BIOL 5385 Experimental Design

Instructor:	Dr. Jim Novak
Office:	1162 Life Sciences Annex; 581-6385
Office Hours:	or by appointment
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Texts: **Magnusson, W. E. and G. Mourão. 2004. Statistics Without Math. Sinauer Associates, Sunderland, MA. (ISBN: 85-902002-2-1)**

Quinn, G. P. and M. J. Keough. 2002. Experimental design and Data Analysis for Biologists. Cambridge University Press, Cambridge, UK. (ISBN: 05-210097-6-6 (PB) or available from the publisher as an eBook.

Class Time: **Lecture MW 50 minutes, Lab F 110 minutes**

Class Location: **Lecture - 1130 Life Sciences Annex, Lab - 1130 Life Sciences Annex**

OBJECTIVES:

GENERAL:

This course will explore the design, implementation and analysis of scientific experiments in biology from a statistical perspective for field and laboratory based studies. The course will focus on the use of modern statistical approaches that include mixed-model, permutational and multi-model procedures within the context of readily available statistical software packages.

SPECIFIC:

1) Students will:

   a) Identify how to take a problem or hypothesis and translate it into a usable statistical design

   b) Utilize modern statistical techniques including mixed-models, permutational statistics and Bayesian inference that can provide a more powerful analytic framework compared to traditional parametric statistics

   c) Develop a proficiency in the use of the SAS statistical package for standard and non-standard analyses

   d) Apply skills in integrating statistics into their research and scholarly activities

FORMAT

Monday and Wednesday classes will cover specific topics in a traditional lecture/discussion format. Laboratory sessions will not occur every week, during the times when there is no lab scheduled WE WILL STILL HAVE CLASS, but it will be a traditional lecture. Both lecture and laboratory sessions will be held in the computer laboratory and will emphasize the use of SAS© to analyze data using statistical techniques previously discussed in class. Each individual will have access to a computer and the appropriate software during the laboratory class period.

GRADES

You will be evaluated based upon the completion of homework assignments, laboratory exercises, and two section exams and one final exam. Exams will be open book/notes part of the exam may be take-home and require the use of computational software to complete the exam. The breakdown of credit is as follows:

Homework – 15%
Laboratory Exercises – 15%
Section Exams – 15% each (30% Total)
Final Exam – 15%
Project – 15%
Miscellaneous – 10%

MISSED EXAMS

If you cannot attend class on the day of an exam or lab, you must notify the instructor at least 24 hours prior to the exam or lab. Exams/labs will only be rescheduled for students that give adequate notification and documentation (as required) of their absence or in extreme cases (sudden illness, family emergency, etc.).

COMMUNICATION

Any relevant announcement of changes, additions, and other information will be via the WebCT email system.

ACADEMIC HONESTY POLICY

I expect that you will never passively or actively cheat on any of my exams, or those administered by your other instructors. Any documented incidence of cheating or plagiarism will result in an automatic failing grade ("F") for the entire course, and notifications to the Dean's office and Judicial Affairs. Please feel free to speak with me, or consult your Student Handbook, if you have any questions concerning this matter.

DISABLED STUDENTS

Disabled Students should contact the Office of Disability Services (9th St.Hall 2002; x6583) for any arrangements that need to be made in order to ensure that you get the most out of this course. Within reason, I am willing to make whatever accommodations are necessary to facilitate your learning of this material.

FURTHER ASSISTANCE

If you suddenly find yourself with a question that is burning a hole in your brain, and cannot reach me, there are several ways of obtaining the answer. Here are some examples:

1. The authors of your text have thoughtfully provided numerous problems for you to practice your statistical skills. The solutions for some of theses are listed in the Answers to Selected Problems section at the end of the book. The companion CD also has additional solutions.

2. Do not be afraid to use the internet. Google is a powerful search engine and can help you find additional information on topics. BE AWARE THAT THE QUALITY OF INFORMATION VARIES GREATLY FROM SITE TO SITE ON THE INTERNET. If the information on the site conflicts with the book you may want to bring this up in class and we can discuss it.

3. Seek help at the Learning Assistance Center (x6696) or the Counseling Center (x3413) to obtain help with studying for this class.

4. Help each other -- get to know your fellow students! Active learning through testing each other on the material is one of the most effective ways to learn where your weaknesses lie with this subject matter.

LECTURE AND LABORATORY SCHEDULE

Week	Topic	Reading	Lab Topic
1	1.) Sampling Design or Designer Samples; 2.) Karl Popper and Stuart Hurlburt (Pseudoreplication in Fact and Fiction)	1.) WEM – 1 & 2 2.) WEM – 5: 40-41 & 4	Leaves of Grass (or Oak) – Data Collection
2	3.) Describing Things or How a Computer Can Make Lying Easy; 4.) What Does Improbably Likely Mean	3.) WEM – 3 4.) WEM – 5: 41-46	Leaves of Grass (or Oak) – Analysis 1& Discussion
3	5.) What DIF Does it Make?	5.) WEM – 5: 41-46 6.) WEM – 5: 46-51	6.) The Same Old Textbook Story
4	7.) Risky Behavior and ANOVA 8.) Statistics for a Non-Black-and-White World	7.) WEM – 6 8.) WEM – 7	Leaves of Grass (or Oak) – Analysis 3& Discussion
5	9.) Making the World Fit 10.) Statistics in the Real World	9.) WEM – 11 10.) WEM – 8: 71-76	Holiday
6	11.) Partially Correct or Partially Wrong? 12.) 2+-Way ANOVA Review	11.) WEM -. 8: 76-77 & 9 12.) GPQ – 9.2	Monkeys, Trees and Shrubs -
7	Nested ANOVA Designs Split-Plots	13.) GPQ – 9.1	14.) GPQ – 11.1.1, 11.2 – 11.10
8	Mixed Model ANOVA: Introduction to Bayesian Thinking	15.) GPQ - Box 9.7; 9.2.3, 9.2.4: 16.) GPQ – 2.6	
9	ANCOVA: Standard ANCOVA, Permutational ANCOVA	17.) GPQ - 12 18.) Handout	Split-Plot & Other Nested designs
11	MANOVA	19.) GPQ - 15 20.) GPQ - 16	ANCOVA & Permutational ANCOVA
12	Repeated Measures – 3 Methods: Split Plot, Profile Analysis, Covariance Modeling	21 & 22.) GPQ – 11.1.1, 11.2 – 11.10; GPQ - Box 9.7; 9.2.3, 9.2.4:	MANOVA
13	PCA and Factor Analysis: Uses in data reduction and EDA	23 &24.) GPQ - 17	Repeated Measures ANOVA
14	Generalized Linear Models: Relaxing the assumption of Normality	25 & 26.) GPQ - 13	PCA Primer
15	Path Analysis and Causal Modeling	27 & 28.) GPQ – 6.3; Handout	Logistic Regression
16	Multimodel Inference: Why Popper was Wrong, Maybe	29 & 30.) - Handout	Model Selection in the Real World

FINAL EXAM

Note: All dates represent my best guess and are subject to change based upon class interest and progress