BI592 Theoretical Ecology

Course Syllabus - Fall 2023

Course Times & Location
T & Th 10-11:50 am Bexell 416

Instructor:
Mark Novak, CRB (*off-campus*)
mark.novak@oregonstate.edu

Course web site: Canvas
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.

***Learning Outcomes*:** More than anything, my goals for this course are to help you…
(i) to peel away at any apprehensions of mathematical equations you may have,
(ii) independently interpret the classic and modern literature of theoretical ecology,
(iii) apply analytic and simulation-based approaches in evaluating ecological questions and get better at communicating them to your colleagues and collaborators, 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).

Grading: Grades (because I have to) will be determined 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 are graduate students; what you get out of the course is up to you (assuming I don't bungle the material). I recognize that fieldwork and other conflicts will prevent some of you from being able to attend all classes. That's not a problem at all, just please get in touch with me ahead of time to work out a plan to avoid your falling behind.

Problem sets: Problem sets are posted to our website (in the *Modules* 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 submitting them and completing the associated "survey" (i.e. five quick questions to help me gauge how things are going for everyone). I'm more than happy to provide feedback, either to groups or individually, at any time, just ask! [*Note:* there's no need to use a separate text file 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 what the code is doing. 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 these discussions. 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. (There is an IB-owned photocopier next to the A&P study area on the 1st floor of Cordley Hall. If needed, the code for our class is: *1592*). Please also submit a pdf of your summary via Canvas so I can post it for everyone. 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*. There's a few steps to follow to obtain a copy. They're explained here: https://softwarelist.oregonstate.edu/software/mathematica Although we won't start using Mathematica immediately, please make sure you 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

Date		Class	Topic	Due	Discussion Papers
0	9.28	1	Philosophy of modeling		
Week 1	10.3	2	Discussion #1 & Density-independent growth		Levins '66, May '04
	10.5	3	Intro to R & PS #1	Quiz #1	
Week 2	10.10	4	Density-independent stochastic growth		
	10.12	5	Density-dependent growth	PS #1	
Week 3	10.17	6	Fitting models to data	Quiz #2	
	10.19	7	Model comparison, Discussion #2 & PS #3		Anderson et. al '00, Stephen et al. '05, Shmueli '10
Week 4	10.24	8	Stability analysis - Single species dynamics	PS #2	
	10.26	9	1D Stability analysis cont. & Discussion #3		May '74, Hassell et al. '76
Week 5	10.31	10	Graphical analysis - Lotka-Volterra competition	PS #3	
	11.2	11	*~No class (I'm traveling)~*		
Week 6	11.7	12	Non-dimensional LV comp. & 2D stability analysis	Quiz #3	
	11.9	13	2D Stability analysis - Consumer-resource intxns	Quiz #4	
Week 7	11.14	14	2D Stability analysis cont. & Discussion #4	PS #4	
	11.16	15	Eigenvalues		
Week 8	11.21	16	Routh Hurwitz Criteria	PS #5	Ives & Carpenter '07, May '72
	11.23	*~Thanksgiving break~*			
Week 9	11.28	17	Network modules	Quiz #5	
	11.30	18	Press perturbations		
Week 10	12.5	19	Tipping points	PS #6	
	12.7	20	Discussion #5 & Parting thoughts	Quiz #6	Aber '97, Gunawardena '13, 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.

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Academic Calendar

All students are subject to the registration and refund deadlines as stated in the Academic Calendar:

https://registrar.oregonstate.edu/osu-academic-calendar

Statement Regarding Students with Disabilities

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.

Student Conduct Expectations

https://beav.es/codeofconduct

Student Bill of Rights

OSU has twelve established student rights. They include due process in all university disciplinary processes, an equal opportunity to learn, and grading in accordance with the course syllabus: https://asosu.oregonstate.edu/advocacy/rights

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)

Disclaimer: I reserve the right to change the schedule, policies, and assignments in this course due to extenuating circumstances.

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