Models in Evolutionary Ecology

Anthropology/Biology 5471
Spring 2021

Instructor:
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Office Hours: By appointment
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Course time and location:
Lecture: Online
Lab: Tues or Thurs 12:25pm - 1:45pm, GC 1855 (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 phenomenon 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 and behavioral 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 continually edited, 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. Letter grades will be assigned as: A, >90%; A-, >85%; B+, >83%; B, >80%; B-, >77%; C+, >75%; C, >73%; C-, >70%; D+, >65%; D, >60%; D-, >55%. Grading my also be “curved” at the instructor’s discretion.

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 5-minute presentation describing their findings. The oral report of the project is the final exam.

Schedule

Date	Lecture Topic	Reading assignment	Lab due
	Mathematical Foundations		
Jan 19	Course introduction, why models are useful, first exercises; Derivatives, maxima and minima, 2nd-order conditions	Ch 1, algebra refresher	--
Jan 26	Selection and optimization	Ch 2.1	1
Feb 2	Drift	Ch 2.2	2
Feb 9	A Markov Process	Ch 3	3
Feb 16	Evolutionary game theory	Study guide	4
Feb 23	**Exam 1**	Ch 4.2, 4.3	
	Applications		
Mar 2	Hawks, doves and sex ratio	Ch 5	--
Mar 9	Clutch size and the phenotypic gambit	Ch 6	5
Mar 16	Foraging	Ch 7	6
Mar 23	Producer-scrounger and social learning	Ch 8	7
Mar 30	Social learning strategies	Ch 9	8
Apr 6	The Price equation, cooperation and conflict	Ch 10	9
Apr 13	Kin selection, parent-offspring conflict	Study guide	10
Apr 20	**Exam 2**		--
Apr 27	**Research Project Presentations**		