MthSc 450: Introduction to Mathematical Modeling

Spring 2013

Martin Hall E-004, TTh 8:00-9:15am

Instructor

Matthew Macauley (macaule@clemson.edu)
Office: Martin Hall O–325
Phone: (864) 656–1838
Office Hours: TTh 9:30–10:45, or by appointment

Textbook

Mathematical Concepts and Methods in Modern Biology : Using Modern Discrete Models, by Raina Robeva and Terrell Hodge (editors).

Prerequisites

Officially: MthSc 302 (statistics for science and engineering), MthSc 360 (intermediate mathematical computing), and MthSc 440 (linear programming). Unofficially: Neither 302, 360, or 440 are necessary, but MthSc 208 (differential equations) and MthSc 311 (linear algebra) are recommended.

Policies

- Attendance: Class attendance is mandatory. If you miss a class for some reason, it is your responsibility to get notes, etc. from someone in class. I will not repeat lectures during my office hours.
- Course material will be posted on Blackboard and/or my website (prefered), as I like to make all materials freely available to everybody (Warning: Websites such as *Course Hero* that troll for free online materials, repackage them and charge students for them are a SCAM!)
- All drop/add procedures are your responsibility.
- Absent Professor Policy: If the instructor has not arrived within 10 minutes of the scheduled class time, you may assume that class has been canceled.
- All use of cell phones, laptops, tablets, and PDAs is prohibited during lectures and exams.
- Cell phone policy: `http://www.youtube.com/watch?v=FYwpxU_G4Z0`

Learning Outcomes

This course will be an introduction to mathematical modeling with a particular focus on mathematical biology. We will sample from a variety of problems and modeling techniques throughout the class. Unlike most undergraduate math classes, the scope of this class will be more about breadth than depth. We will begin with some classical models such as the logistic and predator-prey models for population growth and the SIR model in epidemiology. Most of the class will be spent learning about a relatively new but widely popular trend of discrete modeling. In particular, the field of mathematical biology has been transformed over the past 15 years by researchers using novel tools from discrete mathematics and computational algebra to tackle old and new problems. These ideas have impacted a wide range of topics such as gene regulatory networks, RNA folding, genomics, infectious disease modeling, phylogenetics, and ecology networks and food-webs. In some cases they have even spawned completely new research areas. This is approach is arguably more accessible and appealing to many scientists and engineers, encouraging cross-disciplinary communication and collaborations.

Upon successful completion of this course, a student will be able to:

- Explain the process and goals of mathematical modeling
- Construct simple models of real life scenarios and perform computer simulations using MATLAB
- Understand the simplifying assumptions accompanying a particular model
- Test a model against a given data set and draw conclusions on the quality of the model
- Calculate phylogenetic distances
- Calculate conditional probabilities for Bayesian inference
- Calculate gene frequencies in populations, etc.

Grading

The final grade will be calculated as follows:

Homework:	25%
Midterm:	30%
Quizzes:	20%
Final project:	25%

Grading scale: $A \geq 90\% > B \geq 80\% > C \geq 70\% > D \geq 60\% > F$

The final project will consist of a written report on some topic related to what we're studying in class. Additionally, there will be a short one-on-one oral presentation of the project (like an oral exam) in my office. This will satisfy the capstone requirement for the Mathematical Sciences major at Clemson University.

Homework

Students can collaborate on their homework problems, but they *must* write up and submit their homeworks separately. Late homeworks will **not** be accepted, but anyone typesetting their homework using LaTeX will get an extra 24 hours to complete it (okay to hand-draw pictures, though). You should keep all the graded homeworks in case of missing grades due to missing name or typo errors.

Key Dates

January 9 (Wed)	Classes begin; late enrollment fee applies
January 15 (Tue)	Last day to register or add a class
January 21 (Mon)	Holiday: MLK Day
January 22 (Wed)	Last day to drop a class or withdraw from the University without a W grade
March 15 (Fri)	Last day to drop a class or withdraw from the University without final grades
March 18–22 (M–F)	Spring break
April 26 (Fri)	Last day of class
May 2 (Thu)	MthSc 450 Final Prentations (11:30am – 2pm)

Note

- `http://bb.clemson.edu/` (Blackboard)
- `http://www.registrar.clemson.edu` (acad. calendar, registration, grading)
- `http://www.clemson.edu/academics/academic-integrity` (academic integrity)

The official statement on Academic Integrity

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a *high seminary of learning.* Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

When in the opinion of a faculty member, there is evidence that a student has committed an act of academic dishonesty, the faculty member shall make a formal written charge of academic dishonesty including a description of the misconduct, to the Dean of the Graduate School. At the same time, the faculty member may, but is not required to, inform each involved student privately of the nature of the alleged charge.