OEB 137: Experimental Design & Statistics for Ecology
Fall 2023
Tues. & Thurs. 10:30 – 11:45

Instructor:

Ben Taylor
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Office: Weekly office hours Tuesdays 9:15 – 10:15 (HUH 223)
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Course Description:

OEB 137 serves as a practical introduction to designing experiments and analyzing data for ecological research. This course will take students through the process of defining ecological questions that can be rigorously tested quantitatively, creating appropriate study designs tailored to the forthcoming statistical analyses, and analyzing data using multiple inference frameworks. At the end of the course, students will possess the practical blueprint to take a variety of ecological projects from question to results. The major components of the course are lectures, weekly labs, readings from the text and primary literature, and individual student-led research projects.

The Weekly Schedule will consist of two in-person lectures, an in-person lab session (day and time TBD), and office hours for both the professor and TF.

Course Materials:

Primary Text:
"*A Primer of Ecological Statistics, 2nd Edition*" Gotelli, N. J. & A. M. Ellison. 2013

Additional Helpful Texts:
"*Ecological Models and Data in R*" B. Bolker. 2008
"*Design and Analysis of Ecological Experiments, 2nd Edition*" Scheiner & Gurevitch. 2001
"*Bayesian Models: A Statistical Primer for Ecologists*" Hobbs, N.T. & M.B. Hooten. 2015
*Students will also receive primary literature articles from the instructor throughout the semester

Lab (required):

Weekly lab sections will instruct students on the practical, hands-on implementation of the concepts covered in lecture. These lab exercises will be led primarily by the TF and will follow as closely as possible with the schedule of lecture topics. The lab will focus heavily on the use of R statistical software (https://www.r-project.org/) to carry out lab assignments, as learning to code in R has become a standard skill for analysis of ecological data. Many of these lab exercises will work with real data collected from various open-access sources.

Individual Projects:

Each student will be required to carry out an individual research project on the topic of their choosing (this will ideally align with the student's thesis/dissertation work where applicable, but this is not a requirement).

Grading:

Students' grades are comprised of a combination of 10 Lab Assignments (primarily conducted in R), a take-home written mid-term exam, a group data analysis project, a proposal and written report on each student's individual project. The breakdown of students' grades will be as follows:

Lab Assignments: 30%
Midterm Exam: 15%
Project Proposal: 15%
Group Data Analysis Project: 10%
Written Project Report: 25%
Course Participation: 5%

At the end of the semester, the lowest grade on each student's lab assignments will be dropped. Students will also be given 5 "flex" late days to turn in assignments. These can be used individually or as a set of days as needed, but each student will only get 5. Outside of those flex days, grades will be penalized 10% for each day late on each assignment.

Academic Integrity:

All students will be expected to uphold the Harvard College Honor Code and adhere to all department and university academic integrity policies. Any violations of these policies will result in disciplinary action in accordance with University policy. Because the real-world application of the concepts covered in this course (the act of conducting ecological research) is an inherently collaborative process, many of the course assignments require working with partners and/or seeking outside resources. The bounds on seeking outside resources and the extent of appropriate classmate collaboration will be clearly defined in each assignment.

Course Schedule:

***Note:** This schedule is tentative and subject to change during the semester

Week	Topic(s) Covered	Lab	Readings
Sept. 5; Sept. 7	How to ask answerable questions; Data, Distributions, & Probability		*Platt* 1964 *Primer*, Ch. 1
Sept. 12; Sept. 14	Hypothesis testing, Signal and Noise	Introduction to R	*Primer*, Ch. 2 *Primer*, Ch. 3
Sept. 19; Sept. 21	Manipulative vs. Natural Experiments; Study Types and Logistics	Introduction to R Part deux	*Primer*, Ch. 4; *Primer*, Ch. 6
Sept. 26; Sept. 28	Continuous Driver Variable Designs; Discrete Driver Variable Designs	Distributions and Summary Stats	*Primer*, Ch. 7
Oct. 3; Oct. 5	Covariates & Confounding Factors; Physically setting up experiments	Data Simulation	
Oct. 10; Oct. 12	Replication Do's & Don'ts; Data Management & Curation	Power Analysis	Hurlbert 1984; *Primer*, Ch. 8
Oct. 17; **Oct. 19**	Data Digging & Data Fishing; **Midterm Exam**	Handling Big Data & Assessing Significance	Hampton 2013;
Oct. 24; Oct. 26	Regression I; Regression II	Regressions	*Primer*, Ch. 9
Oct. 31; Nov. 2	ANOVA I; ANOVA II	(M)AN(C)OVA's & Tabular Analyses	*Primer*, Ch. 10
Nov. 7; Nov. 9	Tabular Data Analysis (Asynchronous); Multivariate Analyses	PCA, NMDS, & Cluster Analyses	*Primer*, Ch. 11 *Primer*, Ch. 12
Nov. 14; Nov. 16	Mixed-Effects Models; Time-Series Analyses	GLMM's & Time Series Analyses	Harrison 2018; S & G, Ch. 8
Nov. 21; **Nov. 23**	Likelihood; **Thanksgiving Holiday – No Class**	No Lab	*Primer*, Ch. 5 Bolker, Ch. 6
Nov. 28; Nov. 30	Likelihood/Bayesian Bayesian;	Maximum Likelihood Functions	Bolker, Ch. 7-8
Dec. 5	**Project Presentations**;	Bayesian Analyses	H & H, Ch. 5
Dec. 11 - 20	**Final Exam**		