Georgia Institute of Technology
Course Syllabus: ISYE 6420 Bayesian Statistics

Term: Spring 2027	School of Industrial and Systems Engineering
Delivery: 100% Web-Based, Asynchronous	**LMS for Content Delivery:** Canvas Only
Dates course will run: Jan 11 – May 6, 2027	

Instructor Information

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General Course Information

Description

An introduction to Bayesian statistical inference and applications.

Pre-requisites

- Introductory courses 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

- The TA course notes site contains Python code, TA-written notes, and known errata for all lectures.
- Homework and other course materials can be accessed online from Canvas.

Recommended Reading

- Vidakovic, B. (2017) Engineering Biostatistics: An Introduction using MATLAB and WinBUGS, Wiley. 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.

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Units	Recommended Chapters from *Engineering Biostatistics*
1–3	3–4
4	5.1–5.5, 5.7–5.10, 6.1–6.5, 8, 9.3–9.4, 9.8
5	See handouts uploaded with Homework 4.
6	19
7	10.2, 11.1–11.2, 11.4, 11.6, 14.1–14.10, 15
8	16
9	No readings.
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	01/11 12:00AM ET	(optional)	1–3	0%
Homework #2	01/18 12:00AM ET	01/31 11:59 PM ET	4.1–4.9	6%
Homework #3	02/01 12:00AM ET	02/14 11:59 PM ET	Rest of 4	6%
Homework #4	02/15 12:00AM ET	02/28 11:59 PM ET	5	6%
Homework #5	03/15 12:00AM ET	03/28 11:59 PM ET	6–7	6%
Homework #6	03/29 12:00AM ET	04/11 11:59 PM ET	8–9	6%
Midterm	03/05 06:00PM ET	03/07 06:00 PM ET	1–5	25%
Project	03/08 12:00AM ET	04/18 11:59 PM ET	1–10	10%
Final	04/23 06:00PM ET	04/25 06:00 PM ET	1–10	35%
Total				100%

Time Zones
The above times 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.

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

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.

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 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.**

Students may not use ChatGPT, OpenAI Prism, or other generative AI tools to create, write, edit, format, typeset, compile, convert, or export submitted reports, including PDF and LaTeX files. This restriction applies even when the underlying mathematical solutions and explanations were written independently by the student. Students must prepare their submissions using conventional document-authoring tools without generative AI assistance. The use of generative AI to produce submitted solutions, explanations, code, or figures is also prohibited unless explicitly authorized by the instructional team.

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.

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 **one to three supporting code files**. Even if you don't use code on Homework 2, you must submit an .ipynb file that says, "No code used." This is to eliminate any ambiguity and make sure that all students understand this policy.
- 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 sure 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.
- 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.
- 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. You are always required to submit the original .ipynb file, even if you are also submitting a PDF file with code included.

- Approved file type: .ipynb.
- They can be separate code files for individual problems, or you can use one code file for the entire assignment.

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- **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 requests should be based on specific issues. Below are good and bad 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 Students 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[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. 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 them. Humor and sarcasm may be easily misinterpreted by your readers. Try to be as matter-of-fact and professional as possible. Ed Discussion Public Posts are meant for technical discussions of course material and for helping every student to learn the course material better. Private Ed Discussion messages are a way to quickly communicate with the course staff, and as such should primarily be used in emergencies such as personal illness, injury, or other accommodation requests such as Disability Services. In some cases, such as during exam periods or debugging code that contains your answer to a homework problem, private posts may also be

appropriate. Before making a private Ed post rather than a public one, please consider whether your question could help others learn, since TAs have limited available hours to devote to one-on-one time with students.

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 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.

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. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, we 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 and Ed Discussion. It is the responsibility of students to check email messages and course announcements to stay current in their online courses.