Week 5 Problem Set: Hypothesis testing I

**(30 pts)**

Part I (Warm up) (5 pts)

One concern about applying metal tags to penguins is that doing so may increase drag in the water. In a study of the impact of foraging tags on penguin foraging efficiency, the mean length of 344 foraging trips for penguins with a metal tag was 12.70 days with a standard deviation of 3.71 days. For those with an electronic tag (which presumably would not increase drag), the mean foraging trip length was 11.60 days with standard deviation of 4.53 days over 512 trips. Calculate the confidence interval for the difference in foraging trip length and calculate the p-value for the null hypothesis that there is no difference between tag types. (Do not use the R function ‘t.test’. I’m asking you to calculate these yourself.) Do these data provide evidence that mean foraging trips are longer for penguins with a metal tag?

Part II (13 points)

Download the dataset “diabetes.csv”. This dataset describes a diabetes study in which blood glucose ($stab.glu) was recorded for males and females ($gender) in each of two locations ($location).

1. Aggregating across locations, calculate the test statistic for the t-test to test the null hypothesis that males and females do not differ in their average blood glucose levels and compare it to its distribution under the null hypothesis (do not use the R function t.test, I want you to create your own script or function to do this) (Copy and paste here) (3 pts):
2. Compare your results with the R function “t.test”. (Copy and paste results below.) Explain what every single number reported in the output of t.test means. (3 pts)
3. Interpret your results in words as you would in the results section of a manuscript (1-2 sentences) (1 pts)
4. How would the results differ if you used the median rather than the mean as the test statistic? Write a script to test the null hypothesis . Keep in mind that you will have to determine the distribution of the test statistic under the null hypothesis. (4 pts)
5. If these were your data, under what circumstances would you feel comfortable lumping the data for each location together? Assuming you could lump the data together, what would be one advantage of doing so? (2 pts)

Part III (12 points)

Download the dataset “WaterSamples.csv”, which represent soil water content (% water by volume) for independent random samples of soil from two experimental fields growing bell peppers. (Reference: Journal of Agricultural, Biological, and Environmental Statistics, Vol. 2, No. 2, p 149-155)

Here we are interested in the variance within each field, with the null hypothesis:

1. What is the equation for and numerical value of the test statistic for testing this null hypothesis? (2 pts)
2. If we assume a two-sided test, what is the p-value for testing this null hypothesis? (Use the test statistic from 1 and the appropriate distribution under the null hypothesis.) (3 pts)
3. What is the p-value if we are interesting only in ? (2 pts)
4. What is the p-value if we are interesting only in ? (2 pts)
5. Confirm that you can reproduce the answers for 2-4 above using the R function ‘var.test’. (3 pts)