a)** Yes. **(b)** No.

7.7 4.19 to 10.14 hours per month.

7.9 Using $t^* = 2.776$ from Table D: 0.685 to 22.515. Software gives 0.683 to 22.517.

7.11 The sample size should be sufficient to overcome any non-Normality, but the mean μ might not be a useful summary of a bimodal distribution.

7.13 The power is about 0.9192.

7.15 The power is about 0.9452.

7.17 **(a)** $t^* = 2.201$. **(b)** $t^* = 2.086$. **(c)** $t^* = 1.725$. **(d)** t^* decreases with increasing sample size and increases with increasing confidence.

7.19 $t^* = 1.753$ (or -1.753).

7.21 For the alternative $\mu < 0$, the answer would be the same ($P = 0.034$). For the alternative $\mu > 0$, the answer would be $P = 0.966$.

7.23 **(a)** df = 26. **(b)** $1.706 < t < 2.056$. **(c)** $0.05 < P < 0.10$. **(d)** $t = 2.01$ is not significant at either level. **(e)** From software, $P = 0.0549$.

7.25 It depends on whether $\bar{x}$ is on the appropriate side of μ_0.

7.27 **(a)** H_0: $\mu = 4.7$; H_a: $\mu \neq 4.7$. $t = 14.907$ with $0.002 < P < 0.005$ (software gives $P = 0.0045$). **(b)** 4.8968% to 5.0566%. **(c)** Because our confidence interval is entirely within the range of 4.7% to 5.3%, it appears that Budweiser is meeting the required standards.

7.29 **(a)** H_0: $\mu = 10$; H_a: $\mu < 10$. **(b)** $t = -5.26$, df = 33, $P < 0.0001$.

7.31 **(a)** Distribution is not Normal; it has two peaks and one large value. **(b)** Maybe; we have a large sample but a small population. **(c)** 27.29 ± 5.717, or 21.57 to 33.01 cm. **(d)** One could argue for either answer.

7.33 **(a)** Yes; the sample size is large. **(b)** $t = -2.115$. Using Table D, we have $0.02 < P < 0.04$, while software gives $P = 0.0381$.

7.35 H_0: $\mu = 45$ versus H_a: $\mu > 45$. $t = 5.457$. Using df = 49, $P \approx 0$; with df = 40, $P < 0.0005$.

7.37 **(a)** $t = 5.13$, df = 15, $P < 0.001$. **(b)** With 95% confidence, the mean NEAT increase is between 191.6 and 464.4 calories.

7.39 **(a)** H_0: $\mu_c = \mu_d$; H_a: $\mu_c \neq \mu_d$. **(b)** $t = 4.358$, $P = 0.0003$; we reject H_0.

7.41 **(a)** H_0: $\mu = 925$; H_a: $\mu > 925$. $t = 3.27$ (df = 35), $P = 0.0012$. **(b)** H_0: $\mu = 935$; H_a: $\mu > 935$. $t = 0.80$, $P = 0.2146$. **(c)** The confidence interval includes 935 but not 925.

7.43 **(a)** The differences are spread from -0.018 to 0.020 g. **(b)** $t = -0.347$, df = 7, $P = 0.7388$. **(c)** -0.0117 to 0.0087 g. **(d)** They may be representative of future subjects, but the results are suspect because this is not a random sample.

7.45 **(a)** H_0: $\mu = 0$; H_a: $\mu > 0$. **(b)** Slightly left-skewed; $\bar{x} = 2.5$ and $s = 2.893$. **(c)** $t = 3.865$, df = 19, $P = 0.00052$. **(d)** 1.15 to 3.85.

7.47 For the sign test, $P = 0.0898$; not quite significant, unlike Exercise 7.38.

7.49 H_0: median = 0; H_a: median $\neq$ 0; $P = 0.7266$. This is similar to the t test P-value.

7.51 H_0: median = 0; H_a: median > 0; $P = 0.0013$.

7.53 Reject H_0 if $|\bar{x}| \geq 0.00677$. The power is about 7%.

7.55 $n > 26$. (The power is about 0.7999 when $n = 26$.)

7.57 -20.3163 to 0.3163; do not reject H_0.

7.59 Using df = 14, Table D gives $0.04 < P < 0.05$.

7.61 SAS and SPSS give $t = 2.279$, $P = 0.052$.

7.63 **(a)** Hypotheses should involve μ_1 and μ_2. **(b)** The samples are not independent. **(c)** We need P to be small (for example, less than 0.10) to reject H_0. **(d)** t should be negative to reject H_0 with this alternative.

7.65 **(a)** No (in fact, $P = 0.0771$). **(b)** Yes ($P = 0.0385$).

7.67 H_0: $\mu_{Brown} = \mu_{Blue}$ and H_a: $\mu_{Brown} > \mu_{Blue}$. $t = 2.59$. Software gives $P = 0.0058$. Table D gives $0.005 < P < 0.01$.

7.69 The nonresponse is $(3866 - 1839)/3866 = 0.5243$, or about 52.4%. What can we say about those who do (or do not) respond despite the efforts of the researchers?

7.71 **(a)** While the distributions do not look particularly Normal, they have no extreme outliers or skewness. **(b)** $\bar{x}_N = 0.5714$, $s_N = 0.7300$, $n_N = 14$; $\bar{x}_S = 2.1176$, $s_S = 1.2441$, $n_S = 17$. **(c)** H_0: $\mu_N = \mu_S$; H_a: $\mu_N < \mu_S$. **(d)** $t = -4.303$, so $P = 0.0001$ (df = 26.5) or $P < 0.0005$ (df = 13). **(e)** -2.2842 to -0.8082 (df = 26.5) or -2.3225 to -0.7699 (df = 13).