Quant Methods in Ecol and Evo Spring 2023

Edit

BIOL 5504: **Quantitative Methods in Ecology and Evolution**

Location: Davidson 301

Time: Tuesday/ Thursday, 2-3:15 PM, 75 min each

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Office: Personal meeting room:

https://virginiatech.zoom.us/my/kate.langwig?pwd=NjNnMi9wVVRuUlhLUWRUcjVHRWtMUT09

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Office hours: widely available by appointment

Course GitHub (with all the updated course materials):

https://github.com/VTQuantMethodsEEB/klangwig (https://github.com/VTQuantMethodsEEB/klangwig)

Overview

This course focuses on a general overview of common computational and quantitative approaches to plotting, manipulating, and analyzing data in ecology and evolution. The aim of this course is to work with **student supplied datasets** to make progress in understanding fundamental practices for wrangling data, visualizing data, and fitting models. The course will be taught in the R programming environment, and assignments will be turned in on GitHub. By working with data, we will cover model comparison, hypothesis testing, and statistical approaches, but course emphasis is on the gain of practical skills rather than an in-depth background of statistical theory. This course is intended as a broad overview of commonly used approaches for working with ecological and evolutionary data.

Course goals:

- Introduce foundations for interpreting and analyzing practical data in ecology and evolutionary biology
- Learn the fundamentals of data management and visualization in the R programming environment
- Establish a base of core knowledge that will enable independent exploration of more sophisticated methods for analyzing data
- Develop a set of skills for interfacing data and models
- Enhance quantitative literacy in scientific reading

Pre-requisites:

Students are expected to work with a dataset of their choosing over the course of the semester rather than the dataset selected by the instructor. This is for two reasons: 1) The student can gain experience working with data that is most similar to their discipline, and 2) Work done in the course can serve as the basis for future papers. This dataset will also be used for the final project.

The data used in the course does not have to be a thesis dataset, but can be data provided by their advisor or found on an online repository. Students have previously used the course as an opportunity to work on thesis chapters and explore newly collected datasets, and this is highly encouraged.

Prior to the course, it is often helpful, although not mandatory, if students have done some independent exploration of R and taken a statistics course (undergraduate or graduate level).

Texts:

Readings will be assigned on a weekly basis and distributed accordingly. There is no set textbook. We will read a mix of primary literature, textbook chapters, and online vignettes and guides for working in R.

However, there are some great texts on analyzing data in ecology and evolution. Here are a few that might provide helpful background for the course:

A great new online book (free!) and in R:

https://fw8051statistics4ecologists.netlify.app/index.html

Another exceptionally useful resource is on Ben Bolker's book ***Ecological Models and Data in R.*** I strongly suggest purchasing this book and consider it an essential reference for aspiring ecologists. Much of this information is available via the web: **http://ms.mcmaster.ca/~bolker/emdbook/index.html (http://ms.mcmaster.ca/~bolker/emdbook/index.html)**

Ray Hillborn and Marc Mangel, ***The Ecological Detective***, Princeton Univ. Press

Nicholas Gotelli and Aaron Ellison, ***A Primer of Ecological Statistics,*** Sinauer

Weekly course overview

Week 1 (Jan 17): Introduction to R

Week 2 (Jan 24): GitHub and Data Management

Week 3 (Jan 31): Visualization

Week 4 (Feb 7): Statistical Philosophies (**Multiple readings**, Discussion on Thurs)

Week 5 (Feb 14): Tests and Permutations

Week 6 (Feb 21): Distributions (Read Ch. 4A, quiz to follow).

Week 7 (Feb 28): Phylogenies (Josef Uyeda will likely guest lecture on THURSDAY, No class on TUESDAY, take quiz, **assigned reading**)

March 5-13 SPRING BREAK

Week 8 (Mar 15): Linear Models (RECORDED LECTURE Tues, Thurs TBA)

Week 9 (Mar 22): Advanced Linear Models

Week 10 (Mar 29): Generalized linear models

Week 11 (Apr 5): Model Comparison

Week 12 (Apr 12): Mixed Models

Week 13 (Apr 19): Tues: Class selected topic* / Thurs: Project assistance

Week 14 (Apr 26): Class selected topic*/ Thurs: Peer Review - Project draft due!

Week 15 (May 3): Bad ggplot contest/ Project due Wed May 4 11:59 PM

* Students vote on alternative topics to cover in the last several weeks. Previous topics have included temporal/phylogenetic autocorrelation models, non-linear models, and making interactive graphics using Shiny. Other possible topics including coding ordinary differential equation models, network approaches, other topics tailored to student's interests.

Course Policies

Grading and Assignments

1. Participation in class activities. This includes discussion of readings, attending class, and completing in-class exercises (10%). Students are expected to speak at least once during all class discussions. Participation points are lost through (1) failure to attend to class, (2) failure to speak at least once during class discussions, and (3) not completing peer reviews or class surveys on extended topics.
2. Lab exercises and assignments. This will largely be completed in-class, but may occasionally require outside work (60%). Assignments are typically assigned in class on Thursday and due the following Wednesday by midnight.
3. Final project (30%). The final project will be to discuss and perform a group of statistical analyses, make figures, and present tables. Students are encouraged to use their own data, if available. Both the scientific and statistical background should be clearly presented, and future statistical steps you plan to take. These should be written and presented like the results section of a scientific paper, with a very brief introduction, methods, and discussion section sufficient for understanding the results. Additional details on this will be forthcoming.

   Late policy: Assignments will be decremented two points per day for each day the assignment is late, and no credit will be given for assignments submitted more than 10 days following the due date.

   Attendance policy: Students enrolled for credit are allowed to miss a maximum of 4 classes for conferences, field work, etc. You are solely responsible for catching up on missed work including getting notes from classmates, and learning the material you missed in class.

   Audit policy: If you would like to audit the class, you must enroll in the class as an official auditor. I do not allow students to sit-in if they are not enrolled. You are responsible for attending 60% of classes and participating in in-class activities. You are expected to attempt the class exercises using your own data but you are not expected to turn in assignments.

Grade cutoffs:

A: 93 – 100% , A-: 90 – 92%, B+: 87 – 89%, B: 83 – 86%, B-: 80 – 82%, C+: 77 – 79%, C: 73 -76%, C-: 70 – 72%, D+: 67 – 69%, D: 63 – 66%, D-: 60 – 62%, F: 0 – 59%

Honor Code:

Please refer to the University website for details on the Honor Code. The Honor Code pledges that each member of the university community agrees to abide by states:

“As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do.”