Homework Solutions
Chapter 16: #1, 7, 8, 16, 17
Chapter 12: #73, 80; Chapter 13: #50, 51; Chapter 17: #2, 14

Assigned Mon, Nov 29

16.1 **a.** Appropriate. The response variable is quantitative and this is a comparison of independent groups.
b. Not appropriate. The response variable is categorical.
c. Appropriate. The response variable is quantitative and this is a comparison of independent groups.
d. Not appropriate. It's not a comparison of independent groups. There was only one group and

16.7 **a.** The null hypothesis is that the mean ideal number of children is the same for all age groups. There are four age groups so this is written using notation as H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$. The alternative hypothesis is that the mean ideal number of children is not the same for all age groups. This can be written as H_a: not all μ_i are the same. The samples represent the populations of all people in these age groups in the United States.
b. F = 7.41 and the p-value is given as .000. Because the p-value is so small the null hypothesis can be rejected. So, the conclusion is that the population means are not all the same.
c. A possible interpretation is that the population mean may be lower for the middle two age groups than it is for the youngest and oldest age groups.
d. The sample standard deviations given for the four groups are similar so the assumption seems reasonable. Notice that the smallest standard deviation is 0.8198 (group 2) and the largest is 0.9903 (group 4).

16.8 **a.** The population mean for the 60+ age group is different from the population means for the middle two age groups. (The confidence intervals for the differences do not include 0.) The population mean for the youngest age group is also different from the population means for the middle two age groups. We cannot conclude a difference between population means for the youngest and oldest age groups, and we cannot conclude a difference between the population means for the two middle age groups.
b. There is 95% confidence that all six intervals capture the corresponding population parameters. And, there is a 100%−95% = 5% chance that at least one of the six intervals does not capture the corresponding population parameter. (In this situation, a parameter is a difference in population means.)

16.16 **a.** H_0: $\mu_1 = \mu_2 = \mu_3$ versus H_a: not all μ_i are the same, where μ_i is the mean number of finger taps that would be produced by the population of college men, after consuming the amount of caffeine given to group i.
b. There are no outliers, the variation is roughly the same for the three groups, and there is not extreme skewness.

16.17 **a.** The completed table is:

Source	DF	SS	MS	F	P
Caffeine	2	61.40	30.70	6.18	0.006
Error	27	134.10	4.97		
Total	29	195.50			

In the Caffeine row, df = $k-1=3-1=2$ and $MS = SS$ /df = 61.40 /2 = 30.70
In the Error row, df = $N-k$ = 30–3 =27 and $MS = SS$ / df = 134.10 / 27 = 4.97. Equivalently, the df and the SS can be determined by subtracting the df and SS for Caffeine from the corresponding values for Total. Finally, $F = \frac{MS\ Caffeine}{MSE} = \frac{30.70}{4.97} = 6.18$

b. $s_p = \sqrt{MSE} = \sqrt{4.97} = 2.23$. This statistic estimates the population standard deviation of the response variable (for any of the caffeine amounts).
c. The *p*-value is small so we can conclude that the population means are not the same for the three caffeine amounts.

Assigned Wed, Dec 1

12.73 Very small. With a small sample, the standard error is relatively large, so the test statistic can be small even if its numerator is large. As a result the sample result may not be statistically significant, even when in truth the null hypothesis is false.

12.80 **a.** Yes, the difference is statistically significant. The reported *p*-value (.005) is less than .05, the usual standard for significance.
b. No, this is not a contradiction. There is not much (if any) practical importance to the observed difference in incidence of drowsiness (6% versus 8%), but the large sample sizes led to a *statistically* significant difference.
c. A statistically significant difference indicates that the difference in the population is not zero but does not indicate that it has any practical significance. The meaning should be clarified when the word is used.

13.50 **a.** $\mu_1 - \mu_2$ where μ_1 and μ_2 are the mean running times for the 50-yard dash for the populations of first grade boys and girls, respectively.
b. p = the proportion of trees of that type in the entire forest that have the disease.
c. There are two separate questions of interest. For the first one, p = proportion of all adults who have a fear of going to the dentist. (The proportion can be converted to a percent.) For the second one, μ = mean number of visits made to a dentist in the past 10 years for the population of adults who fear going to the dentist.
d. $\mu_1 - \mu_2$ where μ_1 and μ_2 are the mean number of visits made to a dentist in the past 10 years for the populations who fear going to the dentist and who don't fear doing so, respectively.

13.51 **a.** Both. A confidence interval would be more appropriate to find the magnitude of the mean difference in running times. A hypothesis test could be used to determine if the mean times are significantly different.
b. A confidence interval would be appropriate, to estimate the proportion. A hypothesis test would not be appropriate because there is no obvious null value.
c. Confidence intervals would be appropriate for both parameters. There are no obvious null values to do a hypothesis test.
d. Both. A confidence interval would be appropriate to do find the magnitude of the mean difference in number of visits. A hypothesis test could be used to determine if the mean number of visits for people who fear going to the dentist is lower than for those who do not have the fear.

17.2 Study #1 apparently was a randomized experiment. The article states that participants were "given either a placebo or a calcium supplement." We aren't told whether the researchers randomly assigned teens to groups, but it seems likely that they did. Assuming this was a randomized experiment, the headline is justified because cause-and-effect relationships can be inferred from randomized experiments (see Rule for Concluding Cause and Effect on p. 706).

17.14 **a.** The treatment given to the participant was recorded as a categorical variable, either placebo or a calcium supplement. Presumably the participant's blood pressure was measured as a quantitative variable as would typically be the case for blood pressure.
b. They would use a paired *t*-test because blood pressure was measured at both times for each participant.
c. Define μ_d to be the hypothetical mean drop in blood pressure after eight weeks of taking calcium supplements, for the population of teens like the ones in this study. Then the hypotheses are H_0: $\mu_d = 0$ and H_a: $\mu_d > 0$.
d. Measurements for the two groups are independent so they would use a *t*-test for the difference in means for independent samples. The data for each person would be the change in blood pressure over the eight weeks.
e. Define μ_1 to be the change in blood pressure after eight weeks of taking calcium supplements and μ_2 to be the change in blood pressure after eight weeks of taking a placebo, for the population of teens like the ones in this study. Then the hypotheses are H_0: $\mu_1 - \mu_2 = 0$ and H_a: $\mu_1 - \mu_2 \neq 0$. Note: It may make sense to use a one-sided alternative hypothesis, if the researchers hypothesized in advance that if calcium had any affect, it would be to lower blood pressure and not to raise it.