Georgia Institute of Technology
Course Syllabus: ISyE 6420 Bayesian Statistics

Term: Spring 2020	School of Industrial and Systems Engineering
Delivery: 100% Web-Based, Asynchronous	**LMS for Content Delivery:** edX & Canvas
Dates course will run: January 6, - April 28, 2020	

Instructor Information

Roshan Vengazhiyil, Ph.D., Professor	Brani Vidakovic, Ph.D. Professor (Video Lectures)

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

Course Goals
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, to 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 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 will rely on the expert system provided by WinBUGS/OpenBUGS software.

Course Materials
Course Text

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- Homework and various course materials can be accessed online
  https://www2.isye.gatech.edu/~brani/isye6420/
- There is no designated textbook for this course.
- 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 8, 9, 19 from Engineering Biostatistics: An Introduction using MATLAB and WinBUGS, Wiley
- Ntzoufras, I. (2009) *Bayesian Analysis Using WinBUGS*, Wiley.

Additional Materials/Resources

Additional material and links to resources will be posted at
https://www2.isye.gatech.edu/~brani/isye6420/ under link "Supporting Material."

Course Website and Other Classroom Management Tools

https://www2.isye.gatech.edu/~brani/isye6420/

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 Homeworks constitute 30% (lowest score dropped, max score = 5 x 6% = 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 for Submission	Due Date	Weight
Homework #1	**1/20 12:00pm**	**1/26 11:55pm**	**6%**
Homework #2	**2/3 12:00pm**	**2/9 11:55pm**	**6%**
Homework #3	**2/10 12:00pm**	**2/16 11:55pm**	**6%**
Homework #4	**2/24 12:00pm**	**3/1 11:55pm**	**6%**
Homework #5	**3/30 12:00pm**	**4/5 11:55pm**	**6%**
Homework #6	**4/6 12:00pm**	**4/12 11:55pm**	**6%**
Midterm	**Released 3/2 12:00pm**	**3/8 11:55pm**	**25%**
Project	**4/13 12:00pm**	**4/26 11:55pm**	**10%**
Final	**Released 4/20 12:00pm**	**4/28 11:55pm**	**35%**
Total (With Lowest HW Dropped)			**100%**

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:
A   90-100%
B   80-89%

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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 faculty. The Midterm will be worth 25% of the course grade, while the Final will be worth 35% of the grade.
2. There will be 6 homework assignments, each is worth 6% of the course grade, but the lowest score will be dropped, 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 11:55 PM ET of the week that it occurs. Homework will remain accessible (open for submission) for 24 hours after the (Sunday, 11:55 PM ET) due date and will no longer be accessible or submitted after 11:55 PM ET on the Monday immediately after the Sunday that is due.   However, all homework submitted after 11:55 PM ET on the Sunday that it is due is considered late and will be subject to late submission penalties (penalty of 25%, max is 75% of the achieved score). After Monday at 11:55 PM ET the homework will close and can no longer be submitted or accepted.

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 the LMS. If there are technical issues, please notify the help desk, as well as each professor immediately.

Assignment Due Dates
All assignments a 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. A valid written excuse (e.g., signed by a doctor/nurse, excuse from dean of student's office, or similar) is necessary in order to be able to take a make-up exam. In the case you do not have a valid written excuse, late submission of the exam would not be possible.

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

The grading shall be returned within one week from the submission closing time. The solutions of the homework will be provided after 48 hours after the homework submission is closed.

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.

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- Complete Microsoft Office Suite or comparable and ability to use Adobe PDF software (install, download, open and convert)
- Mozilla Firefox, Chrome and/or Safari browsers
- WinBUGS and OpenBUGS statistical software (free download: https://www.mrc-bsu.cam.ac.uk/software/bugs/ , http://www.openbugs.net/w/FrontPage). It is good idea to have both BUSG softwares installed on your computer.
- OCTAVE (MATLAB clone) or R or Python (needed for calculations for which WinBUGS/OpenBUGS are not appropriate) (free downloads; www.gnu.org/software/octave/ , www.r-project.org/, www.python.org/)

Technology Skills

Students are expected to be proficient in one of the text editing programs, such as (MS Word or LaTeX, as well as in one of the computing environments (MATLAB/Octave, R, Python).

Canvas & edX
This class will use Canvas and edX to deliver course materials to online students. ALL course materials and activities will take place on these two platforms as well as on the course page http://zoe.bme.gatech.edu/~bv20/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 Piazza. 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 staff at isye6420@gmail.com.

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- For serious personal issues, you can contact Dr. Roshan Vengazhiyil.
- We will use Piazza 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 (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.
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

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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/.

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/or staff and/or posting homework/exams to non-GT sites are considered serious violations of the honor code.

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 edX 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.
- Review the edX Honor Code: https://www.edx.org/edx-terms-service.
- You are responsible for completing your own work.
- Any learner found in violation of the edX Honor Code will be subject to some/all of the actions listed in the edX 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.

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, Piazza, 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.

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Course Schedule

Consult the Calendar and Plan tabs at https://www2.isye.gatech.edu/~brani/isye6420/ for detailed Course Schedule