Syllabus

Mathematical and Computational Models in Biology

Biol 553L / Math 553L

Fall 2019

**Introduction:**

Welcome! This lab course will introduce methods for developing and analyzing mathematical models of biological systems, paired with the lecture material in Biol/Math 553. In the lab you will develop models using Mathematica and MATLAB (which we will teach you!).

**Instructors:**

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Office hours: Wed 1:00-2:00pm Office hours: Tues 2:00-3:00pm

If you are unable to come during office hours meetings can be scheduled by appointment.

**Lab:**

M, 2:00-4:00, Wilson 213

The labs will be used to reinforce ideas learned during the lectures and to give you experience writing programs to analyze biological problems. You will learn both Mathematica and MATLAB in the labs.

**Obtaining Mathematica and MATLAB:**

Students can obtain both Mathematica and MATLAB from Software Acquisitions https://sa.unc.edu/shop using your Onyen. Both packages are free for students. You can choose to get the software as a download or order a DVD to pick up.

Please make sure you have them loaded on your computer by the **FIRST** lab. For MATLAB, only the base package (no toolboxes) are required if you need to save space when installing the program.

**Textbook:**

The textbook (required for Biol/Math 553), which is available in Student Stores, is:

*A Biologist’s Guide to Mathematical Modeling in Ecology and Evolution*

by S.P. Otto and T. Day, Princeton University Press, 2007.

**Evaluation:**

Grades will be determined in the following way:

Lab assignments: 65%

Group project programming implementation: 20%

Final exam: 15%

*Lab assignments*: You will be assigned questions to address during the labs. Labs will be due on Wednesdays (at 5pm); lab assignments turned in late without a prior-approved extension will incur a 50% penalty. The key for each lab assignment will be posted the as soon as the lab is due. You will grade your work using the key and turn the graded assignment in by Friday at 5pm. During grading you may explain your errors and provide corrections to earn back up to half of the missed points, at the discretion of the instructors. Graded labs returned late incur a 50% penalty and no corrections are allowed. If either the original or graded version of a lab is more than one week late you will receive no credit for that lab assignment.

*Group projects*: You will end the semester with a group project on a topic of your choice. This project will give you the opportunity to explore a biological question of interest in more depth. Groups will consist of approximately 4 students, and will be formed towards the beginning of October (see BiolMath 553 Syllabus). Brief abstracts describing the topics for your projects will be due two weeks later.

Your lab grade for the project will be based on the quality and correctness of your software implementation of your chosen model. We will assign an initial grade for code implementation based on the material handed in on Nov. 20 (see Biol/Math 553 syllabus). You will have a chance to earn up to half of the unearned points back, at our discretion, by correcting your model in the final material turned in on Dec. 6.

*Final exam*: The final exam will be written and include multiple choice, fill in the blank and code rearrangement exercises.

**Course Schedule**

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| Date | Lab topic |
| Aug 26 | Intro to programming – do Hour of Code @ code.org prior to class / Intro to MMA |
| Sept 2 | Labor Day – no lab |
| Sept 9 | MMA - Numerical iteration of recursion equations |
| Sept 16 | MMA - Analytical and graphical techniques for analysis of non-linear recursion equations I |
| Sept 23 | MMA - Analytical and graphical techniques for analysis of non-linear recursion equations II |
| Sept. 30 | Intro to MATLAB; Numerical solutions to ODEs |
| Oct 7 | MATLAB – Implementing a published model of predator-prey dynamics |
| Oct 14 | MATLAB – Studying oscillatory systems |
| Oct 21 | MMA - Implementation of a host-parasitoid model |
| Oct 28 | MMA – Probabilistic models  **Reading assignment:** Otto and Day Chapter 13 |
| Nov 4 | MATLAB – Stochastic Ion Channels |
| Nov 11 | Project workday |
| Nov 18 | Project presentations |
| Nov 25 | MATLAB – Cellular Automata |
| Dec 2 | FINAL |