INDENG 173 Introduction to Stochastic Processes
Syllabus (Spring 2021)

Instructor

Professor Zeyu Zheng (IEOR)
Office Hour: Monday 1:00 - 2:00 PM
Email: zyzheng@berkeley.edu

Lectures

Lectures are held on Zoom, Monday and Wednesday 12:00 PM - 12:59 PM, through the following link or ID/Passcode. Berkeley Zoom account login may be required to access the link.

`https://berkeley.zoom.us/j/94622934557?pwd=YU1MTUo1MStMQU80aUNjVi9qVEY1UT09`

Meeting ID: 946 2293 4557
Passcode: 531422

Discussions

Discussion Section 1: Friday, 1:00 - 1:59 PM
Discussion Section 2: Friday, 2:00 - 2:59 PM

Discussion sections are held on Zoom, through the same link as the lectures. The two sections are completely identical. There is no discussion section in the first week.

Teaching Team

Jingxu Xu (Ph.D. student in IEOR, GSI), jingxu_xu@berkeley.edu

Yufeng (Hector) Zheng (Ph.D. student in IEOR, GSI), yufeng_zheng@berkeley.edu

Yi (Eddi) Xu (MS in IEOR, reader), eddi@berkeley.edu

Office Hours of GSI and Reader

Monday 7:00 - 8:00 PM (Yufeng Zheng)
Tuesday 7:00 - 8:00 PM (Jingxu Xu)
Wednesday 7:00 - 8:00 PM (Eddi Xu)
Thursday 5:00 - 6:00 PM (Yufeng Zheng)
Thursday 7:00 - 8:00 PM (Jingxu Xu)

Office hours will be held in the personal Zoom meeting room of each teaching team member.

Jingxu Xu, personal Zoom meeting room ID: 861 553 0610
Yufeng Zheng, personal Zoom meeting room ID: 789 986 5687
Eddi Xu, personal Zoom meeting room ID: 759 272 9613

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, the course will be largely focused on the fundamental theory to facilitate the understanding of stochastic processes.

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 are recommended to 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, and will likely shorten the waiting time for a response):

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: ZRW22Y, if you find yourself not automatically linked). No late submission is accepted, except for medical necessity. (For medical reasons, documents are generally required in fairness to everyone.) The lowest two homework grades will be dropped. Each assignment carries equal weights.

Please correctly select the corresponding pages for each problem when submitting answers to Gradescope. Mis-selection may cause no grade for the particular problem.

Each part of a problem (generally 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 in the beginning of the submitted solution. Copying homework from another student (past or present) is forbidden.

Exams

Two midterm exams: March 1 and April 12, 2021. Policy to be announced. No lectures on midterm exams day.

Final exam: May 12, 2021.

Grades

5% Participation
(Participation score will be given as long as you attend two of the three exams)
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.