Homework 4

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

1. Using the F-distribution.
   [a] Find the f satisfying $P(F_{17,20} > f) = 0.05$
   [b] Find the f satisfying $P(F_{5,15} > f) = 0.025$
   [c] Find $F_{0.01(1),30,3}$
   [d] Find the f satisfying $P(F_{3,30} > f) = 0.99$ [Hint: Lower-tail values can be found from upper-tail values by swapping *df* to find an F, then inverting it].

2. Power curves. You have been hired as a statistical consultant by a small firm. (Even with only a few weeks of QSCI 482 under your belts, you're still way ahead of a lot of other people!) Your client is going to be comparing the soils from two areas with respect to a number of measured responses (like carbon/nitrogen ratio, water holding capacity, pH, nitrogen mineralization rate, and a number of toxicants DDT, heavy metals like lead, mercury, etc.). Since there are so many potential responses to consider, one way to have a sample size/power analysis discussion is to make a graph, with (δ/σ), i.e., the Minimum Detectable Effect (MDE) on the y-axis and "n per treatment group" (assuming equal n's) on the x-axis. This simplifies things greatly as opposed to focusing on any one particular response. Because of the expense involved, the sample sizes per area are going to be rather small, perhaps as low as 3 samples per area for either soil properties or toxic elements. You're trying to show your client what happens statistically in terms of how the MDE changes as the number of samples does. So, try out the values n = 3, 4, 5, 6, and 10 [that's the n *per group*], solve for the quantity (δ/σ), and plot (δ/σ) against n. The client wants to use one-sided tests, so let $\alpha(1) = .05$ and power = .75.

   After you get your graph, what point would you emphasize to your client if you were doing a sample-size-power-analysis presentation? (Just use a few sentences).

3. Consider the following data on additional hours of sleep gained by 10 patients who participated in an experiment with a newly developed drug. Determine whether these data justify the claim that this drug produces additional sleep. Each patient was randomly assigned to the drug (active pill) or the placebo (inactive pill) the first week. Then, one week later, each patient was given the other kind of pill. The results below are the hours of sleep on the drug minus the hours of sleep on the placebo.

Patient:	1	2	3	4	5	6	7	8	9	10
Hours gained:	0.7	-1.1	-0.2	-1.2	-0.1	3.4	3.7	0.8	1.8	2.0

   [a] What set of hypotheses would you suggest?

   [b] Now test the null hypothesis against the alternative at the 10% significance level, assuming that the hours of sleep are normally distributed for the individuals taking either the active or placebo drug. State your conclusion in terms of the original research context.

4. Two species of trees were planted on a total of 20 randomly selected plots located on a particular soil type to determine which performed the best on that soil type. The average height per plot was measured after six years. The results (in meters) were as follows:

   Species 1: 3.2, 2.7, 3.0, 2.7, 1.7, 3.3, 2.7, 2.6, 2.9, 3.3

   Species 2: 2.8, 2.7, 2.0, 3.0, 2.1, 4.0, 1.5, 2.2, 2.7, 2.5

   [a] Test to see whether the two variances are the same or different at the .05 level of significance.

   [b] Based on results of (a) above, use an appropriate formula to compute a 95% Confidence Interval for the difference in the means. Would you say the means are the same? Be sure to phrase your answer in the context of the original research question.