Math 76 Period 10 MWF 10:00 - 11:05 AM, Room: Kemeny 007

Instructor: Dr. Olivia Prosper, Office: Kemeny 318, E-mail: olivia.f.prosper@dartmouth.edu, Phone: 603-646-1614

Office Hours: Wednesday, 2:30-4:30pm and by appointment.

Students are strongly encouraged to attend office hours when they have questions about the course material. Students may show up anytime during the scheduled office hours (see instructor info above), or may schedule an appointment with their instructor to meet outside the scheduled office hours.

Course Webpage: `http://www.math.dartmouth.edu/~m76w14/`

Textbook: As a supplement to in-class notes, students can find the following text freely available online: Leah Edelstein-Keshet, *Mathematical Models in Biology*, `http://dx.doi.org/10.1137/1.9780898719147`

Prerequisites: Math 22, Math 23, or permission of the instructor.

Course Objectives: Biology presents complex problems requiring quantitative approaches to tackle them. This term, Math 76 introduces you to mathematical modeling in biology, with an emphasis in modeling disease dynamics using differential equations. You will learn to construct, analyze, and simulate models and interpret your results within their biological context. By the end of the term, you will have experience posing biological problems and using mathematics to elucidate them.

Course Outline:* Below is a tentative outline of topics we will cover during this course. Students will learn to write simple MATLAB code to simulate models and aid with the analysis of these models. Throughout the term, students will be assigned reading of research articles in the area of mathematical epidemiology. By the 5th week of the term, students are expected to have formed groups of 3 or 4 and submit a project proposal. The instructor will review and grade these project proposals. Students will use the remaining weeks to develop and complete their research project. During the last week of the term, each group will present their research project to the class. Each student is required to participate equally in their group's presentation. Finally, each group must submit a report of their research project on the last day of class.

*Topics and dates may deviate from this outline.

One-dimensional continuous population models ..... week 1-2

- Malthus Model, Logistic model
- Logistic equation in epidemiology
- Qualitative analysis

Planar systems ..... weeks 2-3

- Example: Lotka-Volterra
- Equilibria and linearization
- Qualitative behavior of solutions of linear systems
- Example: variations of SIR model

Intro to parameter estimation and model selection ..... weeks 3-4

- Estimating the recovery rate
- Ordinary least squares
- AIC and AICc

Sensitivity analysis ..... weeks 4-5
Modeling vector-borne disease ..... weeks 5-6
Computing R_0 for complex models ..... weeks 7-8

- Routh-Hurwitz Criterion
- Next Generation Approach

Group presentations ..... week 9

Homework: Homework will be assigned every Friday and will be due at the beginning of class the following Friday. No late homework will be accepted except in extreme circumstances discussed with the instructor prior to the deadline.

Each homework assignment must be written up neatly and your solutions must be clearly explained. Any code written for the assignment should be carefully commented, printed out, and turned in with the assignment. Staple pages of the assignment together before turning it in.

Group Project: The instructor will outline potential project topics. Groups may use one of these topics as inspiration for their project, or, groups may select a different topic as long as it has been approved by their instructor. Each group must work on a different topic. Each project must include

- Background about the biological problem and references to papers that have tried to tackle this problem.
- A mathematical model developed to address the biological problem.

- An analytical component
- A numerical component
- A discussion section interpreting the group's results
- A section addressing any challenges the group encountered, whether they were able to address these challenges, and if not, ideas about how to tackle them.

Grading: The breakdown of grades is given in the table below.

Assignment	**Percent of Grade**
Class Participation	15
Homework	30
Project Proposal	10
Final Project Report	30
Final Presentation	15
Total	100

Academic Honesty:

- On the **homework exercises**, you are encouraged to form small study groups and work collaboratively. However, collaboration does not include copying someone else's work - a clear violation of the Honor Principle. Feel free to talk with other students about the material; when it comes to writing up the homework, however, you should do this by yourself without outside assistance.
- On **group projects**, each student must clearly state what his/her contribution was to the project and each student must contribute equally during the final presentation.

Extra Help: Dot not hesitate to come to my office during office hours or by appointment to discuss a homework problem, project, or any other aspect of the course.