Math 40a: Introduction to Applied Mathematics

Spring 2022

Instructor: Thomas Fai (tfai@brandeis.edu)

Time: Tuesday and Thursday, 3:30–4:50pm

Location: Hybrid (TBA)

Office Hours: Tuesday 2:30–3:30pm and Thursday 8–9am

Introduction

This course is organized around seminal papers of applied mathematics drawn from public health, finance, sports, game theory, and other areas. The broad range of topics illustrates the many opportunities for using mathematics to understand the world.

The course is organized around two-week cycles. Within each cycle, class sessions will include explanations of the key mathematical concepts, interactive Python programming exercises, and student presentations. Students will carry out final projects in which they explore a mathematical model and develop video presentations. Learning oral communications skills focused on how to effectively communicate mathematical concepts will be emphasized throughout the course.

Prerequisites

MATH 15a or 22a and MATH 20a or 22b. Students should have familiarity with single variable calculus, multi-variable calculus, and linear algebra.

Objectives

1. Effective oral communication of the main ideas and results presented in mathematical papers
2. Construction and critique of simple mathematical models
3. Basic familiarity with Python and its numerical capabilities

Course Work and Grading

• Participation: 15% of total grade.
  - Students are expected to be active participants during class. Class sessions will include interactive groupwork and peer reviews that will count toward the participation portion of the grade. Synchronous class attendance is expected.

• Homework & lab problems: 30% of total grade.
- Homeworks and lab problems are due weekly. The lowest two scores are dropped. Late assignments will only be accepted under exceptional circumstances (e.g. medical emergency).

- In-class paper presentation: 25% of total grade.
- Final project and video presentation: 30% of total grade.
  - The video project will serve as the final assessment. Students will make short (3–6 minute) YouTube videos further exploring one of the papers discussed in the course. There will be preliminary steps of storyboarding and peer review so that students receive feedback before final submission.

Success in this 4 credit hour course is based on the expectation that students will spend a minimum of 9 hours of study time per week in preparation for class (readings, homework, preparation for exams, etc.).

Learning Expectations and Resources

This course will be conducted in a hybrid fashion, with course sessions taking place in-person and remotely through Zoom. Synchronous attendance is expected—there will be in-class breakout rooms and other mandatory activities during class sessions. If you face any challenges to participating in class because of your current time zone, please contact me.

In this course, the minimal set of hardware, software and course supplies needed to be successful in this course are a computer with Zoom and Python. Instructions on how to set up Python will be provided in the first few class sessions. Students facing any difficulties participating because of issues with technology, etc. should contact me.

Undergraduate students from SAS with financial need should contact Student Financial Services to discuss options available to purchase equipment and other technology and supply needs. GSAS students should contact Monique Howell in GSAS.

Breaks

Class meetings of 90 minutes include a 10-minute break, while class meetings of 180 minutes include two breaks, at the instructor’s discretion.

Academic Integrity

Students are encouraged to work together on the final project and homeworks. However, homeworks, including relevant code, will be graded individually and are expected to reflect students’ own thoughts and work.

You are expected to be honest in all of your academic work. Please consult Brandeis University Rights and Responsibilities for all policies and procedures related to academic integrity. Students may be required to submit work to verify originality. Allegations of alleged academic dishonesty will be forwarded to the Director of Academic Integrity. Sanctions for academic dishonesty can include failing grades and/or suspension from the university. Citation and research assistance can be found at LTS - Library guides.
Accommodations for students with disabilities

If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please see me immediately.

Topics and associated papers

1. Sports analytics

2. Information theory

3. Imaging

4. Epidemiology

5. Random walks

6. Game theory and linear programming