



Course Description

Introduction to Markov chain Monte Carlo (MCMC) algorithms for scientific computing. Generation of random numbers from a 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.

Course Objective

This course provides students with a solid foundation in probability, statistics, and computational methods for simulating and analyzing complex systems. Students will learn techniques for generating random variables, apply Monte Carlo methods for integration and variance reduction, and develop an understanding of Markov chains and their convergence properties. The course further introduces Markov Chain Monte Carlo (MCMC) methods, including the Metropolis–Hastings algorithm and Gibbs sampling, with applications to Bayesian inference. By the end of the course, students will be able to apply these tools to solve practical problems in statistical modeling and data analysis.

Instructor Information:

Mark S. Handcock See <https://faculty.stat.ucla.edu/handcock>

Office Hours:

I will hold in-person office hours every Monday and Wednesday from 3:00 to 4:00 p.m. at Mathematical Sciences 8105, Suite C.

Lecture

Time: MW, 2:00 - 3:15 PM

Location: Kaplan A51

All classes, discussion sections, and office hours are held in person. You should attend every class and ensure you stay up to date on the class's progress.

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/help/services-resources/equipment-lending> (<https://www.library.ucla.edu/help/services-resources/equipment-lending>).*

Course Tentative Schedule

Week	Topic	Reading Reference
0-1	Probability and Statistics Review: Key definitions and concepts in probability and statistics	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), 2.1-2.6
2	Random Variable Generation I: Inverse CDF method, rejection sampling	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), 3.2, 3.3
3	Random Variable Generation II: Transformation methods	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), 3.4, 3.5, and 3.6
4	Midterm Exam + Monte Carlo integration	-
5	Monte Carlo Methods I: Antithetic variables, Control variates	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), Chapter 6
6	Monte Carlo Methods II: Stratified sampling, importance sampling	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), Chapter 6
7	Introduction to Markov Chains: Theory, examples, and convergence	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), Chapter 7
8	MCMC Methods I: Integration problems in Bayesian inference	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), Chapter 11
9	MCMC Methods II: Metropolis–Hastings algorithm	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), Chapter 11
10	MCMC Methods III: Gibbs sampler and applications	• Statistical Computing with R, Second Edition, Maria L. Rizzo (2019), Chapter 11
Final Week	Final Exam	-

Course Assignments

Quiz

There will be **6-9** online timed quizzes posted on BruinLearn, each available 3 days in advance. The homework assignment will be assigned weekly, depending on the progress. 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 homework assignment will be assigned on a biweekly basis, depending on the 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 administered in person on the specified dates. You are required to bring your UCLA ID and a laptop (or tablet) to complete the in-class assessments. Please avoid making any travel plans that conflict with the exam dates, as no make-up exams will be offered under any circumstances. Attendance at both exams is essential for evaluating your understanding of the course material, so plan accordingly and prioritize your participation on exam days. If you have any questions or concerns, please feel free to contact me.

- **Midterm Exam:** Wednesday, Oct. 28, 2026, 5:00 PM - 6:15 PM
- **Final Exam:** Wednesday, Dec. 11, 2026 (tentative)

Course Policies

Grading Policy

The final grade will be calculated using the weights listed below, and your letter grade will be assigned accordingly.

- 2% Attendance
- 5% Quiz (The weight will be evenly distributed across all quizzes)
- 20% Homework (The weight will be evenly distributed across all homework)
- 35% Midterm Exam
- 38% Final Exam

Note: The exam grades will be posted on MyUCLA Gradebook.

Grade Distribution

Final grades typically follow the standard scale, as shown in the following table; however, the cutoffs can be flexible to accommodate score distributions that do not fit the scale very well. Plus and minus cutoffs will be determined at the end of the quarter. **If everyone does well, everyone will get a good grade.**

Letter Grade Scheme

Grade	Percentage
A+	100% to 97%
A	96.99% to 93%
A-	92.99% to 90%
B+	89.99% to 87%
B	86.99% to 83%
B-	82.99% to 80%
C+	79.99% to 77%
C	76.99% to 73%
C-	72.99% to 70%
D+	69.99% to 67%
D	66.99% to 60%
F	59.99% to 0%

P-NP Grading

P	>= 73%
NP	< 73%

Academic Integrity Agreement

Please upload the signed integrity agreement before the due date of the first assignment. **No work would be graded without a signed agreement.**

Email Policy

Any email to the instructor or TA must include **your UID, your enrolled lecture**, and the **discussion section number** (e.g., "Stats 102C Dis 1A") in the subject heading.

Assignment Policies

- All assignments must be turned in through the respective submission portals on <https://bruinlearn.ecula.edu> ➡️(<https://bruinlearn.ecula.edu>). Email submissions will not be accepted: **Do not attach assignments to email.**
- A **ONE-hour** grace period will be granted for any late submissions. Assignments submitted after the grace period will receive a **10%** penalty for each **2-hour** period or portion thereof after the submission deadline. Exceptions to the late penalty are considered on a case-by-case basis to accommodate extenuating documented circumstances.
- Submissions must be reasonably presentable, properly indented, well-formatted, and easily readable to the grader. **Any submissions that are difficult for the grader to read will receive a penalty for style/readability.** For guidance on best practices for readable code: <https://code.tutsplus.com/tutorials/top-15-best-practices-for-writing-super-readable-code-net-8118> ➡️(<https://code.tutsplus.com/tutorials/top-15-best-practices-for-writing-super-readable-code-net-8118>)
- All submitted work must be independently written by each student and adhere to the university policy on academic integrity. **Searching for, finding, or using solutions online is considered academically dishonest.**
- Collaboration between students on any submission, whether in draft or final form, to meet course requirements will be considered unauthorized unless explicitly stated in the assignment in question, or expressly permitted by the instructor or TA.

Regrade Policy

Requests for homework regrade should be sent to the TA, with the professor copied on the email. The TA will address the grading concern. Homework submissions will be regraded in their entirety, and any grade adjustments (whether an increase or decrease) will be considered final.

Homework Extension

I will grant a **24-hour** reprieve from the late penalty for homework submissions if the homework is accompanied by **documentation**. **The documentation must be uploaded onto CCLE with the homework submission.**

Homework settings on CCLE will be adjusted to accept multiple file submissions. Submit a PDF or photograph of the documentation showing the date and reason for your inability to submit the homework on time. **Please don't email the professor your documentation.** Extensions beyond **24** hours will be granted **in only the most extreme circumstances**, and will only be granted in person by the instructor.

Course Grade Changes

It is the student's responsibility to check grades on Bruinlearn/myUCLA's gradebook in a timely manner so that any grade issues (e.g., missing or incorrect grades) are resolved well before the quarter is over. All grades are considered final **24** hours after the final exam and cannot be appealed.

After course grades have been submitted to the Registrar, grades are final. Grade changes will only be considered if there has been a clerical or procedural mistake. Students have one quarter to make requests for a grade change. Graded exams and other materials will be kept for one quarter. After one quarter, course grade changes will not be made.

Anti-Racism Resources

The University of California is committed to eradicating systemic racism in university life and operations. Here, our campus leaders have gathered anti-racism resources in <https://diversity.universityofcalifornia.edu/anti-racism-resources/> (<https://diversity.universityofcalifornia.edu/index.html>) to share, including links to articles, books, podcasts, films, and listings of anti-racism training and webinars. These materials can guide all of us to become active participants in combating racism on our campuses and in our communities.

University Policies

Academic Integrity

UCLA is a community of scholars. In this community, all members, including faculty, staff, and students alike, are responsible for maintaining standards of academic honesty. As a student and member of the University community, you are here to get an education and are, therefore, expected to demonstrate integrity in your academic endeavors. You are evaluated on your own merits. Cheating, plagiarism, collaborative work, multiple submissions without the permission of the professor, or other kinds of academic dishonesty are considered unacceptable behavior and will result in formal disciplinary proceedings, usually resulting in suspension or dismissal. See the [Dean of Students website \(https://deanofstudents.ucla.edu/\)](https://deanofstudents.ucla.edu/) for more information.

[source: Dean of Students syllabus statement ([syllabus \(https://deanofstudents.ucla.edu/file/4b995724-f033-476a-bccc-f6103528d959\)](https://deanofstudents.ucla.edu/file/4b995724-f033-476a-bccc-f6103528d959).)]

Accommodations for Students with Disabilities:

If you are already registered with the Center for Accessible Education (CAE), please request your Letter of Accommodation in the Student Portal. If you are seeking registration with the CAE, please submit your request for accommodations via the CAE website. Students with disabilities requiring academic accommodations should submit their request for accommodations as soon as possible, as it may take up to two weeks to review the request. For more information, please visit the [CAE website \(http://www.cae.ucla.edu/\)](http://www.cae.ucla.edu/), visit the CAE at A255 Murphy Hall, or contact us by phone at (310) 825-1501.

[source: Center for Accessible Education ([Faculty Questions \(https://cae.ucla.edu/faculty/faqs/\)](https://cae.ucla.edu/faculty/faqs/))]

Resources for Students

UCLA provides resources if you are feeling overwhelmed and need personal and/or academic assistance.

Please see the [Red Folder REV2020 web \(https://studentincrisis.ucla.edu/file/39679e1c-a57d-48d0-83a2-a906c1e53669\)](https://studentincrisis.ucla.edu/file/39679e1c-a57d-48d0-83a2-a906c1e53669) for more information.

Title IX

Advocacy and Confidential Services

Please note that Title IX prohibits gender discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking.

If you have experienced sexual harassment or sexual violence, you can receive confidential support and advocacy at the CARE Advocacy Office for Sexual and Gender-Based Violence, 205 Covel Commons, Los Angeles, CA, 90095, care@careprogram.ucla.edu, (310) 206-246 5.

Counseling and Psychological Services (CAPS) provides confidential counseling to all students and can be reached 24/7 at (310) 825-0768.

Reporting and Non-confidential Services

Your professor is required under the UC Policy on Sexual Violence and Sexual Harassment to inform the Title IX Coordinator should he become aware that you or any other student has experienced sexual violence or sexual harassment. In addition, You can also report sexual violence or sexual harassment directly to the University's Title IX Coordinator, 2255 Murphy Hall, titelx@equity.ucla.edu, (310) 206-3417. Reports to law enforcement can be made to UCPD at (310) 825-1491.