Theoretical Ecology (BIOL 4422/6422) Spring 2012

Course Syllabus

Instructors: Dr. Joshua Weitz & Dr. Michael Cortez

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Lectures: MWF 9:05-9:55 AM in College of Computing Room 53 (sometimes CE 206)

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.

The overall objective of the course is to teach graduate students and advanced undergraduates how to develop, simulate and analyze models of ecological systems.

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, however laptops are not required.

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) mathematical analysis; and (ii) Matlab.

Grading Scheme:
40% homework
20% in-class exam
15% final presentation
15% final paper
10% class participation

Exams: There will be a midterm exam covering the first section of course content. The tentative exam date is February 27th. Changes to this date will be announced at least 1 week in advance.

Final project: Final project proposals will be handed in on March 9. Final presentations will take place during the week of April 23-27 Final papers will be due on the date of the final exam. More information will be available later in the term.

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 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 9:	Course logistics; course overview	
2. January 11:	Single species dynamics	
3. January 13:	Introduction to Matlab	

II. Age Structured Models

Readings: H 2.2

January 16:	MLK Holiday (no class)	
January 18:	Structured populations I	
January 20:	Structured populations II	*HW1 out

III. Population Genetics

Readings: H 3.1-3.6

January 23:	Models of selection I	
January 25:	Models of selection II	
January 27:	In-class exercises	*HW1 due; HW2 out

IV. Game Theory

Readings: H 3.7 and additional papers

January 30:	Game theory in action I	
February 1:	Game theory in action II	
February 3:	In-class exercises	*HW2 due; HW3 out

V. Density-dependent Population Growth

Readings: H4

February 6:	Logistic models I	
February 8:	Logistic models II	
February 10:	In-class exercises	*HW3 due; HW4 out

VI. Resource Competition Models

Readings: H 6-7

February 13:	Competition models I	
February 15:	Competition models II	
February 17:	In-class exercises	HW4 due; HW5 out

VII. Predator-Prey Models

Readings: H8

February 20:	Predator-prey models I	
February 22:	Predator-prey models II	
February 24:	Midterm review	HW5 due;

VIII Exam and Final Project Planning Week

February 27	In-class exam

February 29:	In-class final project lab I	
March 2:	Exam return & in-class final project lab II	*Abstract out

IX. *Disease and Epidemiology*
Readings: H10

March 5:	Epidemics I	
March 7:	Epidemics II	
March 9:	In-class exercise	*Abstract due; HW6 out

X. Disease and Epidemiology
Readings: TBA

March 12	Within-host dynamics of pathogens I	
March 14	Within-host dynamics of pathogens II	
March 16	In-class exercise + (make-up) project lab	*HW6 due; HW7 out

Spring break, March 19-23

XI. *Eco-evolutionary dynamics*
Readings: TBA

March 26:	Models of fast ecology, slow evolution I	
March 28:	Models of fast ecology, slow evolution II	
March 30:	In-class exercise	*HW7 due

XII. *Eco-evolutionary dynamics*
Readings: TBA

April 2:	Models of slow ecology, fast evolution I	
April 4:	Models of slow ecology, fast evolution II	
April 6:	Paper discussion	*Abstract revisions

XIII. Neutral theory of biodiversity
Readings: TBA

April 9:	Neutral theories I	
April 11:	Neutral theories II	
April 13:	Final project work session	

XIV. Theories of model fitting
Readings: TBA

April 16:	Fitting dynamic models to data I	
April 18:	Fitting dynamic models to data II	
April 20:	Final project work session	

XV. Final presentations

April 23:	Final project presentations	
April 25:	Final project presentations	
April 27:	Final project presentations	* Final paper due