STATS 102C - Introduction to Monte Carlo Methods

Course Description

Introduction to Markov chain Monte Carlo (MCMC) algorithms for scientific computing. Generation of random numbers from specific distribution. Rejection sampling and importance sampling and their roles in MCMC. Markov chain theory and convergence properties. Metropolis and Gibbs sampling algorithms. Extensions as simulated tempering. Theoretical understanding of methods and their implementation in concrete computational problems.

Office Hours:

I will hold in-person office hours every Monday from 3:30 to 4:30 p.m. at Slichter 3879 and remote office hours every Thursday from 4:30 to 5:30 p.m. You may use the link below for the remote office hours.

https://ucla.zoom.us/j/96759738087?pwd=qxxIOROZvxWGSOOPheCvxIGPTTxCxh.1 ⤵ **[(https://ucla.zoom.us/j/96759738087?pwd=qxxIOROZvxWGSOOPheCvxIGPTTxCxh.1)](https://ucla.zoom.us/j/96759738087?pwd=qxxIOROZvxWGSOOPheCvxIGPTTxCxh.1)**

Meeting ID: 967 5973 8087

Passcode: 084676

Lectures

Time: MW, 12:30 - 1:45 PM

Location: KAPLAN A65

All classes, discussion sections, and office hours are held in person. You should attend every class and ensure you catch up on the class's progress. If extenuating circumstances arise that may make this difficult, please let me know as soon as you can.

Course Materials

Required Textbook

None. Lecture notes will be provided on CCLE.

Course Resources

- Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), Chapman & Hall/CRC The R Series.
- Introducing Monte Carlo Methods with R, Robert C.P., and Casella, G (2010), Springer.

Required Software

- Programming Language/Software: R (Free to download at **https://cran.r-project.org** **(https://cran.r-project.org)**)
- Integrated Development Environment: RStudio (Free to download at **https://www.rstudio.com/** **(https://www.rstudio.com/)**)
- You will need a laptop (or tablet) for the exams. Please ensure your device is compatible with the lockdown browser.
- *If you don't, you may borrow one from CLICC. Information about borrowing laptops from CLICC is available here:* ***https://www.library.ucla.edu/clicc/lending*** ***(https://www.library.ucla.edu/clicc/lending)***

Tentative Course Outline

Course Outline

1. Probability and Statistics Review: Some definitions and concepts in probability and statistics.

2. Methods for Generating Random Variables: Inverse CDF, rejection sampling, and multivariate normal distribution.
3. Monte Carlo Methods: Monte Carlo integration, Antithetic variables, control variate, stratified sampling, and importance sampling.
4. Introduction to Markov Chains: Theory, examples, and convergence.
5. Markov Chain Monte Carlo Methods: Integration problems in Bayesian inference, the Metropolis-Hastings algorithm, and the Gibbs sampler.

Course Assignments

Quiz

There will be **5-7** online timed quizzes posted on BruinLearn, each available 3 days in advance. Please be aware of the deadlines; we will not extend them for any reason. The quizzes are open-book, and you will need the lockdown browser to complete them.

Homework

There will be **5-6** homework assignments depending on our progress. The assignments will be posted on the course website and (typically) due by 11:00 PM on the specified due date. Please include your first and last name, and student ID on every homework assignment. It is your responsibility to verify that your homework assignment is successfully uploaded by the deadline.

Exam

Please note that there will be two exams for this course, both of which will be held in person on the specified dates. It is essential that you bring your UCLA ID and laptop (or tablet) with you to take the in-class assessment. To ensure your success in the course, please do not make any travel plans that conflict with the exam dates, as no make-up exams will be given for any reason. Your attendance at both exams is crucial for your understanding of the course material, so please plan accordingly and prioritize your attendance on exam days. If you have any questions or concerns, please don't hesitate to reach out to me.

- **Midterm Exam:** Monday, Nov. 4, 2024, 12:30 PM - 1:45 PM
- **Final Exam**: Wednesday, Dec. 11, 2024, 11:30 AM-1:30 PM