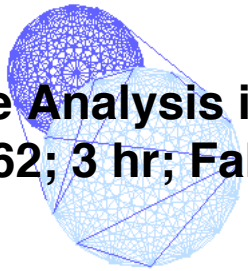

Multivariate Analysis in Ecology
BISC 662; 3 hr; Fall 2013

Instructor - Steve Brewer
Lecture and Lab – Thursday, 1:00 – 3:45 pm
(Shoemaker 225)

Office Hours – After class until 5:30 or by appointment
Prerequisites: Biometry (BISC 504) or a comparable statistics course

Course Description – A survey of a variety of multivariate statistical techniques that are currently widely used in ecology, with a particular emphasis on community ecology. This course differs from more generalized multivariate courses in that it focuses to a greater extent on non-parametric and non-linear techniques, which are generally regarded as being more appropriate for analyzing multivariate ecological data.

Learning Outcome - Students are expected to become familiar enough with multivariate statistics to recognize how to answer specific ecological questions and which techniques are most appropriate for analyzing a particular ecological data set. In addition, students will become familiar with some software applications specialized for analyzing multivariate data, including R.

Independent Learning - Familiarity with both the concepts and the applications of the techniques taught in this course should be of significant intellectual and practical value to students. Such familiarity will help them become self-sufficient when conducting independent research projects involving multiple variables and complex ecological relationships.

Outline of Topics Covered

Why use multivariate statistics to study ecological data?
- *Integration of Responses, Avoiding Inflated Type I Error, Accounting for Correlated Responses*

What is meant by distance in species space (community dissimilarity)?

How is dissimilarity among samples measured?

How and why do we graphically arrange samples according to dissimilarity (i.e., how and why do we generate ordinations)?
- *Weighted Averaging, Principal Components Analysis, Factor Analysis, Principal Coordinates Analysis, Correspondence Analysis, Nonmetric Multidimensional Scaling*

How do we interpret these graphical arrangements of samples or ordinations?
- *Loadings, Weights, Quantitative Graphical Overlays, Bubble Plots*

How do we examine correlations between species composition and environmental variation?
- *Indirect Gradient Analysis*
  - *Ordination and Multiple Regression, Ordination and Path Analysis, Structural Equations*
- *Direct Gradient Analysis (Constrained Ordination)*

Redundancy Analysis (Multivariate Regression), Canonical Correlation, Distance-Based Redundancy Analysis, and Canonical Correspondence Analysis

How do we examine differences among groups?

Discriminant Analysis and Logistic Multiple Regression, permutation MANOVA, Distance-Based Discriminant Analysis (Canonical Analysis of Principal Coordinates), Mantel Tests. Analysis of Similarity

How do we examine responses over time?

Univariate versus Multivariate Repeated Measures Analysis of Variance

How do we examine changes in species composition over time?

Repeated-Measures Permutation MANOVA, Compositional Vectors

Homework Assignments

1. Calculating Multivariate Distances and Do-it-Yourself Ordination (10 pts)

2. Principal Components Analysis and Factor Analysis (20 pts)

3. Weighted Averaging, Correspondence Analysis and Multidimensional Scaling (15 pts)

4. Comparison of Principal Components and Principal Coordinates Analyses, Correspondence Analysis, and Multidimensional Scaling (15 pts)

5. Gradient Analysis, Path Analysis, and Hypothesis Testing (20 pts)

6. Distance-Based Redundancy Analysis and Canonical Correspondence Analysis (15 pts)

7. Discriminant Analysis and Logistic Multiple Regression (15 pts)

8. Repeated-Measures Analysis of Variance (Univariate and Multivariate Approaches; 20 pts)

9. Analysis of Compositional Differences Between Groups and Over Time (20 pts)

Take Home Final - Essay (50 pts)