25 January 2023

Syllabus

MATH420/AMSC420 Spring 2023
Mathematical Modeling

Instructor: Radu Balan
Classes: Tuesday, Thursday, 11:00pm – 12:15pm in PHY 2211
Office Hours: Radu Balan: Thursday, 3:30pm-5:00pm in MATH 2308
Contact Information:
Radu Balan: **rvbalan@umd.edu** , (MTH) Kirwan Hall, Room 2308, x55492 / (Brin Center) CSI Building , Room 4131, x51217

Math 420, Mathematical Modeling (3 credits) The course will develop skills in mathematical modeling through practical experience. Students will work in groups on specific projects involving real-life problems that are accessible to their existing mathematical backgrounds. In addition to the development of mathematical models, emphasis will be placed on the use of computational methods to investigate these models, and effective oral and written presentation of the results.

Course Prerequisites

- Math 240 (Introduction to Linear Algebra) or Math 461 (Linear Algebra for S&E) or MATH 341 (Multivariable Calculus, Linear Algebra, Differential Equations II (Honors));
- Math 241 (Calculus III) or MATH 340 (Multivariable Calculus, Linear Algebra, Differential Equations I (Honors));
- Math 246 (Introduction to Ordinary Differential Equations) or MATH 341 (Multivariable Calculus, Linear Algebra, Differential Equations II (Honors));
- Stat 400 (Applied Probability and Statistics I) or Stat 410 (Introduction to Probability Theory);
- permission of the Mathematics Department.

Students will be expected to work with Matlab, Python, or some other high-level computer language. It is helpful to have taken either AMSC 460 (Scientific Computing) or AMSC 466 (Numerical Analysis).

Our More Detailed Description

This is a course on data-driven mathematical modeling as a process, not as a collection of techniques. Students will work in teams on projects motivated by real-life problems, and will, with the aid of the instructor, complete the entire process from analyzing data to formulating mathematical models calibrated from that data to mathematical, statistical, and computational analysis of these models to oral and written presentation of the results. Some background in linear algebra, ordinary differential equations, basic probability and

statistics, and computational methods is expected. Additional mathematics will be introduced as dictated by the projects.

Projects

There are two projects in the course --- one before spring break and one after spring break. Teams will be assigned to topics for **Project One** around the second week of classes and for **Project Two** around the first week after spring break.
Students who are teammates for the first project will not be teammates for the second project.

Teams are expected to meet regularly outside of class. For Project One each team should meet with the instructor during the week of **February 27.** For Project Two each team should meet with their supervisor during the week of **April 17** and again during the week of **May 1 (dates subject to change).**

For each project, the team must submit a written report describing (among other things) the problem that was investigated, the model used and the justification for it, results from analysis and simulation of the model, and the conclusions drawn from the results. Teams will also give a brief oral report summarizing their methods and findings. Teams must submit an electronic copy (pdf) of the slides used in their oral presentation. Teams must submit both a paper copy and an electronic copy (pdf) of their written report. Each team member must participate in the team's oral presentation as well as in its written report. The maximum score for these components is given by the following table.

	Preparation	Oral Presentation	Written Report	Total
Project One	10 points	10 points	30 points	50 points
Project Two	15 points	15 points	45 points	75 points

Grading Policies

Your course grade will be based on the sum of your scores on:

+your homework assignments (maximum of 10 points each)	70 points (about 32%)
+your first project (maximum of 50 points)	50 points (about 23%)
+your second project (maximum of 75 points)	75 points (about 34%)
+your class participation (maximum of 25 points)	25 points (about 11%)

The maximum total score possible for the course is 220 points. The point cutoffs for course grades will be no higher (and might be a bit lower) than those set forth in the following table:

198 points (90%) for a grade of **A-**
176 points (80%) for a grade of **B-**
154 points (70%) for a grade of **C-**
132 points (60%) for a grade of **D-**

Pluses and minuses might be awarded to those whose point total is close to a cutoff.

The course grade of **I** will be awarded only if all the following conditions are met:

1. You have completed all but a small portion of the required work.
2. You have an average grade of **C-** or better on the work completed.
3. You have a valid reason for not completing the course on time.
4. You agree to make up the material within a short period of time.
5. You request the incomplete no later than the day after the final exam.
6. You fill out a contract form with the Undergraduate Office.

Academic Integrity Policies

The University has a nationally recognized *Code of Academic Integrity,* administered by the *Student Honor Council.*
It is expected that all students will abide by this code during all assignments in this course.
A summary of the code can be found on Testudo.

The Student Honor Council proposed and the University Senate approved an Honor Pledge.
This Pledge reads:

> *I pledge on my honor that I have not given or received any unauthorized assistance on this assignment.*

Visit the Student Honor Council webpage about the University of Maryland Honor Pledge.

The basic principle to keep in mind is to avoid representing the work of others as your own. Solo homework assignments should be done individually. For team homework assignments and projects, input from sources outside of your team (other than from the instructors) should be cited. It is sufficient to submit one homework per team, but all team names should be indicated clearly. Team members are supposed to know the content of their homework assignments and projects.

Topics

Lectures will cover two modules. The first module covers topics in Epidemiology. The second module covers topics in Data Embeddings, Dimension Reduction and Graph Partitions.