Math 4500-001: Introduction to Mathematical Modeling

Spring 2015

Martin Hall E-004, MW 3:35-4:50pm

Instructor

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Office Hours: MW 1:30–2:30, and after class

Textbook

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

Prerequisites

Officially: Math 3020 (statistics for science and engineering), Math 3600 (intermediate mathematical computing), and Math 4400 (linear programming). Unofficially: Neither 3020, 3600, nor 4400 are necessary, but Math 2080 (differential equations) and Math 3110 (linear algebra) are recommended.

Policies

- Attendance: We have a very small class. Please attend every class if possible. If you know in advance that you cannot make it, it would be nice to let me know in advance. (Thank you!)
- 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! Spread the word!)
- 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, unless explicitly specified otherwise.
- 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. The second half 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 and/or Sage.
- 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.
- Model the *lactose operon* regulatory network using both continuous (differential equations) and discrete methods (Boolean networks), and understand the strengths and weaknesses of each.
- Calculate phylogenetic distances.

Grading

The final grade will be calculated as follows:

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

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

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 7 (Wed)	Classes begin; late enrollment fee applies
January 13 (Tue)	Last day to register or add a class
January 29 (Mon)	Holiday: MLK Day
January 21 (Wed)	Last day to drop a class or withdraw from the University without a W grade
March 13 (Fri)	Last day to drop a class or withdraw from the University without final grades
March 16–20 (M–F)	Spring break
April 22 (Wed)	Last day of class
April 28 (Tue)	Math 4500 Final Prentations (7:00–9:30pm)

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.