Bayesian Computing for Data Science
DATS 6311, Summer 2020

1 Meeting Time and Location

- Meeting time: Tuesday / Thursday, 2:00 PM - 4:30 PM
- Location: `https://gwu.webex.com/join/yuxiaohuang`

2 Instructor

- Name: Yuxiao Huang
- Email: yuxiaohuang@gwu.edu
- Office address: `https://gwu.webex.com/join/yuxiaohuang`
- Office hours: By appointment

3 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

4 Learning Outcomes

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

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

5 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.

6 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

7 Homework

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

8 Exam

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

9 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.

9.1 Deliverables

- Code (`R` files and a `txt` readme file should be submitted to `blackboard`)
- Report (a `pdf` file should be submitted to `blackboard`)
- Video (the video for the presentation should be submitted to `blackboard`)

9.2 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

9.3 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

9.4 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

10 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.

11 Grading Scheme

- 40% Homework (4)
- 30% Final project (1)
  - 10% Code
  - 10% Report
  - 10% Presentation
- 30% Exams
  - 10% Midterm Examination
  - 20% Final Examination

12 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

13 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

14 University Policies

14.1 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://students.gwu.edu/accommodations-religious-holidays`.

14.2 Academic Integrity Code

Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information. For details and complete code, see: `https://studentconduct.gwu.edu/code-academic-integrity`.

14.3 Safety and Security

In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek shelter at a predetermined rendezvous location.

15 Support for Students Outside the Classroom

15.1 Disability Support Services (DSS)

Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Rome Hall, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information see: `https://disabilitysupport.gwu.edu/`.

15.2 Mental Health Services 202-994-5300

The University's Mental Health Services offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include: crisis and emergency mental health consultations confidential assessment, counseling services (individual and small group), and referrals. For additional information see: `https://counselingcenter.gwu.edu/`.

16 Tentative Schedule

Class Date	Topic	Release Date	Due Date
05/19	Introduction: Credibility, Models, and Parameters		
05/21	Probability and Bayes' Rule	Homework 1	
05/26	Inferring a Binomial Probability via Exact Mathematical Analysis	Homework 2	Homework 1
05/28	Markov Chain Monte Carlo	Homework 3 Midterm exam	
06/02	Markov Chain Monte Carlo (continued)		Homework 2
06/04	Jags		Homework 3 Midterm exam
06/09	Hierarchical Models	Homework 4	
06/11	Hierarchical Models (continued)		
06/16	Model Comparison and Hierarchical Modeling		Homework 4
06/18	The Generalized Linear Model	Final exam	
06/23	The Generalized Linear Model (continued)		
06/25	The Generalized Linear Model (continued) Review		Final project report / video Final exam