Georgia Institute of Technology
ISYE 6420: Bayesian Statistics

Course Syllabus

Fall 2026

Course Information

School: Industrial and Systems Engineering

Delivery: 100% Web-Based, Asynchronous

Learning Management System: Canvas

Course Dates: August 24 – December 17, 2026

Instructor Information

Instructor: Roshan Joseph, Ph.D., Professor

Featured Instructor in Videos: Brani Vidakovic, Ph.D., Professor

Course Description

This course provides an introduction to Bayesian statistical inference and its applications.

Prerequisites

Students are expected to have:

- Introductory coursework in probability and statistics
- Basic programming proficiency
- Calculus

Course Goals and Learning Outcomes

By the end of this course, students will be able to model and infer from the 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.
- Formulate prior information in terms of probability distributions (priors) and understand what the conducted inference implies.

- After accumulating more information about the problem at hand, coherently incorporate this information and update your inference.
- Use PyMC for probabilistic modeling.

The core of the 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.

Students will use both Python and a probabilistic programming language (PPL) called PyMC to complete assignments. PyMC may not be used for assignments until after the midterm (starting with Homework #5). Until that point, students should use Python as a general-purpose programming language.

Course Materials

- TA course notes, Python code, and lecture errata are available at: https://areding.github.io/6420-pymc/intro.html
- Homework assignments and all additional materials are provided through Canvas

Recommended Reading

Vidakovic, B. (2017). *Engineering Biostatistics: An Introduction using MATLAB and WinBUGS*. Wiley. https://statbook.gatech.edu/statb4.pdf

This is the main course textbook but covers a mix of frequentist and Bayesian statistics. It is a good reference because the lectures generally assume basic familiarity with the frequentist concepts covered within them. If you are already very familiar with these concepts, many of these readings may be skipped.

Units and Recommended Chapters from Engineering Biostatistics

- Units 1–3: Chapters 3–4
- Unit 4: Chapter 4
- Unit 5: Sections 5.1–5.5, 5.7–5.10, 6.1–6.5, 8, 9.3–9.4, 9.8
- Unit 5: See handouts uploaded with Homework 4.
- Unit 6: Chapter 19
- Unit 7: Sections 10.2, 11.1–11.2, 11.4, 11.6, 14.1–14.10, 15
- Unit 8: Chapter 16
- Unit 9: No readings.
- Unit 10: No readings.

The following books were used in the creation of the course:

- Ntzoufras, I. (2009) *Bayesian Analysis Using WinBUGS*, Wiley. Georgia Tech Library e-book link.
- Lee, Peter M. (2012) *Bayesian Statistics: An Introduction*, 4th Edition, Hodder Arnold. Georgia Tech Library e-book link.

Course Requirements, Assignments & Grading

Assignment	Open	Due Date	Related Units	Weight
Homework #1	08/24 12:00AM ET	(optional)	1–3	0%
Homework #2	08/31 12:00AM ET	09/13 11:59 PM ET	4.1–4.9	6%
Homework #3	09/14 12:00AM ET	09/27 11:59 PM ET	Rest of 4	6%
Homework #4	09/28 12:00AM ET	10/11 11:59 PM ET	5	6%
Homework #5	10/26 12:00AM ET	11/08 11:59 PM ET	6–7	6%
Homework #6	11/09 12:00AM ET	11/22 11:59 PM ET	8–9	6%
Midterm	10/16 06:00PM ET	10/18 06:00 PM ET	1–5	25%
Project	10/26 12:00AM ET	12/06 11:59 PM ET	1–10	10%
Final	12/11 06:00PM ET	12/13 06:00 PM ET	1–10	35%
Total				100%

Time Zones

All times listed are Eastern Time (ET). Students are responsible for converting deadlines to their local time zone. The course uses ET consistently for all assignments and exams.

Grading Scale

The students' course grades will be based on their performance on homework, midterm, project, and final. The overall score will be calculated as a weighted average where homework constitutes 30%, the midterm 25%, the project 10%, and the final 35% of the total. The grade will be based on the cut points specified below. There is no curve applied to the course grades.

- A: 90–100%
- B: 80–89%
- C: 70–79%
- D: 60–69%
- F: 0–59%

Exams and Projects

Project Description

More details will be released after the midterm, but you will write a Bayesian analysis on a topic of your choice. This will be an individual project only.

Exam Description

The exams are open-book and un-proctored but restricted to course materials only. Outside materials of any kind are not allowed for any purpose, including the use of personal notes derived from sources outside the course materials. TAs will discuss the exam rules in more detail as we get closer. You have the full 48-hour period to complete the exam. Multiple submissions are allowed (TAs will grade the most recent submission only). No late submissions will be accepted.

Submitting Assignments

Homework will remain accessible (open for late submission) 24 hours after the (Sunday, 11:59 PM ET) due date. During this 24-hour late-submission period, you may submit your homework assignment for a 25% penalty. After this 24-hour period, no submissions will be accepted. There is no late submission period for exams or projects.

Academic Integrity and Plagiarism

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 see the honor code and the code of conduct.

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. **ChatGPT and other large language models are not allowed as valid sources for our course. Further, if you took notes using an LLM during the semester, you may not use those notes on the exam because all outside sources are banned during exams.**

Discussing the homework and exams with someone outside of the course student body, faculty, and staff and/or posting homework/exams/other course materials to non-GT sites are considered serious violations of the honor code. Furthermore, internet searches related to course topics and other material from outside the class are not allowed to be used during exam periods. Your work on exams must use methods/models from our course materials, with appropriate modifications for the problem at hand. **Using methods from outside our course materials is considered cheating on our exams**, even if they are based on personal notes taken before the exam period, so make sure your notes carefully delineate the course methods from outside methods if you choose to use outside materials for taking notes.

Any student suspected of cheating or plagiarizing a homework, exam, or assignment **will be directly reported to the Office of Student Integrity**, who will investigate the incident and identify the appropriate penalty for violations. There will be no further warnings given about this, so please take it to heart.

Students are expected to comply with Georgia Tech's Honor Code and Code of Conduct:

- https://catalog.gatech.edu/rules/17/
- https://catalog.gatech.edu/rules/18/

Submitting work created by others without proper attribution constitutes plagiarism. The use of ChatGPT or other large language models is not permitted as a source for coursework or exams.

Any suspected violation will be reported directly to the Office of Student Integrity.

Attendance and Participation

This is a fully online, asynchronous course. No formal attendance is taken. Students are expected to log in regularly, engage with course materials, and complete assignments by posted deadlines.

Submission Format Rules

You are responsible for following these guidelines. Failure to do so **will result in penalties** for the assignment. These apply to all assignments, including exams and the project.

General

- Students should submit **one report file** and **up to three supporting code files**. If there was no code used for the assignment whatsoever, students may omit the supporting code files.
- 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 on Canvas. Try re-downloading your files after uploading to confirm they are correct.
- The files should not be in a compressed format such as .zip.
- **Absolutely no handwritten work** is accepted. Equations must be typeset. You can use Latex, Typst, convert handwritten equations using OCR software like Mathpix, or any other method that works for you.
- Additional requirements will apply to PyMC-based assignments. These will be posted on the course forums after the midterm.

Reports

This is a document that fully supports the mathematical or simulation-based solution to the questions stated. If you have not fully supported your solution, you will lose points. If you use methods from outside the course on assignments, you must cite them in your report. Outside methods are not allowed on exams.

- Approved filetypes: .pdf, .html. If exporting from a Jupyter notebook, we prefer .html as it renders more accurately and is less likely to cut off parts of the text or output.
- Do not submit final answers only. You must show your work and explain your reasoning for full credit. It is especially important to explain any deviations or extensions from the course materials.
- Again, absolutely no handwritten work! **You will receive a 0** on any portion of your assignment that is handwritten.

Supporting Code Files

We will use Jupyter notebooks for all coding this semester. If you used any code at all for your assignment (which will be most of them), you are required to submit the original .ipynb file.

- Approved file type: .ipynb.
- They can be separate code files for individual problems, or you can use one code file for the entire assignment.
- **Take steps to ensure your code can be run by the graders and that it outputs the same solutions in your report.** Code that doesn't work or doesn't reproduce your results will receive penalties.
    - Many of our problems involve randomly-generated numbers. Use a random seed of "6420" wherever possible for reproducible results.
    - Before submitting your Jupyter notebook, always restart and run all cells, then check the output for discrepancies or errors.

- Use relative file paths when importing data (something like data = pd.read_csv("data_file.csv")) so that TAs don't need to change the code to run your report.

Assignment Grading, Follow-up, and Regrade Policy

Grade turnaround has generally been two weeks. Assignment solutions will be provided after the submission window has closed for all students. Please do not request solutions; we will provide them when we can for all assignments.

Grading the assignments for this class can be labor-intensive, and the amount of feedback the grading TA is able to give may vary. Students should compare their solutions to the official ones to see where they went wrong. If there's something you don't understand, you are welcome to create a post on Ed Discussion asking for clarification. Asking for clarification on Ed is not the same as a regrade request!

If you would like to dispute your grade on an assignment, please **email** your grading TA (their names may be found on Canvas) and cc the head TA. **Your grades 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.

Re-grade Request Examples

Good:

- "My answer is in a different form but mathematically equivalent to the official solution. Here's why..."
- "The grading TA said I didn't include this deliverable, but it's actually in my report on page 3."

Bad:

- "I need one more point to get over the threshold for an A, can you take another look at my homework?"
- "I think my error was minor, I should have been deducted fewer points."

Late and Make-up Work Policy

In the case of emergency, you (or the 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.

Student Honor Code

All course participants (the professor, 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 we can help you comply with the honor code, please do not hesitate to ask. We 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.

Technology Requirements: Computer Hardware and Software

- You will need access to a personal computer with high-speed internet.
- You will need to be able to use or learn Python and Jupyter notebooks. We are aware of other notebook software and agree that Jupyter notebooks are not ideal for all situations, but for our purposes they work well enough and are easy to use.
- After the midterm, you will learn to use a probabilistic programming language called PyMC. We currently only provide examples and solutions in PyMC and require it for homeworks 5, 6, and the final.

Other 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 via email or private Ed Discussion post.
- For serious personal issues, you can contact Dr. Roshan Joseph at roshan@gatech.edu.
- We will use Ed Discussion for all regular course correspondence, except for re-grade requests.

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

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. 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.
2. Avoid language that may come across as strong or offensive.
3. Follow the language rules of the Internet.
4. Consider the privacy of others.
5. Keep attachments small.
6. No inappropriate material.

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 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.

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 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.

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 expectations that you can have of the course staff and that we have of you.