BI592 Introduction to Theoretical Ecology
Course Syllabus - Fall 2019

Course Times & Location
T & Th 10-11:50 am
Weniger 275

Instructor:
Dr. Mark Novak, Cordley 3006
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Course web site:
Canvas (http://main.oregonstate.edu)

Course Credits: 4

Office Hours: By appointment

Prerequisites: Motivation & graduate standing or by instructor approval

Description and Goals: This course entails a quantitative treatment of the central concepts of theoretical ecology. Emphasis is on the mathematical analysis and modeling of single populations and multi-species interactions, with some integration of models with data. Topics include discrete- and continuous-time models of population growth, stochastic and deterministic processes in unstructured populations, the sustainability of harvested populations, numerical and analytical investigations of population and community invasibility and stability, and a brief introduction to model-fitting and comparison in an information-theoretic framework.

Primarily, my goals for this course are to:
(i) peel away at any apprehensions of mathematical equations you may have,
(ii) enable you to independently interpret the classic and modern literature of theoretical ecology,
(iii) enable you to apply analytic and simulation-based approaches in evaluating ecological questions and communicate them to an audience of your peers, and
(iv) develop a working knowledge for simulating population dynamics in *R,* and an introductory knowledge for analyzing models in *Mathematica*.

Readings*:* There is no required textbook. Three types of readings are posted on the course website: required, optional, and discussion papers. Required readings are to be read *before* the topic is covered in class. Optional readings are simply recommended for further exploration; they may be of historic relevance, provide a different view, or just be good additional material. Discussion papers are, surprise, for in-class discussions (see below).
Errata for Ted Case's «*Illustrated Guide to Theoretical Ecology*» book (which we will use frequently) may be found at: http://www.nceas.ucsb.edu/BookCase/known-typos.html

Grading: Grades (because I have to) will be derived as follows...

Attendance & Participation	70%		Paper discussion	10%
Problem set completion	15%		Quizzes	5%

Attendance & Participation*:* Showing up, staying awake, participating in discussions, asking questions, pointing out all the mistakes I make when writing equations on the board, etc., is all you really have to do. You're grad students; what you get out of the course is up to you. I recognize that fieldwork and other conflicts will prevent some of you from being able to attend all classes. Please get in touch with me ahead of time so we can work out a solution regarding the assignments.

Problem sets: Problem sets are posted to our website (in the *Assignments* section). Some we will start together in class. Often a problem set will consist of two or more parts. You should be able to tackle Part A the same day that the homework is assigned; Part B, however, might require attending and having done the readings for a subsequent class. Problem sets will *not* be graded. Rather, you will receive credit simply for completing them. I'm more than happy to provide feedback, either to the group or individually, at any time, if requested. [Note that there's no need to use a separate text file (e.g., Word) to submit written answers. Just comment-out such text in your script files.]

Collaborating on problem sets: I strongly encourage you to work on the problem sets with others. My only request is that the scripts you submit reflect your own level of understanding, even if you have to add commentary to indicate what you didn't understand. That is, don't just copy blindly from others, but rather do your best to figure out what you do and don't understand. (Remember, I'm not grading these!) Please contact me with questions at any point in time. (Usually the earlier you are in your struggles the better.) There's also a Discussion board on our website. Use it liberally, because everyone will benefit from your doing so! I'll respond to posts as soon as I am able.

***Paper discussions*:** In the first week you will each choose a paper on which to lead a discussion. We'll reserve part of class time for the discussion. Please be sure to have read all of each week's discussion papers, not just the one that you're leading. Each discussion leader will be responsible for providing a 1-2 page summary of the paper, in bullet-point form, to the rest of us. (Our code for the office photocopiers is: **1592**). Discussion leaders should also make themselves a general outline of what they want to discuss and how they might see the discussion going; a game plan so to speak.

Quizzes: I will post or handout a number of "quizzes" to take at various points in the course. They're meant to be no-pressure! They're not graded, should take less than 15 minutes, and are simply meant for you to self-assess your grasp of the material (and help me to ensure that we're all up to speed and on the same page). I'll post a key at the end of the week after I've looked them over.

Computers: Computers are a necessary part of this course and you will need one on which *R* and *Mathematica* are installed. Let me know if you do not have a laptop that you can bring to class. You'll need one occasionally (of which I'll warn you a class ahead).

Programming languages & script editors:

Simulations: We'll be using *R* for most of the simulations in this class. See the "*Getting started with R*" on our website for information on installation, or go to http://www.r-project.org/ where you can find many more "Starting R" manuals.

Symbolic mathematics: We'll be doing a little bit of single-variable calculus and a lot of algebra. For all but the simplest situations this can get tedious. We'll thus be using *Mathematica* to help us out with this. OSU has an unlimited site license for *Mathematica*. (Great, but you can only use it while you're here at OSU.) There's a few steps to follow to obtain a copy. They're explained here: http://is.oregonstate.edu/accounts-support/ous-inoc/software/software-list/mathematica Although we won't start using Mathematica immediately, please make sure you can get it up and running at the start of the term. Alternatively (though not recommended because of speed issues), you can access both applications online via https://apps.oregonstate.edu

***Script editors*:** You can type commands into the command line of any of the above software and save everything (i.e. your code and output) as a file. Frequently, however, it is far simpler and more convenient to write your code in a separate text editor and save it as a text file. This aids in organizing your codes when you start accumulating them. It also means you can easily run your code again when your input data changes. You can simply copy and paste your code from the text file into the command prompts to perform the calculations again. Any text editor will suffice (e.g., *TextEdit*, *Notepad*, etc.) but there are many other editors that offer syntax highlighting whereby the different commands of your code (e.g., functions, annotation comments, printed text) will be highlighted in different colours. This greatly aids in programming. They also offer keyboard shortcuts for sending your code to *R* (rather than having to copy-paste). R comes with one built-in, but it's relatively limited in abilities. Check out: http://www.sciviews.org/_rgui/projects/Editors.html and http://en.wikipedia.org/wiki/Comparison_of_text_editors. [Confession: After resisting for many years, I have now finally switched to using *RStudio*. There's still things I don't like about it, but the conveniences now generally outstrip the costs for me.]

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Reach Out for Success: University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it's important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at oregonstate.edu/ReachOut. If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255).

Statement Regarding Students with Disabilities: Please come talk to me at any time. Boiler plate: Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Academic Honesty and Student Conduct: Students are expected to adhere to the OSU Student Conduct Regulations described at http://studentlife.oregonstate.edu/studentconduct/offenses-0. Cheating or plagiarizing by students is subject to the disciplinary process outlined in the Student Conduct Regulations. Behaviors disruptive to the learning environment of others will not be tolerated.

Disclaimer: I reserve the right to change the schedule, policies, and assignments in this course due to extenuating circumstances or by mutual agreement with you.
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Date		Clas	Topic	Due	Discussion Papers
0	9.26	1	Philosophy of modeling		
Week 1	10.1	2	Discussion #1 & Density-independent growth		Levins '66, May '04
	10.3	3	Intro to R & PS #1	Quiz #1	
Week 2	10.8	4	Density-independent stochastic growth		
	10.10	5	Density-dependent growth	PS #1	
Week 3	10.15	6	Fitting models to data		
	10.17	7	Model comparison, Discussion #2 & PS #3	Quiz #2	Anderson et. al '00, Stephen et al. '05
Week 4	10.22	8	Stability analysis - Single species dynamics	PS #2	
	10.24	9	1D Stability analysis cont. & Discussion #3	Quiz #3	May '74, Hassell et al. '76
Week 5	10.29	10	Graphical analysis - Lotka-Volterra competition	PS #3	
	10.31	11	Non-dimensional LV comp. & 2D stability analysis		
Week 6	11.5	12	2D Stability analysis - Consumer-resource intxns	Quiz #4	
	11.7	13	2D Stability analysis cont. & Discussion #4	PS #4	Ives & Carpenter '07, May '72
Week 7	11.12	14	Eigenvalues		
	11.14	15	Routh Hurwitz Criteria	PS #5	
Week 8	11.19	16	Network modules	Quiz #5	
	11.21	17	Network modules cont.		
Week 9	11.26	18	Press perturbations		
	11.28	*~Thanksgiving break~*			
Week 10	12.3	19	Tipping points & PS #6	PS #6	
	12.5	20	Discussion #5 & Parting thoughts	Quiz #6	Aber '97, Ellner '06, Sand-Jensen '07, Fawcett '12

* PDF's of the discussion papers and other required weekly reading assignments are on our website, as are PDF's of additional, recommended papers.