Theoretical Ecology (BIOL 4422/6422) Spring 2010

Course Syllabus

Professor: Dr. Joshua Weitz

Contact information:

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Office hours: Mon 4-5pm & by appointment

Lectures: MWF 3:05-3:55 PM in Cherry Emerson 320

Textbooks:

Required: Alan Hastings (abbreviated H), Population Biology: Concepts and Models. Springer 1997.
Suggested reading: J.D. Murray Mathematical Biology I. Springer 2004.
Special readings to be posted on http://tsquare.gatech.edu

Course Topics: Current and foundational theoretical issues in ecology and evolutionary biology. Topics include: Mathematical foundations; Population models; Community models; Stochasticity in model formulation; Evolutionary ecology; Game theory; Spatial models; Epidemiology; Ecological networks.

Prerequisites: One year of calculus and one year of biology are required for the course. We assume you are comfortable with basic mathematical concepts of simple probability, statistics, and integration/differentiation.

Overview

This class emphasizes the application of mathematical concepts to ecology, evolution and epidemiology. The course is built around assignments that introduce students to

techniques for developing and analyzing quantitative models;

software such as MATLAB, to support a thorough understanding of stochastic and dynamic modeling using mathematics as a structural and logical tool.

Course format

Three hours each week are scheduled for the class. Class time will be divided among traditional lectures and group problem-solving exercises or discussions.. A component of the course will involve formulating and solving problems in small cooperative groups of three to four members.

Some class days will be devoted to in-class modeling exercises. These days will be announced at least one day prior to class. You are invited and encouraged to bring laptop computers to class to work on these problems.

The reading listed for each week should be done *prior* to the first lecture of the week. The course is tightly tied to Hasting's book and you will get more out of and contribute more to in-class discussions if you are up to date with the reading.

Software: Implementation of homework requires use of (i) mathematic analysis; and (ii) Matlab.

Grading Scheme:

40% homework
20% midterm exam
15% final presentation
15% final paper
10% class participation

Midterm exam: There will be one in-class midterm exam, counting for 20% of the final grade. This exam will be closed book, i.e., no notes, no calculator, and no collaborative work. The exam date is March 1. Graded midterm exams will be returned on March 3.

Final project: Final project proposals will be handed in on March 12, and final presentations are scheduled for April 26, 28 and 30. Final papers will be due on April 30th. More information will be available later in the term. **Note:** *Students registered in BIOL 4422 will develop collaborative final projects, while students registered in BIOL 6422 will develop individual final projects.*

Homework: The following rules apply to homework:

1. You are encouraged to work individually or in small groups (< 4 students per group) to discuss concepts and approaches to solving problem sets.
2. If you use any sources other than class notes or your own original ideas, you must cite the source(s).
3. Every student must write/type their own homework solutions based on their own understanding of the problems.

Violation of these guidelines is a violation of the GT Honor Code.

Attendance: Regular attendance in lectures is expected – most lectures will include some component of group work and problem solving. Exceptions will be accepted for valid, documented reasons only, including: (1) official representation of the Institute; and (2) medical emergencies.

Academic Integrity: Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code and Student Code of Conduct, available online at:
http://www.deanofstudents.gatech.edu/integrity/policies/honor_code.php
http://www.deanofstudents.gatech.edu/codeofconduct.
Any violations must be reported to directly to the Dean of Students.

Additional Resources:

- Tsquare — http://tsquare.gatech.edu
- Tech Tutoring — http://www.undergradstudies.gatech.edu/supportTutoring.htm

Updates: This syllabus is subject to modification. Any changes will be announced in class and posted on the course website.

Lecture Schedule:

I. Introduction to Theoretical Ecology
Readings: H 1, 2.1

1. January 11:	Course logistics; course overview	
2. January 13:	Single species dynamics	
3. January 15:	Introduction to Matlab	
January 18:	MLK Holiday (no class)	
January 20:	Prof. Weitz at DARPA conference (no class)	
January 22:	Prof. Weitz at DARPA conference (no class)	

II. Age Structured Models
Readings: H 2.2

4. January 25:	Structured populations I	
5. January 27:	Structured populations II	
6. January 29:	In-class exercises	

IV. Population Genetics
Readings: H 3.1-3.6

7. February 1:	Models of selection I	
8. February 3:	Models of selection II	
9. February 5:	In-class exercises	* Homework 1 due

V. Game Theory
Readings: H 3.7 and additional papers

10. February 8:	Game theory in action (I)	
February 10:	Prof. Weitz at NSF panel (no class)	
February 12:	Prof. Weitz at NSF panel (no class)	* Homework 2 due
11. February 15:	Game theory in action (II)	

VI. Density-dependent Population Growth
Readings: H4

12. February 17:	Logistic models I	
13. February 19:	Logistic models II	* Homework 3 due
14. February 22:	In-class exercises	

VII. Evolution of Life Histories
Readings: H5

15. February 24:	Evolution of reproduction	
16. February 26:	Evolution of dispersal	* Homework 4 due

VIII Midterm and Final Project Planning Week

17. March 1	Midterm exam
18. March 3	Midterm returned & in-class final project lab I
19. March 5	In-class collaborative final project lab II

IX. Resource Competition Models
Readings: H 6-7

20. March 8	Competition models I	
21. March 10	Competition models II	
22. March 12	In-class exercise	* Homework 5 (final project proposals) due

X. Predator-Prey Models
Readings: H8

23. March 15	Models of predation I	
24. March 17	Models of predation II	
25. March 19	In-class exercise	* Homework 6 due

Spring break, March 22-26

XI. *Disease and Epidemiology*
Readings: H10

26. March 29	Epidemics I	
27. March 31	Epidemics II	
28. April 2	In-class exercise + (make-up) project lab	* Homework 7 due

XII. Disease and Epidemiology
Readings: TBA

29. April 5	Within-host dynamics of pathogens I	
30. April 7	Within-host dynamics of pathogens II	
31. April 9	In-class exercise + (make-up) project lab	* Homework 8 due

XII. Scaling in Ecology
Readings: TBA

32. April 12	Scaling in ecology I	
33. April 14	Scaling in ecology II	
34. April 16	In-class exercise + (make-up) project lab	

XIII. Spatial Models in Ecology
Readings: TBA

35. April 19	Spatial models I	
36. April 21	Spatial models II	
37. April 23	In-class exercise + (make-up) project lab	

XIV. Presentations

38. April 26	Group presentations	
39. April 28	Group presentations	
40. April 30	Group presentations	* Final papers due