Problem set 9

S520

Upload your answers through the Assignments tab on Canvas by 11:59 pm, Thursday 7th November. Draw graphs in R and include code.

1. Trosset chapter 11.4 Problem Set D. Data: `http://mypage.iu.edu/~mtrosset/StatInfeR/Data/globulin.dat`

2. (From the Fall 2016 final.) In a randomized experiment in Georgia, a treatment group of 592 convicts received cash payments upon being released from prison, while a control group of 154 convicts received no money upon release. In the first year after release, the members of the treatment group averaged 16.8 weeks of paid work, with a standard deviation of 15.9 weeks. The members of the control group averaged 24.3 weeks of paid work, with a standard deviation of 17.3 weeks. The samples were large and right-skewed.

   We wish to test the hypothesis that the treatment and control will, on average, result in the same number of weeks worked.

   (a) To allow interpretation, the researcher would prefer not to transform the data. Explain why we may do a Welch's t-test even though the samples are right-skewed.

   (b) Calculate the test statistic, and give R code to find the P-value. Notes: We do not have the full data set so you can't use `t.test()`. The correct number of degrees of freedom should be about 225.

   (c) Calculate a 95% confidence interval for the average difference in weeks worked between the treatment and control.

3. (Adapted from the Summer 2015 midterm.) A large sample of statistics students is randomly split into two groups, each containing 100 students. Group A is shown *The Joy of Stats*,[1] a documentary about the history and philosophy of statistics. Group B is shown the 1992 Steven Seagal movie *Under Siege*. After the screenings, all students are given the same statistics test. Group A has an average score of 61 with a sample standard deviation of 10. Group B has an average score of 59 with a sample standard deviation of 13. Both sets of scores are approximately normal.

   (a) Is there a significant difference between the averages of the two groups? Calculate a test statistic and find the P-value of an appropriate two-tailed test.

   (b) Find a 90% confidence interval for the difference in averages between the two groups.

   (c) What do you conclude based on this analysis? You must take all of the sample size, P-value, and confidence interval into account.

[1] `http://www.gapminder.org/videos/the-joy-of-stats/`

4. (Adapted from the Spring 2015 takehome final.) A group of 24 stroke patients is randomly split into a treatment group and a control group. The treatment group receives aerobic exercise, while the control group does not. The VO2 (a measure of fitness, in mL/kg/min) of each patient in both groups is measured before and after the treatment. The changes in VO2 (VO2 after minus VO2 before, positive is good) for the treatment group are

$$-2.3, -0.7, -0.2, 0.1, 0.5, 0.8, 0.9, 1.6, 2.0, 3.9, 4.5, 6.0$$

while the changes for the control group are

$$-2.9, -1.5, -0.9, -0.8, -0.7, -0.5, -0.2, 0.2, 0.6, 1.2, 1.9, 2.8.$$

   (a) What kind of hypothesis test would you use here? Does the data come close to satisfying the assumptions of this test?

   (b) Find a P-value for a *one-tailed* test of the kind you named in part (a).

   (c) Find a 95% confidence interval for the difference in population means.

   (d) A doctor, who does not know statistics but know how to interpret VO2, wishes to know what can be concluded from the confidence interval. Explain this to her without using the word "confidence."

5. "Glycemic index" is a measure of how quickly blood sugar level rises after eating a particular food. (Glucose has a glycemic index of 100, while water has a glycemic index of 0.) A group of researchers wished to study glycemic index when dates and coffee were consumed together by individuals with type 2 diabetes. They performed a study on 10 subjects with diabetes. Firstly, they measured glycemic index for each patient after consuming dates without coffee. The mean was 53 with standard deviation 19. Then (several days later) they measured glycemic index for each patient after consuming dates with coffee. The mean was 41.5 with standard deviation 17. The differences between the measurements ("without coffee" minus "with coffee") had mean 11.5 with standard deviation 21, and were not obviously non-normal.

   (a) What is the experimental unit? What measurements are taken on the experimental units? Is this a problem with one or two independent samples?

   (b) Give null and alternative hypotheses for an appropriate two-tailed t-test, and calculate the t-statistic.

   (c) The P-value (significance probability) was calculated to be 0.12, so the null hypothesis was not rejected. From this and the other information given, is it correct to conclude that we are sure that on average, dates have the same glycemic index with or without coffee? Explain.

6. A researcher wanted to see if live reggae music improved students' math test scores.[2] He selected a sample of 61 students from his university and gave them a math test. The students then studied for two and a half hours while an acoustic reggae band played quietly. The students then took another math test of the same difficulty.

   The researcher's variable was the *change* in test score for each student — a positive change meant the student did better, while a negative change meant a student did worse. He found

[2] I am not making this up.

that the changes had an approximately normal distribution with mean 6.5 and standard deviation 12.

(a) Assuming the sample is random, test the hypothesis that the population average change is positive.

(b) Does the study provide convincing evidence that live reggae music improves students' math test scores? Explain why or why not.