STA477/2006, Winter 2025
Stochastic processes
Course outline

Basic information.

- **Instructor:** Wenlong Mou (wenlong.mou@utoronto.ca), Assistant Professor, Department of Department of Statistical Sciences, University of Toronto.
- **Course website:** https://mouwenlong.github.io/teaching/sta447w25/index.html. All the course material will be posted on this website.

Description. This is an introductory course for stochastic processes. In this semester, we will discuss stochastic processes with various structures, including (discrete-time) Markov chains, martingales, Brownian motion and Poisson processes. Topics include, but are not limited to, recurrence and convergence of Markov chains, optional stopping and martingale convergence, and basics of stochastic calculus. If time permits, we will also cover applications including Monte Carlo algorithms, random walks on graphs, branching processes, option pricing, queuing theory, and more.

Prerequisites. STA347H1/MAT377H1/STAC62H3. The prerequisite is strictly enforced for undergraduate students); for graduate students, it suffices to have taken a course equivalent to STA347 at another university.

Textbooks.

- A first look at stochastic processes, by Jeff Rosenthal (main)
- Introduction to stochastic processes, by Greg Lawler (additional)
- Essentials of stochastic processes, by Rick Durrett (additional)

Topics covered.

- Markov chain theory: discrete-space discrete-time Markov chains, recurrence and transience, stationary distribution and convergence theorems, mean recurrence time.
- Discrete-time martingales: stopping time, optional stopping theorems, uniform integrability and martingale convergence.
- Brownian motion and introduction to stochastic calculus: reflection principle, stochastic integration and Itô's calculus.
- Poisson processes and continuous-time discrete-space Markov processes.