**Biol 669-005 Simulating ecology**

**Instructor:**

Caroline Tucker

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334 Wilson Hall

**Day/Time**: TBD

**Office hours**: By appointment

**Texts:**

No required texts, but potential useful further reading can be found online and at the library:

*Ecological Models and Data in R. Ben Bolker* (<https://ms.mcmaster.ca/~bolker/emdbook/book.pdf>)

A Primer of Ecology with R. Hank Stevens.

**Course Overview:**

This class is meant to provide (or expand) your tools for understanding the connection between the fundamental models at the center of ecology and observed patterns in nature. Using topics from individual behaviour, population dynamics, species interactions, and community assembly, the goal is to connect mathematical and conceptual ideas using R, and to understand their relevance for ecological studies and data. Students will then have the opportunity to apply these skills their own research.

Most of the work will occur in-class, which will be primarily hands on. Students should have installed the most recent version of R (base or RStudio okay) and bring their laptops to each class. There will be a relevant paper to read between class, with students each leading a short guided discussion.

Enrollment is by instructor’s permission only, students should have a background in ecology and evolution (i.e. enrolled in the graduate program, or, for undergraduates, have taken Biol201 and Biol461) with at least moderate experience using R.

**Grading:**

Participation/Attendance: 60%

Final Presentation: 40%

(Undergraduates will need to pass in a final paper as well, see me to discuss).

**Expectations:** Students need to plan to attend each class period and do any required readings between classes. Practice in R may be useful for students between class.

**Final project:**

Each student will develop their own model for their system of interest. Their model can be built upon those models discussed in class or can be based on a different conceptual design (but cannot be purely statistical). The project will be presented both as a short manuscript in journal form (Abstract, Introduction, Methods, Results, Discussion) and as a presentation (suitable to present at a conference). PowerPoint presentation will be 15 minutes in length and occur during the Finals time slot for the class.

**Schedule:**

1. Introduction: Logistical meeting, syllabus.
   1. Best practices for R
   2. R for ecologists (writing functions, for loops, apply statements, plotting)
2. Population growth models.
   1. Discrete vs. continuous time
   2. Intro to deSolve library
   3. Writing and running density independent + dependent models
3. How to analyze models?
   1. Equilibria and stability
   2. Numerical solutions + complex models
   3. Exploring parameter space (plotting: heat plots)
4. Exploring Individual Based Models
5. Advanced plotting (Connor Fitzgerald)
   1. ggplot, lattice, loops + plotting
   2. Present 5 min proposals for final project
6. Two species interactions - Competition
   1. Beverton Holt vs. Lotka volterra, annual plant model
7. Two species interactions - enemy victim interactions
8. Incorporating space
   1. Dispersal kernels
   2. Explicit space (island biogeography)
   3. Implicit space (metacommunities)
9. Multi-species interactions and community assembly
   1. lottery model
   2. storage effect model
   3. metacommunity models
10. Likelihood and model fitting (Geoff Legault)
11. Customized ecological simulations + Null models
12. Consultation for presentation analyses
13. Stochasticity and variation, probability distributions
14. Final exam period: Student presentations

**Changes to the syllabus:**

Note on possible changes to syllabus: This syllabus is subject to change including changes in the schedule or specific class requirements. Any changes will be presented clearly by the professor and discussed among the class members if the changes are of significant importance.

**Diversity statement:**

The Department of Biology values the perspectives of individuals from all backgrounds reflecting the diversity of our students. We broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. We strive to make this classroom and this department an inclusive space for all students.