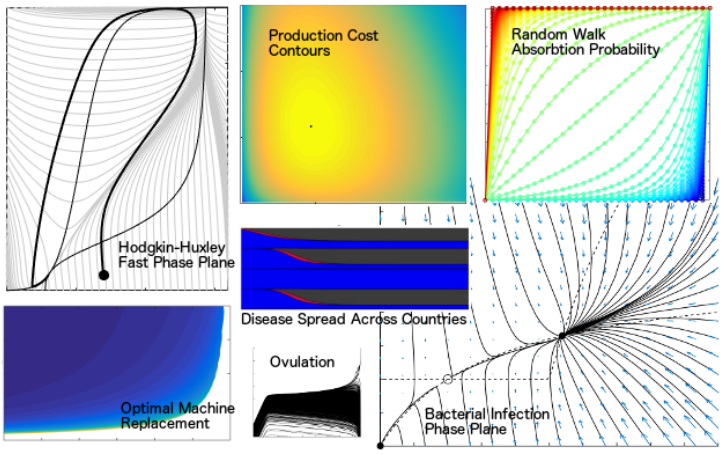
MAT482 Topics in Mathematics: Math Models



"If people do not believe that mathematics is simple,
it is only because they do not realize how complicated life is." --John von Neumann

Course Synopsis
This course is designed to provide upper level undergraduates and beginning graduate students with an understanding of how mathematical modeling is the link between mathematics and the rest of the world. Nature is highly complex and mathematical modeling can help to unlock the secrets to problems in engineering, physics, astronomy, biology, medicine, chemistry, economics, and the social sciences among other fields. Modeling is a way of structuring questions about the world so that mathematical techniques may provide insight. It is as much an art as a science.

This course will cover a broad spectrum of modeling approaches including optimization, dynamical systems, and stochastic processes. Some topics covered include sensitivity analysis, model robustness, multi-variable optimization, linear programming, operations research, compartment models, neuronal models, bifurcation theory, renewal theory, Markov chains, queuing theory, diffusion, and some stochastic models in biology. Regular computer lab sessions will be used to teach visualization and simulation of the mathematical models studied.

A substantial component of the course grade will be a modeling project with a student-selected topic. Evaluation of the project will be based on a research report and a presentation. Regular written homework and two midterm exams will also be part of the course grade.

Instructor
Dr. Adam R. Stinchcombe
Office: TBD
E-mail: TBD
Office Hours: TBD or by appointment

Course Location
TBD

Course Website
URL TBD. The website will be used to post announcements, as well as to assign and collect homework and lab reports.

Prerequisites
In order to be successful in this course, it will be necessary to have a solid foundation in ordinary differential equations (MAT244) and linear algebra (MAT223,MAT224). A course in probability or some experience with Matlab or Python would be helpful.

Project
Students should work in teams of two or three, preferably, although you can discuss with me the possibility of individual projects or larger groups. For the project, you will give a 15 minute in-class presentation during the last two weeks of the course and submit a research report. Attendance at the presentations of other groups will form part of your grade. Start thinking early about topics that interest you and locate research materials on that topic. Be prepared to submit a project outline in mid-March.

For the project, you can develop a novel mathematical model related to your topic, or provide extensions or new applications for an existing mathematical model. It will not be sufficient to study an existing model and present already reported results for the model; there must be a novel component to your project.

Project presentations will take place in class on the last three lecture dates. The final project report is due at 5:00pm on the last day of classes.

Exams
There will be two in-class midterm exams (dates TBD). Please contact me as soon as possible if you have an unavoidable conflict with these dates. This course does not have a final exam.

Computer Labs
There will be regular computer labs, only on Fridays. We will make considerable use of Matlab.

Homework
There will be approximately three written homework assignments and seven lab reports. Please submit a PDF on the course website on the due date before 11:59pm. Late homework will not be accepted unless permission is given ahead of time.

Grading Scheme
Course grades will be determined from the following components:

- written homework and lab reports 30%
- two midterm exams 2 x 15%
- project report and presentation 40%

Textbook
Required: "Mathematical Modeling" by Mark M. Meerschaert (4th ed.) ISBN: 0123869129
Optional: "Modeling and Simulation in Medicine and the Life Sciences" by Frank C. Hoppensteadt and Charles Peskin (2nd ed.) ISBN: 978-0387215716

Testing Accommodations
If you think you need an accommodation for a disability, please let me know as soon as possible. Please provide appropriate documentation to me at least two weeks prior to the need for a test accommodation.