Course Number:	**MAR 536**
Course Title:	**Biological Statistics II**
	Instructor:
	Gavin Fay, Assistant Professor
	School for Marine Science & Technology
	SMAST East 228; (508) 910-6363; gfay@umassd.edu
	Teaching Assistant:
	Amanda Hart, PhD candidate
	School for Marine Science & Technology
	SMAST East 222; ahart2@umassd.edu
Class Location:	SMAST East Room 247
Class Time:	Tuesday/Thursday 10:30-11:45
	Wednesday 10:30-12:30 (January 22 to Mar 18)
Student Hours:	GF: Tu 9:30-10:30, W 13:30-14:30, Th 9:30-10:30, & by appointment
	AH: Tu 9-10:30, W 13:30-14:30
	Commencing 3/23/2020, Student hours will be held via Zoom, please email to make appointments for other times.

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. 1-2 sentence project topic idea due Jan 30 (1% of course grade).
   b. Brief (1-2 page) description of the topic including a statement of the problem, proposed statistical method, and supplemental reference(s) is due Feb 13 (4% of course grade).

c. Data exploration report containing data summaries and visualizations of the dataset to be used in the project, including observations of implications of data structure for the analyses to be conducted. Due Mar 06. (10% of course grade).
d. **Student lecture and project presentation with 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 (30% of course grade).
e. Project report (**due Apr 28**). A written description of the methods and results of the project in the form of a draft scientific manuscript (Introduction, Methods, Results, Discussion). (20% of course grade).

2. **Mid-term examination on statistical concepts and literacy (20% of course grade). Take home exam. Exam distributed Mar 06. Due Mar 23.**
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. Extra credit: Lab exercises can be completed using R-Markdown for additional 5 points on each assignment.
5. Extra credit: An additional 1% towards the total course grade can be obtained by students contributing to the #TidyTuesday, a public weekly data project in R from the R4DS online learning community (https://github.com/rfordatascience/tidytuesday). To obtain course credit, students should send Gavin Fay and Amanda Hart an email containing a visualization of analysis of one Tidy Tuesday data set, and a link to a repository containing code that reproduces the analysis and visualization (sharing of work with the #RStats community via Twitter is encouraged but not required for course credit).
6. 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.
7. 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.
8. If you have read this far, please use google search to find a picture or gif of an animal that best reflects your opinion of statistics, and send it to Gavin Fay attached to an email with the subject line "Here is a statistical opinion", worth an extra 5 points on one lab assignment.
9. University policy on academic dishonesty, including plagiarism, applies (see: http://www.umassd.edu/studenthandbook/academicregs/ethicalstandards.cfm).

A full description of Academic Policies associated with this and other UMass Dartmouth courses can be found at:
https://www.umassd.edu/media/umassdartmouth/provost/omnibus_language_for_syllabi_-jan_11_2019.pdf

Required Hardware: Class will take place in the SMAST-East computer teaching lab. Students are able to make use of the workstations in this lab outside of classroom. However, students may find that completing coursework and lab exercises on individual laptop computers is useful.

Required Software:

1. R (free download at http://r-project.org, students should also install Rstudio, an integrated development environment for R, free download at http://www.rstudio.com). It is recommended to update your version of R for the course. Web browser access to R sessions will also be provided through RStudio Cloud.

Course Materials: Materials will be distributed through a Google Drive folder for the course.

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 free ebook available 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: https://www.umass.edu/it/accounts/courtesy-accounts-non-employees-non-students-nens

Supplementary Texts (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/)

Also:

Ismay, C. and Kim, A.Y., 2019. Statistical Inference via Data Science: A ModernDive into R and the Tidyverse. CRC Press.

McElreath, R., 2018. Statistical rethinking: A Bayesian course with examples in R and Stan. Chapman and Hall/CRC.

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 schedule of lectures/labs:

Type	Day	Date	Reading	Topic	Instructor
Lecture	Tue.	Jan 21	Zuur et al. Chap. 1-4	Introduction, statistical rethinking	GF
Lab	Wed.	Jan 22		R Lab 1	GF/AH
Lecture	Thu.	Jan 23	Bolker 2008 Chap. 4	Probability review	GF
Lecture	Tue.	Jan 28	Zuur et al. Chapter 5	Linear regression review	SXC
Lab	Wed.	Jan 29		R Lab 2	AH
Lecture	Thu.	Jan 30	Zuur et al. Chap. 1-4	data exploration, checking	AH
Lecture	Tue.	Feb 04	Hilborn & Mangel Chap 7	Likelihood	GF
Lab	Wed.	Feb 05		R Lab 3	GF/AH
Lecture	Thu.	Feb 06	Zuur et al. Section 6.1	Extending the linear model (GLM) (Poisson)	GF
Lecture	Tue.	Feb 11	Zuur et al. Section 6.2	GLM 2 (logistic regression)	GF
Lab	Wed.	Feb 12		R Lab 4	GF/AH
Lecture	Thu.	Feb 13	James et al. Chapter 5	Resampling methods, Cross-Validation	GF
	Tue.	Feb 18		No class - Monday Schedule	-
Lab	Wed.	Feb 19		R Lab 5	GF/AH
Lecture	Thu.	Feb 20	Zuur et al. Chapter 12	Matrix Algebra Review	GF
Lecture	Tue.	Feb 25	Zuur et al. Chapter 12	Principal Components Analysis	GF
Lab	Wed.	Feb 26		No meeting	-
Lecture	Thu.	Feb 27	Zuur et al. Chap. 11-15	Ordination methods	SXC
Lecture	Tue.	Mar 03	Zuur et al. Chapter 14	Classification / Linear Discriminant Analysis	GF
Lab	Wed.	Mar 04		R Lab 6	GF/AH
Lecture	Thu.	Mar 05		Zero-inflated models	AH
				SPRING BREAK	
	Tue.	Mar 17		SPRING BREAK EXTENDED	
	Wed.	Mar 18		SPRING BREAK EXTENDED	
	Thu.	Mar 19		SPRING BREAK EXTENDED	
	Mon	Mar 23		**Midterm exam due**	
Lecture	Tue.	Mar 24	James et al. Chapter 7	Nonlinear models, splines	GF
Lab	Wed.	Mar 25		R Lab 7 (multipanel ggplots, mapping)	AH/GF
Lecture	Thu.	Mar 26	Zuur et al. Chapter 7	GAMs	GF
Lecture	Tue.	Mar 31	Zuur et al. Chapter 9	Trees	AH
	Wed.	Apr 01		No meeting, **Lab 7 due**	-
Lecture	Thu.	Apr 02	Zuur et al. Chapter 8	Linear mixed effects models	GF
Lecture	Tue.	Apr 07		Spatial GLMMs	GF
Lab	Wed.	Apr 08		Presentations: Adrienne, Debie	student
Lecture	Thu.	Apr 09		Presentations: Mike	student
Lecture	Tue.	Apr 14		Presentations: Tricia	student
Lab	Wed.	Apr 15		Presentations: Amanda, Cait	student
Lecture	Thu.	Apr 16		Presentations: Alex	student
Lecture	Tue.	Apr 21	James et al. Section 10.3	Cluster Analysis	GF
	Wed.	Apr 22		No class - Monday Schedule	-
Lecture	Thu.	Apr 23		Ensemble methods	GF
Lecture	Tue.	Apr 28		Review, **Project report due**	GF
Lab	Wed.	Apr 29		Extra Date	GF