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

Instructors:
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Class Location: SMAST East Room 247
Class Time: Tuesday/Thursday 10:30-11:45
Wednesday 10:30-12:30 (January 24 to Feb 28)
Office Hours: 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 (65% of course grade).
   a. Brief description of the topic including a statement of the problem, proposed statistical method, and supplemental reference(s) is due March 1 (5% of course grade).
   b. Student lecture and project presentation chapter assignment or supplemental reading on the statistical method used in the project. A 40-minute lecture on the method, and demonstration of the method using the project dataset. 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 (35% of course grade).
   c. Project report (due May 4). 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. Mid-term examination on statistical concepts and literacy (20% of course grade). Take home exam. Due 3/20/18.
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. Lab assignments are due before lab session the following week.
5. Late submissions will be penalized 10 points (out of a 100) for each day that an assignment is late – assignments submitted later than three days after the deadline will not be graded.
6. 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.
7. 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) and 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 (http://highstat.com/index.php/analysing-ecological-data)

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://ms.mcmaster.ca/~bolker/emdbook/index.html, http://emdbolker.wikidot.com/)

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/)

Wickham, H. and Grolemund, G., 2016. R for data science. O'Reilly. (http://r4ds.had.co.nz/)

Title IX statement: The purpose of a university is to disseminate information, as well as to explore a universe of ideas, to encourage diverse perspectives and robust expression, and to foster the development of critical and analytical thinking skills. In many classes, including this one, students and faculty examine and analyze challenging and controversial topics.

If a topic covered in this class triggers post-traumatic stress or other emotional distress, please discuss the matter with the professor or seek out confidential resources available from the Counseling Center, http://www.umassd.edu/counselling/, 508-999-8648 or -8650, or the Victim Advocate in the Center for Women, Gender and Sexuality, http://www.umassd.edu/sexualviolence/, 508-910-4584. In an emergency contact the Department of Public Safety at 508-999-9191 24 hrs./day.

UMass Dartmouth, following national guidance from the Office of Civil Rights, requires that faculty follow UMass Dartmouth policy as a "mandated reporter" of any disclosure of sexual harassment, abuse, and/or violence shared with the faculty member in person and/or via email. These disclosures include but are not limited to reports of sexual assault, relational abuse, relational/domestic violence, and stalking. While faculty are often able to help students locate appropriate channels of assistance on campus, disclosure by the student to the faculty member requires that the faculty member inform the University's Title IX Coordinator in the Office of Diversity, Equity and Inclusion at 508-999-8008 to help ensure that the student's safety and welfare is being addressed, even if the student requests that the disclosure not be shared.

For confidential counseling support and assistance, please go to http://www.umassd.edu/sexualviolence/

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**
Lecture	Tue	Jan 23	Zuur et al. Chap. 1-4	Introduction, data exploration
Lab	Wed	Jan 24		Introduction to R and R Studio, working with data
Lecture	Thur	Jan 25	Zuur et al. Chapter 5	Linear regression review
Lecture	Tue	Jan 30	Bolker 2008 Chap. 4	Probability review
Lab	Wed	Jan 31		Introduction to plotting, manipulating data
Lecture	Thur	Feb 1	Hilborn & Mangel Chapter 7	Likelihood
Lecture	Tue	Feb 6	Zuur et al. Section 6.1	Extending the linear model (GLM)
Lab	Wed	Feb 7		Probability, Linear modeling in R
Lecture	Thur	Feb 8	Zuur et al. Section 6.2	GLMs II, logistic regression
Lecture	Tue	Feb 13	Zuur et al. Chapter 12	Matrix Algebra Review
Lab	Wed	Feb 14		Programming practices, conditional statements
Lecture	Thur	Feb 15	Zuur et al. Chapter 12	Principal Components Analysis
	Tue	Feb 20	NO CLASS	Monday Schedule
Lab	Wed	Feb 21		Creating functions, debugging
Lecture	Thur	Feb 22	Zuur et al. Chapter 14	Classification, Linear Discriminant Analysis
Lecture	Tue	Feb 27	James et al. Chapter 5	Resampling methods, Cross-Validation

Lab	Wed	Feb 28		More on functions, Advanced plotting
Lecture	Thur	Mar 1	James et al. Chapter 7	Nonlinear models, splines **Project descriptions due**
Lecture	Tue	Mar 6	Zuur et al. Chapter 7	GAMs (guest lecture, M. Winton) **Mid-tem exams distributed**
	Wed	Mar 7	NO LAB	
	Thur	Mar 8	Zuur et al. Chapter 7	GAMs II (guest lecture, M. Winton)
Lecture	Tue	Mar 20	Zuur et al. Chap. 11-15	Ordination methods (guest lecture, S. Cadrin) **Mid-term exams due**
Lecture	Thur	Mar 22	TBD	Zero-inflated models
Lecture	Tue	Mar 27	Zuur et al. Chapter 8	Linear mixed effects models
Lecture	Thur	Mar 29		No Class. Rescheduled.
Lecture	Tue	Apr 3	Zuur et al. Chapter 9	Trees
Lab	Wed	Apr 4		Midterm review Spatial mixed effects models
Lecture	Thur	Apr 5	James et al. Section 10.3	Cluster Analysis
Lecture	Tue	Apr 10	Student Presentations	Sofia (breakpoint analysis)
	Wed	Apr 11	Student Presentations	Maggie (GLMMs)
Lecture	Thur	Apr 12	Student Presentations	Beth (PCoA)
Lecture	Tue	Apr 17	Student Presentations	Nish (GLMs – Survival analysis)
Lecture	Thur	Apr 19	Student Presentations	Allex (GLMMs)
Lecture	Tue	Apr 24	Student Presentations	Becca (Permutation tests)
Lecture	Thur	Apr 26	Student Presentations	Joe (State-space movement models)
Lecture	Tue	May 1		Review