MAT199–APC199 Math Alive, Spring 2025

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Introduction Over the last century, mathematics has profoundly changed our world and advanced mathematics is now a crucial component in a number of tasks we take for granted on a daily basis. To name a few, we use encryption algorithms to securely send personal information over the internet every time we log into a website or make a purchase online. The development of new medicine and vaccines relies on scientists designing statistical methods to analyze clinical trials. Companies like Netflix, Google, Facebook and Amazon use statistical recommendation algorithms to promote personalized advertisements. Machine learning algorithms have been used to improve self-driving cars, autonomous robots, facial recognition software and much more.

This course is designed for those who have not had college mathematics, but would like to understand some of the mathematical concepts behind important modern applications. The emphasis is on ideas, not on sophisticated mathematical techniques, but there will be substantial problem-set requirements. Students will learn by doing examples.

Course topics In this course we will cover the mathematical principles behind selected applications as largely independent 2-week units. The topics this year will include:

- Probability
- Statistics
- Epidemiology
- Cryptography
- Game Theory
- Machine Learning (including Deep Learning and Artificial Intelligence)

Lecture slides will be available for download via canvas.

Course organization Classroom: Jadwin Hall A09. The first class is on Jan 28, 2025. There are two lectures per week: Tu, Th 11:00am–12:20pm (Eastern Time).

Course website `https://princeton.instructure.com/courses/17071`
A PALINDROME number, and $17, 71$ are two prime numbers, but 17071 is not ($17071 = 43 \times 397$).

Office Hours Arseniy: 4:00-5:00 pm Tuesday in Fine Hall 206
Jui-Hui: 4:30-5:30 pm Wednesday in Fine Hall 206
Sheng: 4:00-5:00 pm Thursday in Fine Hall 206 or by appointment

Homework Homework is assigned weekly and should be submitted by the due date, on Gradescope: `https://www.gradescope.com/courses/967021`. Entry Code:7E6Z3J.

Late homework cannot be accepted except in unusual circumstances, and by prior arrangement. Cooperation is encouraged, but you must write up all your solutions independently and list your collaborators on the problem set.

Grading The final grade will be comprised of the following components:

- Homework 40%
- Class participation 10%
- Midterm exam 25%
- Final essay 25%

The midterm exam will be take home, open book and consist of a few homework-style problems. The final essay should be 3 – 4 pages exploring some application of math in your own discipline that interests you (more instructions will be announced closer to the end of the term).

Class Schedule

Lect 1	Tue	1/28	Probability 1
Lect 2	Thu	1/30	Probability 2
Lect 3	Tue	2/4	Statistics 1
Lect 4	Thu	2/6	Statistics 2
Lect 5	Tue	2/11	Epidemiology 1, **HW 1 due**
Lect 6	Thu	2/13	Epidemiology 2
Lect 7	Tue	2/18	Epidemiology 3, **HW 2 due**
Lect 8	Thu	2/20	Cryptography 1
Lect 9	Tue	2/25	Cryptography 2, **HW 3 due**
Lect 10	Thu	2/27	Midterm review
Midterm	Wed	3/5	Due 11:59 pm
Lect 11	Tue	3/18	Cryptography 3
Lect 12	Thu	3/20	Cryptography 4
Lect 13	Tue	3/25	Cryptography 5, **HW 4 due**
Lect 14	Thu	3/27	Game theory 1
Lect 15	Tue	4/1	Game theory 2, **HW 5 due**
Lect 16	Thu	4/3	Game theory 3
Lect 17	Tue	4/8	Machine learning 1, **HW 6 due**
Lect 18	Thu	4/10	Machine learning 2
Lect 19	Tue	4/15	Machine learning 3, **HW 7 due**
Lect 20	Thu	4/17	Machine learning 4
Lect 21	Tue	4/22	Machine learning 5, **HW 8 due**
Lect 22	Thu	4/24	Machine learning 6
Final	Sun	5/11	Due 11:59 pm