7.11. (a) \( t = \frac{428 - 40}{\sqrt{\frac{259}{20}}} = 5.1250 \) with df = 15, for which \( P \approx 0.0012 \). There is strong evidence of a change in NEAT. (b) With \( t^* = 2.131 \), the 95\% confidence interval is 191.6 to 464.4 cal/day. This tells us how much of the additional calories might have been burned by the increase in NEAT. It consumed 19\% to 46\% of the extra 1000 cal/day.

7.16. Because the value of \( \bar{x} \) is positive, which supports the direction of the alternative \( (\mu > 0) \), the \( P \)-value for the one-sided test is half as big as that for the two-sided test: \( P \approx 0.04 \).

7.18. (a) Use df = 19: \( t^* = 2.093 \). (b) Use df = 29: \( t^* = 1.699 \). (c) Use df = 40: \( t^* = 1.303 \).

(Using software, the appropriate critical value for df = 49 is \( t^* = 1.299 \).)

7.21. (a) df = 29. (b) \( 1.311 < t < 1.699 \); for \( t^* = 1.311 \), \( p = 0.10 \); for \( t^* = 1.699 \), \( p = 0.05 \). (c) Because the alternative is two-sided, we double the right-tail probabilities to find the \( P \)-value: \( 0.10 < P < 0.20 \). (d) \( t = 1.35 \) is not significant at 10\% or 5\%. (e) On the right. (f) From software, \( P \approx 0.1875 \).

7.22. (a) df = 11. (b) Because \( 3.106 < |t| < 3.497 \), the \( P \)-value is between \( 0.0025 < P < 0.005 \). (c) From software, \( P \approx 0.0042 \).

7.23. Let \( P \) be the given (two-sided) \( P \)-value, and suppose that the alternative is \( \mu > \mu_0 \). If \( \bar{x} \) is greater than \( \mu_0 \), this supports the alternative over \( H_0 \). However, if \( \bar{x} < \mu_0 \), we would not take this as evidence against \( H_0 \), because \( \bar{x} \) is on the "wrong" side of \( \mu_0 \). So, if the value of \( \bar{x} \) is on the "correct" side of \( \mu_0 \), the one-sided \( P \)-value is simply \( P/2 \). However, if the value of \( \bar{x} \) is on the "wrong" side of \( \mu_0 \), the one-sided \( P \)-value is \( 1 - P/2 \) (which will always be at least 0.5, so it will never indicate significant evidence against \( H_0 \)).

7.34. (a) \( \bar{x} = 5.36 \) mg/dl and \( s = 0.6653 \) mg/dl, so \( SE_{\bar{x}} = 0.2716 \) mg/dl. (b) For df = 5, we have \( t^* = 2.015 \), so the interval is 4.819 to 5.914 mg/dl.
7.53. (a) The distribution cannot be normal, because all numbers are integers. (b) The $t$ procedures should be appropriate, because we have two large samples, with no outliers. (c) $H_0: \mu_I = \mu_C$; $H_a$: $\mu_I > \mu_C$ (or $\mu_I \neq \mu_C$). The one-sided alternative reflects the researchers’ (presumed) belief that the intervention would increase scores on the test. The two-sided alternative allows for the possibility that the intervention might have had a negative effect.

(d) $SE_D = \sqrt{s_I^2/n_I + s_C^2/n_C} = 0.1198$ and $t = (\bar{x}_I - \bar{x}_C)/SE_D = 6.258$. Regardless of how we compute degrees of freedom (df $\geq 354$ or 164), the P-value is very small: $P < 0.0001$. We reject $H_0$ and conclude that the intervention increased test scores. (e) The interval is $\bar{x}_I - \bar{x}_C \pm t^*SE_D$; the value of $t^*$ depends on the df (see the table), but note that in every case the interval rounds to 0.51 to 0.99. (f) The results for this sample may not generalize well to other areas of the country.

7.66. (a) Because 0 is not in the confidence interval, we would reject $H_0$ at the 5% level. (b) Larger samples generally give smaller margins of error (at the same confidence level, and assuming that the standard deviations for the large and small samples are about the same). One explanation for this is that larger samples give more information, and therefore offer more precise results. Alternatively, in looking at the formula for a two-sample confidence interval, we see that $SE_D = \sqrt{s_I^2/n_1 + s_C^2/n_2}$, so that if $n_1$ and $n_2$ are increased, the standard error decreases.

**Note:** For (a), we can even make some specific statements about $t$ and its P-value: The confidence interval tells us that $\bar{x}_I - \bar{x}_C = 1.95$, and the margin of error is 0.35. As $t^*$ for a 95% confidence interval is at least 1.96, $SE_D = \frac{0.35}{t^*}$ is less than about 0.179, and the $t$-statistic $t = 1.95/SE_D$ is at least 10.9. (The largest possible value of $t$, for $df = 1$, is about 70.8.) A little experimentation with different $df$ reveals that $P < 0.009$ for all $df$, and if $df > 4$, then $P < 0.0001$.

7.66. (a) Results for this randomization will depend on the technique used. (b) $SE_D \equiv 0.5235$, and the options for the 95% confidence interval are given on the right. (c) Because 0 falls outside the 95% confidence interval, the $P$-value is less than 0.05, so we would reject $H_0$. (For reference, $t = 3.439$ and the actual $P$-value is either 0.0045 or 0.0074, depending on which $df$ we use.)

7.83. (a) We test $H_0: \mu_b = \mu_f$; $H_a: \mu_b > \mu_f$. $SE_D = 0.5442$ and $t = 1.654$, for which $P = 0.0532$ $(df = 37.6)$ or 0.0577 $(df = 18)$; there is not quite enough evidence to reject $H_0$ at $\alpha = 0.05$. (b) The confidence interval depends on the degrees of freedom used; see the table. (c) We need two independent SRSs from normal populations.