Lesson 12.1.2

12-9. a. $b = 0.0173$

b. $r = \sqrt{0.09794} = 0.313$

c. $s_y = 0.71$ kg

12-10. a. Yes. The plants represent a random sample. It can be assumed that the sample is small compared to the population of these coffee plants. The data has a linear form, as evidenced by the random residuals. The randomness of the residuals also indicates that a uniform variability in the response for each fixed fertilizer amount is a reasonable assumption. The histogram of the residuals reveals a symmetric pattern, so normality of the response variable for each fixed explanatory variable is reasonable.

b. df = 31

c. $t^* = 2.0395$

d. ME = (2.0395)(0.0094) = 0.0192; The 95% confidence interval is 0.0173 ± 0.0192 kg/g or (–0.00187, 0.03647) kg/g.

e. We can be 95% confident that the overall slope for the linear relationship between the total mass (kg) of coffee produced per plant and the amount of fertilizer (g) is between –0.00187 and 0.03647 kg/g.

12-11. a. Yes, the confidence interval does include negative values.

b. Yes, 0 is included in the interval.

c. Assuming there is any variability in the explanatory and response variables (which there is), both s_x and s_y will be positive, nonzero values. Therefore, if $b = 0$, it must be true that $r = 0$.

d. No, because 0 is included in the confidence interval, it is plausible that the slope is zero and therefore that there is no correlation at all between the fertilizer and coffee beans produced.

12-12. a. H_0: $\beta = 0$, H_A: $\beta \neq 0$

b. $t = \frac{0.0173-0}{0.0094} = 1.84$

c. p-value = 0.0753

d. Because the p-value (0.0753) is not less than the level of significance (0.05), students cannot conclude that there is a nonzero slope. Students cannot conclude that there is a linear relationship between the organic fertilizer and the coffee production. This agrees with the conclusion from the confidence interval.

12-13. a. The y-intercept is 0.85, indicating that when no fertilizer is used, the predicted mass of coffee produced per plant is 0.85 kg.

b. $3.8151 = \frac{0.85-0}{SE_a} \rightarrow SE_a = \frac{0.85}{3.8151} = 0.2228$

12-14. a. H$_0$: $\rho = 0$ vs. H$_A$: $\rho \neq 0$

b. p-value = 0.0138

c. Because the p-value (0.0138) is less than the level of significance ($\alpha = 0.05$), students have sufficient evidence to reject the null hypothesis. The evidence seems to indicate that there is a correlation between the cumulative number of minutes tardy and the overall grade for a student.

d. H$_0$: $\rho = 0$ vs. H$_A$: $\rho < 0$. The p-value in the printout represents a two-tailed p-value. Since this is now a one-tailed test, the p-value is divided by 2: $\frac{0.0138}{2} = 0.0069$.

e. $SE_r = 0.1742$

12-15. a. Answers may vary: He should use a pre- and post-test model to help control for variation between individuals. He may choose to block on a variable like age or gender to additionally control variation. He should then randomly assign the students to each group. At the end of the semester compare the average of the changes in each group.

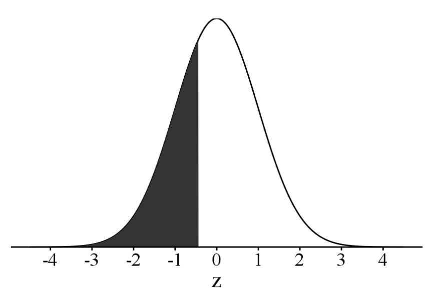
b. By allowing the 28 students to self-select to be in the heart rate monitor group he will have introduced a confounding variable into the experiment. For example, suppose students who are more fit like heart rate monitors more. Then the changes in the heart rate monitor group might be smaller since their overall fitness level would probably change less.

c. Answers may vary, one answer: two sample t-test since the standard deviation is not known. H$_0$: $\mu_1 - \mu_2 = 0$, H$_A$: $\mu_1 - \mu_2 \neq 0$, μ_1 and μ_2 = mean change in the monitor and no-monitor groups.

12-16. a. The question states that the new implant is less invasive than the existing surgical treatment. If patients are facing the potential risks of the existing treatment, they will probably be open to trying a new, less invasive procedure instead. Including the existing surgical treatment in the experiment allows for comparison between the two.

b. Placebo surgery raises some ethical concerns. Should doctors really make an incision if there is no possible medical benefit?

12-17. a. Using an inverse normal probability density function or table: z = –0.4399, $X = 48.45 + (-0.4399) \cdot 2.08 = 47.535$ cm or invnorm(0.33, 48.85, 2.08). See diagram at right.



b. $P(X > 6) = 1 - P(X \leq 6) =$ 1 – binomialcdf(15, 0.33, 6) = 0.1951

c. $SE = \frac{2.08}{\sqrt{15}} = 0.5371$ cm,

$P(\bar{x} < 47.535)$ = normalcdf(–E99, 47.535, 48.45, 0.5371) = 0.0442

