Bayesian Statistics - STAT 438
Spring 2020 (Monday / Wednesday: 3:30 − 4:45 pm) at Blocker 448

Course description: Bayes rule; conjugate priors; Bayesian hypothesis testing; MCMC in non-conjugate models, Hierachical Bayesian models; Bayesian generalized linear models; Data analysis using `R`

Prerequisites: MATH 221; STAT 408 or equivalent.

Instructor Information: Dr. Debdeep Pati

- Email: debdeep@stat.tamu.edu (*When you send me an e-mail, use subject-line* "[STAT438]")

- Office: Blocker 401C, Ph: (979) 845-3141

- Office Hours: Monday / Wednesday: 4:45 − 5:45pm (*If you are unable to meet at these times, then schedule an appointment with the instructor for an alternative time.*)

- Undergraduate office hours: To be announced

Course Webpage:

- **Class website:** http://stat.tamu.edu/∼debdeep/438_s20.html (will be available by January 13, 2020).

- The class web site will have important information about the course.

- **Ecampus:** To access the blackboard site go to http://ecampus.tamu.edu and login using your NetID and password. Only grades will be posted on that site and you can access it. All the important information will be posted on the course webpage.

Textbooks (Recommended): The material taught in the class will be based on

- *Doing Bayesian Data Analysis: A Tutorial with `R`, `JAGS` and `STAN`* by John Kruschke.

- *Statistical Rethinking: A Bayesian Course with Examples in `R` and `STAN`* by Richard McElreath

Course objective: This course will cover introductory topics in Bayesian inference. Some homeworks will involve writing programs in `R` (using `JAGS` and `STAN`) for data-analysis.

Course topics & calendar of activities (subject to change): Tentatively, we will cover following topics.

- Introduction and a review of probability and statistics (Jan 13, 15)

- Bayes Rule; parameters, prior, posterior (Jan 22)

- Conjugate priors: examples (Jan 27, 29)

- Using `R` for Bayes (Feb 3, 5)

- Non-conjugate priors and introduction to MCMC (Feb 10, 12)

- Bayesian hypothesis testing (Feb 17, 19)

- Bayesian model selection (Feb 24)

- Using `JAGS` in `R` for MCMC & Examples (March 2, 4)

- Bayesian hierarchical models (March 16,18)

- Bayesian hierarchical models (March 23, 25)

- Generalized linear models (March 30, April 1)

- Generalized linear models (April 6)

- Using `STAN` in `R` for MCMC & Examples (April 13, 15)

- More examples (April 20, 22)

- Review (April 27)

Software: We will primarily use `R` for data analysis. Refer to `http://cran.r-project.org/doc/manuals/R-intro.pdf` for an R introduction.

Grading policies: Your grade will be based on attendance and class participation (5%), homeworks (15%), 2 mid-terms (25% each) and final (30%). The grade cutoffs are 90.0% for the lowest A, 80.0% for the lowest B, and 70.0% for the lowest C. However, these grade cutoffs may be adjusted downward at my discretion. Note that all the exams will be closed book and closed notes.

Exam dates:

- Midterm 1: February 26 (Wed), in class.

- Midterm 2: April 8 (Wed), in class.

- Final exam: May 4 (Monday 10:30 a.m. - 12:30 p.m.), in Blocker 448.

Other important dates:

- First class: January 13 (Monday)

- Last class: April 27 (Monday)

- Reading day (no class): April 29 (Wednesday)

- University declared Holiday on January 20 (Monday)

- Spring Break: March 9 - March 13

Homeworks There will be about 5 homeworks starting with homework zero (designed to evaluate preparedness for taking the course). Solution sketches may be provided or discussed in class. To receive credit for the homework you must show all work neatly, write in blue or black pen or pencil (never in red), clearly label each problem, circle your final answers, staple your entire assignment together in the correct order with your full name printed (as appeared in howdy/ecampus) on the first page. Assignments written in latex are also acceptable. Any homework violating any of these rules will receive a grade of zero for the entire assignment.

Homework give out dates (subject to change):

- Homework 0: Jan 13

- Homework 1: Jan 29

- Homework 2: Feb 17

- Homework 3: March 18

- Homework 4: April 15

Attendance: You will get the 5% points for attendance and class participation if you do not miss more than four classes. Please note that if you miss more, except in very special cases, you will get 0% on 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 and the student will get 0% on the attendance. 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.

Disabilities Help: 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 Resources, located in the Student Services Building on the Main Campus, call 979-845-1637, or email disability@tamu.edu. For additional information, visit the Office of Disability Resources (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." Refer to http://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.

Title IX and Statement on Limits to Confidentiality: Texas A&M University and the College of Science are committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws provide guidance for achieving such an environment. Although class materials are generally considered confidential pursuant to student record policies and laws, University employees, including instructors, cannot maintain confidentiality when it conflicts with their responsibility to report certain issues that jeopardize the health and safety of our community. As the instructor, I must report (per Texas A&M System Regulation 08.01.01) the following information to other University offices if you share it with me, even if you do not want the disclosed information to be shared: *Allegations of sexual assault, sexual discrimination, or sexual harassment when they involve TAMU students, faculty, or staff, or third parties visiting campus.* These reports may trigger contact from a campus official who will want to talk with you about the incident that you have shared. In many cases, it will be your decision whether or not you wish to speak with that individual. If you would like to talk about these events in a more confidential setting, you are encouraged to make an appointment with the Student Counseling Service (https://scs.tamu.edu/).

Students and faculty can report non-emergency behavior that causes them to be concerned at http://tellsomebody.tamu.edu.