ECO 590 (Advanced Topics in Economics)
Mathematical Models of Social Evolution

Fall 2012, Mon 3:10PM - 5:25PM, Winslow Hall 201

Tim Waring (timothy.waring@maine.edu) - *Office hours by appointment*

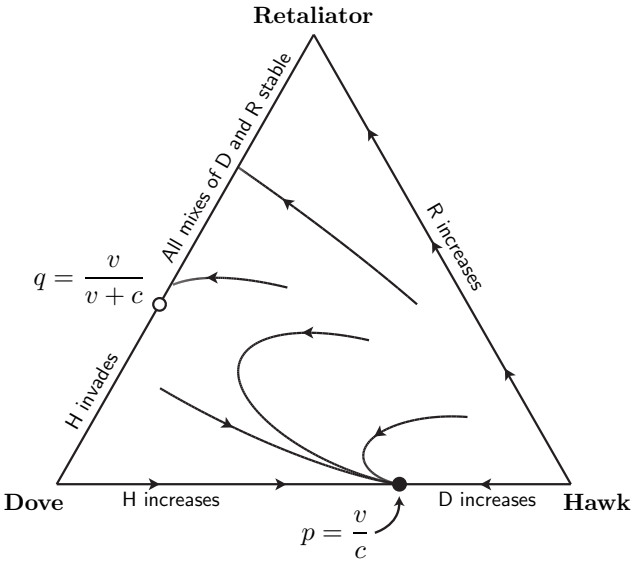

Figure 1. A ternary plot of the invasion dynamics in a three-strategy game.

Summary

This course, along with the book on which it relies, is designed to lower the barrier to entry into the rarefied world of mathematical theory in the realm of evolution and behavior. Drawing from the mathematical literature in evolutionary biology, the course is of direct value to anyone studying behavior. The course is relevant to problems commonly encountered in many fields, including ecology, evolution, economics and anthropology, and the focus on cooperation will be of use to political scientists, psychologists, sociologists, and environmental scientists concerned with collective action and environmental conservation.

The course is aimed at the student who maybe had calculus a long time ago but has forgotten most of it. The course focuses on learning the basic machinery of game theoretic and simple population genetic models, and applying them to a suite of topics from conflict and signaling to altruism and sexual selection. This foundation in mathematical machinery will allow students to read and critique mathematical work in the primary literature. The adventurous student will be able to go further and use these tools to address new questions.

Course Materials

- McElreath, R., & Boyd, R. (2007). *Mathematical Models of Social Evolution: A Guide for the Perplexed*. University Of Chicago Press.
- Pencil & Paper

Assignments

50% Homework (40%) and Participation (10%)
50% Exams, Midterm (20%), Final (30%)

Course Structure

Focused exclusively on skill building, the course will stay close to the book chapter, and homework problems in each chapter. Each class I will rehearse the new mathematical content on the board. We will take time to answer questions from previous work and the new material. Finally, we will have time to work the new assignments in class each week. **Homework will be due the Friday following each Mondays class.**

Evaluations

Exams will be take-home format. Students must work on these exams individually. However, each student is free to use other materials, including lecture notes, previous homework, and published sources to help them complete the exams.

Schedule

The course will proceed by fitting the work of each chapter into the allotted weeks for the semester. We have 15 weeks and only 8 chapters, but I will not presume to be able to predict our rate of progress. I will instead present a list of each. If we are really speedy, we may switch gears to designing our own simple models.

	Chapters	**Skills**
1	**Mathematical Theory**: Basic population genetics: life cycles, replicator dynamics, equilibrium and stability analysis, mating tables	Recursions, equilibrium analysis, linear stability analysis, mating tables
3	**Animal Conflict**: Hawk-dove game, retaliation, continuous stable strategies, asymmetries, sequential play	Evolutionary stable strategies, continuous stable strategies, backwards induction
3	**Altruism and Inclusive Fitness**: Prisoner's Dilemma, Kin-selection, Hamilton's rule, parental investment, reproductive skew	Covariance population genetics (part 1)
4	**Reciprocal Altruism**: Reciprocity, solving repeat games, reciprocity in large groups, errors, multiple invading strategies, punishment and spite	Iterated games, n-person games and finding their equilibria
5	**Signaling**: Costly signaling theory, commitment, green-beards and two-locus genetics, signaling in repeat games, social learning	Two-locus models, coupled recursions
6	**Group Selection**: The price covariance equation, the relationship between kin selection and between-group selection, inter-demic and intra-demic models, dispersal	Covariance population genetics (part 2)
7	**Sex Allocation**: Fisherian sex ratio, multidimensional stability analysis, reproductive value, local mate competition	Diploid ESS analysis, multi-dimensional linear stability analysis
8	**Sexual Selection**: Quantitative genetics, Fisherian run-away, "good genes" models	Quantitative genetics, state-dependent games

Other Important Dates

Date	Topic	Notes
Mon, 10-Sep	Introductions, Chapter 1	**Homework Due Thurs, 3pm
Mon, 17-Sep	Chapter 2	**Last day to drop
Mon, 24-Sep	. . .	
Mon, 1-Oct	. . .	
Mon, 8-Oct	*- no class -*	**No transcript drop
Mon, 15-Oct	. . .	
Mon, 22-Oct	*- no class -*	
Mon, 29-Oct	. . .	
Mon, 5-Nov	**Mid Term Exam**	
Mon, 12-Nov	. . .	
Mon, 19-Nov	. . .	
Mon, 26-Nov	. . .	Our own projects?
Mon, 3-Dec	. . .	
Mon, 10-Dec	. . .	
Exam Week	**Final Exam**	

Expectations and Guidelines

As graduate students, I will treat you as intellectual peers, with all of the independence, commitment and responsibility that status entails. Below are some of the things that I try to train undergraduates on. I expect these will not be a problem for you, as a professional-grade student.

Attendance - please plan to attend all classes, on time or early.
Deadlines - please have all assignments completed on the due date.
Participation - read the readings, participate in discussions, kill cell phones, etc.
Originality - please make sure that all submitted work is entirely your own.
Respect - treat fellow students and the teacher with respect.
Support - the University of Maine offers several great support services for students. Among them are the drop-in UMaine Writing Center, the School of Economics Laboratory & Advising Center, 305 Stevens Hall, my own office hours, and the Services for Students with Disabilities Onward Program, 121 East Annex, 581-2319.