CS 3130/ECE 3530: Probability and Statistics for Engineers

Administrative Details and Syllabus
Spring 2020

Course Web Page: http://www.cs.utah.edu/~bhaskara/courses/cs3130/

Description. An introduction to probability theory and statistics, with an emphasis on solving problems in computer science and engineering. Probability and statistics is an important foundation for computer science fields such as machine learning, artificial intelligence, computer graphics, randomized algorithms, image processing, and scientific simulations.

Topics in probability include discrete and continuous random variables, probability distributions, sums and functions of random variables, the law of large numbers, and the central limit theorem. Topics in statistics include sample mean and variance, estimating distributions, correlation, regression, and hypothesis testing. Beyond the fundamentals, this course will also focus on computational methods such as simulation and the bootstrap. Students will learn statistical computing using the freely available R statistics software: http://www.r-project.org/.

Instructor. Aditya Bhaskara. *Office:* 3470 MEB. *Email:* bhaskara@cs.utah.edu.

Class Meetings. Tuesdays and Thursdays, 3:40 – 5:00pm, WEB L104.

Getting Help. Try your best to take advantage of the instructor and TA office hours. We will work hard to be accessible to students. Please post a message to the instructors on Piazza if you need to meet outside of office hours. Don't be shy if you don't understand something: come to office hours, post on Piazza, or speak up in class!

The class will rely on discussions on Piazza. While we will use Canvas for the course schedule and material, we will use Piazza for discussions. Feel free to post questions regarding anything related to the course: homeworks, schedule, material covered in class. Also feel free to answer questions, the instructor and the TAs will also actively be answering questions. But, **do NOT post potential homework answers**. Such posts will be immediately removed, and the students will face appropriate penalty.

All important announcements will be made through Piazza, there is otherwise no class mailing list.

Textbook. *A Modern Introduction to Probability and Statistics: Understanding Why and How* by Dekking, Kraaikamp, Lopuhaa, and Meester

An electronic version of this book is freely available through the University! The website is here:

https://link.springer.com/book/10.1007%2F1-84628-168-7

To access the book you must be visiting this website from the campus network. Or if you are off campus, you can access it using VPN: https://vpnaccess.utah.edu/.

Grading Policy. The final course grade is based on the homework assignments (40% total), quizzes (35%), and the final exam (25%). Letter grades are assigned as follows:

		86-89	B+	74-77	C+	60-64	D+		
93-100	A	82-85	B	70-73	C	55-59	D	0-49	E
90-92	A-	78-81	B-	65-69	C-	50-54	D-		

Homework assignments will consist of writing R code to solve problems as well as written questions. We will use the open-source statistical software R, which is here: http://www.r-project.org/

Homeworks are due by the start of class on the due date. Students can turn in hard copies in class, or electronic copies through Canvas. Late assignments will receive a 10% deduction during the first 24 hours they are late, and a 20% deduction if they are 24-48 hours late. Assignments will not be accepted beyond 48 hours late.

If you believe there is an error in grading (homeworks or quizzes), you may request a regrading within **one week** of receiving your grade. Requests must be made in writing, explaining clearly why you think your solution is correct.

Working Together. You are welcome to discuss the concepts in a homework assignment with your fellow classmates. However, you must develop and write up your own solutions. Do not read another person's answers or code, and do not show your answers or code to anyone else. *Presenting someone else's solutions as your own will be considered cheating.* Also, it is important that you first try to solve problems on your own, and discuss them only when you are stuck or to reassure yourself about your answer.

Posting homework questions on internet forums is **not** allowed and is considered cheating. This is cheating regardless of whether or not you use any of the posted answers.

Posting potential answers to the class discussion forum is not allowed.

Of course, there must be no collaboration during in-class quizzes or the final exam. If a student is caught cheating on a homework or quiz, they will receive a failing grade for the course. For a detailed description of the university policy on cheating, please see the University of Utah Student Code: http://www.regulations.utah.edu/academics/6-400.html.

School of Computing Cheating Policy. The School of Computing has instituted a "two strikes and you're out" cheating policy, meaning if you get caught cheating twice in any SoC classes, you will be unable to take any future SoC courses.

Students with Disabilities. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.

University Safety Statement. The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit: http://safeu.utah.edu.

Addressing Sexual Misconduct. Title IX makes it clear that violence and harassment based on sex and gender (which Includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status

as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Wellness statement. Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc. can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources, contact the Center for Student Wellness online, or on the phone at 801-581-7776.

Syllabus

The following topics will be covered. See the course web page for a detailed schedule.

- *Foundations of Probability.* Sample spaces, probabilities and distributions, discrete and continuous random variables, expectation, joint probabilities and independence.
- *Limit Theorems.* Law of large numbers, central limit theorem.
- *Basic Statistics.* Mean, variance, covariance, correlation.
- *Regression.* Linear models, least squares estimation.
- *Hypothesis Testing.* Null hypothesis, test statistics, type I and II errors, t-tests.
- *Computational Methods.* Simulation, bootstrapping.

Course Outcomes. At the conclusion of CS 3130/ECE 3530, students should:

- Understand basic concepts in probability including combinatorics, independence, conditional probability and Bayes' rule.
- Solve basic problems arising in engineering that involve discrete and continuous probability distributions.
- Use statistical concepts such as means, variances and various types of graphs to analyze datasets using computational software such as R.
- Understand confidence intervals and perform statistical inference such as hypothesis testing and regression.