

Statistical Methodology II: Bayesian Modeling and Inference- STAT 632

Spring 2018 (Tuesday/Thursday: 2:20 – 3:35 pm) at Blocker 411

Course description: *Statistical Methodology II: Bayesian Modeling and Inference* is a graduate level course on Bayesian methods. The course will introduce the Bayesian paradigm and focus (more or less equally) on Bayesian modeling, computation and inference. Broadly, the course objective is to enable the students to (a) understand the fundamental aspects of the Bayesian paradigm and (b) gain expertise in setting up a Bayesian model in an applied context and perform posterior computation & inference. Accordingly, the course will have a theoretical as well as an applied component.

Prerequisites: STAT 610 (Distribution theory), STAT 611 (Statistical Inference) or equivalent. Familiarity with some high level programming language (preferably R or Matlab) will be necessary.

Instructor Information: Dr. Anirban Bhattacharya

- Email: anirbanb@stat.tamu.edu (*When you send me an e-mail, use subject-line “[STAT632]”*)
- Phone: 979-845-3141 (Department of Statistics Front Office)
- Office: Blocker 401D
- Office Hours: Tuesday/Thursday 3:35 – 4:35 pm (*If you are unable to meet at these times, then schedule an appointment with the instructor for an alternative time.*)
- No Teaching Assistants are assigned for this course. Feel free to ask questions anytime by email or schedule appointment for meeting.

Course Webpage:

- **Ecampus:** To access the blackboard site go to <http://ecampus.tamu.edu> and login using your NetID and password. Your main resources for this course are the regular classes and the course materials disseminated through *ecampus*. All course messages will be sent via ecampus; please make sure to check your inbox regularly. I shall occasionally post short lecture notes on topics that may not be sufficiently elaborated in the books.

Textbooks: I shall combine/select materials from the following two books:

- Christian P. Robert (2007). *The Bayesian Choice: From Decision-Theoretic Foundations to Computational Implementation*. Springer (Second Edition).
- Peter Hoff (2009). *A first course in Bayesian statistical methods*. Springer.

Electronic copies of both of these books should be available from the TAMU library. We shall tentatively cover (parts of) Chapters 1 – 11 of Hoff & Chapters 1 – 8 & 10 of Robert. Specific chapters/sections shall be mentioned while the topics are being covered in class.

Course objective: This course will cover topics on Bayesian modeling and inference.

Course topics & calendar of activities: Tentatively, we will cover following topics.

- Review of distribution theory and basic sampling methods. Monte Carlo (MC) and importance sampling. Fundamentals of Bayesian inference. ([Weeks 1-2](#))
- Conjugate priors in one-parameter and multi-parameter exponential families. ([Weeks 3-4](#))
- Bayesian asymptotics. Bernstein–von Mises theorem. ([Week 5](#))
- Posterior computation with non-conjugate priors. Bootstrap filter, Metropolis–Hastings algorithm, Markov chain Monte Carlo (MCMC) methods. Gibbs & slice Sampling. MCMC diagnostics. ([Week 6-9](#))
- Data augmentation and latent variable models ([Week 10-11](#))
- Hypothesis testing and model selection ([Week 12-13](#))
- Advanced topics (TBD) ([Week 14](#))

Software: We will primarily use R and MATLAB for data analysis. Refer to <http://cran.r-project.org/doc/manuals/R-intro.pdf> for an R introduction. You are free to use whichever software you prefer.

Homework & writing assignment: Homework will be assigned (approx.) biweekly and will be due in class one week from the day assigned. Homework problems will contain both theoretical and numerical problems. It is essential that you work through the homework problems carefully to master the course material. *Some comments regarding the homework.* I may not grade all problems for a particular homework. If you have specific questions about a particular problem, it is your responsibility to discuss with me during office hours and not wait until I return the graded copy. I do not have a TA for this course, and may take some time to return the homework depending on other commitments. Before you submit the homework, do keep a copy with you. Each homework carries equal weight. You are allowed to work with other students on the homework problems, however, verbatim copying of homework is absolutely forbidden and constitutes a violation of the Honor Code. Therefore, each student must ultimately produce his or her own homework to be turned in and graded.

Homework dates

- Homework 0: Jan 25 in class.
- Homework 1: Feb 6 in class.
- Homework 2: Feb 24 in class
- Homework 3 March 27 in class
- Homework 4: April 16, in class
- Homework 4: April 25, in class

Exams: There will be two midterms and one final exam. The two midterms will be held in class during regular class hours on *Thursday, February 22 (Midterm 1)* and *Thursday, April 5 (Midterm 2)*. The midterm dates may be changed by an in-class announcement. The final exam is scheduled in class on *May 8, Tuesday, 1-3 pm.* (check <http://registrar.tamu.edu/general/finalschedule.aspx>)

Grading policies: The weightage for the different components are provided in the left panel of the table below. The scheme in the right panel (or its close variant according to my discretion) will be used to convert the percentage points to letter grades.

20%	Homework	A	90 - 100 %
25%	Midterm 1	B	80 - 90 %
25%	Midterm 2	C	70 - 80 %
30%	Final	D	60 - 70 %

Table 1: Grade distribution & percentage to grade conversion

Attendance: You are strongly encouraged to attend all classes. Regarding the university attendance policy, refer to <http://student-rules.tamu.edu/rule07>.

Make up policy: If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence. The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details <http://student-rules.tamu.edu/rule07>). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at <https://stuactonline.tamu.edu/app/sponsauth/index>.

2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
 - (a) Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
 - (b) Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
 - i. Texas A&M University Explanatory Statement for Absence from Class form available at <http://attendance.tamu.edu>
 - ii. Confirmation of visit to a health care professional affirming date and time of visit.
 - (c) An absence for a non-acute medical service does not constitute an excused absence.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class. Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

Statement on Disabilities: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information visit <http://disability.tamu.edu/>.

Statement on Plagiarism: The handouts used in this course are copyrighted. By "handouts," I mean all materials generated for this class, which include but are not limited to syllabi, quizzes, exams, lab problems, in-class materials, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy the handouts, unless I expressly grant permission. As commonly defined, plagiarism consists of passing off as one's own ideas, words, writing, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you should have the permission of that person. Plagiarism is one of the worst academic sins, for the plagiarist destroys the trust among colleagues without which research cannot be safely communicated. If you have any questions regarding plagiarism, please consult the latest issue of the Texas A&M University Student Rules, under the Section "Honor System Rules." Reference aggiehonor.tamu.edu if you have questions or concerns.

Academic Honor System: "An Aggie does not lie, cheat, or steal or tolerate those who do". Academic dishonesty cases will be handled in accordance the University's policies. Please see <http://aggiehonor.tamu.edu> for the complete Honor Council Rules and Procedures.