Course Number: **MAR 536**
Course Title: **Biological Statistics II**

Instructors:
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Class Location: SMAST II Room 157
Class Time: Tuesday/Thursday 10:30-11:45
Wednesday 10:30-12:30 (January 27 to March 9)
Office Hours: Tuesday/Thursday afternoon by appointment

Course Description: Student-led learning in statistical analysis of ecological data. This course provides guided learning in advanced statistical analysis, as applied to ecological research and other fields of marine science. Advanced concepts in probability, hypothesis testing, and estimation will be presented by students, including analyses of example data sets and problems. Students will be required to learn selected methods independently, present topics to the class that are relevant to their graduate research and complete a class project. A computer lab, focused on introductory and intermediate programming and analysis using R, will be held for the first half of the semester.

Course Objectives:

1. Self-learning in advanced quantitative concepts and methods
2. Familiarity with advanced statistical methods
3. Experience communicating advanced quantitative topics
4. Experience in statistical programming

Credits: 4

Prerequisites: Students should have taken an introductory graduate statistics course (e.g. MAR 535 Biological Statistics I or equivalent), or seek permission from the instructors.

Evaluation procedures:

1. An advanced statistical analysis of data relevant to the student's graduate research topic, including a detailed report and oral presentation (55% of course grade).
   a. Brief description of the topic including a statement of the problem, proposed statistical method, and supplemental reference(s) is due February 25 (5% of course grade).
   b. Oral presentation on the project at the end of the semester (25% of course grade).
   c. Project report (due May 3rd 2016). A written description of the methods and results of the project in the form of a draft scientific manuscript (Introduction, Methods, Results, Discussion). (25% of course grade).

2. Student Lecture (30% of course grade) - Chapter assignment or supplemental reading on a statistical topic relevant to the student's graduate research. A one-hour lecture on assigned reading, including introduction of the method, demonstration of the method using example datasets and leading class discussion. Lectures will be graded based on the instructors' evaluation of accuracy, clarity, and comprehensiveness. Feedback from other students will also be considered in evaluation of presentations.
3. Participation in class discussions (5% of course grade). Attendance at all lectures and labs is the best way to understand topics and assignments, but is not required for evaluation.
4. Computer lab exercises (10% of course grade). Completion of short laboratory exercises using R during the first half of the semester.
5. Failure to complete any of these requirements for evaluation will result in a score of zero for missing components. A final grade of 'incomplete' may be recorded at the request of the student and the discretion of the professor.
6. No academic dishonesty, including plagiarism, will be tolerated and the University Academic Integrity policy applies: http://www.umassd.edu/studentaffairs/studenthandbook/academicregulationsandprocedures/

Required Hardware: laptop computer

Required Software:

1. R (free download at http://r-project.org, students may also wish to install Rstudio, an integrated development environment for R, free download at http://www.rstudio.com)

Principal Text:

Zuur, A.F., Ieno, E.N. and Smith, G.M. (2007). Analysing Ecological Data. Springer. 700p. Series: Statistics for Biology and Health. (available as ebook through the UMass Amherst library system, or hard copy ~$100 online).
Support website for book (www.highstat.com/book1.htm)

The form for students to request access to UMass Amherst ebook collection is available at: http://www.umassmarine.net/wp-content/uploads/2014/04/NENS-Form-for-UMass-Amherst.pdf

Supplementary Text (others as needed):

Bolker, B.M. 2008. Ecological Models and Data in R. Princeton University Press. (http://press.princeton.edu/titles/8709.html)

James, G., Wittem, D., Hastie, T., and Tibshirani, R. (2014). An Introduction to Statistical Learning With Applications in R. Springer. (ebook available online)
Support website for book (http://www-bcf.usc.edu/~gareth/ISL/)

Course outline and tentative schedule of lectures/labs (the schedule of advanced topics later in the semester is expected to change based on student needs)**:**

Type	Day	Date	Reading	Topic	Presenter
Lecture	Tue	Jan 26	Zuur et al. Chap. 1-4	Introduction, data exploration	Steve
Lab	Wed	Jan 27		Introduction to R and R Studio, working with data	Gavin
Lecture	Thur	Jan 2	Bolker 2008 Chap. 4	Probability review	Gavin
Lecture	Tue	Feb 2	Zuur et al. Chapter 5	Linear regression review	Steve
Lab	Wed	Feb 3		Introduction to plotting, manipulating data	Gavin
Lecture	Thur	Feb 4	Zuur et al. Section 6.1	Extending linear model (GLM)	Steve
Lecture	Tue	Feb 9	Zuur et al. Section 6.2	Classification, Logistic regression	Steve
Lab	Wed	Feb 10		Probability, Linear modeling in R, PCA.	Gavin
Lecture	Thur	Feb 11	Zuur et al. Chapter 12	Matrix algebra review and PCA	Steve
Lecture	Tue	Feb 16	NO CLASS	Monday schedule	
Lab	Wed	Feb 17		Programming practices, conditional statements	Gavin
Lecture	Thur	Feb 18	Zuur et al. Chapter 14	Linear Discriminant Analysis	Steve
Lecture	Tue	Feb 23	James et al. Chapter 7	Nonlinear models, splines	Gavin
Lab	Wed	Feb 24		Creating functions, debugging	Gavin
Lecture	Thur	Feb 25	Zuur et al. Chapter 7	GAMs **Project descriptions due**	Alex
Lecture	Tue	Mar 1	James et al. Chapter 5	Resampling methods, Cross-Validation	John/Lauren/ Arjun?
Lab	Wed	Mar 2		Permutation analysis	Gavin
Lecture	Thur	Mar 3	Zuur et al. Chapter 9	Trees 1	John/Lauren/ Arjun?
Lecture	Tue	Mar 8	Zuur et al. Chap. 11-15	Ordination	Ashley
Lab	Wed	Mar 9		Advanced plotting	Gavin
Lecture	Thur	Mar 10	James et al. Section 10.3	Cluster Analysis	John/Lauren/ Arjun?
Lecture	Tue	Mar 22		Project Feedback	Steve
Lecture	Thur	Mar 24		Project Discussions	Steve

Lecture	Tue	Mar 29		Presence-Only Discrimination	Tammy
Lecture	Thur	Mar 31		Bayesian Methods	Chris
Lecture	Tue	Apr 5	NO CLASS		
Lecture	Thur	Apr 7	NO CLASS		
Lecture	Tue	Apr 12	Agresti	Analysis of Categorical Data	Brooke
Lecture	Thur	Apr 14	Zuur et al. Chapter 19	Spatial statistics (Gaussian spatial processes)	Megan
Lecture	Tue	Apr 19		Review	Steve
Lecture	Thur	Apr 21		Presentations	
Lecture	Tue	Apr 26		Presentations	
Lecture	Thur	Apr 27		Presentations	
Lecture	Tue	May 3		Presentations	