

# Probability and Statistics for Civil Engineers (CE 311S)

## Spring 2022

**Instructor:** Steve Boyles

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**Course Meeting Time and Place:** Monday/Wednesday/Friday, 9:00–9:50, CPE 2.210 and/or Zoom

**Lab Sessions:** (A) Mon. 1:00–2:00 (#15950), (B) Mon. 2:00–3:00 (#15955), (C) Fri. 2:00–3:00 (#15960), all in ECJ 2.218 and/or Zoom

**Office Hours:** Monday 10–11 and Tuesday 9:30–10:30 (Zoom); TA office hours TBD

**Course Website:** <http://tinyurl.com/boyles311s>, homework submission and grades posted on Canvas

**TAs:** Bushra Islam, Jui Shriniva Dixit, Pin-Chun Cho

Welcome to CE 311S! This course will expose you to the basic concepts of probability and statistics. This course will relate this material specifically to civil engineering problems, but real-world examples from current events and other fields may be brought in as well. We live in an uncertain world — literally every field of study is impacted by events which cannot be fully predicted in advance. Within civil engineering, structures must be built without fully knowing the wind load or weather deterioration they will experience; water resource infrastructure and planning must recognize that in some years the problem is too much rain, and in other years the problem is the opposite; in transportation systems, over half of roadway congestion is due to unpredictable events such as accidents or bad weather, rather than lack of capacity; and so on and so forth. To be a successful engineer, you must recognize how to (a) describe unpredictable events in a quantitative way and (b) learn how these events can be incorporated into engineering analysis. These are the primary goals of this course, and Upon successfully completing CE 311S you will be familiar with the fundamentals of probabilistic modeling, including elementary combinatorics, facility with discrete and continuous distributions, confidence intervals, hypothesis testing, and their application to engineering problems.

### Prerequisites

Mathematics 408D or 408M is a required prerequisite for 311S. Probability and statistics rely very heavily on calculus, so if it has been a while since you took these courses or if you feel your calculus is weak, you may find it worthwhile to review these topics before the semester gets too busy. Still, while many students find CE 311S a challenging course, this is generally *not* because of the mathematics. All of the math techniques used in this course you've seen before, and with the exception of calculus, most calculations involve nothing more complex than addition and multiplication. Rather, the challenge is learning which techniques apply to which problems. This may be one of the first courses you see where this is true, but as you progress in your curriculum this will only become more and more true; indeed, the hard part about engineering in practice is not the calculations, but deciding what part of your knowledge needs to be applied when. **This means that success in CE311S relies on understanding the underlying concepts and not just the calculations involved.**

### Course Materials

The required text for the course is *Introduction to Probability, Statistics, and Random Processes* by Hossein Pishro-Nik. This text is available freely online at <http://www.probabilitycourse.com>, or a hard copy can be purchased on Amazon for \$20-35. All homework problems will be posted on the course website listed above. In addition, additional lecture notes or slides will be posted as needed.

## Grading

Final course grades are determined by performance on homeworks, two in-class exams, and a final exam. The weight of each of these factors is as follows:

Category	Weight
Reading responses	5%
Homeworks	25%
Exam 1	20%
Exam 2	20%
Final Exam	30%

The  $+/-$  grading system will be used. At the end of the course, I may apply a curve if needed to ensure a proper grade distribution. You are encouraged to work together on homeworks, but you must submit solutions in your own words. These homeworks will require a significant amount of time and effort — do not wait until the night before to start! Any late assignment will receive an automatic grade penalty of 10% per day (starting **immediately** after the posted deadline on Canvas). You are responsible for making sure your homework is correctly uploaded. While attendance is not a component of the final grade, students are strongly encouraged to attend all lectures, and few students are able to successfully master the course material without lecture attendance and participation.

If you know you will have a time conflict with an exam, please notify me as soon as possible to make alternate arrangements. Based on circumstances, these arrangements may include taking a completely different exam before or after the regularly-scheduled time, additional assignments, and/or adjusting a student's final grade distribution. Except for unforeseen and documented emergencies, makeup exams will not be given without prior notice.

The final is cumulative and will be held at the University-scheduled time. The two in-semester exams are not intentionally cumulative, but all the material in the course builds on earlier topics and can't be fully separated. You may bring a single double-sided sheet of paper to the two in-class exams, and two double-sided sheets of paper to the final. Calculators are optional; Internet or communications-capable devices (laptops, tablets, phones, etc.) cannot be used.

Most weeks in this course have an associated reading from the textbook or another resource. You are required to compose a short response to these readings and post them on the appropriate Canvas discussion board at the start of the week. These responses are free-form and can include questions about things in the reading which are unclear; summarizing what you have read in your own words; thoughts or questions about how these concepts apply in practice; critiques of notation, presentation format, and explanations; or anything else which demonstrates that you have read the assigned sections and made an honest effort to engage with them. The TAs and I will use these to prepare for class and answer questions you have.

A high-level schedule for the course is shown below; a more detailed schedule is available on the course website and Canvas.

- (2 weeks) Probability fundamentals and descriptive statistics
- (1 week) Combinatorics
- (2 weeks) Discrete random variables
- (2 weeks) Continuous random variables
- (2 weeks) Multiple random variables
- (1.5 weeks) Confidence intervals

- (1.5 weeks) Hypothesis tests
- (1 week) Linear regression
- (1 week) Point estimation
- (1 week) Course retrospective and the future

Major dates:

- Exam 1 will be on February 25
- Exam 2 will be on April 1
- The final exam will be at the University-scheduled time (tentatively Tuesday, May 17 from 9 AM to noon).

## Miscellanea

Title IX is a federal law that protects against sex and gender based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. Faculty members and certain staff members are considered “responsible employees” or “mandatory reporters,” which means that they are required to report violations of Title IX to the Title IX Coordinator. **I am a Responsible Employee and must report any Title IX related incidents that are disclosed in writing, discussion, or one-on-one.**

Before talking with me, or with any faculty or staff member about a Title IX related incident, be sure to ask whether they are a responsible employee. If you want to speak with someone for support or remedies without making an official report to the university, email [advocate@austin.utexas.edu](mailto:advocate@austin.utexas.edu). University Health Services, the Counseling and Mental Health Center, and Legal Services for Students are also confidential resources. For more information about reporting options and resources, visit [titleix.utexas.edu](http://titleix.utexas.edu) or contact the Title IX Office at [titleix@austin.utexas.edu](mailto:titleix@austin.utexas.edu)

The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. For more information, contact the Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259 (Videophone: 512-410-6644) or <http://diversity.utexas.edu/disability/>.

Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. For further information, please see <http://catalog.utexas.edu/general-information/appendices/appendix-c/student-discipline-and-conduct/>.

An evaluation of the course and instructor will be conducted at the end of the semester using the approved UT course/instructor evaluation forms.

From the 1st through the 12th class day, an undergraduate student can drop a course via the web and receive a refund, if eligible. From the 13th through the university’s academic drop deadline, a student may Q drop a course with approval from the Dean, and departmental advisor.

Emergency Preparedness means being ready. It takes an effort by all of us to create and sustain an effective emergency preparedness system. You are your own best first responder. Please use <https://preparedness.utexas.edu/welcome-emergency-preparedness> as a resource to better understand emergency preparedness at the university, and how you can become part of and contribute to the preparedness

community. To monitor emergency communications for specific instructions go to [utexas.edu/emergency](http://utexas.edu/emergency). To report an issue (none emergency) call 512-471-4441. In case of emergency, call 911.

A student who misses classes or other required activities, including examinations, for the observance of a religious holy day should inform the instructor as far in advance of the absence as possible, so that arrangements can be made to complete an assignment within a reasonable time after the absence.

All other university policies not explicitly included on this syllabus can be found on the General Information Catalog: <http://catalog.utexas.edu/general-information/>.

**Sharing of Course Materials is Prohibited:** No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class unless you have my explicit, written permission. Unauthorized sharing of materials promotes cheating. It is a violation of the University's Student Honor Code and an act of academic dishonesty. I am well aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course.

Wearing a recommended protective face mask at all times when inside university buildings will be mandatory except when alone in a private office, eating in a campus dining facility or when students are in their own residence hall rooms. UT will encourage compliance by increasing awareness and fostering a spirit of cooperation. Students who refuse to follow directives to wear a mask will be referred to Student Conduct and Academic Integrity in the Office of the Dean of Students for disciplinary action. More information on how you can help keep our campus healthy this Fall can be found at "Protect Texas Together."

**Class Recordings:** Class recordings are reserved only for students in this class for educational purposes and are protected under FERPA. The recordings should not be shared outside the class in any form. Violation of this restriction by a student could lead to Student Misconduct proceedings.

**COVID Caveats:** "Keep Learning" Resources; this course may be offered in a format to which you are unaccustomed. If you are looking for ideas and strategies to help you feel more comfortable participating in our class, please explore the resources available here: <https://onestop.utexas.edu/keep-learning/>.