Probabilistic Models in Civil and Environmental Engineering

The language of probability allows us to speak quantitatively about some situation which may be highly variable, but which does have some consistent average behavior. Our most precise description of nature must be in terms of probabilities.

– Richard Feynman

Course website

This course will be facilitated online through Canvas (`canvas.stanford.edu`). We will use Ed Discussion for Q&A and discussions and GradeScope for homework submission and grading. Both of these tools are accessible via links from the Canvas site.

Course meeting times and schedule

- Lecture videos will be provided on the website for viewing outside of class.
- Interactive discussions will be on T/Th 9:00-10:20 am, in Turing Auditorium.

See this link for a schedule of exams, videos to watch, and assignments:
`https://docs.google.com/spreadsheets/d/1r_nj7zuEKc1zcaShN8ohRk9Kj43ce5uWzb3-sZt6jfo`

Teaching team

Instructor	**Course Assistants**
Jack Baker	Tinger Zhu Tyler Rodrigues
Office hours: T/Th 10:30am - 12:00pm	Office hours: M/W 2:30-4:00 pm

Office hours are a productive and enjoyable way to engage with you. We hope you will attend regularly!

Electronic correspondence should generally take place on the Ed Discussion tool, so the entire teaching team can see your inquiries and all students can see questions and respond with ideas. Please write us there with questions or requests. You can use Anonymous posts if you prefer to hide your name from other students, or private posts for issues unique to you. For confidential items, feel free to e-mail Prof. Baker at bakerjw@stanford.edu.

Learning objectives

This course will introduce graduate students to concepts and applications of probability and statistics in civil engineering. By the end of this class, you will be able to:

- Communicate using the language of probability and statistics
- Choose appropriate probabilistic models for a given problem, using information from observed data and knowledge of the physical system being studied
- Use probability tools to perform civil engineering calculations
- Identify topics where probability and statistics have been or should be applied in civil engineering
- Critically examine the work of others for valid use of probability and statistics

Prerequisites

This course is intended for engineering students with basic probability and statistics experience. Knowledge of basic calculus is required (see Homework #1 for examples).

Textbook

The only required document for this course is a set of notes that will be provided and distributed through the course website. The following is an optional but excellent reference and is available at low cost online. It is also available online through Stanford's campus resources: `https://searchworks.stanford.edu/view/11927193`.

- Benjamin, J. R. and C. A. Cornell (2014). *Probability, Statistics, and Decision for Civil Engineers*. Dover Publications, Mineola, New York.

Evaluation

Grades will be computed using the following weighting scheme:

Video quizzes	5%
Homework	35%
Midterm	25%
Final exam	35%

Online quizzes will accompany each section of the online videos, and will be a chance for you to verify your understanding of the material and offer feedback to the teaching team. If you get at least 70% of the questions correct over the course of the quarter, you will get full credit for this portion of the course, so don't worry about missing a few questions or even missing a few quizzes–it won't affect your evaluation.

Homework assignments will consist of calculations that develop an understanding of the materials presented in class. A final assignment will evaluate your ability to synthesize and utilize concepts from throughout the class.

The midterm and final exams will be similar to the homework in content and format, so if you can easily complete the homework assignments, you should be able to complete the

exams. The midterm exam will be in class on the scheduled day, and the final exam will be during the registrar-scheduled time. You may bring in a calculator and a page or two of notes to the exams, but they are otherwise not open-book or open-note. The exam dates and times are listed in the schedule that is linked at the top of the syllabus. If you foresee any potential conflicts with the scheduled exam times, please speak with Prof. Baker during the first week of the quarter, to discuss whether an accommodation can be granted or not.

Homework policy

- Homework assignments are to be submitted on GradeScope by midnight on the due date listed on each assignment. Late homework will be penalized at a rate of 10% per day late. To ensure equitable treatment, and to manage logistics with a large class, we will not grant exceptions for late penalties other than for a medical or family emergency, and we reserve the right to request documentation in those cases. Homework submitted after the solutions have been provided will not be accepted.
- Clearly explaining what you have done to solve a homework or exam problem is as important as obtaining a correct numerical result. Computer or calculator computations must be accompanied by appropriate documentation of how the calculation was carried out. See Homework #1 for more details. If you are uncertain about what to include, contact the teaching team.
- Some homework assignments will require computer calculations. It is suggested that these computations be done using Matlab. I will provide some example code for it, and we will be able to assist with it a bit. Matlab is free for students at `https://www.mathworks.com/academia/tah-portal/stanford-university-30569029.html`. Make sure to install the *Statistics and Machine Learning*, *Symbolic Math*, and *Optimization* toolboxes when you install Matlab. You can use other computer programs if you prefer, as long as you clearly document your work. All of the calculations are also feasible using Excel, though will be less efficient in some cases.
- For more background on using Matlab, see the interactive training module at `https://matlabacademy.mathworks.com/details/matlab-onramp/gettingstarted`. It should take about 2 hours, and it's interactive, so I think you'll learn more in this format than you would by watching videos or reading manuals.

Honor code

It is expected that Stanford's Honor Code will be followed in all matters relating to this course. You are encouraged to meet and exchange ideas with your classmates while studying and working on homework assignments, but you are individually responsible for your own work and for understanding the material. You are not permitted to copy or otherwise reference another student's homework or computer code. If you have any questions regarding this policy, please contact Prof. Baker.

Course material copyrights

The materials provided to you for this course are copyrighted or licensed to Stanford University. Stanford grants you a limited license to use the materials solely in connection with

the course for your own personal educational purposes. Any use of the materials outside of the course may be in violation of copyright law. You agree that you will not post, share or copy the materials.

Penalties for copyright infringement can be harsh. Fines of up to $150,000 in civil statutory damages may apply for each separate willful infringement, regardless of the actual damages involved. Stanford may also take administrative action against copyright infringement, including loss of networking privileges and SUNet ID, or disciplinary action up to and including termination for faculty and staff, and expulsion for students. Proceeding with this course indicates that you have read the above statement, agree to be bound by its terms.

COVID considerations

We will comply with all University policies related to maintaining a safe learning environment. If you feel sick, *do not come to the live sessions*, even if you suspect you just have a cold or allergies. Please do this out of an abundance of caution and out of respect for your peers and the teaching team. We will provide recordings of class lectures to assist students with illness-related absences.

Respect for Diversity

It is my intent that students from diverse backgrounds, perspectives, and situations be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity in gender, sexuality, disability, age, socioeconomic status, ethnicity, race, religion, political affiliation, and culture. I acknowledge that there is likely to be a diversity of access to resources among students and aim to support all of you as best as I can. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

All people have the right to be addressed and referred to in accordance with their personal identity. Please indicate the name that you prefer to be called and, if you choose, identify pronouns with which you would like to be addressed. I will do my best to address you accordingly and support classmates in doing the same.

Students with disabilities

Students with Documented Disabilities who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend accommodations, and prepare an Accommodation Letter for faculty. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations (650-723-1066, `https://oae.stanford.edu/`).