Modeling Biology With Differential Equations
Wednesday, 5:00pm-8:00 pm
Class Size: 15
Instructor: Will McFadden

Course Objective:
This course is designed to introduce a student with a reasonable understanding of biology to the basic techniques of mathematical modeling. Specifically, the student will be able to take a conceptual model of some biological system and transform it into an appropriate mathematical framework. The student will also be able to develop intuition based on their model and to interpret simulation results to draw conclusions.

Design:
Content, Converse, Convey
For each lesson in the course, the assignments will proceed in three parts. First, students will familiarize themselves with the **content** of that week's lesson and take a short quiz to ensure that they have done the necessary reading. Second, the students will meet in class or use the online forum to **converse** on a problem related to the lesson. Finally, ever student will be given their own related problem to solve and **convey** their answer on our class wiki for other students to evaluate.

Programming Projects
In addition to the weekly assignments, the students will also be synthesizing their knowledge of mathematical modeling concepts to build their own simple modeling projects. By the third week the students will be able to pick a biological system to study. They will work during a few of the hour long discussions to put together their own model of the system and explain it to the rest of the class. Finally, they will present an in-depth description of their project on the class wiki.

Assignments:
Readings and Quizzes
There are readings and lectures online for you to become introduced to the material before you come to class. There will be online quizzes on Chalk which will be due by Tuesday at midnight the day before new material is covered in class. These quizzes should resemble simple multiple choice exam questions; they merely check whether you have viewed the material. However, in total these quizzes count towards 25% of your overall grade so take them seriously.

Class Forum Discussions
Every week, the class will meet together to tackle a problem related to the lesson. The problems are frequently posed based on questions left unanswered by students

in the previous year. The class should come to a reasonable consensus by the end of the session or they should follow up online to come to an agreement.
We've designed the discussion sections so that you don't need to be the most boisterous student to participate in the discussion meaningfully. There will be an equal weight to valuable comments given in person as well as those on our online forum. In addition, our class discussions will often contain smaller discussions that allow for one-on-one interaction. Nevertheless, class discussion accounts for 25% of your grade so, whether in the forums or in person, your participation is required.

Wiki Articles
Each student will be given a more in-depth problem for each lesson to be written up and posted to the group wiki. Here we are not just looking for a solution to the problem. We need an explanation of your approach and why it is right. Your peers will be evaluating your work to make sure that it makes sense to them. The writing and evaluation of these assignments will count for another 25% of your grade.

Final Project: *Due the last day of finals*
By the third week of this course, the student should start to have an understanding of what types of systems can be modeled with a differential equation. At this point in time, the students will select a biological system to model as their final project. The class during 4th week will involve every student briefly stating their problem area how they will model it.

After this introduction, you are required to meet once with the instructor to make sure that you're working correctly. Please note that the system you are modeling does not have to be extremely complex, and the model you generate does not have to be perfectly accurate. The goal of this project is simply to show that you understand all of the steps in moving from an abstract idea to a mathematical model. By the end of the quarter you should have a reasonably involved computational model with some .

During finals we will have another class discussion of everyone's topics and your last wiki article will be on this topic. The whole project will account for another 25% of your grade.

Readings:
Lecture notes and reading are all available online. The course is entirely self-contained, but we will be providing a supplemental reading list for those who are interested.

Grading:
Quizzes: 25%
Class Forum: 25%
Wiki Articles: 25%

Final Project: 25%

Schedule:

Lesson 1: Diagramming Biological Models

Lesson 2: Understanding Differential Equations

Lesson 3: Diagram to Equation to Diagram

Project Week 1: Describing your Biological System

Lesson 4: Simplifying Equations

Project Week 2: Converting your System to Equations

Lesson 5: Analyzing Equations and Output

Project Week 3: Developing the Simulation

Lesson 6: Presenting Simulation Results

Project Week 4: Final Reports