MTH 707A: Markov chain Monte Carlo

INSTRUCTOR

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Th: 12:00pm - 1:15pm (on Zoom)

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COURSE DESCRIPTION

The course will provide a theoretical foundation for constructing and studying Markov chain Monte Carlo (MCMC) algorithms, along with tools for analyzing MCMC output. The course will primarily focus on discrete-time Markov chains on general state spaces. Special focus will be given on rates of convergence of a Markov chain and comparing different MCMC algorithms. Focus will be on the theoretical details embedded within an MCMC algorithm. The objective is to equip students with the tools to develop, study, and implement an MCMC algorithm for any given problem.

COURSE WEBPAGE

The course will run completely on mooKIT. All video lectures and notes will be updated there. A bare-bones webpage is at `https://dvats.github.io/teaching/MTH707`, which will have generic information about the course.

REFERENCES

There will be no one particular book we will follow. The course notes will be the primary reference. However, following will be useful references.

- Meyn, S. and Tweedie, R. (2009). Markov Chains and Stochastic Stability. Cambridge University Press
- Robert, C. and Casella, G. (1999). Monte Carlo Statistical Methods. SpringerVerlag, New-York.
- Brooks, Steve, Andrew Gelman, Galin Jones, and Xiao-Li Meng, eds (2011). Handbook of Markov chain Monte Carlo. CRC press.
- General state space Markov chains and MCMC algorithms by Roberts and Rosenthal.

TOPICS COVERED

Basics of Measure theory, Markov chain transition kernels, reversibility, irreducibility, ergodicity, Harris recurrence. Types of MCMC algorithm, rates of convergence, proving geometric ergodicity, Markov chains as operators, ordering Markov chains, Markov chain CLT, variance estimation, output analysis, visualization, and implementation.

PREREQUISITES

There is no particular prerequisite required for the course, except for a comfortable familiarity with analysis, statistics, randomness, and measure theory.

COMPUTING IN R

All implementations of MCMC algorithms will be done in `R`. Often, I would expect students to run short `R` programs. So sufficient working knowledge of `R` is required.

MARKS

There are will be homeworks to be submitted online on mooKIT approximately every two weeks. Depending on the final size of the class-room after the add/drop phase, I will decide whether homeworks submitted in groups will be allowed.

There is a project, which makes for 30% of the grade. This project may be broken down into smaller projects with presentations or a bigger project. More will be shared on this later. Since the class is relatively big, project will be group based. These groups will be made after the add-drop period is over.

There is no mid-sem exam.

Homeworks	30%
Project	30%
Final Exam	40%

What is Cheating?

Reproducing another student's homework is cheating. Reproducing from a paper without reference is cheating. Copying code is cheating. This class encourages group discussions and brainstorming sessions, but each student must write their own assignment independently. Academic dishonesty and plagiarism will have consequences.