Term: Fall 2023

Course ID: 119502

Course Instructor: Martin Nowak

Teaching Fellows: David Brewster (dbrewster@g.harvard.edu) and Bright Liu (brightliu@college.harvard.edu)

Course Description: Introduces basic concepts of mathematical biology and evolutionary dynamics: evolution of genomes, quasi-species, finite and infinite population dynamics, chaos, game dynamics, evolution of cooperation and language, spatial models, evolutionary graph theory.

This course was offered as Math 153 in past years (2019 (Links to an external site.)) (2017Links to an external site.).

Schedule: Lectures meet each **Tuesday 12:00-1:15 PM** in **Science Center 309A**. Optional working group and project discussions meet each **Thursday 12:00-1:15 PM** in **Science Center 309A**.

Office Hours:

- David - Wednesdays 12pm - 1:15pm, ~~Science Center, Room 411~~ [Zoom Link], starting 9/20
- Bright - Mondays 8 - 9:30pm, Mather Dining Hall, starting 10/9

Textbook: *Evolutionary Dynamics*, Martin A. Nowak 2006.

Prerequisites: Some exposure to matrices and differential equations at the level of Math 1b, 19a, 21b, or 22a. Experience with probability, programming, or biology would be helpful but is absolutely not required. If you have special circumstances or concerns about your preparedness, please talk to us -- we're committed to making the course accessible to all.

Grading: Project proposal (30%), project presentation (30%), final project writeup (30%), lecture attendance (10%).

Late Policy: All assignments should be turned in by 11:59PM the night of the due date.

Problem Sets: *Optional* problem sets will be released after each lecture. These problem sets can be used to develop project ideas or gain a better understanding of the material. Solutions will be posted the following week.

Project: Throughout the semester, students will make progress on a research question in mathematical biology or evolutionary dynamics. Students will submit an initial 2-3 page proposal by mid-October outlining the following: the research question of interest, relevant past literature, a proposed model or algorithm, preliminary analysis, and a plan for further investigation. Students will then submit a 6-8 page final report at the end of the term; details will be provided later in the semester. All students are invited to continue their project or begin a new project in the spring follow-up course Math 243.

Past Literature Review Papers:
https://docs.google.com/document/d/1RaWpKucHdGnVEDuzZc3WU9cdOs85s1AhN092G4mMN4c/edit?usp=sharing

Project Collaboration Sheet:
https://docs.google.com/spreadsheets/d/1bXdlORYk73aZ3HSKAuGTF59j3BUQ10u2dNraQBWzMwM/edit?usp=sharing

Project Presentation Signup Sheet:
https://docs.google.com/spreadsheets/d/1ReSejJGpGhKsqBq5sD0B0FMNjIupxyMv9a4iCms9r-4/edit#gid=0

Tentative Calendar:

September 5, 2023	Lecture 1: Evolution of cooperation
September 12, 2023	Lecture 2: History, selection, and mutation

September 19, 2023	Lecture 3: Fitness landscapes and quasispecies
September 26, 2023	Lecture 4: Evolutionary game theory
October 3, 2023	Lecture 5: Ecology and infection dynamics
October 10, 2023	Lecture 6: Repeated prisoner's dilemma
October 17, 2023	Optional section: stochastic processes and project work
October 19, 2023	*Project proposal due*
October 24, 2023	Lecture 8: Games in finite populations
October 31, 2023	Lecture 9: Evolutionary graph theory, part 1
November 7, 2023	Lecture 10: Evolutionary graph theory, part 2
November 14, 2023	Lecture 11: Games on graphs
November 21, 2023	Lecture 12: Evolution as a chemical reaction
November 28, 2023	Lecture 13: Student Presentations
November 30, 2023	Lecture 14: Student Presentations
December 14, 2022	*Final project due*