ISYE 4045 Syllabus

Course Name: Simulation
Credits: 3
Term: Spring 2027

Instructor Information

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General Course Information

Description

[Catalog] Advanced modeling and statistical concepts in discrete-event simulations; Monte Carlo simulation; estimation of error and risk; advanced input modeling techniques; comparison and optimization of systems.

Modeling of discrete-event dynamic systems and introduction of methods for using these models to solve engineering design and analysis problems. Emphasis on estimation of error and risk in simulation experiments; input modeling techniques; generation of random realizations and processes; comparison of alternative systems via simulation; and simulation-based optimization (minimal coverage).

Course Learning Outcomes

At the completion of this course, you will be able to:

- Develop a deeper understanding of estimation of error and risk in simulation studies.
- Model complex systems with Simio, a state-of-the art simulation package.
- Understand advanced techniques for selecting appropriate input probability distributions and arrival processes.
- Employ efficient techniques for generating realizations from statistical distributions and arrival processes.
- Understand fundamental concepts pertinent to the estimation of the mean and marginal quantiles of stationary output processes; and employ state-of-the-art algorithms for estimating these metrics.
- Use effective methods for comparison of alternative simulated systems. Develop a basic understanding of simulation-based optimization.

Required Course Materials

- Extensive handouts and/or slide sets will be provided on the Canvas site. These materials are arranged in Modules.
- Law, A. M., *Simulation Modeling and Analysis*, 6th edition, McGraw-Hill, 2024 (required).
- Smith, J. S., and D. T. Sturrock (KSS), *Simio and Simulation: Modeling, Analysis, Applications*, 7th edition, Simio LLC, 2025 (required).

The last text is available online at no cost. The spreadsheets, example models and data files referenced throughout the text are also available via links therein, and are packaged in archives (ZIP files): Keep in mind that Simio is evolving at a rapid pace, so objects often have new or enhanced properties.

- **Simio Software**
  - We will model with Simio, a comprehensive discrete-event simulation package with extensive modeling, animation, and statistical analysis capabilities. Simio runs on reasonably new computers and is limited to the Microsoft Windows 11 operating system. It also runs on Macintosh computers via *an emulator* (e.g., Parallels Desktop or VMware Fusion) ***on top of macOS***. Details on the current version of Simio as well as downloading a free version of the software will be provided in Canvas.
- **ExpertFit**
  - The ExpertFit software is available on a virtual desktop (see Canvas). Do not attempt to download/use the Student Version listed in Law's text because it has very limited functionality.
- **Excel Add-In**
  - We will use the free SIPMath tools from www.probabilitymanagement.org. The current version of the Free Legacy SIPmath Modeler Tools at https://www.probabilitymanagement.org/chancecalc works with Excel 2016, 2019 and 365 for Windows, and Excel 2016, 2019, 2021 and 365 for macOS. The download requires free registration at the site (and a short message). The website https://www.probabilitymanagement.org/videos contains several short instructional videos illustrating the functionality of various features.

Grading Policy

Graded Component	*Weight*
Midterm Exam	35%
Final Exam	40%
Assignments	25%

Your final grade will be assigned as a letter grade according to the following cutoff points:

A	$\geq 90\%$
B	$\geq 80\%$
C	$\geq 70\%$
D	$\geq 60\%$
F	$< 60\%$

(See here for more information about the grading system at Georgia Tech.)

The overall scores will be computed by adding the average assignment score (out of 25), the midterm-exam score (our of 35), and the final exam score (out of 40). Depending on the shape of the histogram of the overall course grade, I may lower the cutoff points above.

Description of Graded Components

Exams

- Midterm Exam: in class
- Final Exam: in class (2 hours during the scheduled exam window)

Individual homework assignments

- Individual homework assignments will be assigned regularly; their due dates will be posted on Canvas.
- You may discuss your homework assignments with the professors, TAs, fellow students, and others. However, you are expected to write up your solutions to individual homework on your own.

General Policies

- Using, in any manner, solutions to any assignments given as part of this course in previous semesters to prepare solutions for current assignments is a violation of the student honor code for this course.
- Homework will be assigned approximately every 1.5 weeks, and will be submitted on Canvas. The assignments will contain analytical problems and computer programming problems. We may choose not to grade some questions. Assignments due during the last week of classes will cover material taught prior to that week. **Late submissions will not be accepted.**
- Handwritten documents should be scanned and submitted in PDF format (files in JPEG or other image formats will not be graded). ***If an assignment involves multiple electronic files, you should submit a single archive (a zip file).***
- This course will involve extensive computer programming in Simio, Microsoft Excel, and a scripting language such as Python or R. You are also free to program in C/C++ or Java if you are unfamiliar with scripting languages. Modeling assignments may go beyond class instruction.

USG Required Course Policies

Attendance and/or Participation

Class attendance is not required but strongly encouraged. You are encouraged to actively participate in this class by asking questions and contributing during discussions.

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. Review Georgia Tech's Academic Honor Code and the student Code of Conduct.
- Any student suspected of cheating or plagiarism on an exam or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Core IMPACTS

Not applicable.

Additional Georgia Tech Required Policies

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services 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.

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. The Student-Faculty Expectations articulate some basic expectations that you can have of the instructor and that the instructor will have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, you are encouraged to remain committed to the ideals of Georgia Tech while in this class.

Optional Course Expectations, Policies, and Resources

Pre- &/or Co-Requisites

ISYE 2027/3030/6739. In particular, this class requires:

- Solid knowledge of probability and statistics at the level of ISYE 2027/3030/6739. Many topics such as generation of realizations from probability distributions and analysis of simulation input/output require a variety of statistical tools.
- We will also review fundamental probabilistic and statistical properties (Chapter 4 of Law's text), but I will assume that you will be able to rapidly grasp properties related to variance and correlation.
- Prior exposure in simulation modeling with Arena or Simio will be helpful.

Additional Materials and Resources

Collaboration, Group Work, and Acceptable Resources

Homework assignments are designed to develop your ability to understand, formulate, and solve problems. You are encouraged to work together when conceptualizing and analyzing the homework assignments. However, you are required to prepare your own solutions and perform the calculations yourself and turn in (for grading) your own analysis and write-up. Copying or rephrasing someone else's work is unacceptable. Further, copying someone else's work is a disservice to your own understanding of the material. There is a big difference between the ability to read and understand a solution and the ability to create and write one. You are allowed to use the materials listed in the syllabus in preparation of your homework responses. If you use material outside those listed in the syllabus, you should cite the material used.

Collaboration is strictly disallowed during the midterm or final exams. Any collaboration on these graded components is a violation of the honor code.

Use of Generative AI

Limited use of Generative AI is permitted in this course.

You may use generative AI programs to

- Explain definitions, restate homework problems, and suggest strategies for solving the problem
- Troubleshoot your attempt at the problem solution after you have already completed it. You must attempt a completed solution to the problems on your own first and only use AI to troubleshoot

Generative AI cannot be used to

- Generate full solutions

Assignments for which Generative AI is allowed with submission of an AI Usage Statement

- Homework Assignments (AI allowed with AI usage statement)

Assignments for which Generative AI is not allowed

- Midterm Exam
- Final Exam

If a Generative AI tool is allowed on an assignment and you use any such tool, you must be transparent and document how you used it in a required *AI Usage Statement* with each submission. The AI Usage Statement must include:

- The tool used and date of access
- The input (prompt) you provided
- A copy of the output
- A description of how you used or edited the AI-generated content

Per Georgia Tech's Honor Code, you may not submit any work generated by a Generative AI program as your own. Failure to follow these guidelines — including using Generative AI when it is not permitted or failing to disclose its use — may be considered a violation of Georgia Tech's academic integrity policies. When in doubt, always consult your instructor before using Generative AI.

You should be aware that the material generated by Generative AI programs may be inaccurate, incomplete, biased, or otherwise problematic. Also, the use of these tools may stifle your own independent thinking and creativity, which could hurt your performance on exams.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Late assignments and extensions are not allowed. If you are unable to complete an assignment on time, you must use one of your dropped homework allowances for this purpose. Any submission received beyond the deadline posted on Canvas will be considered late. You are responsible for checking that your assignment is downloadable by the instructor team; corrupted files will not be accepted.

We only accept notifications from Dean's office or institute Approved Absences; you can find the on-line request form here. Please inform the instructor of your approved absences timely. If the notification from Dean's office is at the instructor's discretion and your absence prevents you from completing assignments or tests, please discuss the accommodations with the instructor as soon as possible. Since it is difficult to create a different but fair test, and solutions to tests or assignments may have already been published, the accommodation will not necessarily be in the form of a makeup test or assignment.

Student Use of Mobile Devices in the Classroom

Research on learning shows that unexpected noises and movement automatically divert and capture people's attention, which means that one student's use of a mobile devices (laptops, cell phones, tablets, etc.) can distract another student and disrupt their ability to learn. In addition, students using mobile devices often become engaged in matters that are not related to the class they are attending. Further, research indicates that students taking notes on laptops tend to process less as they take notes, and the depth of their learning suffers.
Although students may use laptop and tablet devices, these devices should be used only for matters related to our class. For the reasons listed above, I encourage students to be mindful in terms of how using laptop and tablet devices may be impacting their own learning. Cell phones should be silenced and stored during classroom time.

Additional Course Policies

Recordings of Class Sessions and Required Permissions
Classes may not be recorded by students without the express consent of the instructor unless it is pursuant to an accommodation granted by the Office of Disability services. Students may not record or share the materials or recordings unless the instructor gives permission. Digitally proctored exams may require students to engage the video camera, but those recordings will not be shared with or disclosed to others without consent unless legally permitted.

Course website and other classroom management tools

Canvas will be used as the course website. All assignments should be submitted via Canvas.

Regrade requests

If you think there has been an error in the grading of your assignment or exam, you have one week (7 calendar days) from the day it was returned to the class or the scores were posted on Canvas to submit it for a regrade. When you submit a regrade request, you must provide a written explanation of the suspected grading mistake. Regrading entails re-grading the entire assignment or exam; therefore, the regrade process may result in your submission receiving a higher or a lower score after all of the problems have been reconsidered.

Campus Resources for Students and Student Well-Being

The following resources on campus are available to students:

- The Center for Academic Success provides a variety of valuable resources for students, including tutoring.

- The Center for Mental Health Care is the primary resource for mental health support at Georgia Tech.
- The Division of Student Life: The Office of the Vice President for Student Life and Dean of Students provides a number of services to assist students with academic, financial, medical, and personal emergencies.
- At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. The Office of the Vice President for Student Engagement and Well-being. has been compiled and maintains a comprehensive list of wellness related resources.
- Additional resources on supporting student well-being are available through the Learning Well Initiative.

Graduate Student Academic and Professional Success Resources

A list of resources for graduate students is given on the Office of Graduate and Postdoctoral Education website. Specific information for current graduate students includes:

- Academic Resources such as the Communications Center, Language Institute, Library, Catalog, Registrar, resources for conducting research, Advocacy and Conflict Resolution resources, and how to manage unexpected situations that may impact your academic performance.
- Student Resources such as Campus Services, Child Care/Family programs, Health & Wellness, Career Services, and the Student Resource Guide.
- Professional Development such as the programming from the Career Center and other professional development resources and events.