

CEE 6231 Syllabus

Probability and Statistics for Civil and Environmental Engineers

Fall 2026

Instructor Information

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General Course Information

Description

This course provides a systematic review and working knowledge of fundamental probability and statistics methods and their application to engineering problems. Topics include random variables; probability distributions (of one or several random variables); statistical moments; derived distributions; empirical distributions and data analysis; distribution fitting to observed data; statistical hypothesis testing; Monte Carlo simulation methods; forecasting of random variables; and forecast verification procedures. Course assignments depict real-world applications in different disciplines (e.g., water resources and environmental engineering, transportation, and construction management, among others) and aim to build student experience in practical problem solving.

Course Learning Outcomes

Successful completion of this course provides students with (i) an in-depth understanding of probability and statistics; (ii) confidence in conceptualizing engineering problems in ways amenable to probability and statistics methods; (iii) working experience with method application to real-world problem solving; and (iv) enhanced computational and communication skills to carry out such investigations and communicate their findings and solutions effectively.

Required Course Materials

Primary Text: *Probability and Statistics Methods and Applications (2015–2026)*. Lecture notes by A. Georgakakos, Georgia Water Resources Institute, Georgia Tech. Notes to be provided at no cost.

Other References: (a) Probability, Random Variables, and Stochastic Processes, by A. Papoulis and U. Pillai, McGraw Hill, Fourth Edition, 2002;

(b) Statistical Methods in the Atmospheric Sciences, by D. S. Wilks, Academic Press, Second Edition, 2006.

References (a) and (b) are optional.

Grading Policy:

This course include homework assignments and a comprehensive project. Grades will be determined based on active class participation (10%) and performance on homework assignments (50%) and project (40%). Additional details are provided next:

Assignments

- Homework assignments are posted every two-three weeks and are intended to reinforce the understanding of the lecture material and its various applications to practical problems.
- The comprehensive project assignment requires a longer effort and is motivated by real-world engineering problems.

Description of Graded Components

- Homework assignments must be completed by each student *individually*. Conceptual discussions among students are allowed but sharing of spreadsheets, computer codes, or other computational tools is not. Students are required to submit a self-explanatory report describing their approach, results, and findings, as well as a copy of the computational tools developed for the assignments.
- The comprehensive project requires a more substantial effort than that of homework assignments and is to be worked by each student *independently*. Students are expected to submit detailed technical reports describing their solution approach, methods used, information sources, results, interpretation of findings, and recommended solutions. Grading will be based on the correctness of the approach, adequacy of the work performed, thoroughness and valid interpretation of the findings, and communication ability (written and oral) to present the work effort and findings in a clear, informative, and engaging fashion.

Course Policies

Attendance and/or Participation

The course lectures include frequent question-discussion-answer segments as a means of reinforcing and expanding student learning, but also as a means of monitoring the

internalization efficiency of the instructional material. Regular class attendance is expected, except for planned or emergency absences as outlined in the GT catalog (<https://catalog.gatech.edu/rules/4/>) and handled as in the stated rules thereof. Active class participation is highly encouraged and graded by how often students engage in/add to class discussions in non-trivial and perceptive ways.

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 Honor Code](#) and the student [Code of Conduct](#).

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, [contact the Office of Disability Services](#) (404-894-2563) 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.

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 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, students are encouraged to remain committed to the ideals of Georgia Tech while in this class.

Pre- &/or Co-Requisites

Prior exposure to probability and statistics is helpful but not required. Good working knowledge of calculus is required. Homework assignments and projects involve computations, and experience with programming tools such as EXCELL, programming languages, and/or MATLAB is helpful. Students should discuss their math preparation and computational experience with the instructor to ensure they have the necessary background and skills to succeed in the course.

Collaboration, Group Work, and Use of Generative AI

Students are expected to adhere to the following course policies regarding collaboration and the use of AI tools.

- (i) Productive discussions between students on homework assignments are encouraged; however, students must develop and report their own, original work, clearly demonstrating their assignment understanding and solution effort. The rationale and computational process for all findings and solutions must be clearly stated. The submission of only numerical values and tables without clear explanation of how they are derived is unacceptable. Also unacceptable is the submission of just programming codes without reporting and discussing their results. Duplicating another student's work, splitting/sharing assignment tasks with other students, or outsourcing any part of an assignment represents a violation of the Georgia Tech Academic Honor Code.
- (ii) Collaboration in the form of sharing spreadsheets and/or computational codes is not permitted on homework assignments and projects, nor is help from students who have already taken the course or any other individual.
- (iii) Use of course materials from past semesters, such as homework solutions and associated computational tools (e.g., spreadsheets and programming codes) is not permitted.
- (iv) All work submitted must be written exclusively by each student and reflect their own conceptual rationale and internalized understanding. The use of AI tools to *conceptualize* the approach taken on homework assignments and projects will be considered academic misconduct. AI tools *can* be used for compiling supporting information (from literature sources) on specific aspects of the course assignments as well as for polishing and improving report language (e.g., improving spelling, grammar, and writing style). The scope and extent of AI usage, if any, must be clearly stated in all assignment submissions.

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

Students must strive to submit homework assignments and projects within the allotted time, as unjustified late submissions have grading consequences. If there exist valid reasons for late submissions, students must inform the instructor and request authorization *prior* to the assignment due date. Authorization of late submissions will be evaluated on a case-by-case basis.

Student Use of Mobile Devices in the Classroom

In-class use of mobile devices (e.g., laptops, mobile phones, and tablets) is permitted only for note-taking or other course-related purposes, provided it does not distract other students or the lecturing process.

Campus Resources for Students

Student Well-Being

At Georgia Tech, we are concerned about our students' overall physical, social, and mental well-being. A [comprehensive list](#) of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being ([student-resource-guide \(gatech.edu\)](#))

Lecture Topics

Part I: Probability Theory and Applications (20 Lectures)

- Fundamental Probability Concepts
Sample Spaces, Events, and Event Operations; Meaning of Probability; Probability Axioms; Conditional Probability; Bayes' Rule; Independence; Applications.

- Random Variables, Distribution Functions, and Expectation
Discrete and Continuous Random Variables; Cumulative Distribution and Probability Density Functions; Statistical Moments; Characteristic and Moment Generating Functions; Applications.

- Common Probability Models
Uniform; Bernoulli; Binomial; Geometric; Poisson; Exponential, Hyper Exponential; Gamma; Normal; Lognormal; Extreme Type Distributions; Applications.

- Joint and Conditional Distributions
Joint Cumulative Distribution and Probability Density Functions; Marginal and Conditional Densities; Independence; Statistical Moments; Characteristic and Moment Generating Functions; Multinomial Distribution; Multivariate Normal (Gaussian) Distribution; Limit Theorems; Applications.

- Functions of Random Variables
Derived Distributions; Transformations; Expectations of Random Variable Functions; Applications.

Part II: Statistical Methods for Data Analysis (10 Lectures)

- Empirical Distributions and Exploratory Data Analysis
Histograms and Empirical Frequency Distributions; Summary Statistics; Boxplots and Scatterplots; Correlation Maps; Quantile Plots; Applications.

- Hypothesis Testing
Estimators and Estimates; Method of Moments; Maximum Likelihood; Properties of Estimators (Unbiasedness, Consistency, Efficiency, Sufficiency); Sampling Distribution of Maximum Likelihood Estimates; Simple and Composite Hypotheses; Parametric and Nonparametric Test Methods; Bootstrap and Re-sampling Methods; Applications.

- Simulation Methods (Monte Carlo)
Random Numbers; Simulation of Uncorrelated and Correlated Series; Ensemble Forecasting; Simulation of Environmental Systems; Applications.