Stat509 Fall 2014 Homework 7

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Instruction: There will be no quiz based on this homework, we will have the second midterm on 11/20.

1. Data on pH for 16 random batches of low and high volt electrolyte were collected. The data are given by

   `Low volt:  7.78 5.77 7.08 6.75 7.09 8.27 6.5 5.16 6.81 7.28 7.88 7.87 7.2 5.95 6.58 6.99`
   and
   `high volt:  4.54 5.04 5.07 6.18 8.62 6.28 7.41 6.17 6.25 4.25 6.08 7.23 4.68 6.19 5.85 5.83`

   (a) Use `boxplot(sample1,sample2)` to draw the side-by-side boxplot in R. Do you think it is reasonable to assume $\sigma_1^2 = \sigma_2^2$ based on the plot?

   ```
   low<-c(7.78,5.77,7.08,6.75,7.09,8.27,6.5,5.16,6.81,7.28,7.88,7.87,7.2,5.95,6.58,6.99)
   high<-c(4.54,5.04,5.07,6.18,8.62,6.28,7.41,6.17,6.25,4.25,6.08,7.23,4.68,6.19,5.85,5.83)
   boxplot(low,high,names=c("low","high"),col="grey")
   ```

   (b) In R, command `var.test(sample1, sample2)` can be used to test equal variance assumption, where `sample1` and `sample2` are the names of the data vector your give in R. Compare the R output with your calculation in part (a).

   ```
   var.test(low, high)
   ```

   (c) Assuming the two samples are independent. The engineer want to test that the low volt average pH is greater than the high volt average pH. Let μ_L be the average pH of low volt electrolyte and μ_H be the average pH of high volt electrolyte. State the null and alternative hypotheses.

   (d) Calculate the appropriate test statistic for the test. The sample means and sample variances can be computed using R.

   (e) Use R to calculate the p-value of the test.

   (f) State your conclusion at a 0.05 level of significance.

   (g) Use `t.test` in `R` to check your work.

   ```
   t.test(low,high,alternative="greater",paired = FALSE, var.equal = TRUE)
   ```

2. The deflection temperature under load for two different types of plastic pipe is being investigated. Two random samples of 15 pipe specimens are tested, and the deflection temperatures observed are as follows (in Fahrenheit):

   `Type 1:  206, 188, 205, 187, 194, 193, 207, 185, 189, 213, 192, 210, 194, 178, 205`
   `Type 2:  353, 393, 411, 401, 359, 351, 369, 399, 393, 383, 395, 375, 377, 405, 383`

   (a) Construct box plots and normal probability plots for the two samples. Do these plots provide support of the assumptions of normality and equal variances? Write a practical interpretation for these plots.

   (b) Do the data support the claim that the mean deflection temperature under load for type 2 pipe exceeds that of type 1? Use $\alpha = 0.05$. Do the analysis in `R`.

3. According to research published in Science (Feb 20,2004), the mere belief that you are receiving an effective treatment for pain can reduce the pain you actually feel. Researchers tested the placebo effect on 24 volunteers. Each volunteer was put inside an MRI for two consecutive sessions. During the first

session electric shocks were applied to their arms and the blood oxygen level-dependent (BOLD) signal (a measure related to neural activity in the brain)was recorded during pain. The second session was identical to the first, except that prior to applying the electric shocks the researchers smeared a cream on the volunteer's arms. The volunteers were informed that the cream would block the pain, when, in fact, it was just a regular skin lotion (ie, placebo). If the placebo is effective in reducing pain, the BOLD measurements should be higher on average, in the first MRI session than in the second MRI session. The differences are calculated by subtracting second MRI measurement from first MRI measurement.

(a) State the null and alternative hypotheses. (*Hint: this is a dependent 2-sample problem.*)

(b) The differences between the first BOLD measurements and the second were computed and the summarized results is as follows:

Variable	n	$\overline{y}_D$	s_D
size	24	0.21	0.47

Calculate the test statistic.

(c) Calculate the p-value.

(d) State your conclusion.

4. A programmable lighting control system is being designed. The purpose of the system is to reduce electricity consumption costs in buildings. The system eventually will entail the use of a large number of transceivers (a device comprised of both a transmitter and a receiver). Two types of transceivers are being considered. In life testing, 200 transceivers (randomly selected) were tested for each type. Transceiver 1: 20 failures were observed (out of 200) Transceiver 2: 14 failures were observed (out of 200). The engineers want to test for the equality of the proportions. Define p_1 (p_2) to be the population proportion of Transceiver 1 (Transceiver 2) failures.

(a) State the null and alternative hypotheses.

(b) Calculate the test statistic.

(c) Calculate the p-value.

(d) What is your decision and conclusion at $\alpha = 0.05$?

(e) Use `prop.test` in `R` to check your work.

```
prop.test(c(20,14),c(200,200),correct=F)
```