

## ISYE 6650: Probabilistic Models Syllabus

Spring, 2025

**Delivery:** 100% Web-Based, Asynchronous

**Dates course will run:** Jan 6 – May 1, 2024

### Instructor Information

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**Office Hours:** By appointments

### General Course Information

#### Description

This three-credit course will introduce you to basic techniques for modeling and analyzing industrial systems in the presence of uncertainty.

Manufacturing & service systems typically have random components to their behavior such as the demand for products and services. We will learn useful quantitative methods for analyzing, designing, and operating stochastic systems particularly manufacturing and service systems. Much of our attention will be focused on understanding, managing and reducing variability for inventory, production, and service systems.

#### Pre- &/or Co-Requisites

*Basic algebra and calculus*. Note that previous exposure to probabilistic models or stochastic processes is not a prerequisite for this course. However, any exposure to probability at the level of ISyE 2027 will be helpful to successfully finish the course.

#### Course Goals and Learning Outcomes

Once completed, the students should have the following capabilities:

1. Formulate situations in practice into analytically solvable probability models.
2. Analyze the formulated probability models and use them for decision making.
3. Interpret the results of the analysis in a non-technical way.
4. Explain the assumptions underlying these models and the effects on the modeling process when these assumptions do not hold.
5. Explain the limitations of probabilistic operations research as applied to problems in industry or government.

## Course Materials

### Course Text

12<sup>th</sup> edition of *Introduction to Probability Models* by Sheldon Ross (ISBN-10: 9351073831, ISBN-13: 978-9351073833). An electronic copy of the textbook is available for free via the Georgia Tech library at [library.gatech.edu](http://library.gatech.edu).

### Additional Materials/Resources

- Lecture notes available on the course canvas page
- Python coding available on the following link:  
[https://colab.research.google.com/drive/1UQ5OdExUcE0nje9Eo5WYSg5\\_gO\\_DFSIQ?usp=sharing](https://colab.research.google.com/drive/1UQ5OdExUcE0nje9Eo5WYSg5_gO_DFSIQ?usp=sharing)

### Course Website and Other Classroom Management Tools

We use a Canvas platform.

## Course Requirements, Assignments & Grading

| Grading Type    | Description of Graded Assignments              | % Grade |
|-----------------|--|---------|
| Knowledge Check | A short quiz after each week                   | 5%      |
| Homework        | Individual homework assignments                | 15%     |
| Midterm Exam 1  | Online closed-book and closed-note canvas exam | 25%     |
| Midterm Exam 2  | Online closed-book and closed-note canvas exam | 25%     |
| Final Exam      | Online closed-book and closed-note canvas exam | 30%     |

### Assignment Distribution and Grading Scale

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## Assignment Weight Distribution and Due Dates

| Assignment      | Release Date  | Due Date   | Weight<br>(Percentage, points,<br>etc.) |
|-----------------|---|--|---|
| Knowledge Check | Monday 12:01 AM of<br>each module's<br>release week | Saturday 11:59 PM<br>of each module's<br>release week (except<br>1 <sup>st</sup> week) | 5%                                      |
| Homework        | Monday 12:01 AM of<br>each module's<br>release week | Wednesday 11:59<br>PM of the following<br>week from each<br>module's release<br>week   | 15%                                     |
| Midterm Exam1   | Feb 10, Monday,<br>12:01AM                          | Feb 15, Saturday,<br>11:59 PM  | 25%                                     |
| Midterm Exam2   | Mar 24, Monday,<br>12:01 AM                         | Mar 29, Saturday,<br>11:59PM   | 25%                                     |
| Final Exam      | Apr 24, Thursday,<br>12:01 AM                       | Apr 30, Wednesday,<br>11:59 PM   | 30%                                     |

The times listed above are subject to change so please check back often. Please convert from Eastern Time to your local time zone using a [Time Zone Converter](#).

### Grading Scale

- A is guaranteed if you are within the top 40% of the section or your overall score is 90 or above.
- B or higher is guaranteed if you are within the top 80% of the section or your overall score is 80 or above.
- C or higher is guaranteed if your overall score is 55 or above.

### Description of Graded Components

**Knowledge Check:** This is a short Canvas quiz that you will take after you finish watching all lesson videos for each module. The first four Knowledge Checks will be conducted with **Honorlock** so that you get used to Honorlock. For some questions, you will be asked to show your work on a hard copy of scratch paper. Then you should **scan and upload** the scratch paper to the Canvas within 5 minutes after you complete your knowledge check.

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You can take each quiz twice, and we will consider only the highest score. The Canvas will automatically grade your quiz based on correctness upon submission. Then we will manually regrade your quiz, taking into account **your scratch paper**. If your answer is correct but you don't submit your work for the questions whose work is asked, then you will receive 0 points for the problems. For any questions that require entering a numerical answer, always enter up to the **fourth** digit after the decimal place (e.g., 12.3456) if the number is non-terminating.

Each knowledge check is due Saturday 11:59 PM EST of the same week when each module is released. **We do not accept any late submissions**. However, if you need a short extension, please contact the teaching staff as soon as possible.

**Homework:** Homework will be assigned each week when a module is released. Thus, we have a total of 13 homework assignments. These assignments are individual and should be submitted electronically in pdf format to the Canvas. At the end of the semester, we will **drop the two lowest scores**. In general, we do not accept late submissions, but if you need a little extra time to finish an assignment, please contact the teaching staff for an extension. Or you can drop it so that it is counted toward the two lowest scores.

- We cannot accept a late submission after the homework solution is released.
- It is your responsibility to ensure that you submit the correct files containing all your work. Submit early and check the files are submitted. Incorrect submissions get zero credit even if you present files with a time stamp.
- You do not need to type your work (most students submit scans of their handwritten work).
- On some assignments, selected problems may be graded. You may discuss your assignments with professors, TAs, fellow students, and others. However, you are expected to write up your solutions to individual homework on your own and to understand your solution.
- If some homework involves coding, then copy and paste the code and outputs into an editor and convert it as a pdf file.
- Sending homework assignments, whether early, on time, or late directly to the professors is not permitted and will not be accepted.
- If there are technical issues, please notify the help desk and the teaching staff immediately.

**Exams:** Two midterms and the final will be open during their scheduled dates, and you can take it anytime during the open period. Each exam is 120 minutes long. They are formatted as Canvas quizzes with **Honorlock**. All exams are closed-book and closed-note, but you can have/use a hard copy of formula sheet (a.k.a. cheat sheet) with any number of pages. Only one electronic device is allowed for the exam, and the device's screen must remain on the quiz page throughout the entire duration; otherwise, Honorlock will raise a red flag. Therefore, you will need a hard copy of the formula sheet. Although there is no limit on the number of pages, keeping it to 3 to 5 pages should be sufficient.

You must show your work on scratch paper (not an electronic device but hard copy paper), and scan and upload the scratch work to the Canvas within 5 minutes after you are done with an

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exam. Use the pdf format only (no heic format please). Double check if the scratch work is successfully uploaded. For partial points, try to show as much as work possible. A correct numerical answer without work will receive a zero point.

In general, we don't provide any make-up exam. In case of an emergency, you should **contact the Dean of Students (not the instructor) immediately**. Only with a recommendation from the Office of the Dean of Students will we discuss which options you can have.

## Basic Algebra and Calculus

Basic algebra and calculus are prerequisites for this class. You can use <https://www.wolframalpha.com/> or the first set of codes in our Python Colab link for class examples and homework assignments. Even if you cannot manually derive a numerical answer or a final expression for a problem, it should be fine as long as you can do it using WolframAlpha or Python. However, exams will require some minimum levels of algebra, such as solving linear equations with one or two variables, and calculus, including single or double integration of simple equations, such as  $ax^b+c$ ,  $axy$ , or  $ax+by$ .

Check Homework0, which serves as a quick test to assess whether your preparation for algebra and calculus is sufficient. As long as you can get numerical answers by hand, Wolframalpha, or Python, you should be fine.

## Grading and Feedback

Regrade for homework and exams is obtained by submitting a written explanation (via email) to the teaching staff. For regrade, submit a written explanation (via email) *within 3 days of when the results were released*. Regrade will only be discussed *after* submitting the work in this manner.

It is strongly recommended that you do not ask for a regrade on the basis of partial point distribution. As we apply the same rubric and partial point distribution, it is impossible to change the partial point distribution for one student.

## 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 and ability to use Adobe PDF software (install, download, open and convert)
- Latest versions of Mozilla Firefox, Chrome and/or Safari browsers

### Technology Skills

- Navigating a computer operating system, launching, and quitting applications, connecting to the Internet, using a web browser to search the World Wide Web, downloading, saving, and uploading files, and sending and replying to email.

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- MS Word, MS PowerPoint, and MS Excel
- Python programming

## Onboarding Quiz and Proctoring Information

All Georgia Tech online degree and certificate students are required to complete the Onboarding Quiz with Honorlock in the first week of the course. Honorlock is utilized for student identity verification and to ensure academic integrity. Honorlock provides student identity verification via facial and ID photos. You may also be asked to scan the room around you. The Onboarding Quiz is needed to help make sure that your identity is verified and that your system is set up to work with Honorlock online proctoring tool. You are required to complete this quiz early in the semester to avoid problems when taking proctored exams.

## 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.

When posting or sending email requesting help with technology issues, whether to the Helpdesk, message board, or me 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 use the ED discussion board to ask any questions related to Knowledge Check, homework assignments, exams, and course materials. However, Do NOT submit posts of a personal nature to the discussion board. For such questions, please privately email the instructor.
- Email will be checked at least twice per day Monday through Friday; Saturday and Sunday, email is checked once per day. During the week, I will try to respond to all emails within 24 hours; on weekends and holidays, allow up to 48 hours. If you don't hear from the teaching staff within the time frame stated, then please send the teaching staff a reminder.
- The teaching staff (mainly TAs) will check the ED discussion board twice per day Monday through Friday; Saturday and Sunday, the teaching staff will check the discussion board once per day. But there may be a delay due to TAs' availability.
- Virtual office hours will be held using Zoom. The weekly schedule of the Virtual Office hours will be announced once the semester starts.

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- For questions related to technology, the Digital Learning Support team at <https://b.gatech.edu/digitallearningsupport> for assistance. You can also reach the Canvas Hotline by phone at 1(877) 259-8498 or by email at [support@instructure.com](mailto:support@instructure.com).

## Online Student Conduct and (N)etiquette

Although it is not expected to be a problem in a graduate-level class, students are asked to behave in the discussions and other class interactions professionally and civilly. If you are in doubt, do not post it! Instructors reserve the right to remove any postings deemed inappropriate, unprofessional, or otherwise distracting from the course.

## 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 to 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/>.

We are strict with the Institute's Honor Code. Any violation of the honor code will be reported to the Office of Student Integrity and comes with a minimum penalty of one letter grade reduction.

- Copying codes and solutions of other students is also a serious honor code violation.
- One thing we check carefully is your work. If your work does not lead to your final answer, it will be a problem and raise a question about integrity.

## Collaboration & Group Work

Knowledge Check and exams are individual, and you are not allowed to collaborate with colleagues. You are not allowed to use software such as Excel and Python for Knowledge Check and exams. You should not post questions on an open website such as Chegg, CourseHero etc. and ask others to solve the questions.

For homework assignments, you can discuss the problems with your colleagues, TAs, and the instructor. You can also use any materials you find on the Internet. However, you must write your work on your own instead of copying.

## **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.

## **Copyright**

Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise.

## **Student-Faculty Expectations Agreement**

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgment, and responsibility between faculty members and the student body. See <https://catalog.gatech.edu/rules/21/> for an articulation of some basic expectations 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 communicated via the Canvas announcement tool. It is the responsibility of students to check course announcements to stay current in their online courses.

## Course Schedule

| Week/Dates  | Topic                              | Readings                             | Assignments  |
|---|------------------------------------|--------------------------------------|--|
| 1<br>Jan 6 (Mon)<br>9:00am EST                            | Introduction to Probability Theory | Chapter 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 | Knowledge Check 1<br>–Due Jan 11 at 11:59pm EST (Bonus)<br><br>Homework 1 – Due Jan 15 11:59pm EST |
| 2<br>Jan 12 (Sun)<br><i>Release-Jan 10 at 12:01am EST</i> | Random Variables 1                 | Chapter 2.1, 2.2, 2.2, 2.3           | Knowledge Check 2<br>–Due Jan 18 at 11:59pm EST,<br><br>Homework 2 – Due Jan 22 11:59pm EST        |
| 3<br>Jan 19<br><i>Release-Jan 17 at 12:01am EST</i>       | Random Variables 2                 | Chapter 2.4                          | Knowledge Check 3<br>–Due Jan 25 at 11:59pm EST,<br><br>Homework 3 – Due Jan 29 11:59pm EST        |
| 4<br>Jan 26<br><i>Release-Jan 24 at 12:01am EST</i>       | Random Variables 3                 | Chapter 2.5.1, 2.5.2, 2.5.3          | Knowledge Check 4<br>–Due Feb 1 at 11:59pm EST,<br><br>Homework 4 – Due Feb 5 11:59pm EST          |
| 5<br>Feb 2<br><i>Release-Jan 31 at 12:01am EST</i>        | Random Variables 4                 | Chapter 2.8                          | Knowledge Check 5<br>–Due Feb 8 at 11:59pm EST,<br><br>Homework 5 – Will Not Be Collected          |

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| Week/Dates   | Topic  | Readings                                  | Assignments  |
|--|--|---|--|
| 6<br>Feb 9<br><i>Release-Feb 10 (Mon) at 12:01am EST</i> |  | Review chapters covered in Modules 1 - 5  | Midterm Exam 1<br>–Due Feb 15 (Sat) at 11:59pm EST   |
| 7<br>Feb 16<br><i>Release-Feb 14 at 12:01am EST</i>      | Conditional Probability and Conditional Expectation    | Chapter 3.1, 3.2, 3.3, 3.4, 3.5           | Knowledge Check 6<br>–Due Feb 22 at 11:59pm EST,<br>Homework 6 – Due Feb 26 11:59pm EST    |
| 8<br>Feb 23<br><i>Release-Feb 21 at 12:01am EST</i>      | Discrete-Time Markov Chains 1                          | Chapter 4.1, 4.3                          | Knowledge Check 7<br>–Due Mar 1 at 11:59pm EST,<br>Homework 7 – Due Mar 5 11:59pm EST      |
| 9<br>Mar 2<br><i>Release-Feb 28 at 12:01am EST</i>       | Discrete-Time Markov Chains 2                          | Chapter 4.4, 4.5                          | Knowledge Check 8<br>–Due Mar 8 at 11:59pm EST,<br>Homework 8 – Due Mar 12 11:59pm EST     |
| 10<br>Mar 9<br><i>Release-Mar 7 at 12:01am EST</i>       | Variation of Markov Chain and Exponential Distribution | Chapter 4.10, 7.6, 5.2.1, 5.2.2, 5.2.3    | Knowledge Check 9<br>–Due Mar 15 at 11:59pm EST,<br><br>Homework 9 – Will Not Be Collected |
| Week of Mar 16: Spring break                             |  |   |  |
| 11<br>Mar 23   |  | Review chapters covered in Modules 7 - 10 | Midterm Exam 2<br>–Due Mar 29 (Sat) at 11:59pm EST   |

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| Week/Dates  | Topic                                       | Readings  | Assignments  |
|---|---|---|--|
| <i>Release-Mar 24 (Mon) at 12:01am EST</i>                                  |   |   |  |
| 12<br>Mar 30<br><i>Release-Mar 28 at 12:01am EST</i>                        | Poisson Process                             | Chapter 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.4, 7.1, 7.3, 7.4                | Knowledge Check 10 –Due Apr 5 at 11:59pm EST,<br><br>Homework 10 – Due Apr 9 11:59pm EST   |
| 13<br>Apr 6<br><i>Release-Apr 4 at 12:01am EST</i>                          | Continuous-Time Markov Chains               | Chapter 6.1, 6.2, 6.3, 6.5  | Knowledge Check 11 –Due Apr 12 at 11:59pm EST,<br><br>Homework 11 – Due Apr 16 11:59pm EST   |
| 14<br>Apr 13<br><i>Release-Apr 11 at 12:01am EST</i>                        | Queueing Theory 1,<br><br>Queueing Theory 2 | Chapter 8.1, 8.2, 8.3.1, 8.3.2, 8.3.3;<br><br>Chapter 8.3.4, 8.4, 8.5 | Knowledge Check 12 – Due Apr 19 at 11:59pm EST,<br><br>Knowledge Check 13 – Due Apr 22 at 11:59pm EST (Bonus)<br><br>Homework 12 & 13<br>- No submission |
| Reading Period and Final Exam<br><i>Release-Apr 24 (Thu) at 12:01am EST</i> |   | Review chapters covered in Modules 12-15                              | Final Exam<br>–Due Apr 30 (Wed) at 11:59pm EST   |