COURSE DESCRIPTION
CS481/IE410 ADVANCED TOPICS IN STOCHASTIC PROCESSES
Fall 2020 In Person: MW 3PM-3:50PM, MW 4PM-4:50PM 1404 Seibel Center

Instructor: Sheldon H. Jacobson, Siebel Center 3224
Office Hours: Monday via zoom, after class until 520PM (zoom link on COMPASS)

Professor Jacobson’s Course Zoom Link:
https://illinois.zoom.us/j/92678117931?pwd=ZkVaTldWWGYxcHdqU2ZQYWJqUmxMUT09

Teaching Assistants (TAs): Via zoom: Meghan Shanks, Rahul Swamy, John Pavlik
Office Hours: Meghan Shanks TBD,
Rahul Swamy TBD,
John Pavlik TBD

Course Email: ie410.cs481@gmail.com
Text: "Introduction to Probability Models" by Sheldon M. Ross (any edition)
Compass: Much of the course material will be available on the course COMPASS web site
http://compass2g.illinois.edu

Zoom Etiquette: Please use your video during all zoom calls.

Lecture Video Captures: These will be posted as they become available at https://echo360.org

Course Objective: This course is a rigorous introduction to and survey of stochastic models, with applications in engineering & computer systems. Student should complete this course with the ability to identify problems addressed using stochastic models, as well as to use such models to solve/gain insights into such problems.

Prerequisites:
Must: Introduction to Probability and Statistics, or equivalent (e.g., IE300, CS361, Stat400)
Useful: A working knowledge of any computer programming language (C, C++, C Sharp, Java, Python).
Useful: Introduction to Operations Research, or equivalent (IE310)
NOTE: You must have the prerequisites (or equivalent, for graduate students) to take the course.
Important Advice: If you earned a B in any of these courses, you will need to thoroughly review the material in these courses, since all the material in these courses will be assumed to be known.
If you earned a B- or lower in any of these courses, you may find this course extremely challenging and will not be prepared to be successful in this course. You may wish to take the course in the future, once you are better prepared for the material. My advice to you is to not take the course at this time.

ISE Undergraduates: The ISE department has created IE370 (Stochastic Processes and its Applications), a watered down version of this course. It is offered in the spring semester and will satisfy the IE410 requirement for your program of study. The topics covered are similar; the primary difference is the level of depth covered. Since IE410 is delivered at the graduate level, if you are planning to go to graduate school, then this course will be a good choice for you.

General Topics: Review of Probability, Conditional Probability
Poisson Processes and the Exponential Distribution
Markov Chains (Discrete, Continuous, MDPs), Birth and Death Processes
Renewal Theory
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Exams: There will be two take-home exams (the first exam will be in October, the second exam will be held near the end of the semester.) There will be no final exam. Each exam will be weighted 40% towards your final grade. Exam #1 will cover chapters 1-3. Exam #2 will cover Chapters 4-7. Exams will only be given during the designated time windows.

If you feel that you deserve additional credit on your exam, write an explanation on separate pieces of paper where and why you deserve more points, how many additional points you deserve, and return the explanation, with your exam, to the course email address given above within 48 hours of when the exam is first returned. Note that if you hand your exam back to be regraded, return the entire exam, since the entire exam may be regraded, including the questions that you specifically asked to be regraded. Exams should not be altered or written on once returned to you. Any alterations of an exam handed back for regrade may result in penalties.

If you miss both exams, you will earn a failing grade in the course. If you miss one exam, the exam you took will contribute 40% to your final grade. The remaining 40% will be allocated based on the smaller of a) bottom 5% percentile (rounded down) grade among all students (graduate or undergraduate handled separately, based on what you are) that was earned on the exam you missed, including students who missed the exam, b) 10% of the percentile (rounded down, graduate or undergraduate, based on what you are) that you earned on the exam that you took applied to the missed exam.

Grading: Assignments: Assignment questions are posted on COMPASS. Assignment problems will improve your understanding of the course material. You are encouraged to work on these assignment questions in small groups. Solutions to the assignments will be posted on COMPASS and/or reviewed during problem sessions.

To get credit for each chapter assignment, you must submit a sentence in the assignment text box on COMPASS indicating that you attempted the problems. Do not submit or upload the assignment, since they are not graded. See Bonus Points for exceptions. Your sentence submissions are accepted only during the designated time periods (between 3:00:00PM CT on the first day and ending at 2:59:59PM CT on the last day). Late submissions cannot be accepted, under any circumstances and for any reason. The time windows for sentence submissions are: 8/26-9/2 (Chapter 1), 9/3-9/12 (Chapter 2), 9/13-9/21 (Chapter 3), 9/22-10/12 (Chapter 4), 10/13-10/22 (Chapter 5), 10/23-11/1 (Chapter 6), 11/2-11/14 (Chapter 7).

The credit you earn will be in the form of a multiplier for your second exam. Each assignment sentence submitted during the designated time period represents a multiplier of 0.08. Therefore, if you submitted N assignment sentences during the designated time period, your multiplier for the second exam will be 1+0.08*N. This means that a perfect 40% for the second exam will be rescaled to 40%*(1+0.08*N). Note that this multiplier credit only applies to students who sit for and submit the second exam for grading. To be fair to all the students in the class, there will be no exception to missing the cutoff date and time for assignment credit, under any circumstances. This includes health, family, or personal issues, forgetting to submit the assignment, problems with COMPASS, a power outage, a weather event, a national disaster (natural or man-made), or any other reason. Students do so at their own risk when waiting until the last minute to submit. Only submissions received on COMPASS are valid.
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Final Grades: Final grades are determined based on breakpoints
Undergraduate students:
86.0% to 100% = A range, 74.0% to 85.99999% = B range,
67.0% to 73.99999% = C range, 60% to 66.99999% = D range;
Graduate students:
86.0% to 100% = A range, 74.0% to 85.99999% = B range, 67.0% to 73.99999% = C range.

A final total score below 60% will earn a failing grade in the course for undergraduate students, and below 67.0% will earn a failing grade in the course for graduate students.

Classes Times: In-person lectures may be as much as 100 minutes. Talk-over power point slides are available for all the lectures, if you are unable or choose not to attend. Problem sessions will be held during lecture times via zoom.

Graduate students (4 credits) versus undergraduate students (3 credits): Graduate student will have additional questions on one or both of their exams.

COVID-19: All appropriate nonmedical countermeasures will be practiced during lectures. This includes students seated in class with appropriate spacing, and face coverings worn at all times, covering both your mouth and nose. Food and beverages are not permit during the lectures. If you must consume any food or liquid, please exit the lecture hall to do so. When entering and exiting the lecture hall, remain cognizant of spacing between yourself and others.

From the University:
"Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community, including wearing a facial covering properly, maintaining social distance (at least 6 feet from others at all times), disinfecting the immediate seating area, and using hand sanitizer. Students are also required to follow the campus COVID-19 testing protocol. Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work. Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the noncompliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Cumulation of non-compliance complaints against a student may result in dismissal from the University.

Diminished mental health, including significant stress, mood changes, excessive worry, substance/alcohol abuse, or problems with eating and/or sleeping can interfere with optimal academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings at no additional cost. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University’s resources provided below. Getting help is a smart and courageous thing to do -- for yourself and for those who care about you.
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Counseling Center: 217-333-3704, 610 East John Street Champaign, IL 61820
McKinley Health Center: 217-333-2700, 1109 South Lincoln Avenue, Urbana, Illinois 61801

BONUS POINTS: There may be opportunities to earn bonus points during the course. These bonus points are in the form of points added to your multiplier, in increments of 0.01. If you are awarded a bonus point during a lecture or an event, you must send an email to ie410.cs481@gmail.com (cc shj@illinois.edu) no later than 2:59:59PM CT the following day to get the credit for the bonus point. We will also randomly select students to send in a solution to any one of the assignment question. If you are randomly selected and your solution scores at least 80%, you will receive a bonus point. You will receive such an email during regular school hours (M-F. 8AM-5PM CT) and will have a very limited window to send us your solution. To be prepared for such requests and bonus point opportunities, have your assignment problems completed and ready to be uploaded as a pdf and sent.

Participation and Engagement: Learning is a two-way exchange of information. I will frequently ask questions during in-person lectures, so it is in your best interest to be prepared. I also have been known to give out bonus points when questions are asked/answered.

Class Attendance: You are not required to attend lectures, either in-person or virtually. Experience has shown that students who stay engaged also perform better in the course. Also, stay tuned-in to the COMPASS course page for announcements.

Cell Phones: As a courtesy to others, during in-person lectures, please put your cell phone in silence mode or off during all classes, to limit disruptions that affect other students.

General Comments:
- My lectures may not always match the book and its presentation. There are a number of concepts covered in the book that I will not cover, and vice versa. Therefore, although you are not required to attend the in-person or virtual lectures (i.e., no attendance is taken), it is in your best interest to stay engaged, since you will be responsible for all the material covered in the lectures.
- If you are having problems with the course, discuss the situation with me as soon as possible. It is typically very difficult to find a solution in mid-November, while feasible plans of attack may be identified in mid-September.
- The work you hand in on your exams will be your own.
- A review session will be held before each exam, which will provide an overview of the material that you will be tested on, as well as give you an opportunity to see the types of questions you can expect on the exam. No sample exams will be available.
- The best way to prepare for exams is to work a large number of problems, including the problems assigned for your assignments, and to understand the material being presented in the lectures (in particular, listen to what I emphasize). I encourage you to work extra problems in the book that I have not assigned, since the only way to truly understand the material is by working problems. Working only the problems assigned will not be sufficient for you to gain an understanding of the material presented in the course. All such problems represent sample exam questions.
- If the pace of a lecture is too fast / slow, let me know. I am not always aware of it, no matter how obvious it may be to you.
- Probability is an area where you may understand the course material well, yet not be able to solve problems very easily. Solving problems requires a great deal of practice. Your assignments provide you with some of this practice. However, you should also attempt to solve problems not assigned. Working problems out of any probability/stochastic processes book in the library or from the web is encouraged. Use my / the teaching assistants' office hours to get help with those problems that you have difficulty.
- DRES Students: Please contact me no later than September 28, 2020 to discuss your situation. If I do not hear from you by this date, you will have opted out of any accommodations.
- Safety is everyone’s concern. Please visit http://police.illinois.edu/emergency-preparedness/run-hide-fight/
- Some of the material presented will be rather abstract. However, most of it also has real practical value. If I forget to mention it, ask where or how the material can be applied.

TOPICS TO BE COVERED (see detailed week by week topics and modules)
Course Outline: Chapters 1-7 of text (in whole or part)
Introduction to Probability (1.5 weeks, Chapter 1, Modules P1-P9)
  Sample Spaces, Events, Probability and Conditional Probability, Independence and Bayes Formula
Random Variables (1.5 weeks, Chapter 2, Modules P1-P13)
  Discrete and Continuous, Expectation and Variance
  Jointly Distributed Random Variables, Moment Generating Functions, Limit Theorems
Conditional Probability and Conditional Expectation (1 week, Chapter 3, Modules P1-P7)
  Discrete and Continuous
  Computing Expectations and Probabilities by Conditioning
Discrete Time Markov Chains (2.5 weeks, Chapter 4, Modules P1-P13)
  Introduction and Definitions
  Chapman Kolmogorov Equations, Classification of States and Limiting Probabilities
  Branching Processes and Markov Decision Processes
The Exponential Distribution and Poisson Processes (2.5 weeks, Chapter 5, Modules P1-P6)
  Exponential Distribution, Poisson Processes and Generalizations of Poisson Processes
Continuous Time Markov Chains (2.5 weeks, Chapter 6, Modules P1-P6)
  Introduction/ Definitions, Birth & Death Processes, Queueing models, Chapman Kolmogorov
  Differential Equations, Limiting Probabilities
Renewal theory (1 week, Chapter 7, Modules P1-P4)