Syllabus

Advanced Ecological Data Analysis 16:215:599
Spring 2020
Thursdays 12:35 – 3:35
123 ENR

Instructors:
Olaf Jensen (309 DMCS building) – ojensen@marine.rutgers.edu
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Sakai Site: https://sakai.rutgers.edu/portal/site/591fa2c8-9701-4799-991f-bb37401e58e3

Pre-requisites: Knowledge of basic statistics consistent with an introductory statistics course (i.e., probability distributions, t-tests, ANOVA, simple linear regression) and basic knowledge of R or other scientific programming language (e.g., Matlab). The course will be conducted in R.

Summary: This course provides an overview of advanced statistical methods commonly used to model ecological data. Such data often violates assumptions of simpler techniques, including: non-normal distribution of response variables, non-linear and non-monotonic relationships between predictors and response variables, and the presence of spatial and temporal autocorrelation. We will focus on application of these methods with only minimal discussion of their theoretical basis. Students will be encouraged to work with their own datasets.

Course Objectives
Introduce students to best practices for data organization and coding.
Develop skills in the application of statistical methods to complex ecological data.

Learning Outcomes
At the end of this class, students will be able to:
- Organize their data and code for transparent, efficient, and repeatable analysis
- Determine the appropriate statistical method for answering ecological questions given a set of characteristics of the data
- Apply and interpret generalized linear models
- Understand when and how to use fixed and random effects in linear models
- Develop and fit non-linear models to data using maximum likelihood
- Use randomization approaches to estimate bootstrap confidence intervals and develop null models for significance testing

Format: One 3 hour meeting per week. Class time will be largely devoted to discussion and problem-solving

exercises in R. Lectures that students must absorb prior to each class will be provided on Sakai as pre-recorded videos, i.e., a “flipped classroom” design.

Evaluation: mid-term exam (30%), final project (30%), homework (20%), in class discussions (10%), quizzes (10%)

Readings: All required readings to be posted on Sakai.

Topics: Suggested topics as follows, with flexibility based on student interests to be determined prior to the start of the course.

Week 1 (Jan 23; Winfree) Course intro; pre test; review of introductory statistics

Week 2 (Jan 30; Winfree) Review of introductory statistics

Week 3 (Feb 6; Winfree) Data manipulation and visualization

Week 4 (Feb 13; Jensen) Complex error structures and generalized linear models (GLMs)

Week 5 (Feb 20; Jensen or guest) Random effects and mixed effects models

Week 6 (Feb 27; guest instructor Dylan Simpson) Maximum likelihood

Week 7 (March 5) Mid-term (in class)

Week 8 (March 12; guest instructor Dylan Simpson) Bayesian methods

Week 9 (March 26; Jensen) Fitting non-linear models to data

Week 10 (April 2; Jensen) Spatial statistics

Week 11 (April 9; Jensen) Generalized Additive Models (GAMs)

Week 12 (April 16; guest instructor Joyce Ong) Wavelet Analysis

Week 13 (April 23) Guided in-class work on final projects

Week 14 (April 30) Final project presentations