PROB 140

Probability for Data Science

Spring 2021

WEEK 6 STUDY GUIDE

The Big Picture

We develop an algorithm that uses a Markov chain to simulate a probability distribution on an intractably large outcome space.

- Under some conditions that are pretty general, Markov chains have powerful long run properties.
- *Steady state* or *stationarity* has a physical interpretation and many uses.
- Many Markov chains, when run for a long time, exhibit different kinds of *balance*. These can be used to identify steady state properties.
- *Monte Carlo* methods use simulation to address problems that are intractable by math or by complete enumeration.
- *Markov Chain Monte Carlo* (MCMC) can be used to simulate probability distributions on intractably large outcome spaces, even when the normalizing constant of the distribution can't be calculated.

Week At a Glance

Mon 2/22	Tue 2/23	Wed 2/24	Thu 2/25	Fri 2/26
	Instructor's Session		Instructor's Session	
		GSIs' Sessions		GSIs' Sessions
Checkpoint Week 6 (Due Wed 2/24)		**Checkpoint Week 6 Due**		
Homework 5 (Due Mon 3/1)				
Lab 3 (Due Mon 3/1)				Lab 3 Party 5PM
Read/watch Sec 10.1	Skim Sec 10.1-10.3	Read/watch Ch 10, skim Sec 11.1	Read/watch Ch 11	Read/watch Ch 11

Reading, Practice, and Live Sessions

Sections	Topic	Live Sessions: Prof. A.	Live Sessions: GSIs	Recommended Practice
Ch 10	**Markov chains** - 10.1 (covered in Week 5) introduces terminology, notation, and basics, along with a computational approach to the long run - 10.2 narrows down the type of chain we'll be studying, but even the narrowed-down group is pretty large - 10.3 takes a more theoretical approach to the long run - 10.4 has examples and applications	Tuesday 2/23 - Formal discussion of long-run behavior - Balance and detailed balance **Checkpoint is based on Chapter 10 and Section 11.1**	Wednesday 2/24 Ch 11: - Ex 1, 3, 5	Ch 11 - Ex 2, 4 - Kontantopolous Ex 25, 27
Ch 11	**Detailed Balance and MCMC** - 11.1 is about different kinds of balance, and how one of them can make it easy to identify the other - 11.2 solves the code-breaking problem with a tiny alphabet, by complete enumeration - 11.3 develops a general Markov chain Monte Carlo method that can be used to solve the problem with a large alphabet	Thursday 2/25 - The code breaking problem, with a tiny alphabet - Using MCMC to solve the problem with a large alphabet	Friday 2/26 **Lab 3**. Please attend – the lab will make much more sense if you do, and it's one of our rare one-week labs.	

There are no exercises at the end of Chapter 10, because the methods of Chapter 11 make many problems easier to solve.