Summer 2020 Mathematics Course Descriptions

Math 10: Intro Special Topics: Coding Bootcamp: Intro Python, MATLAB, Intro to R

Instructor: Anca Andrei

Instructor email: anca.andrei@tufts.edu

Math 10 AB: Coding Bootcamp: Intro Python

Python is a general-purpose and is a popular choice as a first language because it is concise and easy to read, and it is also a good language to have in any programmer's stack as it can be used for everything from web development to software development and scientific applications. In this class, you will learn about both fundamental programming concepts and the Python programming language.

Math 10 BB: Coding Bootcamp: MATLAB

MATLAB is a special-purpose language that is an excellent choice for solving problems involving the manipulation of numbers/vectors/matrices. MATLAB is easy to learn, versatile and very useful for talents from the natural sciences, through all disciplines of engineering, to finance, and beyond, since it nicely combines calculation and graphic plotting. Starting from variables and basic operations, you will eventually learn how to handle data structures such as vectors and matrices. In the final section, you will dive deeper into the graphical capabilities of MATLAB, and create your own stunning data visualizations.

Math 10 BC: Coding Bootcamp: Intro to R

As one of the leading languages in data science and statistics, R is becoming the tool of choice for data science professionals in various fields. In this course, we will cover practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions, debugging, profiling R code, and organizing and commenting R code.

Math 10 BD: Coding Bootcamp

This course consists of three modules, exposing students to popular introductory level programming and trends. Through this course, students will gain beginning proficiency with software for areas like scientific writing, statistical software, or data mining. Registration in one, two, or three modules is permitted.

MATH 10BA An Introduction to Wealth Inequality (Online) Summer II 2020

Course Information

Block: Online, asynchronous

Instructor: Bruce Boghosian

Email: bruce.boghosian@tufts.edu

Office: 211 Bromfield-Pearson Hall

Live time: Twice per week, at times TBD

Phone: (617) 627-3054

Text: Instructor's notes, plus on-line material.

Prerequisites: High school mathematics. Prior familiarity with logarithms and exponential functions is helpful, but they will be reviewed. No prior background in economics is assumed

Semester hours: 3

Course Description

In 2010, there were 388 billionaires in the world whose combined wealth exceeded that of half the earth's population. Today, that number is under 25, and all indications are that it continues to decrease. The enormous concentration of wealth and the unchecked growth of inequality have emerged as crucial social issues of our time. To what extent can mathematics help shed light on this problem?

In this interdisciplinary course, we will learn to think about wealth distribution in a quantitative fashion. We will learn the difference between wealth, money and income, and we will learn how these things are measured by central banks, governments and international institutions. We will survey historical thought on this subject from mathematical, economic and philosophical perspectives.

We will ask questions such as,

- Can inequality be quantified? What properties should a mathematical measure of inequality have to capture our intuitive notion of the concept?
- Can idealized mathematical models, such as agent-based models, describe the current distribution of wealth with any accuracy?
- Are market economies naturally stable, or is continuous government intervention needed to keep them stable?
- What ethical tools exist to determine the morality of decisions that societies make about wealth distribution and wealth inequality?
- Should societies attempt to manage their levels of inequality? If so, what public policy tools do they have at their disposal for doing so? If not, what, if anything, should be done about runaway concentration of wealth?

What we learn along the way will raise deep mathematical, economic, and ethical questions about the way that human society has chosen to allocate limited resources amongst people and populations. Our emphasis will be on how mathematical thinking contributes to this critically important conversation.

Some description will be given of available databases for the study of wealth distribution, including that maintained by the Federal Reserve and the U.S. Census Bureau, as well as international data available, for example from the World's Top Incomes Database.

Course Mechanics

This is an online course that will not meet on campus. Most course activities and interactions will occur asynchronously and online through Canvas, Tufts' learning management system, and Zoom. You can take this course from anywhere as long as you have a reliable internet connection (broadband highly recommended). Online courses are held to the same academic standards as campus-based courses and students can expect high levels of interaction with faculty and classmates.

Online courses at Tufts are not self-paced, however they typically offer much more flexibility for students. Most of the time, our course content will be organized in a weekly structure, so students will be expected to login and participate regularly. However students can generally set their own schedule within each week as long as assignments and activities are completed on time.

All online courses will have regular instructor office hours where students have an opportunity to speak to their teacher, via telephone or web conferencing. Some courses may require a live session or two where students are expected to login to a web conferencing site at a certain date and time.

As of this writing, details of the examination process are still being worked out for Summer Session II 2020.

Math 19 A: Math of Social Choice

Instructor: Merek Johnson

Instructor email: merek.johnson@tufts.edu

Introduction to mathematical methods for dealing with questions arising from social decision making. Topics vary but usually include ranking, determining the strength of, and choosing participants in multicandidate and two-candidate elections, and apportioning votes and rewards to candidates. Recommendations: High school algebra. Engineering students are not permitted to take MATH 19 for credit.

Math 21 A: Introductory Statistics: Online

Instructor: Linda Garant

Instructor email: linda.garant@tufts.edu

Descriptive data analysis, sampling and experimentation, basic probability rules, binomial and normal distributions, estimation, regression analysis, one and two sample hypothesis tests for means and proportions. The course may also include contingency table analysis, and nonparametric estimation. Applications from a wide range of disciplines. Recommendations: High school algebra and geometry.

Math 21 B: Introductory Statistics

Instructor: Daniel Keliher

Instructor email: daniel.keliher@tufts.edu

Descriptive data analysis, sampling and experimentation, basic probability rules, binomial and normal distributions, estimation, regression analysis, one and two sample hypothesis tests for means and proportions. The course may also include contingency table analysis, and nonparametric estimation. Applications from a wide range of disciplines. Recommendations: High school algebra and geometry.

Math 32 A: Calculus I: Online

Instructor: Kim Ruane

Instructor email: kim.ruane@tufts.edu

Differential and integral calculus: limits and continuity, the derivative and techniques of differentiation, extremal problems, related rates, the definite integral, Fundamental Theorem of Calculus, derivatives and integrals of trigonometric functions, logarithmic and exponential functions. Recommendations: High school geometry, algebra, and trigonometry. Students will receive an additional two credits (with grade) for passing MATH 32 after receiving credit for MATH 30. MATH 32 must be taken at Tufts and for a grade.

Math 32 B: Calculus I

Instructor: Kim Ruane

Instructor email: kim.ruane@tufts.edu

Differential and integral calculus: limits and continuity, the derivative and techniques of differentiation, extremal problems, related rates, the definite integral, Fundamental Theorem of Calculus, derivatives and integrals of trigonometric functions, logarithmic and exponential functions. Recommendations: High school geometry, algebra, and trigonometry. Students will receive an additional two credits (with grade) for passing MATH 32 after receiving credit for MATH 30. MATH 32 must be taken at Tufts and for a grade.

Math 34 A: Calculus II

Instructor: David Gentile

Instructor email: david.gentile@tufts.edu

Applications of the integral, techniques of integration, separable differential equations, improper integrals. Sequences, series, convergence tests, Taylor series. Polar coordinates, complex numbers. Students may count only one of MATH 34 and MATH 36 for credit. Recommendations: MATH 32.

Math 34 B: Calculus II

Instructor: JinCheng Wang

Instructor email: jincheng.wang@tufts.edu

Applications of the integral, techniques of integration, separable differential equations, improper integrals. Sequences, series, convergence tests, Taylor series. Polar coordinates, complex numbers. Students may count only one of MATH 34 and MATH 36 for credit. Recommendations: MATH 32.

Math 42 A: Calculus III

Instructor: Mackenzie McPike

Instructor email: mackenzie.mcpike@tufts.edu

Vectors in two and three dimensions, applications of the derivative of vector-valued functions of a single variable. Functions of several variables, continuity, partial derivatives, the gradient, directional derivatives. Multiple integrals and their applications. Line integrals, Green's theorem, divergence theorem, Stokes' theorem. Prerequisite: MATH 34 or 39.

Math 50 B: Intro to Proof Writing

Instructor: Christopher Guevara

Instructor email: christopher.guevara@tufts.edu

The objective of this course is to learn how to write well-written and logically-justified proofs of mathematical statements, a skill which is vital for higher-level undergraduate math courses such as abstract algebra and real analysis. After establishing a foundation of propositional logic, various proof techniques will be covered, including direct proofs, indirect proofs, existence and uniqueness proofs, proof by cases, and proof by mathematical induction. These techniques will then be readily applied to prove things about numbers, sets, functions, and relations. In-class examples and assignments will help to strengthen and refine the skill of proof-writing, and to become better acquainted with LaTeX.

Math 51 A: Differential Equations

Instructor: Logo Lou

Instructor email: jiayi.lou@tufts.edu

An introduction to linear differential equations with constant coefficients, linear algebra, and Laplace transforms. Recommendations: MATH 42 or 44.

Math 61 A: Discrete Mathematics

Instructor: Srdjan Divac

Instructor email: srdjan.divac@tufts.edu

(Cross-listed as COMP 61.) Sets, relations and functions, logic and methods of proof, combinatorics, graphs and digraphs. Recommendations: MATH 32 or COMP 11 or permission of instructor.

Math 70 A: Linear Algebra

Instructor: Curtis Heberle

Instructor email: curtis.heberle@tufts.edu

Introduction to the theory of vector spaces and linear transformations over the real or complex numbers, including linear independence, dimension, matrix multiplication, similarity and change of basis, inner products, eigenvalues and eigenvectors, and some applications. Recommendations: MATH 34 or 39 or permission of instructor. Students may count only one of MATH 70 and MATH 72 for credit.

Math 123 A: Mathematical Aspects of Data A

Instructor: Abiy Tasissa

Instructor email: abiy.tasissa@tufts.edu

Dimension reduction and data compression via principal component analysis, and the singular value decomposition; k-means clustering; clustering via diffusion on weighted graphs; support vector machines; tensor data analysis; kernel trick. Homework includes programming. Prerequisite: MATH 42, and MATH 70 or MATH 72. Some prior programming experience desirable, but not required.