SA #9-10	Scientific Investigations and Data Analysis

OVERVIEW: This assignment is intended to enhance your skills in experimental design and statistical analysis needed for the Botany Lab Inquiry Project (BLIP) and our prairie restoration study. You are referred to selected readings of Molles' boxed discussions entitled "Investigating the Evidence" and lecture slides.

"*What decision do I make to interpret two or more sets of data, each representing five or more measurements? For example, if they are measurements of species richness, do they suggest that the two experimental treatments being compared have the same richness or different?*

FORWARD: To answer these questions, we will look to some simple *statistics*, mathematical approaches used to provide some reasonable probability that one is correct choosing to answer the questions above with a "yes" or "no."

RESOURCES and PROCEDURE:
Your goal will be to learn how to enter experimental data into a simple Excel spreadsheet program, called *BIOSTATS*, written to compute *means*, *standard deviations*, and ***t**-values* used as a basis for comparing paired means and making decisions about your hypothesis. Please use the following resources:

a. BIO 2500 Lab Resource Page accessible from the BIO 2500 webpage
b. Appendix of your Laboratory Manual discusses statistics and use of *BIOSTATS*
c. PowerPoint slides on the S:\drive explain how to analyze data to compute means, variance, standard deviation, and t-values using *BIOSTATS*, an Excel file obtainable from S:\drive.
d. Molles Ecology text has several boxed discussions called "Investigating the Evidence." The following will be especially helpful:

Scientific Method - Questions and Hypothesis – p 9
Determining Sample Mean – p 19
Determining Sample Median – p 55
Laboratory Experiments – p 88
Sample Size – p 119
Variation in Data – p 151
Clumped, Random, and Regular (Uniform) Distributions – p 221
The Design of Field Experiments – p 315
Comparing Two Populations with the *t*-test – p 422
Assumptions for Statistical Tests (Normal Distributions) – p 441

By studying/reviewing this introduction to statistics, the *t*-test,and the *BIOSTATS* spreadsheet, you should become prepared to enter data, perform statistical analyses, and answer the question, *What decision do I make to interpret two or more sets of data?*

Bring your data, laboratory manual, notes, and questions needing clarified to class and we'll discuss the procedure necessary to interpret your results.

STUDY QUESTIONS: See page 2 —>

STUDY QUESTIONS:

1. Use Figure 1 ("Investigating the Evidence", page 9) to discuss the logic and progression of the scientific method. Then, considering your Botany Lab Inquiry Project (BLIP) assignment, distinguish between hypothetical question and a hypothesis.

2. Distinguish *null hypothesis* (H_o) from an *alternative hypothesis* (H_a). How does the logic of forming a hypothesis differ from hypothesis testing?

3. Discuss two types of error in hypothesis testing. Why is the null hypothesis preferred in statistical analysis?

4. The following interactive website discusses normal distribution, mean, variance and standard deviation:
   http://www-stat.stanford.edu/~naras/jsm/NormalDensity/NormalDensity.html
   a. Define and then explain how to compute the mean, variance, and standard deviation.
   b. Distinguish sample mean from the mean of an entire "population." Then, explain the use of a *statistic* such as a *sample mean*.
   c. Explain the importance of the variance and standard deviation as estimates of departures of data from the mean.
   d. For a normal distribution, how many standard deviations from the mean are necessary to define the range within which 68% of the measurements would fall? How many are necessary to define the range for 95% of the measurements?

5. With respect to possible variables, describe the experimental design of a typical *laboratory experiment* in which a hypothesis is being tested. How does experimental design differ in field experiments? Perhaps you can illustrate by contrasting your chosen BLIP topic with our prairie restoration study.

6. As you receive your data set from our prairie restoration community study in laboratory, use the instructions in your laboratory manual to analyze and discuss the data. You should be able to use Excel or another spreadsheet program to summarize the data and use *BIOSTATS* to compute means, variances, and t-values. Use the PowerPoint slides as a guide to interpretation of t-values and making your decisions on your null hypotheses. ☹ If you "get stuck" please seek help from a peer or from me (Dr. S.). A few minutes of interaction can put you back in business (at least until you reach the next pot-hole ☺).