Biology 6500
Advanced Statistical Modeling for Biologists

Time & Place:  Tuesday/Thursday 12:25 – 1:45 PM, ASB 210

Instructor:
Don Feener (he/him/his)
Biology 308
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Email: donald.feener@utah.edu

Teaching Assistant:
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Biology 321-B
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Email: emerson.arehart@utah.edu

Web:  http://courses.biology.utah.edu/feener/6500/
Text:  Ecological Models and Data in R, Benjamin M. Bolker
       or
       Statistics: An Introduction Using R 2nd Ed, Michael J. Crawley
Supplementary texts:  J. Adler, R in a Nutshell
                       J. S. Clark, Models for Ecological Data
                       R. Hilborn & M. Mangel, The Ecological Detective

The Course. Advanced statistical modeling for biologists is designed for life science
graduate students with a perhaps rusty background in mathematics and statistics who wish
to become real practitioners of the art of modern statistics. The course will be based on
the R programming language and will cover the following topics, among others:

• Introduction to the R language
• Classical statistical tests (t-tests, regression, ANOVA, ANCOVA, etc.)
• Generalized linear models and mixed-effects models
• Analysis of time-to-event data
• Simulating data and analysis

Tuesday’s class each week will introduce a new topic with a lecture and
demonstration. Thursday’s class will give students hands-on experience analyzing
real and simulated data sets on that week’s topic, which will include weekly problem
sets. Students are expected to develop an appreciation of the tight link between
experimental design, model building and statistical analysis of data.
The Americans with Disabilities Act
appeal such action to the Student Behavior Committee.

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classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI)
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Homework. Homework will consist of weekly problem sets that will be discussed during class
sessions on Thursday.

Projects. The project is central to the course, and involves choosing a topic, and presenting
the idea, a progress report, and a full poster (or talk) at the end of the semester, along with
a formal write-up. These projects should be based on the student’s own area of research or
area of research interest, and involve analysis of real or simulated data. During the fifth and
sixth weeks of the semester, I’ll meet with each registered student to discuss this project.

Grading. Grades will be weighted according to the following scheme.

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Written Homework</td>
<td>20%</td>
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<tr>
<td>Project presentation</td>
<td>20%</td>
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<tr>
<td>Project write-up</td>
<td>40%</td>
</tr>
<tr>
<td>Class participation</td>
<td>20%</td>
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</tbody>
</table>

Learning Objectives. The goal of this course is to give graduate students the tools
they need to work with complex data sets. Students will

1. Learn to use the R language
2. Learn to simulate experiments in R
3. Learn the appropriate use of classical statistical tests and tricks of the trade
3. Learn to analyze time-to-event data, generalized linear models and mixed effects models
4. Gain experience with modern model fitting techniques
5. Creatively analyze their data

Content Accommodations. The content of this course fulfills legitimate pedagogical goals. We
do NOT grant content accommodations. Students are responsible for all material presented in the
lectures and required reading. Attendance accommodations are made according to University
policies and procedures (chapter VII section 15; see above): "Students absent from class to
participate in officially sanctioned University activities (e.g., band, debate, student government,
intercollegiate athletics) or religious obligations, or with instructor's approval, shall be permitted
to make up both assignments and examinations..."

University Policies

Course Conduct. All students are expected to maintain professional behavior in the classroom setting,
according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the
classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI)
that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should
read the Code carefully and know they are responsible for the content. According to Faculty Rules and
Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with
verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to
appeal such action to the Student Behavior Committee.

The Americans with Disabilities Act. The University of Utah seeks to provide equal access to its
programs, services, and activities for people with disabilities. If you will need accommodations in this
class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

**University Safety Statement.** The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

**Addressing Sexual Misconduct.** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677 (COPS).

**Drop, Withdrawal or Incomplete.** The University of Utah drop and withdrawal dates are on the class schedule. Also see http://registrar.utah.edu/academic-calendars/index.php. University policy allows assignment of a grade of incomplete (I) if 80% or more of the course work has been completed. We will consider assigning an “incomplete (I)” only under exceptional circumstances unrelated to academic performance, and only if a student is passing the course with a C or better when the “Incomplete” is requested.

**Wellness Statement.** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

**Diversity / Inclusivity Statement.** It is the intent of the instructors that students from all diverse backgrounds and perspectives be well served by this course, that students’ learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is our intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let us know ways to improve the effectiveness of the course for you personally or for other students or student groups.

**English Language Learners.** If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include: the Writing Center (http://writingcenter.utah.edu/); the Writing Program (http://writingprogram.utah.edu/); the English Language Institute (http://continue.utah.edu/eli/). Please let us know if there is any additional support you would like to discuss for this class.
## Course Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Readings &amp; Homework</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Jan 07, 09</td>
<td>Introduction to R</td>
<td>See Canvas</td>
</tr>
<tr>
<td>02</td>
<td>Jan 14, 16</td>
<td>Working with Data</td>
<td>See Canvas</td>
</tr>
<tr>
<td>03</td>
<td>Jan 21, 23</td>
<td>Exploring and Visualizing Data</td>
<td>See Canvas</td>
</tr>
<tr>
<td>04</td>
<td>Jan 28, 30</td>
<td>Classical Basic Statistical Tests</td>
<td>See Canvas</td>
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<tr>
<td>05</td>
<td>Feb 04, 06</td>
<td>Linear Regression</td>
<td>See Canvas</td>
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<td>06</td>
<td>Feb 11, 13</td>
<td>Analysis of Variance</td>
<td>See Canvas</td>
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<tr>
<td>07</td>
<td>Feb 18, 20</td>
<td>Analysis of Covariance</td>
<td>See Canvas</td>
</tr>
<tr>
<td>08</td>
<td>Feb 25, 27</td>
<td>Generalized Linear Models</td>
<td>See Canvas</td>
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<tr>
<td>09</td>
<td>Mar 03, 05</td>
<td>Initial Project Descriptions</td>
<td>See Canvas</td>
</tr>
<tr>
<td>10</td>
<td>Mar 08-15</td>
<td>Spring Break!</td>
<td>See Canvas</td>
</tr>
<tr>
<td>11</td>
<td>Mar 17-19</td>
<td>Mixed Effects Models</td>
<td>See Canvas</td>
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<td>12</td>
<td>Mar 24, 26</td>
<td>Multivariate Analysis</td>
<td>See Canvas</td>
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<tr>
<td>13</td>
<td>Mar 31, Apr 02</td>
<td>Spatial Analysis</td>
<td>See Canvas</td>
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<tr>
<td>14</td>
<td>Apr 07, 09</td>
<td>Phylogenetic Analysis</td>
<td>See Canvas</td>
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<tr>
<td>15</td>
<td>Apr 14, 16</td>
<td>Survival Analysis</td>
<td>See Canvas</td>
</tr>
<tr>
<td>16</td>
<td>Apr 21</td>
<td>Project Presentations</td>
<td>See Canvas</td>
</tr>
</tbody>
</table>

I will be using CANVAS to post readings, announcements, and to disseminate other information. CANVAS will also be used for submission of written assignments. PLEASE ENABLE CANVAS TO NOTIFY YOU FOR ANNOUNCEMENTS OR POTENTIAL CHANGES IN CLASS PLANS OR SYLLABUS.