

Biology 483/483G
Multivariate Methods in Biology
Spring 2008

Meetings: MW 8:00-10:05, EBS 3105
Instructor: Dr. Doug McElroy, 207 TCNW, 745-5996, Email Doug.McElroy@wku.edu
Office Hours: TR 8:00-9:00
Home Page: <http://bioweb.wku.edu/Faculty/McElroy/>
Textbooks: Kachigan, S.K. 1990. Statistical analysis: an interdisciplinary introduction to univariate and multivariate methods. Radius Press, New York, NY.

'When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind: it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science.'

Lord Kelvin

This course is designed to acquaint graduate students and advanced undergraduates with the basic theory and application of statistical techniques to problems in the biological sciences. In general, the course will emphasize operational aspects of experimental design, data analysis and biological interpretation of statistical results rather than mathematical formulae. We will consider the objectives and limitations of different approaches, and the context in which it may be useful for the analysis of biological data. You should try to develop an understanding of the various techniques in a spatial or heuristic sense (that is, in visualization of how the different methods go about searching for patterns in the data). The ultimate goal is for you to develop the skills necessary to (1) critically evaluate studies from the literature in terms of their application and interpretation of multivariate statistical methods, (2) design appropriate, potentially informative, and statistically valid data collection and analysis strategies to investigate given research questions, and (3) effectively utilize various statistical software packages to address questions at hand. I also hope to impress upon you the need to consider the analysis phase of your thesis (or any) research before beginning to collect data, and the significant amount of effort and time that are required to conduct data analysis in a thorough and meaningful way.

Grades will be based on two take-home exams, homework problems, and (for graduate students) an analytical project. Exam questions will ask you to either (1) analyze and interpret a given set of data, (2) design a sampling and analysis protocol to appropriately address a biological problem, or (3) critically evaluate a study from the published literature. Problem sets will require that you analyze a set of data using the techniques currently being discussed. For the analytical project, you will be responsible for developing and carrying out an hypothesis-based study on the question of your choosing. You will be responsible for working in groups of 2-3 to identify the question and frame specific testable hypotheses, (2) collect and/or otherwise acquire appropriate data, (3) devise and carry out appropriate statistical analyses to test your hypotheses, and (4) interpret and present your findings in both oral and written form. More details on this project will be forthcoming. The project will culminate in a 12-minute oral presentation suitable for a scientific meeting, with a written paper in manuscript form to follow.
Undergraduate students are not required to undertake or participate in a research project.

Students with disabilities who require accommodations (academic adjustments and/or auxiliary aids or services) for this course must contact the Office for Student Disability Services, Room 445, Potter Hall. The OFSDS telephone number is (270) 745-5004 V/TDD. Please DO NOT request accommodations directly from the professor or instructor without a letter of accommodation from the Office for Student Disability Services.

Good luck.

Tentative Lecture Outline (Chapters from Kachigan)

Foundations of statistics and statistical inference (23 January through 13 February)

Variables, data, measurement, and estimation (Ch. 1, 2, 4, 5)
Data distributions, probability distributions and sampling distributions (Ch. 2, 6, 7)
Probability Theory (Ch. 6)
Hypothesis testing and the Central Limit Theorem (Ch. 7, 8, 9)
Type I and Type II errors (Ch. 9)
Matrix operations

Prediction (18 February through 05 March)

Data transformations
Correlation analysis (Ch. 10)
Multiple linear regression (Ch. 11)
ANOVA, ANCOVA and MANOVA (Ch. 12)
Categorical analysis (Ch. 13)

Ordination (17 March through 02 April)

Principal components analysis (Ch. 15)
Factor analysis (Ch. 15)
Discriminant function and canonical variates analysis (Ch. 14)

Clustering (07 April through 23 April)

Distance metrics (Ch. 16)
Hierarchical clustering methods (Ch. 16)
Matrix correlation

Special topics (28 April through 30 April)

Canonical correlation (Ch. 10)
Repetitive sampling and randomization techniques

Exams are tentatively scheduled for the weeks of **17 March and 05 May**.

Exams will be placed on the course's 'Assignments' web page by noon on the day in which they're scheduled to become available, and must be turned in by 3:00 pm one week later. Exams will be open-book, but must be completed individually and without reference to the work of others. You may discuss the nature, meaning and intent of the questions with me, but answers you develop should be your own. You should not solicit discussion of the exam, its contents or your developing answers with others in the class or with faculty. My perspective on the exam process is that adopting a system built on honor and personal integrity allows flexibility and advantages to everyone, and so it is in everyone's best interests to uphold and enforce that system; to reaffirm what is expected of every Western student, refer to the [Western Creed](#).

The research projects will be presented orally on 07 May (8:00-10:00 am). Problem sets will generally be due one week after being given out. Assignments, notices, and other materials will be posted on the World Wide Web (access through the home page given above); be sure to check this site frequently.

Grades will be based on the following breakdown of components:

	Graduate	Undergraduate
Exam 1	25 %	33 %
Exam 2	25 %	33 %
Homework Problems	25 %	33 %
Research Project	25 %	

There will be no make-up exams, and no opportunity for extra credit. Cheating, plagiarism and other forms of dishonesty are violations of academic integrity and will be dealt with according to university policy as outlined in the university catalog. You are responsible for monitoring the university's Academic Calendar for important dates relating to add/drop, withdrawal, and the like.

Agreement Form

In order to remain enrolled in BIOL 483/483G, you must print, complete and return this form to the instructor by second class meeting. Failure to submit a completed form by that date will cause you to be dropped from the course.

By submitting your name on the form you are agreeing to the following statement:

"I have read the BIOL 483/483G course syllabus and understand and accept its contents. I also understand that all work in this course must be my own and all required assignments, projects, and tests must be completed to receive a passing grade for this course. I stipulate that I have reviewed the following web sites:

<http://www.indiana.edu/~wts/wts/plagiarism.html>

and understand what constitutes academic plagiarism. I further agree that it is my responsibility to withdraw or make other changes in my enrollment status, according to the policies and deadlines outlined in the University Catalog and/or Academic Calendar. "

Signature

Date

Semester Taken