

Probability, Statistics and Decision for Civil Engineers

[Time] Tues. and Thurs. 3:30-4:45 PM

[Location] ECCR 245

[Instructor] Professor Abbie Liel

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[Office Hours] Mon. 1-3 and Wed. 2-3 or other times
by appointment

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[Office Hours] Tues, Thurs 9:30-11:30



[Other] Course documents will be available on CULearn. Check your email for updates on course schedule and assignments.

Course Description and Objectives

Introduces uncertainty-based analysis concepts and applications in the planning and design of civil engineering systems, emphasizing probabilistic, statistics, and design concepts and methods.

By the completion of this course you should be able to:

- Explain concepts, methods and models related to probability applications in civil engineering and compute event probabilities
- Apply statistical methods to (a) summarize properties of a data set, (b) fit probability distributions or regression models to data and (c) conduct hypothesis testing
- Critically evaluate data and statistics from applications in civil engineering research and applications and identify design situations that must incorporate concepts of uncertainty

Prerequisites

APPM 2360 (Differential Equations) and junior standing

Course Requirements and Assessment

The lectures, in-class activities, homework assignments and exams will explore the critical theory and applications of probability, statistics and decision analysis in civil engineering.

In-class time will be spent in lectures, problem solving and discussion. Attendance is critical for developing understanding and skills needed for homework assignments and exams. Lecture notes will be posted before each class. It is your responsibility to print the notes before coming to class.

Your grade in this course will be weighted as shown for a total of 100%:

- Weekly homework assignments [30%]
- Exams – Midterms [20% each] and Final [30%]

The grading scale is as follows -- A: 90 to 100%, B: 80 to 89.9%, C: 70 to 79.9%, D: 60 to 69.9%, F: 59.9% and below.

Exams

The first midterm exam is scheduled to be held in class on **Tuesday February 16**. The second midterm exam is scheduled to be held in class on **Thursday April 1** (no joke!). The final exam is scheduled for **Wednesday May 5** from 7:30 to 10:00 PM. All exams will have a conceptual (closed book) section and a computational (open book, open notes) section. The final exam will serve as a third test plus a review of the semester. Please make arrangements with me now if you anticipate having a problem making these exam times.

Homework Assignments

You should expect a homework assignment every week. These assignments are due at the beginning of the class period. You have the choice of submitting your assignment individually or in groups of 2. If you work together, please include both students' names on the assignment. Late submission of assignments is not permitted, but you will be allowed to drop your two lowest homework scores.

Homework assignments will be graded on a scale of 1-4. These scores are assigned as follows:

- 4: All questions have been completed and answers are correct.
- 3: All questions have been attempted and answers are mostly correct.
- 2: Submission is partially complete.
- 1: Submission is inadequate and incomplete.

Homework solutions will be posted after the assignment has been submitted.

Textbook

Probability Concepts in Engineering, 2nd Edition, Alfredo H-S. Ang and Wilson H. Tang

Course Schedule

The first 9 weeks of the course will cover probability, a field of mathematics.

The final 6 weeks will cover statistics, which is an application of probability to data analysis.

Course and Subject Intro

Set Theory and Probability Theory (approx. 2 weeks)

- Events, Set Theory, Axioms
- Interpretation of Probabilities
- Conditional Probability

Total Theorem of Probability
Bayes' Rule

Random Variables (approx. 1.5 weeks)

Random Variables (Discrete and Continuous)
Expectation and Moments of Random Variables

Probability Distributions and Models (approx. 3 weeks)

Normal Distribution and Central Limit Theorem
Bernoulli, Binomial Distribution
Geometric and Poisson Distribution
Exponential Distribution
Lognormal Distribution

Joint Random Variables (approx. 1.5 weeks)

Joint Random Variables
Moments and Correlation

Other Probability Topics (approx. 0.5 weeks)

Monte Carlo Simulation
Parameter Estimation

Statistics (approx 2 weeks)

Sample Statistics/Risk
Confidence Intervals
Hypothesis Tests
Distribution Model Fitting

Advanced Topics (approx 1. week)

Linear Regression
Risk Analysis and Applications

Comments

I am always happy to meet with you to discuss your progress in the course or suggestions for how the class can be improved. I also welcome discussion and questions during the class time.

Other Policies

- (1) If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322 and www.colorado.edu/disabilityservices.
- (2) Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. If you have a concern regarding any

activity in this class, please notify me early in the semester so that we can make alternative arrangements.

- (3) Students and faculty each have the responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty has the professional responsibility to treat all students with understanding, dignity and respect.
- (4) All students at the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at <http://www.colorado.edu/policies/honor.html>.
- (5) The University of Colorado at Boulder policy on Discrimination and Harassment (<http://www.colorado.edu/policies/discrimination.html>), Sexual Harassment and Amorous Relationships applies to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based on race, color, national origin, sex, age, disability, sexual orientation or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at <http://www.colorado.edu/odh>.