Syllabus

1 Logistics

- **Instructor:** Will Hartog (whartog@stanford.edu)
- **TAs:** Rahul Kanekar and Nathan Tung
- **Lectures:** Tuesdays and Thursdays, 10:30-11:50 am pacific, Gates Information Sciences, Room B01
- **Office Hours:**
  - Monday/Wednesday 6-7 pm; Zoom (Rahul)
  - Wednesday 3-5 pm; Sequoia Hall 220, 3-4 in-person only (Nathan)
  - Tuesday 3-4 pm and Thursday 12-1 pm; Sequoia Hall 220 (Will)

2 Overview

This course is an introduction to discrete stochastic processes. We will see how to model real-world stochastic processes as simple, structured random systems, and how doing so gives us the power to draw remarkably precise, controlled conclusions about the macroscopic behavior of these chaotic processes. Topics covered include discrete and continuous time Markov Chains, Branching Processes, and Poisson Processes.

Prerequisites: Students will need to have taken probability theory (STATS116, CS109, or MATH151), which in turn necessitates a background in linear algebra (MATH51 or CS205) and calculus (MATH19, MATH20, MATH21). If you have not taken a full college-level probability course, take STATS116 instead.

3 Course Materials

Textbook. We will be mainly using the textbook "Introduction to Stochastic Processes with R" by Robert Dobrow, freely available here.

We might also reference material from "Introduction to Stochastic Modelling" by Karlin and Taylor, available here, and "Markov Chains and Mixing Times" by Levin and Peres, available here. You are welcome to consult either for a different treatment of the material; Pinsky and Karlin fundamentally cover the same content.

Canvas. All course recording and office hours access will be on our course Canvas site, in addition to homework files.

Ed. We will use Ed as the discussion platform for the course. You have been automatically added and can access through the navigation bar on Canvas.

Gradescope. All homeworks and the take-home final should be submitted to Gradescope. Please take care to tag each page to the correct question while submitting. You have been automatically added and can access through the navigation bar on Canvas.

4 Coursework & Evaluation

Homework (70%) There will be 6 homework assignments, with 4 problems each, weighted equally. Homeworks are released on Tuesdays and due the following Thursday at 10:30 am pacific, with no late work accepted, and your lowest homework score will be dropped. You may submit your completed practice final to replace one of your homework grades.

Final Exam (30%) The final exam will be a take-home final which you will complete over the course of a 36 hour period between Friday, August 18 at 8 am pacific and Saturday, August 19, at 8 pm pacific.

5 SCPD

Video cameras located in the back of the room will capture the instructor presentations in this course. For your convenience, you can access these recordings by logging into the course Canvas site. These recordings might be reused in other Stanford courses, viewed by other Stanford students, faculty, or staff, or used for other education and research purposes. Note that while the cameras are positioned with the intention of recording only the instructor, occasionally a part of your image or voice might be incidentally captured. If you have questions, please contact a member of the teaching team, or our course producer, Veronica Craven (vcraven@stanford.edu).

6 Policies

The Honor Code. It is expected that you and I will follow Stanford's Honor Code in all matters relating to this course. You are encouraged to meet and exchange ideas with your classmates while studying and working on homework assignments, but you are individually responsible for your own work and for understanding the material. You are not permitted to copy or otherwise reference another student's homework or computer code.

Late Work Policy. Late work will not be accepted. To allow you some flexibility, your lowest homework will be dropped, and an optional practice final assignment to replace one homework is available.

Accommodations. Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. Students should send their accommodation letter to instructors as soon as possible.

7 Tentative Schedule

The exact specifics of the topics covered in each lecture are subject to change but the order is consistent. All homework due dates are at 10:30 am pacific, at the start of class.

Date	Topic	Readings	Assignment
6/27	Intro to Markov Chains	Dobrow 2.1-2.3	
6/29	Stationary Distributions	Dobrow 2.4, 2.5, 3.1, 3.2	
7/6	Reducibility and Periodicity	Dobrow 3.2-3.5	HW1 Due
7/11	Ergodicity and Time Reversibility	Dobrow 3.6-3.7	
7/13	Absorbing Chains and Expected Visits	Dobrow 3.8-3.9	HW2 Due
7/18	Markov Chain Monte Carlo	Dobrow 5.1-5.3	
7/20	Strong Stationary Times and Mixing	Dobrow 5.4-5.6	HW3 Due
7/25	Branching Processes	Dobrow 4.1-4.4	
7/27	Poisson Processes Intro	Dobrow 6.1-6.3	HW4 Due
8/1	Poisson Process Properties	Dobrow 6.4-6.8	
8/3	Continuous Time Markov Chains	Dobrow 7.1-7.3	HW5 Due
8/8	Limiting Behavior	Dobrow 7.4-7.5	
8/10	Queueing Theory	Dobrow 7.6	HW6 Due
8/15	Renewal Theory	Pinsky-Karlin 7.1-7.4	
8/17	Review and Looking Forward		Practice Final Due
8/18-8/19	Take-home Final Exam		