

# Models in Evolutionary Ecology

Anthropology/Biology 5471

Spring 2018

## Instructor:

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Office Hours: By appointment

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## Course time and location:

Lecture: Tues 2-3pm, AEB 310

Lab: Tues 3-5pm, AEB 330 (Computer Lab)

**Final Exam:** see Project below

**Overview.** Evolutionary ecology is the scientific discipline that uses evolutionary theories to understand the ecology and behavior of plants and animals (including people). As these theories are often quantitative, budding evolutionary ecologists need training in the relevant quantitative methods. This course fills that need. It will cover mathematical concepts such as optimization, difference equations, transition matrices, and game theory to describe phenomena such as genetic selection, conflict, kin selection, and social learning. Satisfies the *Quantitative Intensive Requirement*.

**Learning outcomes.** The goal is for the student to gain experience in explaining biological variation using evolutionary and social theory. As much of this theory is developed through mathematical models, exposure to the relevant mathematical techniques will help students better understand how theories are developed. Each week during lecture we will review the mathematics behind a key biological and/or anthropological theory, then they will explore the math through lab exercises. The research project will give students the opportunity to develop mathematical theory on their own.

## Reading material

Rogers, Alan R. and Adrian V. Bell. *An Introduction to Mathematical Models in Evolutionary Anthropology* (class website).

As the class text is undergoing major editing, the weekly readings will be posted just before they are assigned.

**Prerequisites.** Junior, Senior or Graduate standing; one semester Calculus (Math 1100, 1170, 1210, or equivalent); one semester Ecology.

**Grading.** Two exams (25 pts each), weekly labs (30 pts total), and a research project (20 pts total). The exam on which you get the lowest score will count half as much as the other two. The final point distribution is curved, and grades are based on the higher of the raw and curved scores.

**Teaching and learning methods.** Each class period will consist of a lecture, lab activity and discussion. We will make extensive use of computer software that simplifies equations, solves them, and plots the results.

**Exams:** The exams are cumulative. Exams will consist of a selection of short-answer questions, which we hand out ahead of the exams. On the exam day students will be asked to answer a few of these questions, though slightly modified.

**Project:** A group of two will develop their own mathematical model of a biological or anthropological phenomenon of their choice. The group will give a 12-minute presentation describing their findings. The oral report of the project is the final exam.

### Schedule

Date	Lecture Topic	Reading assignment	Lab due
	<b>Mathematical Foundations</b>		
Jan 9	Course introduction, why models are useful, first exercises; Derivatives, maxima and minima, 2nd-order conditions	Ch 1, algebra refresher	--
Jan 16	Selection and optimization	Ch 2	1
Jan 23	Drift	Ch 3	2
Jan 30	A Markov Process	Ch 4.1	3
Feb 6	Evolutionary game theory	Study guide	4
Feb 13	<b>Exam 1</b>	Ch 4.2, 4.3	
	<b>Applications</b>		
Feb 20	Hawks, doves and sex ratio	Ch 5	--
Feb 27	Clutch size and the phenotypic gambit	Ch 6	5
Mar 6	Foraging	Ch 7	6
Mar 13	Producer-scrourger and social learning	Ch 8	7
Mar 20	<b>No Class - Spring Break</b>		
Mar 27	Social learning strategies	Ch 9	8
Apr 3	The Price equation, cooperation and conflict	Ch 10	9
Apr 10	Kin selection, parent-offspring conflict	Study guide	10
Apr 17	<b>Exam 2</b>		--
Apr 24	<b>Research Project Presentations</b>		--