STAT 4224/5224 — Bayesian Statistics

Spring 2023

Class hours: Monday and Wednesday, 6:10 – 7:25 pm
Classroom: 501 Schermerhorn Hall

Instructor: Prof. Dobrin Marchev
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Office Hours: Monday & Wednesday 4 – 5 pm

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TA Office Hour: Tue, 6 – 8 pm

Course description

This course introduces the Bayesian paradigm for statistical inference. Topics covered include Bayes' rule; probability as a measure of uncertainty; binomial, Poisson and normal models; Markov chain Monte Carlo methods; Metropolis-Hastings algorithm and Gibbs sampler; Bayesian regression models; mixture and multilevel hierarchical models. The emphasis throughout will be on the application of Bayesian methods to the analysis of real data.

Prerequisites

A course in the theory of statistical inference, such as Statistics 4204/5204; a course in statistical modeling and data analysis, such as Statistics 4205/5205. Familiarity with the R statistical programming language is also essential.

Textbook

"A First Course in Bayesian Statistical Methods" by Peter D. Hoff. 2009

Computing

Most examples will be done in R, but sometimes we will also use RStan. You are free to use a different software if your wish, but the instructor and teaching assistant will only be able to help you with R.

Course grading

- Homework assignments collected every other week: 40%
- Midterm covering the first half of the course: 20%
- Cumulative final at the end of the semester covering topics from the entire course: 40%

Tentative weekly breakdown of topics:

Week	Dates	Topics	Reading
1	1/18	Introduction & Bayes' rule	Ch 1-2
2	1/23 – 1/25	Probability Binomial model	Ch 2 - 3
3	1/30 – 2/1	Poisson model Normal model	Ch 3 & 5
4	2/6 – 2/8	Two-parameter normal model Monte Carlo methods	Ch 5 Ch 4
5	2/13 – 2/15	Large-sample inference Hierarchical models	Ch 8
6	2/27 – 3/1	The hierarchical normal model Numerical integration	Ch 8
7	3/6 – 3/8	Review and midterm	
8	3/13 – 3/15	**No class, spring break**	
9	3/20 – 3/22	MCMC Metropolis-Hastings	Ch 10
10	3/27 – 3/29	MCMC diagnostics Gibbs sampler	Ch 6
11	4/3 – 4/5	Finite mixture models Multivariate normal model	Ch 7 & 9
12	4/10 – 4/12	Missing data Linear regression	Ch 7 & 9
13	4/17 – 4/19	Model selection Hierarchical linear models	Ch 9 & 11
14	4/24 – 4/26	GLM	Ch 10-11
15	5/1	Review for final exam	

Working together

Collaboration on homework is allowed, and even encouraged — you should feel free to discuss homework problems with your classmates as well as the instructor and teaching assistant. However, all work submitted must be your own. If multiple students turn in identical solutions, all of them will receive a zero.

Academic Integrity

As students of this class, you must be responsible for the full citations of others' ideas in all of your assignment and projects; you must be scrupulously honest when taking your examinations; you must always submit your own work and not that of another student, scholar, or internet agent. Any breach of this intellectual responsibility is a breach of faith with the rest of our academic community. It undermines our shared intellectual culture, and it cannot be tolerated. Students failing to meet these responsibilities should anticipate being asked to leave Columbia. You will be asked to sign an honor pledge on all homework assignments, quizzes, and examinations of this class.

Read more at https://www.college.columbia.edu/academics/academicintegrity.

Disability services

To receive disability accommodations, students should first be registered with Disability Services (DS). Registered students can contact DS to arrange accommodations for this course, including exam accommodations. Students should bring an accommodation letter for signature to the professor for this course to inform the professor of the types of accommodations they will be needing during the course.