

Syllabus of STAT:6970

Spring 2022

Fundamentals and modern topics in Bayesian statistics

Lectures	MWF 4:30pm - 5:20pm, 31 SH
Instructor	Aixin Tan, 259 SH, 335-0821, aixin-tan@uiowa.edu
Office Hours	T & Th 8:45am - 10:00am, and by appointment
Webpage	Lecture notes, homework assignments, etc. will be posted in ICON.

Prerequisites. The course prerequisites include mathematical statistics courses (e.g. STAT:5100 based on Casella&Berger, or equivalents), applied statistics courses that cover regression (e.g. STAT:5200, or STAT:4540, or equivalents). Prior experience in Bayesian Statistics (e.g. STAT:4520, STAT:7520) will be very helpful but not required. The ability to program in R and to read statistical papers are expected.

In general, the more prepared your are, the more details you will understand. But most students with decent statistical background will benefit from “tasting a sample” of modern topics, techniques, and open problems in Bayesian inference and computing.

Contents. Possible contents for lectures, readings, and projects include:

- Theory: decision-theoretic foundations of Bayesian methods, Bayesian inference, model choice (e.g. Bayes factor and its computing, cross-validations), model averaging, etc.
- Bayesian Models: general hierarchical models, generalized linear mixed models (GLMM), infinite and finite mixture models, topic modeling, neural networks, nonparametric Bayesian models, etc.
- Computing: Markov chain Monte Carlo (MCMC), sequential Monte Carlo (SMC), approximate bayesian computing (ABC), variational methods (VI), integrated nested Laplace approximation (INLA), etc.

Books. Instead of one textbook, we will sample materials from several books and a list of seminal papers. A few classical books we will extract learning materials from are:

- The Bayesian Choice – From Decision-Theoretic Foundations to Computational Implementation. Robert, Christian. Springer, 2007. (Free access to ebook through UI library.)
- Handbook of Markov Chain Monte Carlo. Edited by Brooks, Gelman, Jones and Meng. Chapman and Hall/CRC, 2011. (Free online access to most chapters.)
- Pattern Recognition and Machine Learning. Bishop, Christopher. Springer, 2006. (Free online access.)

Grading. Your semester grade will be based on a few homework assignments (every 2 to 3 weeks, counts for 50% of the semester grade), tests (10%, most likely a few quizzes), and a final project (40%, see below).

Final Project.

Each student must complete a class project on a topic of his/her choice involving Bayesian theory, Bayesian methodology, Bayesian computation and/or Bayesian analysis of an applied problem. The project should represent roughly 20 hours of new work, to be carried out in two phases:

- Project proposal (due Wed, Mar 23)

This is a detailed description of what you plan to do, including question(s) to be addressed, dataset to be used (if any), methods and software to be applied, etc. It should be 2 pages in length, including references.

- The final product of the project will be a 20-minute oral presentation (no more than 30 slides). Expect to turn in your report or presentation slides by Fri, Apr 22. Starting from the week of Apr 25, class time will be spent on student presentations.

Note: Scoring of the final project will be based on quality of the analysis and/or methodology, clarity of the slides, and effectiveness of the in-class presentation. One chance to learn how to give presentations is by attending weekly department seminars. There are also many video resources online (such as <http://videolectures.net>) where you can find famous statisticians giving talks related to our course.

Dept. of Statistics and Actuarial Science 241 SH, <http://www.stat.uiowa.edu>
Prof. Chan, DEO, 335-0712, Kungsik-Chan@uiowa.edu

COLLEGE OF LIBERAL ARTS AND SCIENCES (CLAS)
Graduate Course Syllabus Insert
Spring 2022

ATTENDANCE AND CLASSROOM EXPECTATIONS

Students are responsible for attending class and for knowing an instructor's attendance policies, which vary by course and content area. All students are expected to attend class and to contribute to its learning environment in part by complying with University policies and directives regarding appropriate classroom behavior or other matters.

ABSENCES

Students are responsible for communicating with instructors as soon they know that an absence might occur or as soon as possible in the case of an illness. Delays in communication could result in a forfeit of what otherwise might be an excused absence.

ABSENCES: ILLNESS, UNAVOIDABLE CIRCUMSTANCES, AND UNIVERSITY SPONSORED ACTIVITIES

Students who are ill, in an unavoidable circumstance affecting academic work, or who miss class because of a University sponsored activity are allowed by UI policy to make up a missed exam. Documentation is required by the instructor except in the case of a brief illness. Students are responsible for communicating with instructors as soon as the absence is known (<https://opsmanual.uiowa.edu/students/absences-class#8.1>).

ABSENCES: HOLY DAYS

The University is prepared to make reasonable accommodations for students whose religious holy days coincide with their classroom assignments, test schedules, and classroom attendance expectations. Students must notify their instructors in writing of any such Religious Holy Day conflicts or absences within the first few days of the semester or session, and no later than the third week of the semester. If the conflict or absence will occur within the first three weeks of the semester, the student should notify the instructor as soon as possible. See [Operations Manual 8.2 Absences for Religious Holy Days](#) for additional information.

ABSENCES: MILITARY SERVICE OBLIGATIONS

Students absent from class due to U.S. veteran or U.S. military service obligations (including military service-related medical appointments, military orders, and National Guard Service obligations) must be excused without penalty. Instructors must make reasonable accommodations to allow students to make-up exams or other work. Students must communicate with their instructors about the expected possibility of missing class as soon as possible. (For more information, see <https://opsmanual.uiowa.edu/iv-8-absences-class%C2%A0-0>).

ACADEMIC MISCONDUCT

Plagiarism and the process for addressing academic misconduct of graduate students are defined in [Section IV, Article F "Plagiarism by Graduate Students" of the UI Graduate College Manual of Rules and Regulations](#). Please contact the CLAS Associate Dean for Graduate Education for any necessary assistance in navigating the process mandated by the Graduate College.

ACADEMIC ACCOMMODATIONS

The University is committed to providing an educational experience that is accessible to all students. If a student has a diagnosed disability or other disabling condition that may impact the student's ability to complete the course requirements as stated in the syllabus, the student may seek accommodations through [Student Disability Services](#) (SDS). SDS is responsible for making Letters of Accommodation (LOA) available to the student. The student must provide a LOA to the instructor as early in the semester as possible, but requests not made at least two weeks prior to the scheduled activity for which an accommodation is sought may not be accommodated. The LOA will specify what reasonable course accommodations the student is eligible for and those the instructor should provide. Additional information can be found on the [SDS website](#). Note that accommodations are not granted retroactively but from the time of the student's request to the instructor onward. Graduate students serving as Teaching Assistants, Research Assistants, or Fellows must contact Faculty and Staff Disability Services (<https://hr.uiowa.edu/support/faculty-and-staff-disability-services>) for assistance with accommodations.

CLASS RECORDINGS: PRIVACY AND SHARING

Course lectures and discussions are sometimes recorded or live-streamed. These are only available to students registered for the course and the intellectual property of the faculty member. These materials may not be shared or

reproduced without the explicit written consent of the instructors. Students may not share these recordings with those who are not enrolled in the course; likewise, students may not upload recordings to any other online environment. Doing so is a breach of the Code of Student Conduct and could be a violation of the Federal Education Rights and Privacy Act (FERPA); also see <https://dos.uiowa.edu/policies/code-of-student-life/>.

COMMUNICATION: UI EMAIL

Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community ([Operations Manual, III.15.2](#)). Emails should be respectful and brief, with complex matters addressed during the instructor's drop-in hours, for example. Faculty are not expected to answer email after business hours or during the weekends.

FREE SPEECH AND EXPRESSION

The University of Iowa supports and upholds the First Amendment protection of freedom of speech and the principles of academic and artistic freedom. We are committed to open inquiry, vigorous debate, and creative expression inside and outside of the classroom. Visit Free Speech at Iowa for more information on the University's policies on free speech and academic freedom: <https://freespeech.uiowa.edu/>.

COMPLAINTS ABOUT ACADEMIC MATTERS

Students with a complaint about a grade or a related academic matter should first visit with the instructor and then with the course supervisor (if applicable), and finally with the director of the school, department, or program offering the course. If a graduate student has not been able to resolve the issue through the director of the school, department, or program, they should contact the associate dean for graduate education in the College of Liberal Arts and Sciences.

FINAL EXAMINATION POLICIES

The final exam schedule is published during the fifth week of the fall and spring semesters or on the first day of summer classes; students are responsible for knowing the date, time, and place of their final exams. Students should not make travel plans until knowing this information. A student with exams scheduled on the same day and time or who have more than two final exams on the same day should visit this page for how to resolve these problems by the given deadline (<https://registrar.uiowa.edu/makeup-final-examination-policies>). No exams are allowed the week before finals, but with some exceptions made for labs, language courses, and off-cycle courses (<https://registrar.uiowa.edu/final-examination-scheduling-policies>).

HOME OF THE COURSE

The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the policies and procedures for its courses. Graduate students, however, must adhere to the academic deadlines set by the Graduate College. See <https://grad.uiowa.edu/academics/deadlines>.

MENTAL HEALTH

Students are encouraged to be mindful of their mental health and seek help as a preventive measure or if feeling overwhelmed and/or struggling to meet course expectations. Students are encouraged to talk to their instructor for assistance with specific class-related concerns. For additional support and counseling, students are encouraged to contact University Counseling Service (UCS). Information about UCS, including resources and how to schedule an appointment, can be found at counseling.uiowa.edu. Find out more about UI mental health services at: mentalhealth.uiowa.edu. Student Health can also address related concerns (<https://studenthealth.uiowa.edu/>). These visits are free to students. After hours, students are encouraged to call the Johnson County Community Crisis Line at (319) 351-0140 or dial 911 in an emergency.

NON-DISCRIMINATION STATEMENT

The University of Iowa prohibits discrimination in employment, educational programs, and activities on the basis of race, creed, color, religion, national origin, age, sex, pregnancy, disability, genetic information, status as a U.S. veteran, service in the U.S. military, sexual orientation, gender identity, associational preferences, or any other classification that deprives the person of consideration as an individual. The university also affirms its commitment to providing equal opportunities and equal access to university facilities. For additional information on nondiscrimination policies, contact the Director, [Office of Institutional Equity](#), the University of Iowa, 202 Jessup Hall, Iowa City, IA 52242-1316, 319-335-0705, oie-ui@uiowa.edu. Students may share their pronouns and chosen/preferred names in [MyUI](#), which is accessible to instructors and advisors.

SEXUAL HARASSMENT

The University of Iowa prohibits all forms of sexual harassment, sexual misconduct, and related retaliation. The [Policy](#)

[on Sexual Harassment and Sexual Misconduct](#) governs actions by students, faculty, staff and visitors. Incidents of sexual harassment or sexual misconduct can be reported to the [Title IX and Gender Equity Office](#) or to the [Department of Public Safety](#). Students impacted by sexual harassment or sexual misconduct may be eligible for academic supportive measures and can learn more by [contacting the Title IX and Gender Equity Office](#). Information about confidential resources can be found [here](#). Watch the [video](#) for an explanation of these resources.