

DEPARTMENT OF MATHEMATICS, NORTHEASTERN UNIVERSITY

MTH G7241: Probability 1.

Fall 2020

Class: Tuesday, Thursday 5:50 - 7:20 pm on Zoom

Instructor: Prof. Chris King

Office: 455 Lake; phone x2785; c.king@northeastern.edu

Office hours: M, W, Th 12:00-1:00pm, other times can also be arranged

Course Webpage: on Canvas

Recommended Texts and other Sources:

- “Introduction to Probability models”, S. Ross, n th edition (published by Academic Press).
- “A first look at rigorous probability theory”, J. S. Rosenthal, 2nd edition (published by World Scientific).
- “Introduction to Probability”, C. M. Grinstead and J. L. Snell, second revised edition (published by American Mathematical Society). Also available online from the CHANCE project, can be downloaded (free!) at <http://www.dartmouth.edu/~chance/>.
- “Markov chains” from the Cambridge Stats Lab <http://www.statslab.cam.ac.uk/~rrw1/markov/M.pdf>
- Supplementary notes on Probability will be available on course webpage.

Grading:

Homework problems will be assigned each week or two. They will be partially graded, and solutions will be provided. There will be several quizzes or tests and also a project, see the notes “Project Details”.

Grade breakdown will be approximately 50% for Homeworks/Project, 50% for Tests/Quizzes.

List of main topics:

- 1). **Basics:** events, probability law, conditional probability and independence, discrete random variables, expected value, continuous random variables, IID sequences and random walks, weak law of large numbers, normal distribution, central limit theorem, moment generating functions, maximum excursion for RW, conditioning, Monte Carlo and Metropolis sampling.
- 2). **Finite Markov chains:** classification of states, persistence, classification of chains, stationary distribution, irreducibility, Perron-Frobenius theorem, rate of convergence, time reversibility, Markov chain Monte Carlo.
- 3) **Infinite random sequences:** random walk, strong law of large numbers.
- 4) **Infinite Markov chains:** classification, stationary distribution, random walk, coupling.
- 5) **Large deviations for IID sums:** convergence to the mean, binomial rate function, Legendre transform, Cramer’s Theorem.
- 6) **Selected Topics (as time allows):** Continuous time Markov chains, Poisson process, Bayesian inference, hidden Markov models and Viterbi algorithm, branching processes.

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College of Science Policies: The current College of Science Academic Course Policies are available at <https://cos.northeastern.edu/wp-content/uploads/2012/10/COS-teaching-policies-April-2017.pdf>