Syllabus v.3

Advanced Ecological Data Analysis

16:215:599

Fall 2017 – 3cr

Monday 9:15 – 12:15

Instructors: Olaf Jensen (309 DMCS building) – ojensen@marine.rutgers.edu
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Sakai Site: https://sakai.rutgers.edu/portal/site/b47ebf3a-1b1e-44d2-bb52-7cbc3998746e

Pre-requisites: Knowledge of basic statistics consistent with an introductory graduate 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).

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
- 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
- Understand when and how to use fixed and random effects in linear models

Format: One 3 hour meeting per week: Mondays 9:15 – 12:15, location ENR 123. Class time will be largely devoted to discussion and problem-solving exercises in R. Lectures will be provided 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.

Tentative Schedule (subject to change)

Week 1 (9/11) – Winfree	Course intro; pre test; review of intro stats; correlation, regression, anova
Week 2 (9/18) – Winfree	Continue review of intro stats; multiple regression, ancova
Week 3 (9/25) – Winfree	Data manipulation and visualization
Week 4 (10/2) – Jensen	Complex error structures and generalized linear models (GLMs)
Week 5 (10/9) – Jensen	Maximum likelihood
Week 6 (10/16) – Jensen	Fitting non-linear models to data
Week 7 (10/23)	**Mid-term (in class)**
Week 8 (10/30) – Winfree	Randomization approaches
Week 9 (11/6) – Pinsky	Generalized Additive Models (GAMs)
Week 10 (11/13) – Jensen	Spatial statistics
Week 11 (11/20) – Pinsky	Random effects and mixed effects models
Week 12 (11/27) – Pinsky	Machine learning and tree-based methods (CART, BRTs, RF, etc.)
Week 13 (12/4)	Guided in-class work on final projects
Week 14 (12/11)	Final project presentations