CE 311S: Elementary Probability and Statistics for Civil Engineers

Fall 2019 (#15070, #15075 & #15080)
Lecture: Tu/Th 9:30-11:00 am, ECJ 1.214
Laboratory: Mon 1-2 pm, 2-3 pm, & 3-4 pm, ECJ 2.218

I. Office Hours for Instructor, Dr. Kara Kockelman

Mondays & Wednesdays, 1-3 pm, ECJ 6.904
Or, by appointment: 471-0210 (office phone number) & kkockelm@mail.utexas.edu

II. Prerequisites

According to the College of Engineering Catalog, the following prerequisite must be satisfied before enrolling in CE311S: Mathematics 408D or 808 (Sequences, Series and Multivariate Calculus). It is extremely important that students *demonstrate competency with calculus at the beginning of the semester*: Calculus is a pillar of many statistical concepts.

III. Grading

For purposes of grading, the performance of students enrolled in CE311S will be assessed using the following scoring system:

Participation* (& Quizzes)	5%
Homework	17.5%
Labwork	7.5%
In-class Exams 1, 2 & 3	12.5, 15, 17.5% of score/grade, respectively (45% total)
Final Exam	25%

While the design of the course aims for overall scores such that A's, B's, C's, and D's (including +'s & -'s) are earned by those averaging 90, 80, 70 and 60 or above overall, final grades deviate from these thresholds to recognize level of student understanding. Please inquire with the professor if you are interested in snapshot of your overall performance at any time.

The instructor may administer *un*announced quizzes periodically, based on reading. (These will not be difficult, if you stay up with the reading!) Students should come to class prepared to contribute to each class's lecture and discussion by staying up-to-date with homework and reading.

The TA will be grading homeworks. Questions for this grader should be submitted in writing with assignments (& clearly addressed to the reader).

* Participation score may be up to 5% of your grade, along with pluses & minuses is based on participation in the class (including attendance, in cases where attendance is poor). Pluses and minuses will be used in final course grades.

IV. Homework Assignments

Homework problems will be assigned almost weekly and must be handed in at the ***beginning*** of the period in which they are due. After this time, they will be considered late and given *no credit*. However, ***all*** *assigned problems* ***must*** *be completed* (within 3 weeks of their due date and at least one week before the final exam) or a student's participation score will be negatively impacted. Students are encouraged to discuss & work on homework problems with other CE311S students, but *all problems must be completed by the student him/herself*; no copying will be permitted. The lowest homework score will be disregarded.

Homework Solutions & Academic Dishonesty: The use of unauthorized sources of homework solutions (e.g., websites like cramster, previous semester student solution copies, & instructor CDs) is considered scholastic dishonesty, plagiarism and a violation of UT's Standard of Academic Integrity. Please see the University Honor Code at http://registrar.utexas.edu/catalogs/gi09-10/ch01/index.html and http://deanofstudents.utexas.edu/sjs/acint_student.php, and let me know if you see this happening.

Note: Space in ECJ may be designated weekly for your use, for team-based studying and homework discussions with the TA. Please make use of this opportunity to work together, and do call upon me during that time. I look forward to working with you!

V. Examinations

The in-class exams** are *tentatively* scheduled & the final exam is formally scheduled for the following dates, depending on student progress and/or exams/assignments in other courses:

In-class Exam 1:	Tuesday, October 1
In-class Exam 2:	Tuesday, October 29
In-class Exam 3:	Tuesday, November 19
Final Exam:	Saturday, Dec 14, 7-10 pm

Make-up exams will *not* generally be given to any student. If a student is absent from a scheduled exam due to medical or other problems beyond her/his control and can plainly demonstrate this, the instructor can choose to give the student a completely different exam, additional assignments, and/or change the weighting of the student's various graded contributions.

VI. Laboratories/Discussion Sections

Lab/discussion sections will take place every week in ECJ 3.406 on Wednesdays 12:00-1:00 pm (#15210) and 1:00 – 2:00 pm (#15215). Lab periods will emphasize problem-solving via computer-based lab work and will offer reviews before each of the three midterm exams. Lab assignments can be found on Canvas. See "Labs" listing at the bottom of the left navigation bar. Any assigned lab work is mandatory and must be turned in within 7 days of the lab period, or a student's participation score will be negatively impacted.

The course's primary **Teaching Assistant** is Vasko Lalkov, and his office hours will be held in ECJ 6.406 on Wednesdays 1:00 – 3:00 pm and Fridays 12:00 – 2:00 pm. Ty Wellik will also be offering office hours (Wednesdays from 9:30 am – 12:00 pm in ECJ 6.406) and helping with a lab or two, and doing some grading.

Undergraduate student Christian Galvin will serve as a 5 hr/wk **Tutor,** to help reinforce key concepts and provide a sounding board for all aspects of undergraduate life in engineering! His office hours will be Mondays 9:30 – 11:00 am, Tuesdays 2:00 – 4:00 pm, and Fridays 9:30 – 11:00 am. Please contact him for individual assistance at any time. We want to ensure you get the most out of this class!

VII. Text and Reader/Notes

The required textbook for this course is *Probability and Statistics for Engineering and the Sciences* by Jay L. Devore, 7th Edition, Brooks/Cole/Thompson Learning, 2007. Alternatively, a relatively inexpensive Course Packet consisting of all assigned pages of the Devore text (plus its Table of Contents, distribution tables, odd-numbered solutions, and Index); this can be purchased at IT Printing's Jerome Kubala at 512 West MLK, 512-476-6662, for $25. Sets of *PowerPoint slides* used by the instructor will be made available at Canvas, at http://courses.utexas.edu.

Lab information and assignments will also be made available via Canvas. Students can log on using their UTEID and password. Other key materials will be made available via email. (To preserve trees & departmental budgets, copying will be minimal.)

Students may wish to consult the internet (e.g., khanacademy.com) and other texts for additional insights and different presentations of course material. For example, http://davidmlane.com/hyperstat/Instructional_Demos.html links to a wide variety of interactive animations of statistical concepts (such as expected value calculations, the Central Limit Theorem, sampling, confidence intervals, and regression). (Note: To view the applets, one may need specialized Java & MathML plug-ins, which can be downloaded via http://www.java.com/en/index.jsp & http://www.dessci.com/en/products/mathplayer/welcome.asp.)

Recommended supplemental texts include *Schaum's Outline of Probability & Statistics* (with lots of solved problem examples), Ang and Tang's *Probability Concepts in Engineering Planning and Design* (1975), J. Rice's *Mathematical Statistics and Data Analysis* (1995), and D. Freedman et al.'s *Statistics* (1998). Many other probability and statistical texts exist, and all are likely to be helpful in some form.

VIII. Add/Drop Dates

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.

IX. Evaluation Plan

UT's Course/Instructor Survey form will be used as the basic evaluation tool. All students are encouraged to submit written comments during this survey. Other formal assessment opportunities are likely to arise mid-semester; and students are strongly encouraged to provide feedback at any time during the course, in person, via other students or anonymously, to the TA and/or the instructor.

X. Other Information

1. 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, 471-6259 (voice) or 410-6644 (video phone) or http://ddce.utexas.edu/disability/.

2. 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.

3. Students in this section of CE311S are encouraged and authorized to work on homework assignments together and prepare for exams together. However, all written work handed in by a student is considered to be his/her own work, prepared without *unauthorized* assistance. To ensure your actions never compromise your and our class's integrity, please visit http://deanofstudents.utexas.edu/sjs/acint_student.php. Students who violate University rules on scholastic dishonesty (*e.g.*, anything which gives unfair academic advantage to a student) are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. An "F" grade will be the recommended penalty in most cases of scholastic dishonesty. One should refer to the Student Judicial Services website at http://www.utexas.edu/depts/dos/sjs/ to access the official University policies and procedures on scholastic dishonesty as well as further elaboration on what constitutes scholastic dishonesty.

4. *Math & statistics tutors* and other learning assistance can be obtained via the Learning Skills Center (Jester Center, 471-3614). See https://ugs.utexas.edu/slc/support/one-on-one.

XI. Course Objectives, Academic/Learning Goals, Questions, Content, & Schedule

CE 311S covers many aspects of probability and statistics, both theory and application. There are 3 basic themes:

- *Data follow distributions (DFD).*
- *Distributions provide probabilities (DPP).*
- *Probabilities permit prediction (PPP).*

These themes, and their supporting material, are highly relevant to the planning and design of civil engineering systems, including forecasting demand and system operations, enhancing investment and management decisions, predicting loads and component strength, and setting policy. The course's focus is the application of probabilistic and statistical tools for data analysis, hypothesis testing, and prediction. Its primary objective is an understanding of uncertainty, such that students can more effectively tackle a variety of key civil engineering problems. More specifically, by the end of this course students should be able to:

- *Apply laws of probability to random processes,*
- *Use sample data to estimate parameters governing these processes, and*
- *Undertake tests of experimental hypotheses.*

Many questions are core to these objectives. Students in this course will seek to answer the following question types:

- Knowing the process that underlies a series of random events, what are the probabilities of various

combinations of outcomes, in one realization of the event – and in a series?

- Given a set of data (from a roadway intersection, airport runways, a series of buildings, concrete slump tests, etc.), what distribution best represents the data? What are the key parameters characterizing that distribution? How can we use that distributional assumption to predict outcome probabilities (e.g., the probability of minimal delay, of crashes, building failure, building lifetime, concrete durability)?
- Given a set of data, how can we relate the results to policymakers, adequately characterizing the uncertainty in our results? (In other words, what is the variance in our estimates?)
- Given a variety of predictor/explanatory variables (e.g., materials, mixing, and placement techniques used), what models best predict the experimental outcomes (e.g., concrete strength at 28 days)? What is the marginal impact of each explanatory variable – is it positive or negative, strong or weak, only somewhat or highly uncertain?

To attain our objectives and answer these questions, we will systematically proceed through a series of topics, each with specific objectives. A listing of the course topics (and related chapters for reading) is shown below.

Please be advised that the instructor has high standards, and *workload is considered high* in this course (though it is still well under what experts recommend for a 3-lecture-hour course). *Class sessions are quite interactive*, and students need to contribute. If this is not the style of class you aspire to, please do consider other options. I really would love to have you in the class, but the ultimate decision is yours.

TOPICS TO BE COVERED *(with relative timing of exams dependent upon class progress)*

Lesson 1. Introduction – Chapter 1
Lesson 2. Describing our Data – Chapter 1
(Note: Students may skip the boxplot discussions [pp. 35-39].)
Lesson 3. What's the Likelihood…? Probability Theory – Chapter 2
Lesson 4. Discrete Random Variables – Chapter 3
Lesson 5. Discrete RVs: Binomial & Posson Distributions – Chapter 3
(Note: Students may skip hypergeometric & negative binomial materials [pp. 116-121].)
In-class Exam 1: Tuesday, October 1 (tentative date)
Lesson 6. Continuous RVs – Chapter 4
Lesson 7. Continuous RVs: Gamma & Exponential Distributions – Chapter 4
(Note: Students may skip the Weibull and Beta distribution materials, as well as probability plots [pp. 163-179].)
Lesson 8. Bivariate & Multivariate Distributions – Chapter 5
In-class Exam 2: Tuesday, October 29
Lesson 9. Distributions of Statistics: Combining RVs – Chapter 5
Lesson 10. Putting Bounds on Our Estimates: Statistical Inference & Confidence Intervals – Chapter 7
Lesson 11. Large & Small Sample Confidence Intervals (Normal & t Distributions) – Chapter 7
In-class Exam 3: Tuesday, November 19
Lesson 12. Testing our Hypotheses – Chapter 8
Lesson 13. The Value of Explanatory Variables: Linear Regression Models – Chapter 12
Review for Final Exam (1 lecture)
Final Exam: Saturday, Dec 14, 7-10 pm