Lecture Series: Fundamentals of Ecological Statistics

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In this course, we will cover the basics of using the R programming language, along with simple plotting, data organization, and programming techniques. We will also cover the fundamentals of linear modeling before moving onto generalized linear modeling (non-normal distributions), mixed models (i.e. *random effects*), spatio-temporal effects. Finally, we will discuss how to write about statistical analysis, and will end with short presentations on an analysis of your own datasets (or a simulated dataset, if you haven't collected data yet).

Proposed marking scheme:

- Class participation: 25%
- Final project "peer review": 25%
  - Create a draft write-up, and provide feedback on your colleagues' work
  - Write a review document to send to the editor (SR)
- Final project write-up: 25%
  - Respond to the feedback from your colleagues, and write a response letter
- Final project presentation: 25%
  - Mock committee/proposal meeting: "what are your main results so far?"

Lecture	**Learning Outcomes**
Intro to R	• Learn R syntax, objects, and basic plotting • Write simple R programs
Linear Models Part 1	• Basic structure and terminology of linear models • Fitting simple linear models
Linear Models Part 2	• Structure and fitting of multiple-linear models • Effect sizes, model selection, partial effects plots
Model Validation	• Checking model results and output
`ggplot2`	• How to use the `ggplot2` package • Principles of graphic design
`dplyr` & `tidyr`	• Introduction to the `tidyverse` • Data wrangling, filtering, organization
GLMs Part 1	• Learn common non-normal distributions • Simulate the distributions of your own a
GLMs Part 2	• Basics of likelihood and probability • GLM fitting and plotting
GLM Validation	• Model validation, model selection for GLMs • Preliminary models of your own data
Mixed effects Part 2	• Random versus fixed effects • Random intercept and slope models
Mixed effects Part 2	• Slope/intercept covariance, hypothesis testing • Plotting of mixed models
Nonlinear & Additive Models	• Fitting strategies • Generalized additive models (GAMs/"wiggly" models) • Distributional (non-stationary) models
Spatiotemporal models*	• Spatial and temporal random effects • Dynamic models (e.g. logistic growth)
Other topics?	• Multivariate models (e.g. community ordination) • State-space models (e.g. mark-recapture, camera traps) • R as a GIS (e.g. mapping) • Structural equation models • Custom model coding (TMB or Stan)
Writing	• Structure of scientific papers (IMRaD) • Writing clearly about models • Reading about models critically
Open work time	• Time for open work on your own models and data • Can work together/ask for help or ification
Final Presentations	• Show us your preliminary results! • Think about how this can go into a paper/thesis chapter