Georgia Institute of Technology
Course Syllabus: ISYE 6420 Bayesian Statistics

Term: Spring 2023	School of Industrial and Systems Engineering
Delivery: 100% Web-Based, Asynchronous	**LMS for Content Delivery:** Canvas Only
Dates course will run: Jan 9 – Apr 25, 2023	

Instructor Information

Roshan Joseph, Ph.D., Professor	Brani Vidakovic, Ph.D., Professor in Videos

General Course Information

Description
An Introduction to Bayesian Statistical Inference and Applications

Pre- &/or Co-Requisites
- Intro Course to Probability and Statistics
- Basic Programming Proficiency
- Calculus

Course Goals and Learning Outcomes - By the end of this course, students will:
Model and infer from Bayesian philosophical perspective. The aim is to make you proficient in the following:

- Given a real-life data set, select an appropriate statistical model to conduct inference, to formulate any prior information in terms of probability distributions (priors), and to understand what the conducted inference implies.
- In addition to understanding concepts and being able to select the right methodology for the problem in hand, the course is aimed at hands on approaches and delivering explicit results.
- Another aim of this course is for you to build a solid basis for your data modeling skills, so you can continue to learn throughout your career; new techniques will certainly be developed after you graduate, and we want you to be able to pick them up quickly.
- In addition, when you accumulate more information about the problem in hand, you will be able to coherently incorporate this information and update your inference.

The core of Bayesian approach to data modeling is the Markov Chain Monte Carlo method. Although you would be exposed to theoretical concepts of MCMC and several step-by-step examples will be discussed, we will not cover the details of mathematics and algorithms under the hood, or deeper mastery of the modeling needed to set up an efficient MCMC chain.

We use BUGS software in the lectures, so that is why we recommend using it for assignments. You may use any programming language to complete assignments for this course.

Course Materials
- Homework and various course materials can be accessed online from canvas and https://www2.isye.gatech.edu/isye6420/

Recommended Reading
- Lunn, D., Jackson, C., Best, N., Thomas, A. and Spiegelhalter, D. (2013) *The BUGS Book; A Practical Introduction to Bayesian Analysis,* CRC Press.
- Vidakovic, B. (2017) Chapters 3, 5, 8, 9, 19 from Engineering Biostatistics: An Introduction using MATLAB and WinBUGS, Wiley
- Ntzoufras, I. (2009) *Bayesian Analysis Using WinBUGS*, Wiley.
- Peter M. Lee (2012) *Bayesian Statistics: An Introduction*, 4th Edition, Hodder Arnold.

Georgia Institute of Technology
Course Syllabus: ISYE 6420 Bayesian Statistics

Course Requirements, Assignments & Grading

The students' course grade will be based on their performance on Homeworks, Midterm, Project, and Final. The total score will be calculated as a weighted average where Homework constitute 30%, Midterm 25%, Project 10%, and Final 35% of the total. The grade will be based on a curve with cut points specified below.

Assignment Distribution and Grading Scale

Assignment	Open	Due Date	Weight
Homework #1	1/9 12:00am ET	1/22 11:59pm ET	5%
Homework #2	1/23 12:00am ET	2/5 11:59pm ET	5%
Homework #3	2/6 12:00am ET	2/19 11:59pm ET	5%
Homework #4	2/20 12:00am ET	3/05 11:59pm ET	5%
Homework #5	3/13 12:00am ET	3/26 11:59pm ET	5%
Homework #6	3/27 12:00am ET	4/09 11:59pm ET	5%
Midterm	3/09 12:00am ET	3/12 11:59pm ET	25%
Project	4/10 12:00am ET	4/23 11:59pm ET	10%
Final	4/27 12:00am ET	4/30 11:59pm ET	35%
Total			100%

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:
A   90-100%
B   80-89%
C   70-79%
D   60-69%
F   0-59%

Description of Graded Components
1. There will be one midterm and one final exam that will be graded by course staff. The Midterm will be worth 25% of the course grade, while the Final will be worth 35% of the grade.
2. There will be six homework assignments, each is worth 5% of the course grade, so the contribution of the homework to the total score is 30%.
3. There will be one course project worth 10% of the course grade.
4. You must achieve an overall weighted average of at least 60% to pass the course.

Submitting Assignments
Homework (HW) is open for submission Monday 12:00 AM ET until the Sunday at 11:59 PM ET of the week that it occurs. Homework will remain accessible (open for submission) for 24 hours after the (Sunday, 11:59 PM ET) due date and will no longer be accessible or submitted after 11:59 PM ET on the Monday immediately after the Sunday that is due. All homework submitted after 11:59 PM ET on the Sunday that it is due is considered late and will be subject to late submission penalties

Georgia Institute of Technology
Course Syllabus: ISYE 6420 Bayesian Statistics

(penalty of 25%, max is 75% of the achieved score). After Monday at 11:59 PM ET the homework will close and can no longer be submitted or accepted. Late submissions of the Exams and projects are not allowed.

If the instructional team is **unable to open a file or if the file is not a solution, the student will not have an opportunity to submit the correct files again.** Therefore, it is important for the students to double-check their submissions and make that all the files and calculations within are correct in canvas.

Sending assignments (homework, knowledge checks, exams etc.), whether early, on time, or late to instructors is not permitted and will not be accepted. All assignments (homework, knowledge checks, exams etc.) must be completed and submitted within canvas. If there are technical issues, please notify the help desk, as well as each professor immediately.

For each assignment, students are required to create a document (for example in LaTeX, MS Word, R Markdown etc.) that fully supports your mathematical or simulation-based solution to the stated questions. Submit this document along with any supporting code files to Canvas Assignments. The files can be named anything that is appropriate and professional such as Q1, Assignment1 etc. **Handwritten documents** will receive no credit – we need students to typeset assignments using LaTeX or an equation editor. This rule is in place so that we can grade your assignments quickly.

If you would like to dispute your grade on an assignment, please email your grading TA (their name may be found on Canvas) and cc the head TA (gschreiter3@gatech.edu). **Your grade may increase, stay the same, or decrease based on our decision**. We reserve the right to regrade the whole submission, not just the part a student has an issue with. You will have one week from the return of your grade to request a regrade. After the regrade, the score will be final and there will not be another chance to dispute the grade for that assignment.

Assignment Due Dates
All assignments will be due at the times listed above. These times are subject to change so please check back often. Please convert from UTC to your local time zone using a Time Zone Converter.

Late and Make-up Work Policy
In the case of emergency, you (or a person whom you designate) should inform the instructor promptly via email. An official notification from the dean of student's office is necessary to be able to extend the due date of homework/exam/project.

Timing Policy
- The Units follow a logical sequence that includes knowledge-building and experience-building.
- Assignments should be completed by their due dates.
- Exams must be completed during the time allotted on the schedule.
- You will have access to the course content for the scheduled duration of the course.

Grading and Feedback

Assignment submissions are evaluated and graded by course staff. Grade turnaround has usually been two weeks, but sometimes faster as needed. Assignment solutions will be provided after the submission window has closed for all students.

Georgia Institute of Technology
Course Syllabus: ISYE 6420 Bayesian Statistics

Technology Requirements and Skills
Computer Hardware and Software

- High-speed Internet connection
- Laptop or desktop computer with a **minimum** of a 2 GHz processor and 2 GB of RAM
- Windows for PC computers OR Mac iOS for Apple computers.
- Complete Microsoft Office Suite or comparable ability to use Adobe PDF software (install, download, open and convert)
- Mozilla Firefox, Chrome and/or Safari browsers
- OpenBUGS or WinBUGS statistical software. We suggest using OpenBUGS with the course.
- OCTAVE (MATLAB clone), R or Python - needed for calculations for which WinBUGS/OpenBUGS are not appropriate

Canvas
This class will use Canvas only to deliver course materials to online students. All course materials, and course deliverables and activities will take place solely in Canvas. The course page that includes more detailed course information, and the course schedule can be located here: https://www2.isye.gatech.edu/isye6420/

Technology Help Guidelines
30-Minute Rule: When you encounter struggles with technology, give yourself 30 minutes to 'figure it out.' If you cannot, then post a message to the discussion board; your peers may have suggestions to assist you. You are also directed to contact the Helpdesk 24/7.

Maybe Your Question is Already Answered: Before asking question, check Ed Discussion. Maybe the answer to your question is already there.

When posting or sending email requesting help with technology issues, whether to the Helpdesk, message board, or instructor, use the following guidelines:
- Include a descriptive title for the subject field that includes 1) the name of course 2) the issue. Do NOT just simply type "Help" into the subject field or leave it blank.
- List the steps or describe the circumstance that preceded the technical issue or error. Include the exact wording of the error message.
- When possible, always include a screenshot(s) demonstrating the technical issue or error message.
- Also include what you have already tried to remedy the issue (rebooting, trying a different browser, etc.).

Course Policies, Expectations & Guidelines

Communication Policy
- Please contact your instructor, teaching assistants, and fellow learners via course forums. Often, discussions with fellow learners are the sources of key pieces of learning.
- For special cases such as failed submissions due to system errors, missing grades, failed file uploads, emergencies that prevent you from submitting, personal issues, etc., you can contact the Head TA.
- For serious personal issues, you can contact Dr. Roshan Joseph at roshan@gatech.edu.
- We will use Ed Discussion for all regular course correspondence

Online Student Conduct and (N)etiquette
Netiquette refers to etiquette that is used when communicating on the Internet. Review the Core Rules of Netiquette. When you are communicating via email, discussion forums or synchronously

Course Syllabus: ISYE 6420 Bayesian Statistics

(real-time), please use correct spelling, punctuation and grammar consistent with the academic environment and scholarship[1].

1. Conner, P. (2006-2014). Ground Rules for Online Discussions, Retrieved 4/21/2014 from http://teaching.colostate.edu/tips/tip.cfm?tipid=128

In Georgia Tech's MS in Analytics program, we expect all participants (learners, faculty, teaching assistants, staff) to interact respectfully. Learners who do not adhere to this guideline may be removed from the course.

Communicating appropriately in the online classroom can be challenging. In order to minimize this challenge, it is important to remember several points of **"internet etiquette"** that will smooth communication for both students and instructors:

1. _Read first, Write later_. Read the ENTIRE set of posts/comments on a discussion board before posting your reply, in order to prevent repeating commentary or asking questions that have already been answered.
2. _Avoid language that may come across as strong or offensive._ Language can be easily misinterpreted in written electronic communication. Review email and discussion board posts BEFORE submitting. Humor and sarcasm may be easily misinterpreted by your reader(s). Try to be as matter-of-fact and professional as possible. Ed Discussion is meant for technical discussions and for helping everyone to learn the course better. If there are any concerns, please use email to communicate them to the Professor or the Head TA.
3. _Follow the language rules of the Internet._ Do not write using all capital letters, because it will appear as shouting. Also, the use of emoticons can be helpful when used to convey nonverbal feelings. ☺
4. _Consider the privacy of others_. Ask permission prior to giving out a classmate's email address or other information.
5. _Keep attachments small_. If it is necessary to send pictures, change the size to an acceptable 250kb or less (one free, web-based tool to try is picresize.com).
6. _No inappropriate material._ Do not forward virus warnings, chain letters, jokes, etc. to classmates or instructors. The sharing of pornographic material is forbidden.

NOTE: _The instructor reserves the right to remove posts that are not collegial in nature and/or do not meet the Online Student Conduct and Etiquette guidelines listed above._

University Use of Electronic Email
A university-assigned student e-mail account is the official university means of communication with all students at Georgia Institute of Technology. Students are responsible for all information sent to them via their university-assigned e-mail account. If a student chooses to forward information in their university e-mail account, he or she is responsible for all information, including attachments, sent to any other e-mail account. To stay current with university information, students are expected to check their official university e-mail account and other electronic communications on a frequent and consistent basis. Recognizing that some communications may be time-critical, the university recommends that electronic communications be checked minimally twice a week.

Plagiarism & Academic Integrity
Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. All students enrolled at Georgia Tech, and all its campuses, are to perform their academic work according to standards set by faculty members, departments, schools and colleges of the university; and cheating and plagiarism constitute fraudulent misrepresentation for which no credit can be given and for which appropriate sanctions are warranted and will be applied. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/.

Georgia Institute of Technology
Course Syllabus: ISYE 6420 Bayesian Statistics

Plagiarism is considered a serious offense. You are not allowed to submit materials created or published by others without explicit attributions, that is, as if you created the materials.

Any student suspected of cheating or plagiarizing on a homework, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Discussing the homework and exams with someone outside of the course student body, faculty, and staff and/or posting homework/exams to non-GT sites are considered serious violations of the honor code. Furthermore, internet search related to the course topics are not allowed during the exam period.

Student Honor Code:
All course participants (myself, teaching assistants, and learners) are expected and required to abide by the letter and the spirit of the Georgia Tech honor code. If there is any way I can help you in complying with the honor code, please do not hesitate to ask. I will do the same.
- Ethical behavior is extremely important in all facets of life.
- You are responsible for completing your own work.
- Any learner found in violation of the Georgia Tech Honor Code will be subject to some/all the actions listed in the Georgia Tech Honor Code.

Accommodations for Students with Disabilities
If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Attendance and/or Participation
- This is a fully online course.
- Login on a regular basis to complete your work, so that you do not have to spend a lot of time reviewing and refreshing yourself regarding the content.

Collaboration & Group Work
Collaboration among the students is encouraged; however, each student should submit their individual work. Submitting a copy of another student's work is a serious violation of the honor code.

Student-Faculty Expectations Agreement
At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See http://www.catalog.gatech.edu/rules/22/ for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Subject to Change Statement
The syllabus and course schedule may be subject to change. Changes will be timely communicated via [email, Ed Discussion, the Canvas announcement tool, and/edX bulk email]. It is the responsibility of students to check email messages and course announcements to stay current in their online courses.