Fall 2022
WEEK 11 STUDY GUIDE

The Big Picture

We get as close as we can to establishing the Central Limit Theorem, and then move to estimation.

- The *moment generating function* (mgf) is more powerful than probability generating functions for dealing with sums. This helps us establish the properties of normal and gamma families that we observed by simulation, and indicates why the CLT is true.
- The mgf and *Chernoff's bound* improves on the tail bounds of Markov and Chebyshev.
- In the frequentist world, a parameter is a fixed but possibly unknown number. The method of *maximum likelihood* identifies the parameter that makes the data most likely.
- In the Bayesian world, the data scientist's degree of uncertainty about unknown quantities is described by probability distributions. Unknown parameters are therefore random variables, and inference consists of updating our distribution of the parameter based on the observed data. For these calculations we need some basic methods for conditioning on continuous variables.
- The main example is inference for the unknown *p* of a coin. Independence is affected by the randomization of the parameter.
- If the prior is uniform, the MAP estimate (the mode of the posterior) is the same as the maximum likelihood estimate.

Week At a Glance

Mon 10/31	Tue 11/1	Wed 11/2	Thu 11/3	Fri 11/4
	Lecture	Sections	Lecture	Sections
HW 10 Due HW 11 (due Mon 11/7)				HW 11 Party 3PM - 5PM
Lab 5B Due Lab 6A (Due Mon 11/7)				Lab 6A Party 10AM to noon
Skim Sections 19.1 and 19.2	Work through Sections 19.1, 19.2, 19.3	Work through Section 19.4, skim Section 20.1	Work through Sections 20.1 and 20.2	Work through Chapter 20

Reading, Practice, and Class Meetings

Book	Topic	Lectures: Prof. A.	Sections: GSIs	Optional Additional Practice
Ch 19	**Moment generating functions** The first two sections parallel the start of Ch 14 on the pgf - 19.1 has a formula for the density of a sum, but it's often intractable - 19.2-3 define the mgf and examine its uses including a sort-of proof of the CLT - 19.4 uses the mgf to develop a new tail bound	Tuesday 11/1 - Convolution formula for the density of a sum - Moment generating functions: definition, main uses, Chernoff's bound	Wednesday 11/2 - Ch 18 Ex 4, again - Ch 19 Ex 3, 2	Ch 19 - Ex 1, 7
Ch 20	**Approaches to inference** - 20.1 is about the method of maximum likelihood - 20.2 introduces conditioning on a continuous variable, and shows once again that randomizing a parameter affects dependence and independence (you saw this earlier with Poissonization) - 20.3 formalizes the concepts of prior and posterior distributions of parameters, and compares the MAP estimate and the MLE	Thursday 11/3 - Maximum likelihood - Random parameters: conditioning and independence	Friday 11/4 - Ch 20 Ex 4, 5	Ch 20 - Ex 2, 6