Bayesian Computing for Data Science
DATS 6311, Fall 2021

1 Meeting Time and Location

- Meeting time: Wednesday, 7:10 PM - 9:40 PM
- Location: 1957 E Street 314

2 Instructor

- Yuxiao (James) Huang
  - Email: yuxiaohuang@gwu.edu
  - Github: `https://github.com/yuxiaohuang`
  - Website: `https://sites.google.com/view/yuxiaohuang`
  - Office address: `https://gwu.webex.com/join/yuxiaohuang`
  - Office hours:
    - Thursday, 2:00 PM - 4:00 PM
    - Note: If you would like to meet during my office hours, please send email (including your Webex meeting room address) to set up an appointment, so that we can have a scheduled time slot for one-on-one meeting.

3 Teaching Assistant

- Natasha Vij
  - Email: natashavij@gwmail.gwu.edu
  - Office address: `http://gwstudent.webex.com/meet/natashavij`
  - Office hours:
    - Monday, 10:00 AM - 12:00 PM
    - Tuesday, 5:00 PM - 7:00 PM
    - Wednesday, 2:00 PM - 4:00 PM
    - Thursday, 10:00 AM - 12:00 PM

4 Course Description

- This course is an introduction of Bayesian data analysis
- Topics include Markov chain Monte Carlo, Hierarchical Models, Generalized Linear Models, and `JAGS`
- Although lectures will include some theory, the emphasis of the course will be on implementing these models using `R` and `JAGS`, and applying the models to solve real-world problems

5 Learning Outcomes

As a result of completing this course, students will be able to

- use `R` and `JAGS` to conduct Bayesian data analysis

6 Textbook

The following books are recommended but not required. Specifically, our course will be largely based on the first book (by Kruschke). The second one (by Gelman et al.) is a nice book for further reading.

- Kruschke J. K. (2014). *Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan. 2nd Edition.* Academic Press / Elsevier.
- Gelman A., Carlin J. B., Stern H. S., et al (2014). *Bayesian data analysis. 3rd Edition.* Boca Raton, FL: CRC press.

7 Average Minimum Amount of Out-Of-Class or Independent Learning Expected Per Week

- Going over the theories and coding covered in class is integral for success in this course
- You should spend at least 5 hours of out-of-class or independent learning per week

8 Homework

- There will be 4 homework, which will only include coding questions
- Homework must be completed individually

9 Exam

- There will be 2 exams (Midterm and Final), which will only include coding questions

10 Final Project

- The final project is a good opportunity for you to apply Bayesian methods to solve real-world problems.
- While each team can choose a problem in the domain of their interest, you are strongly encouraged to work on Kaggle Competitions. The bottom line is, you must use real-world data. Please talk to the instructor if you are not sure about the nature of the data.
- The final project should be completed by teams of 1, 2, or 3 students.

10.1 Deliverables

- Code (`R` files and a `txt` readme file should be submitted to `blackboard`)
- Report (a `pdf` file should be submitted to `blackboard`)

10.2 Code

- Each team must submit the code with a readme file describing how to run the code
- For full consideration, empirical results must be reproducible given the (link to the) data, code, and readme file

10.3 Report

The report is 3-4 pages. It should include:

- Title
- Introduction (including the problem and motivation)
- Empirical results (including the discussion of the results)
- Conclusions

10.4 Presentation

- Each team will present their final project
- A presentation should be no longer than 10 minutes (and no shorter than 8 minutes), and will be followed by a Q & A session (no longer than 2 minutes)
- All team members should present

11 Submission

- Homework and final project (proposal and report) will be due for submission through `blackboard` by Wednesday at 11:59 PM (Eastern time)
- Submission will no longer be accepted after the deadline, and will receive a grade of 0.

12 Grading Scheme

- 60% Homework (4)
- 40% Exams
  - 20% Midterm Examination
  - 20% Final Examination

13 Grade Appeals

- A grade becomes permanent one week after you receive the grade
- Grade appeals and questions must be raised in writing (email) within one week after the day on which the grade was received

14 Letter Grade Distribution

$[93, 100]$	A
$[90, 93)$	A-
$(87, 90)$	B+
$[83, 87]$	B
$[80, 83)$	B-
$(77, 80)$	C+
$[73, 77]$	C
$[70, 73)$	C-
<70	F

15 University Policies

15.1 University Policy on Observance of Religious Holidays

In accordance with University policy, students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance. For details and policy, see: https://provost.gwu.edu/policies-procedures-and-guidelines.

15.2 Academic Integrity Code

Academic Integrity is an integral part of the educational process, and GW takes these matters very seriously. Violations of academic integrity occur when students fail to cite research sources properly, engage in unauthorized collaboration, falsify data, and in other ways outlined in the Code of Academic Integrity. Students accused of academic integrity violations should contact the Office of Academic Integrity to learn more about their rights and options in the process. Outcomes can range from failure of assignment to expulsion from the University, including a transcript notation. The Office of Academic Integrity maintains a permanent record of the violation.

More information is available from the Office of Academic Integrity at https://studentconduct.gwu.edu/academic-integrity. The University's "Guide of Academic Integrity in Online Learning Environments" is available at https://studentconduct.gwu.edu/guide-academic-integrity-online-learning-environments. Contact information: rights@gwu.edu or 202-994-6757.

16 Support for Students Outside the Classroom

16.1 Virtual Academic Support

- A full range of academic support is offered virtually in fall 2020. See https://coronavirus.gwu.edu/top-faqs for updates.
- Tutoring and course review sessions are offered through Academic Commons in an online format. See https://academiccommons.gwu.edu/tutoring.
- Writing and research consultations are available online. See https://academiccommons.gwu.edu/writing-research-help.
- Coaching, offered through the Office of Student Success, is available in a virtual format. See https://studentsuccess.gwu.edu/academic-program-support.
- Academic Commons offers several short videos addressing different virtual learning strategies for the unique circumstances of the fall 2020 semester. See https://academiccommons.gwu.edu/study-skills. They also offer a variety of live virtual workshops to equip students with the tools they need to succeed in a virtual environment. See https://library.gwu.edu/events?order=DATE_ASC&format=workshop&open_to=GWorld&series=&category=&sponsor=&events_date_start=&events_date_end=&terms=&page=1.

16.2 Writing Center

GW's Writing Center cultivates confident writers in the University community by facilitating collaborative, critical, and inclusive conversations at all stages of the writing process. Working alongside peer mentors, writers develop strategies to write independently in academic and public settings. Appointments can be booked online. See https://gwu.mywconline.com.

16.3 Academic Commons

Academic Commons provides tutoring and other academic support resources to students in many courses. Students can schedule virtual one-on-one appointments or attend virtual drop-in sessions.

Students may schedule an appointment, review the tutoring schedule, or access other academic support resources at https://academiccommons.gwu.edu. For assistance contact academiccommons@gwu.edu.

16.4 Disability Support Services (DSS) 202-994-8250

Any student who may need an accommodation based on the potential impact of a disability should contact https://disabilitysupport.gwu.edu to establish eligibility and to coordinate reasonable accommodations.

16.5 Counseling and Psychological Services 202-994-5300

GW's Colonial Health Center offers counseling and psychological services, supporting mental health and personal development by collaborating directly with students to overcome challenges and difficulties that may interfere with academic, emotional, and personal success. See https://healthcenter.gwu.edu/counseling-and-psychological-services.

17 Safety and Security

- In an emergency: call GWPD 202-994-6111 or 911.
- For situation-specific actions: review the Emergency Response Handbook at https://safety.gwu.edu/emergency-response-handbook.
- In an active violence situation: Get Out, Hide Out or Take Out. See https://www.youtube.com/watch?v=CpBT6tAa0dY&feature=youtu.be.
- Stay informed: https://safety.gwu.edu/stay-informed.

18 Tentative Schedule

Date	Topic	Release	Due
09/01	Introduction: Credibility, Models, and Parameters		
09/08	Probability and Bayes' Rule	Homework 1	
09/15	Inferring a Binomial Probability via Exact Mathematical Analysis	Homework 2	Homework 1
09/22	Markov Chain Monte Carlo	Homework 3	Homework 2
09/29	Markov Chain Monte Carlo (continued)		
10/06	Jags		Homework 3
10/13	Midterm		
10/20	Hierarchical Models	Homework 4	
10/27	Hierarchical Models (continued)		
11/03	Model Comparison and Hierarchical Modeling		Homework 4
11/10	The Generalized Linear Model		
11/17	The Generalized Linear Model (continued)		
11/24	Thanksgiving Break (no classes)		
12/01	The Generalized Linear Model (continued)		
12/08	Final project presentation		Final project code and report
12/15	Final		