Syllabus for STAT 4041 25FS - Bayesian Data Science

Tu/Th 12:30-1:50pm, rm273 in 60WCharton

Instructor: Seongho Song, Professor

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Office Hours: Tu/Th 11:00am-12:00pm or by appointment

This is an in-person class. No course recordings or broadcasting will be provided.

Prerequisite: Minimum Grade of C- STAT 3038 & STAT 3041 or permission by instructor

Course Objectives: The course introduces Bayesian statistics in data science. It emphasizes statistical computing skills and simulation-based inferential approaches to implement Bayesian analysis. Bayesian ideas and models are introduced in handling data, including parameter estimation, predictive modeling, and hypothesis testing tasks.

The course will use R and Python as the main programming language because they are standard programming tools in data science.

Textbook: Doing Bayesian Data Analysis, 2nd Edition: A Tutorial with R, JAGS, and Stan. The book is also available online through the UC Library.

Course Webpage: All course-related information will be posted on UC Canvas (https://uc.instructure.com/), including announcements, course syllabus, lecture slides, sample code (R/Python), homework. Visit the Canvas page frequently.
Go to the web page, https://sites.google.com/site/doingbayesiandataanalysis for textbook information.

Exams: Midterm project: Available at 12:30pm on Tuesday, October 21, 2025
Due in class on Tuesday, October 28, 2025
Final Project: (Tentatively) Available at 12:30pm on Dec. 2 (Tu), 2025
Due (by email) at 12:30pm on Dec. 9 (Tu), 2025
Academic misconduct including act of cheating will not be tolerated.

mework: Homeworks will be assigned from each chapter. Homeworks will be available on the Canvas throughout the semester. The due date of the homework will be announced in the Canvas. Please note that your solutions need to be presented in a clear, readable format with sufficient details. NO CREDIT will be given to solutions lacking details or that are hard to read. All students must submit their own written work in their own words. Academic misconduct including plagiarism will not be tolerated. Homework will be collected at the start of the class on the due date, and this is the only acceptable way to turn in

homework. No late assignments will be accepted unless there are extreme and documentable circumstances that are approved by the instructor.

Course Grade: Your final course grade will be assigned based on the total points that you have accumulated from

Attendance:	**10%**
Homework:	**20%**
Midterm Project:	**30%**
Final Project:	**40%**

Grading scales will be determined.

About withdrawal: **The last day to withdraw from the course is November 21, 2025**
In case a withdrawal shall occur, the instructor will be required to affirm whether or not you minimally participated in the class. Although the instructors will do the best to answer accurately, in the absence of any evidence to the contrary the instructors will affirm that you did **not** minimally participate. Ways for you to provide clear evidence of your presence in the class include submitting homeworks or projects.

Academic Integrity Policy: The University Rules, including the Student Code of Conduct, and other documented policies of the department, college, and university related to academic integrity will be enforced. Any violation of these regulations, including acts of plagiarism or cheating, will be dealt with on an individual basis according to the severity of the misconduct. (https://www.artsci.uc.edu/student-experience/academic-forms-and-policies.html)

Regrading Policy: If a student believes that a grading error has occurred, he/she should request for regarding within the next 5 days after the work is returned to the class. This will apply even if the student is absence in the class on the day the work is returned unless prior permission was obtained from the instructor.

Policy about make-up exam: Only students with legitimate excuses will be allowed to make up missed exam/quiz. The student must request make-up tests within a reasonable amount of time after one of the following excusable events occurs:

1. **Illness**. Need official certification from you doctor, typed on medical stationary (with their license # to practice medicine on it).
2. **Attending the funeral of an immediate relative**. Need proof of attending the funeral with the date of the ceremony.
3. **Mandatory courtroom appearance**. Need a copy of your official court summons with the date.
4. **Winthrop Athletic event participation**. Need a signed letter from your coach no later than **one week prior to** the day of the exam.

Special Needs Policy:	If you have any special needs related to your participation in this course, including identified visual impairment, hearing impairment, physical impairment, communication disorder, and/or specific learning disability that may influence your performance in this course, you should meet with the instructor to arrange for reasonable provisions to ensure an equitable opportunity to meet all the requirments of this course. At the discretion of the instructor, some accommodations may require prior approval by Disability Services. In order to take advantage of those available accommodations, students may contact the Disability Services Office at 210 University Pavillion, (513) 556-6823. (http://www.uc.edu/aess/disability.html).
Personal Communication Devices Policy:	Cell phones and PDAs must be either turned off or put on vibrate mode during class. Additionally, please make all efforts not to use cell phones during the class time.
Email Communication Policy:	All communications will be done via UC mail.

Weekly Tentative Schedule		Notes
Week 1	Introduction to Classical Statistics.	
Week 2	Chap 2. Introduction: Credibility, models, and parameters. Strongly recommended article: "Bayesian data analysis for newcomers" at https://link.springer.com/article/10.3758/s1342301712721 or https://psyarxiv.com/nqfr5/	
Week 3	Chap 3. The R programming language. Instructions for installation of software are here: https://sites.google.com/site/doingbayesiandataanalysis/softwareinstallation and for textbook materials in https://learning.oreilly.com/library/view/doing-bayesian-data/9780124058880/B9780124058880000039.xhtml	
Week 4	Chap 4. Probability & Chap 5. Bayes' Rule	
Week 5	Chap 6. Inferring a probability via mathematical analysis	
Week 6	Chap 7. Markov Chain Monte Carlo (MCMC)	
Week 7	Chap 7. Markov Chain Monte Carlo (MCMC) Reading days, Th. Oct 9, 2025	
Week 8	Chap 8. JAGS	
Week 9	Chap 9. Hierarchical models	
Week 10	Chap 10. Model Comparisons Midterm available Tuesday (10/21)	

Week 11	Chap 11. Null hypothesis significance testing (NHST). Strongly recommended article: “The Bayesian New Statistics” at https://link.springer.com/article/10.3758/s1342301612214 or https://osf.io/ksfyr/ Midterm Due on Tuesday, October 28, 2025	Midterm due
Week 12	Chap 12. Bayesian null assessment. See also articles “Bayesian assessment of null values via parameter estimation and model comparison” at http://www.indiana.edu/~kruschke/articles/Kruschke2011PoPScorrected.pdf and “Rejecting or accepting parameter values in Bayesian estimation” at http://journals.sagepub.com/doi/full/10.1177/2515245918771304	
Week 13	Chap 15. The generalized linear model.	
Week 14	Chap 16. Metric predicted variable, 1 or 2 group predictor variable.	
Week 15	Chap 17 & 18. Metric predicted variable, one/multiple metric predictor variable(s). Final available on Tuesday, December 2, 2025	
Week 16	Final Exam Week – Final project due December 9, 2025	Final due