

MATH 4397: The Mathematics of Evolution

BIOL 4397/6397: Evolutionary Theory

Lectures: MW 4 – 5:30 in SEC 203

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Prerequisites:

This course is an introduction to the mathematical underpinnings of evolutionary theory. It assumes a knowledge of linear algebra, differential equations, and genetics.

Text:

Evolutionary Dynamics, by M. Nowak.

Evolutionary Theory, by S. Rice.

Topics Covered:

Evolutionary Theory is a course designed for advanced undergraduate and graduate students who want to understand the mathematical and biological reasoning that underlies evolutionary theory. The course will cover the major theoretical approaches used to study the mechanics of evolution. These will include classical one- and two- locus models, diffusion theory, coalescent theory, quasispecies theory, and game theory. Each subject will be illustrated by focusing on those results that have the greatest impact on our thinking about the workings of evolution. These mathematical treatment of these major results will be will be complemented by illustrations, showing exactly how the mathematics relates to the biological insights that they yield. Thus, the students will learn something of the actual mathematical machinery of the theory while gaining a deeper understanding of the evolutionary process. Throughout, emphasis will be placed on the fundamental relationships between the different branches of theory, illustrating how all of these branches are united by a few basic, universal, principles.

Computers:

There will be several computational challenges that will require the use of Matlab. You will need to learn the basics of Matlab on your own. Here are a couple of tutorials to get you started

<http://www.math.ufl.edu/help/matlab-tutorial/>

<http://www.math.utah.edu/lab/ms/matlab/matlab.html>

These should take a relatively short time to go over. The TA for the course, as well as the instructors will be able to assist you.

How to get in touch with me:

The best way to get in touch with me is by e-mail. Use it if you have a question that can be answered quickly, or need to set up an appointment.

A blog for the course where you will be able to post questions and comments is here

<http://mathbioevoltheory.blogspot.com/>

Homework:

There will be 4 homework assignments during the semester. You are free to work together on the homework sets, however the work you turn in must be your own. In other words you are encouraged to work together on solving the problems, but not to copy the solutions from other students. To insure that this is the case, *write up the solutions on your own*, and not in a group. **I will hold you to this standard, and if will investigate any cases of plagiarism.**

The homeworks will be worth 20% of your grade.

Project:

There will be a research project for the course. You will be able to choose your own topic (as long as it is within the scope of the course). There will also be a set of potential projects that will be available from the instructors.

The topic will be decided in consultation with the instructor. You will also prepare a short oral presentation on the paper to the class. Papers will be submitted both electronically (in .doc, .rtf or .pdf format) and as a hard copy. Presentations will be submitted in .ppt, .key or .pdf format. Submitted papers and presentations become the property of the class and may be given to future classes as examples (with your identifying information removed).

Deadlines: 2/4 topic proposal; 3/9 one page synopsis; 4/15 draft of project. The final version of the project, as well as presentations must be submitted on 5/4 by 5:00PM.

Attendance:

Attendance is strongly encouraged.

Reading Assignments:

Reading assignments from the textbooks are indicated in the course schedule. You will be expected to read the assigned chapters carefully, ahead of time and to participate in the discussions in class.

Grades:

Grades will be assigned on the following basis:

5%	class participation
30%	project
20%	homework
20%	midterm
25%	final exam

Please see the schedule for the dates of the exams.

Academic Honesty:

Dishonesty includes cheating on your homework, falsifying data, and misrepresenting the work of others as your own (plagiarism). I will take all instances of academic dishonesty very seriously. I urge you to read the sections of the student handbook discussing academic dishonesty and the disciplinary actions it entails.

Tentative Schedule

Date	Topic	Book/Chapter	HW/Project
1/21	Introduction (What Evolution Is)	Nowak/2	
1/26	Fitness Landscapes and Sequence Spaces	Nowak/3	
1/28 – 2/2	Finite Populations	Nowak/6	
2/4	<i>Dan Graur</i> : Molecular Evolution	–	Project proposal 2/4
2/9	Evolutionary Games	Nowak/4	
2/11 – 2/16	Prisoner's Dilemma	Nowak/5	HW 1 on 2/11
2/18	Games in Finite Populations	Nowak/7	
2/23 – 2/25	<i>Blaine Cole</i> : Kin Selection	–	
3/2	Evolut. Graph Theory and Spatial Games	Nowak/8,9	
3/4	<i>Kevin Bassler</i> : Evolution on Networks	–	
3/9	Selection on one locus	Rice/1	Project outline 3/9
3/11	MIDTERM		
3/16–3/18	SPRING BREAK		
3/23 – 3/25	Selection on two loci	Rice/2	HW 2 on 3/23
3/30	The Evolution of Sex – Theory	–	
4/1	<i>Tim Cooper</i> : The Evolution of Sex – Experimental Tests	–	
4/6–4/13	Drift and Finite Population Size	Rice/3,4	
4/15	<i>Tim Cooper</i> : Adaptive Evolution	–	Project Draft 4/15
4/20–4/22	<i>Gábor Balázs</i> : Noise and Evolution	–	HW 3 on 4/20
4/27	Diffusion Theory	Rice/5	
4/29	Price's Theorem	Rice/6	
5/4	FINAL EXAM		HW 4 on 5/4
5/11	Oral presentations at 5pm		