Homework 3

QSCI 482: Hypothesis Testing & Estimation for Ecologists & Resource Managers

1. In the home, the amount of radiation emitted by a color television set does not pose a health problem of any consequence. Not so, perhaps, in department stores where as many as 15 to 20 sets may be turned on at once in a relatively small area. The following readings were taken at ten different department stores, each having at least ten sets turned on in their display areas. The following are radiation level readings (in milliroentgens, or mr, per hour):

   0.40, 0.48, 0.60, 0.55, 0.50, 0.80, 0.50, 0.36, 0.46, 0.89

   [a] Let's say the recommended safety limit for exposure to this type of radiation set by the National Council is 0.4 mr/hour. Define meaningful null and alternate hypotheses under the scenario that you are the regional agent for the Council, and you were sent to evaluate regional levels of radiation of this type in department stores. Choose an appropriate test statistic, giving reasons why you chose it.
   [b] Test your hypothesis in (a) using 0.01 as your Type I error rate. Report a p-value for the test, as well (bracketing is OK). Be sure to state your conclusions in terms of the original problem.
   [c] Compute a 99% confidence interval around the true mean radiation level in department stores with ten or more TV's turned on simultaneously in a small display area.
   [d] Determine the minimum sample size necessary to conduct this test at 90% power, significance level 0.05, if you wish to detect a difference of 0.2 mr/hour.

2. Suppose that the mean wing beats per second of the European-American honeybee, μ, is 500. A sample of 16 African honeybees produced a mean of 460 and a standard deviation of 60.

   [a] What power would result in assessing the evidence that the wing beats per second of the African honeybees is less than that of the European-American honeybee using $\alpha = 0.10$? Using $\alpha = 0.01$?
   [b] If 30 samples were used, what size difference could be detected at 90% power, with $\alpha = 0.05$?

3. [a] If df = 10, find P($\chi^2 > 18.307$).

   [b] If df = 61, find P($\chi^2 < 80.232$).

   [c] Given a χ^2 random variable with 96 df, find P($78.725 < \chi^2_{96} < 114.131$).

   [d] Systolic blood pressure results from contraction of the heart muscles. Based on past results from the National Health Survey, it is claimed that women have systolic blood pressures with a mean and standard deviation of 130.7 and 23.4, respectively. Consider the following systolic blood pressure measurements and use them to derive an interval estimate for the population standard deviation, assuming normality, and allowing for the possibility of a 10% error to occur.

   104, 102, 94, 108, 123, 89, 107, 181, 100, 107, 97, 106, 105, 133, 113, 95, 114, 125, 92

   Do you think these data come from a population with a standard deviation of 23.4?

4. Sometimes trees are fertilized with nitrogen to increase their growth (like many agricultural crops). It would be useful to know if bark thickness was affected at all by nitrogen fertilization. It is believed that if the fertilization had any affect at all, it would be to increase bark thickness. Sixteen 1-hectare spruce plantations of the same age and spacing were available for study, eight were fertilized and eight were not fertilized. After a suitable response period, the following data were collected representing mean bark thickness (in mm of bark thickness) from each plantation:

   Control plantations: 40, 32, 32, 24, 28, 32, 28, 28

Treated plantations: 28, 28, 36, 44, 48, 50, 38, 32

Test to see whether there is an increase in bark thickness when comparing treatment conditions to control conditions. Use .05 significance level and you may assume equal variances. Write down the p-value that goes along with the observed test statistic (if necessary either linearly interpolate or use a statistics program). Be sure to state your conclusion in terms of the original research question.