STT 465: Bayesian Statistical Methods

Michigan State University, Fall 2025

Instructor: Shrijita Bhattacharya

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OFFICE HOUR: Mondays 12:00 PM - 2:00 PM at office or by appointment.

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Lectures Schedule:

In Person: Mondays and Wednesdays 10:20 AM-11:10 AM, NS140 NatSci Building.

Online: Fridays 10:20-11:10 AM, Zoom (https://msu.zoom.us/j/93181184160?from=addon; Passcode: 656871). This will focus more on Examples and R-tutorials.

Help Room: https://stt.natsci.msu.edu/academics/statistics-learning-center/.

Course Web Page: All course materials and homeworks will be posted on D2L.

Recommended Background:

- Knowledge of statistics and probability at the level STT 441 & 442 is required throughout the course. We will review some basic probability and statistics theory at the beginning of the course.
- STT 180 is recommended. We will use the programming language `R` for statistical computing and graphics throughout the course. `R` (https://www.r-project.org/) and `RStudio` (https://posit.co/products/open-source/rstudio/) can be downloaded for free. We will get some brief introduction to `R` but I will NOT be teaching `R` in this class.

Required Course Materials:

- Peter D. Hoff (2009). *A First Course in Bayesian Statistical Methods*. Springer.
  - This is the textbook we will follow, and it has been used for this course over the past few years. It is available through https://link.springer.com/book/10.1007/978-0-387-92407-6 (Springer Link) or MSU library.
- Ben Lambert (2018). *A student's guide to Bayesian statistics*. SAGE Publications Ltd.
  - It provides a much friendlier read for an introduction to Bayesian analysis. We will use this mostly as a reference book. It can be ordered from Amazon. An electronic version may be found using google.

Attendance: You are expected to attend all meetings of the class. If you miss a class for whatever reason, you are responsible for all covering materials, assignments and deadlines.

In case a student is unable to attend lectures over an extended period, please collect lecture notes uploaded online and reach out to the instructor for additional help.

In case the instructor is unable to attend lectures over an extended period, lecture notes will be made available online. Also, make up classes and/or substitute lectures shall be arranged for.

Exams: There will be 2 midterms during the term, and the final project.

Table 1: **Examination Schedule**

EXAM	DATE	TIME
MIDTERM1:	Wednesday, October 15	10:20 AM - 11:10 AM at NS140 NatSci Building
MIDTERM2:	Wednesday, December 3	10:20 AM - 11:10 AM at NS140 NatSci Building
FINAL PROJECT:	Friday, December 12	Take Home

Final Project (20%): There will be a final data analysis project. You will apply statistical methods learned from this course to analyze real data using `R`. You are required to submit two files to D2L: one is the `pdf` of your report, and the other is an `R` file with all your code. The project will be assigned (with all the details) on 12/03 and due at 11:59 PM, 12/12.

If you cannot take an exam, contact the instructor as soon as possible for other arrangements (to be considered only in case of verifiable excuses). Make-ups cannot be given after the exams are returned.

Homework: There will be ten homeworks to turn in (each contributing to 4% of the total grade). Unexcused late homework (turned in up to one class date late) is given only 60% credit. Later homework is given no credit. There is no make-up for homework.

Grading: Homework: 40%, Midterm1: 20%, Midterm2: 20%, Final Project: 20%.

$$\begin{aligned} 4.0 &: 90\% \leq \text{Score} < 100\% & 2.0 &: 60\% \leq \text{Score} < 65\% \\ 3.5 &: 80\% \leq \text{Score} < 90\% & 1.5 &: 55\% \leq \text{Score} < 60\% \\ 3.0 &: 70\% \leq \text{Score} < 80\% & 1.0 &: 50\% \leq \text{Score} < 55\% \\ 2.5 &: 65\% \leq \text{Score} < 70\% & 0.0 &: 0\% \leq \text{Score} < 50\% \end{aligned}$$

Academic Honesty: The Department of Statistics and Probability adheres to the policies of academic honesty as specified in the General Student Regulations 1.0, Protection of Scholarships and Grades, and in the All-University of Integrity of Scholarships and Grades which are included in Spartan Life: Student Handbook and Resource Guide. Plagiarism or any other sort of fraudulent behavior in exam and/or homework assignment will result in an automatic zero in that exam and/or homework assignment.

ADA: To arrange for accommodation, a student with special need should contact the Resource Center for People with Disabilities [Phone: 353-9642, Web Site: http://www.rcpd.msu.edu].

Mandatory reporting: MSU employees, with limited exceptions, are required to report allegations of sexual assault, sexual harassment, and other prohibited conduct involving members of the University community. Details for reporting can be found at

https://civilrights.msu.edu/policies/relationship-violence-and-sexual-misconduct-and-title-ix-policy.html.

Grief absences: MSU has a policy on grief absences. It is described at

https://reg.msu.edu/ROInfo/Notices/GriefAbsence.aspx.

FERPA rules on student privacy rights are available at

http://www.reg.msu.edu/ROInfo/Notices/PrivacyGuidelines.asp.

Emergency situations: For additional suggestions for handling emergency situations in the classroom, contact the Ombudsperson's office

https://ombud.msu.edu/education-training-assessments/presentations-trainings.

MSU 2030: Excellence for Global Impact: Background about the Access, Opportunity and Excellence framework can be found on the IDI website

https://inclusion.msu.edu/about/access-opportunity-and-excellence-at-msu.html?utm_source=other-email&utm_medium=em&utm_campaign=faculty-staff

and broader updates will be forthcoming.

Disclaimer: The instructor reserves the right to make any changes she considers academically advisable. Changes will be announced in class and on the course web page. It is students' responsibility to keep up with any changed policies and assignments.

Course Outline:

The schedule is tentative and subject to change

Date	**Topics**
Week 1 (08/25 - 08/29)	Basics of probability theory, Bayes' theorem, Prior and posterior distributions, Bayesian vs. Frequentist
Week 2 (09/01 - 09/05)	Beta-Binomial Model, Conjugate Prior, Sufficient Statistics, Predictive Distribution, Intro to `R`
Week 3 (09/08 - 09/12)	Poisson-Gamma Model, Exponential Family Models
Week 4 (09/15 - 09/19)	Exponential Family Models, Normal Model
Week 5 (09/22 - 09/26)	Normal Model, Monte Carlo Approximation
Week 6 (09/29 - 10/03)	Monte Carlo Approximation, Gibbs Sampler
Week 7 (10/06 - 10/10)	Gibbs Sampler, Markov Chain Monte Carlo
Week 8 (10/13 - 10/17)	Least Squares in Linear Regression, **Midterm 1**
Week 9 (10/20 - 10/24)	Bayesian Estimation for Linear Regression, Model Selection
Week 10 (10/27 - 10/31)	Bayesian Estimation for Linear Regression, Model Selection
Week 11 (11/03 - 11/07)	Generalized Linear Models, Nonconjugate Prior
Week 12 (11/10 - 11/14)	Metropolis-Hastings algorithms
Week 13 (11/17 - 11/21)	Metropolis-Hastings algorithms
Week 14 (11/24 - 11/27)	Logistic Regression
Week 15 (12/01 - 12/05)	Probit Regression, **Midterm 2**
Week 16 (12/08 - 12/12)	**Final Project Due Friday 11:59 PM, 12/12**

Important Dates:

Aug 25	Classes begin; late enrollment fee begins.
Aug 29	Close of add period.
Sep 1	Labor Day (no classes).
Sep 18	Last day for 100% refund.
Oct 13	Middle of semester; last day to drop with no grade.
Oct 15	Midterm1 (10:20 AM - 11:10 AM).
Oct 20-21	Fall break.
Nov 27-28	Thanksgiving break.
Dec 03	Midterm2 (10:20 AM - 11:10 AM).
Dec 07	Last day of classes.
Dec 12	Final project due.