ST 512 Course Syllabus

ST 512 – Experimental Statistics For Biological Sciences II

Section TBD

FALL 2013

3 Credit Hours

Special Notes

Are you in the right class? While all students are welcome in ST512, ST512 emphasizes topics that are most pertinent to the biological sciences. When in doubt, consult with your advisor to make sure that this is the right class for you. If you are in the Statistics graduate program, then you should be in ST512R. ST512R is only offered in the Fall semester. Bioinformatics and biomathematics students should consult their advisors regarding ST512 vs. ST512R. If you are an engineer, be advised that there is a parallel sequence (ST515 / ST516) specifically designed for engineering grad students. ST516 is only offered in the Spring semester. If you are rusty or uncomfortable with any of the following topics --- basic probability calculations, estimates of means and variances, confidence intervals for means, hypothesis tests, p-values --- then you may want to consider taking ST511 before ST512.

Communication: Students are expected to check their NCSU email regularly to receive course announcements. The appropriate time to ask for additional explanations of course material or assistance on assignments is during lab or office hours. Course-related e-mail to the instructor or the TAs should be used sparingly, and primarily for administrative purposes.

Course Description

The goal of this course is to introduce statistical methods and concepts that are fundamental to analyzing data that arise in the biological sciences. The pedagogy of the course is based on the view that a practical knowledge of statistics requires mastery of three separate types of understanding. They are:

- Logical understanding. Ultimately, statistics does not exist for its own sake. Instead, statistics provides a tool for using data to evaluate and illuminate scientific ideas. The logical connections between statistical methods and scientific thinking are a fundamental component of contemporary scientific discourse. Understanding this logic is central to intelligent data analysis.
- Mathematical understanding. Statistical methods are rooted in mathematics. Although it is conceivable to take a 'black box' approach to statistics, such an approach has serious drawbacks. At the least, treating statistical methods as a black box results in fragmented understanding that hides the common theory underlying the methods. Understanding the mathematical theory behind statistical methods illuminates the deep connections among the methods, which in turn provides a more enduring understanding. In addition, understanding mathematics makes the assumptions and limitations of statistical methods clear, as they arise as a logical consequence of the mathematics.
- Computational understanding: In today's world, nearly everyone analyzes data with statistical software – very few do statistical calculations by hand. Although practical constrains limit the number of software packages that we can examine in class, most software packages share several common denominators. We will gain exposure to two contemporary statistical software packages, R and SAS.
- Most disciplines within the biological sciences have specific methods that are commonly used
or favored. We will not cover these discipline-specific methods. Instead, the goal of an applied statistics class with a diverse clientele is to teach the fundamental statistical concepts and models from which more specialized methods are derived. An understanding of these basic models empowers students to master the specialized techniques that are specific to their own research fields.

### Learning Outcomes

Course objectives, philosophy and overview: The goal of this course is to introduce statistical methods and concepts that are fundamental to analyzing data that arise in the biological sciences. The pedagogy of the course is based on the view that a practical knowledge of statistics requires mastery of three separate types of understanding. Logical understanding. Ultimately, statistics does not exist for its own sake. Instead, statistics provides a tool for using data to evaluate and illuminate scientific ideas. The logical connections between statistical methods and scientific thinking are a fundamental component of contemporary scientific discourse. Understanding this logic is central to intelligent data analysis.

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### Course Structure

Exams: There will be 2 mid-terms and a final. The exam schedule is:

- Monday, October 7: Mid-term 1
- Wednesday, November 20: Mid-term 2
- Friday, December 13 (subject to change): Cumulative final exam

Exams will cover material from lecture and lab. Because of time constraints, the mid-terms are unavoidably a test of fluency as well as mastery. Be prepared. Re-grade requests must be made in writing and must be submitted by the assigned date. Exams will be closed book. You will be allowed to bring one single-sided page (8.5 inch by 11 inch letter-sized paper) of hand-written notes to each midterm, and two single-sided pages of hand-written notes to the final. Unlike ST511, notes for exams must be hand-written. Some elementary calculations may be required on exams. Students should bring a calculator to an exam. Additional calculators will be provided for students who may need them. Cell phones, iPhones, or any other device with wireless capabilities may not be used as a calculator.

Lab assignments: There will be 10 lab assignments throughout the semester. Lab assignments will consist of pencil-and-paper problems and/or computer-based problems. Lab assignments will be available from the course website by 12:00pm on Monday of the week that a lab is assigned. Students should be able to make substantial progress on lab assignments during their regularly scheduled lab period. Attendance at lab periods is not required, but is encouraged. Lab assignments are due at the beginning of Monday’s lecture on the week after
the lab is assigned. If you cannot attend lecture, labs may be placed under Dr. Gross's office door (4246 SAS Hall) by 2:30 pm on the due date. Labs turned in at the end of class will incur a 2-point deduction. Labs turned in after class but within 24 hours after the due date will incur a 3-point deduction. Labs will not be accepted beyond 24 hours after the due date. Lab assignments are worth 10 points each. Each student is expected to earn at least 85 points on lab assignments. Your final lab score is a percentage out of 85, with a maximum of 100%. Working together on lab assignments to overcome obstacles is encouraged. However, any work that is handed in must reflect that student's own understanding. (Put another way, students should be able to explain their own answers in full if asked.) Each student must compose and write his or her own programs, analyses, and reports. Do be sure to put your name on your assignment when you hand it in. Failure to do so will incur a one-point penalty.

Course Policies

In-class computer use: Laptop computers may not be used in class. Tablets or tablet computers may be used to take notes, as long as they do not distract other students.

Instructors

Dr. Kevin Gross (krgross) - Instructor
Email: kevin_gross@ncsu.edu
Web Page: http://www4.stat.ncsu.edu/~gross/
Phone: 919-513-4690
Fax: 919-515-1909
Office Location: 4246 Sas Hall
Office Hours: Thursday 10:15 – 11:45

Course Meetings

Lab

Days: MW
Time: 3:00pm - 4:15pm
Campus: Main
Location: 218 Daniels Hall
This meeting is required.

Course Materials

Textbooks

A First Course in Design and Analysis of Experiments - Gary W. Oehlert
Edition: PDF Form
Cost: Free
This textbook is required.

Expenses

None.

Materials

An Introduction to Statistical Methods and Data Analysis by R.L. Ott and M. Longnecker. - Varies
This material is optional.
Experimental Design and Data Analysis for Biologists by Gerry P. Quinn and Michael J. Keough. - Varies
  This material is optional.

Statistical Research Methods in the Life Sciences by P.V. Rao - Varies
  This material is optional.

The Statistical Sleuth by F.L. Ramsey and D.W. Schafer. - Varies
  This material is optional.

Requisites and Restrictions

Prerequisites

ST 511 or equivalent. In my experience, many students have taken a class similar to ST511 at their undergraduate institution. I leave it up to students to determine whether their previous training is suitable for ST512. I expect incoming students to be familiar with the basics of statistical inference, including point estimation, confidence intervals, and hypothesis testing. Although we will review these ideas briefly in class, the expectation is that this review is a refresher, not a first exposure. Students wishing to brush up on their elementary statistics may consult the excellent on-line (and free) textbook at http://www.openintro.org/stat/.

Co-requisites

None.

Restrictions

None.

General Education Program (GEP) Information

GEP Category

This course does not fulfill a General Education Program category.

GEP Co-requisites

This course does not fulfill a General Education Program co-requisite.

Transportation

This course will not require students to provide their own transportation. Non-scheduled class time for field trips or out-of-class activities is NOT required for this class.

Safety & Risk Assumptions

None.

Grading

Grade Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-term average</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>Component</td>
<td>Weight</td>
<td>Details</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Weekly assignments</td>
<td>20%</td>
<td>Letter grades will be assigned on a curve. +/- grading will be used. A+'s will not be awarded. There is no extra credit. Students are expected to earn homework grades of 100%. Homework rarely improves a final grade, but it can lower it substantially. Grades will be posted on WolfWare. Students are responsible for ensuring that their grades are recorded correctly. Partial credit will be awarded on exams. Partial credit is not necessarily proportional credit.</td>
</tr>
<tr>
<td>Cumulative final</td>
<td>35%</td>
<td></td>
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</tbody>
</table>

**Letter Grades**

This Course uses Standard NCSU Letter Grading:

\[
\begin{align*}
97 \leq & \quad A+ \leq 100 \\
93 \leq & \quad A \quad < 97 \\
90 \leq & \quad A- \quad < 93 \\
87 \leq & \quad B+ \quad < 90 \\
83 \leq & \quad B \quad < 87 \\
80 \leq & \quad B- \quad < 83 \\
77 \leq & \quad C+ \quad < 80 \\
73 \leq & \quad C \quad < 77 \\
70 \leq & \quad C- \quad < 73 \\
67 \leq & \quad D+ \quad < 70 \\
63 \leq & \quad D \quad < 67 \\
60 \leq & \quad D- \quad < 63 \\
0 \leq & \quad F \quad < 60
\end{align*}
\]

**Requirements for Credit-Only (S/U) Grading**

Performance in research, seminar and independent study types of courses (6xx and 8xx) is evaluated as either "S" (Satisfactory) or "U" (Unsatisfactory), and these grades are not used in computing the grade point average. For credit only courses (S/U) the requirements necessary to obtain the grade of "S" must be clearly outlined.

**Requirements for Auditors (AU)**

Information about and requirements for auditing a course can be found at [http://policies.ncsu.edu/regulation/reg-02-20-04](http://policies.ncsu.edu/regulation/reg-02-20-04).

Auditing: Students may register for auditor credit. Auditors must accumulate at least 80 points on the weekly assignments, and attend lecture regularly. Auditors do not take exams.

**Policies on Incomplete Grades**

If an extended deadline is not authorized by the Graduate School, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) by the end of 12
months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at http://policies.ncsu.edu/regulation/reg-02-50-03. Additional information relative to incomplete grades for graduate students can be found in the Graduate Administrative Handbook in Section 3.18.F at http://www.fis.ncsu.edu/grad_publicns/handbook/

**Late Assignments**

**Attendance Policy**

For complete attendance and excused absence policies, please see http://policies.ncsu.edu/regulation/reg-02-20-03

**Attendance Policy**

Lecture attendance and participation: The instructor reserves the right to adjust grades upward for students who enhance the learning experience for others by their participation or behavior. By the same token, the instructor reserves the right to lower grades for students whose behaviors distract others from learning. Among the latter, these include doing any of the following during class: leaving in the middle of class, reading the newspaper, text-messaging (or engaging in any other on-line activity) in a blatant, conspicuous or distracting manner, or letting one’s cell phone ring.

Lab attendance and registration: All students registered for lecture must also register for a lab. Attendance at labs is encouraged but is not required. Scheduled lab times are the only guaranteed opportunity to interact with members of the teaching staff individually. Although office hours also provide an opportunity to interact with the teaching staff on an individual or small-group basis, it is inevitable that office hours will be scheduled at times that are inconvenient for some students.

**Absences Policy**

Absentee policy for exams: If you know in advance that you will not be able to attend an exam, tell the instructor as soon as possible. If feasible, you will be given the chance to take the exam in advance. Make-up exams for unexpected absences will be given rarely, and at the instructor’s discretion.

**Makeup Work Policy**

None.

**Additional Excuses Policy**

None.

**Academic Integrity**

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Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at http://policies.ncsu.edu/policy/pol-11-35-01

**Academic Honesty**

See http://policies.ncsu.edu/policy/pol-11-35-01 for a detailed explanation of academic honesty.

**Honor Pledge**
Your signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment."

### Electronically-Hosted Course Components

There are no electronically-hosted components for this course.

### Accommodations for Disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, student must register with the Disability Services Office (http://www.ncsu.edu/dso), 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at http://policies.ncsu.edu/regulation/reg-02-20-01.

### Non-Discrimination Policy

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at http://policies.ncsu.edu/policy/pol-04-25-05 or http://www.ncsu.edu/equal_op/. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

### Course Schedule

**NOTE:** The course schedule is subject to change.

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab MW 3:00pm - 4:15pm</td>
<td>Review: Simple linear regression</td>
<td>1 - 3</td>
</tr>
<tr>
<td>Lab MW 3:00pm - 4:15pm</td>
<td>Multiple regression</td>
<td>4 - 7</td>
</tr>
<tr>
<td>Lab MW 3:00pm - 4:15pm</td>
<td>Analysis of variance</td>
<td>8 - 10</td>
</tr>
<tr>
<td>Lab MW 3:00pm - 4:15pm</td>
<td>Analysis of covariance</td>
<td>11 - 11</td>
</tr>
<tr>
<td>Lab MW 3:00pm - 4:15pm</td>
<td>Blocked designs and variations</td>
<td>12 - 14</td>
</tr>
<tr>
<td>Lab MW 3:00pm - 4:15pm</td>
<td>Logistic regression</td>
<td>15 - 15</td>
</tr>
<tr>
<td>Lab MW 3:00pm - 4:15pm</td>
<td>Lab — TBD - TBD</td>
<td></td>
</tr>
</tbody>
</table>