INDENG 173 Introduction to Stochastic Processes Syllabus (Spring 2020)

Instructor

Professor Zeyu Zheng (IEOR)
Office: Etcheverry 4125, Office Hours: 1-2 PM Monday
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Lectures

Location: Kroeber 160
Time: Monday and Wednesday 12:00 PM - 12:59 PM

Discussions

Discussion 1: Friday, 12:00 - 12:59 PM, Tan 180
Discussion 2: Friday, 2:00 - 2:59 PM, Etcheverry 3108

Teaching Team

Hansheng Jiang (Ph.D. student in IEOR, GSI)
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Haixiang Zhang (Ph.D. student in Math, GSI)
Office hours: Wednesday 2:00 - 3:00 PM and Thursday 9:30 - 11 AM
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Course Description

INDENG 173 serves as an introduction to stochastic processes and their applications in industrial engineering, management science, and operations research. The primary focus will be on Markov chains (in both discrete and continuous time), but additional topics such as queueing theory will also be treated. Throughout the semester, we will try to strike a balance between mathematical theory and real-world applications.

Website

Course materials will be available via Bcourses. All announcements will be handled through Bcourses; you are responsible for keeping up with what is posted there.

Email Policy

Emails sent to the teaching team should contain "INDENG 173" in the subject line. We will try our best to respond to email inquiries within 24 hours over weekdays. If you find yourself waiting longer, please feel free to resend your message.

Questions that are highly technical or require extensive mathematical notation will not be answered via email. Such types of questions should be asked during office hours.

Other than questions of a personal nature, please direct general questions to the following group mailing list (which permits the whole teaching team to receive messages simultaneously):

indeng-173-teaching-team@googlegroups.com

Homework

There will be a total of 11 problem sets, generally due on Thursday 11 PM, via Gradescope. (entry code 9R6WV3). No late submission is accepted, except for medical necessity. (Documents are generally required in fairness to everyone.) The lowest two homework grades will be dropped. Each assignment carries equal weights.

Each problem (supposing worth 2 points) will be graded on the following scale:

- If you do not do the problem you will receive zero points.
- If you attempt the problem, but have major conceptual mistakes, you will receive 1 point.

- If you attempt the problem and do not have major conceptual mistakes, you will receive 2 points, even if small mistakes are marked up.

We expect everyone who makes a reasonable effort at each problem will receive 2 points. You can discuss the assignments with your classmates, but everybody must write his/her own solutions. Please list the names of classmates with whom you have discussed assignments. Copying homework from another student (past or present) is forbidden.

Exams

Midterm Exams: March 2 and April 13, 2020
Midterms will be in-class and closed-book.
Final: Wed, May 13, 3:00 - 6:00 PM, location TBA

No calculators are allowed in exams. For the midterm, one sheet of letter-sized paper is allowed (with both sides). For the final, two sheets of letter-sized paper is allowed (with both sides). If printed, the text font size should be no smaller than 8pt.

Grades

5% Participation
30% Homework
15% First Midterm
15% Second Midterm
35% Final

Prerequisites

You should have taken a first course on probability theory, such as INDENG 172, or equivalent. You should also possess a solid command of undergraduate calculus and linear algebra.

In view of the aforementioned prerequisites, you are expected to be familiar with the following concepts/terminology:

- Sample space, events, probability axioms, basic rules of probability, independence, basic counting arguments, conditional probability, random variable, probability density function (pdf), probability mass function (pmf), cumulative distribution function (cdf), expected value, moments, moment generating function, variance, standard deviation, covariance.
- Common distributions such as Geometric(p), Bernoulli(p), Binomial(n, p), Poisson(λ), Normal(μ, σ^2), Exponential(λ), Gamma(α, β), and Uniform(a, b).

- Geometry and algebra of vectors, matrix operations, determinants, (linear) subspaces of $\mathbb{R}^n$, eigenvalues and eigenvectors, orthogonality.
- Limits, continuity, derivatives, integrals (in $\mathbb{R}$, $\mathbb{R}^2$, and $\mathbb{R}^3$), fundamental theorem of calculus, sequences and series.

You are not expected to have mastered, but should have heard of the following concepts/terminology (they will be revisited during lecture):

- Integration in $\mathbb{R}^n$ for $n > 3$.
- Markov's inequality, convergence in probability, (weak) law of large numbers.
- Convergence in distribution, central limit theorem, confidence intervals.
- (Statistical) estimators, bias/unbiasedness, mean squared error.

Optional Textbook

You will only be tested on material presented in lectures, and/or learned through the problem sets. Some of the problems and supplementary material will draw on Introduction to Probability Models (Eleventh Edition), by Sheldon Ross; this is the recommended textbook for the class, and available online for Berkeley students at:

http://www.sciencedirect.com/science/book/9780124079489

A few other books to consider, for an alternate perspective (presented in increasing order of difficulty):

Bertsekas and Tsitsiklis, Introduction to Probability. This is an excellent introduction to basic probability, at the advanced undergraduate level. It contains two chapters on random processes and (finite state) Markov chains.

Norris, Markov Chains. This is a slightly more mathematical treatment of the subject, but one of the most clearly presented versions of the material available.

Durrett, Essentials of Stochastic Processes. This book is also more mathematical than Ross' book; it is a good place for an introduction to martingales that is not very technical.

Grimmett and Stirzaker, Probability and Random Processes. This book is a comprehensive treatment of basic probability and Markov chains, at a more rigorous pace than the books above.