PROB 140

Probability for Data Science

Fall 2022

WEEK 10 STUDY GUIDE

The Big Picture

More technique, and three important distribution families

- To study the joint behavior of two random variables, we define their joint density, which is the analog of the discrete joint distribution. Probabilities and expectations are now double integrals.
- The family of *beta* densities is crucial for machine learning, and offers a good example of how joint densities are constructed.
- The normal and gamma families are heavily used in modeling.
- We start by establishing some properties of the standard normal that we have taken for granted without proof. We notice connections with gamma distributions. By simulation, we notice key properties of sums: sums of independent normals are normal, and sums of independent gammas (with the same rate) are gamma.
- The two most important branches of the gamma family have integer or half-integer shape parameters.

Week At a Glance

Mon 10/24	Tue 10/25	Wed 10/26	Thu 10/27	Fri 10/28
	Lecture	Sections: **QUIZ 3**	Lecture	Sections
HW 9 Due HW 10 (Due Mon 10/31)				HW 10 Party 3PM - 5PM
Lab 5A Due Lab 5B (Due Mon 10/31)				Lab 5B Party 10AM - noon
Skim Sec 17.1	Study for the quiz	Work through Sec 17.1-17.2; skim Sec 18.2	Work through Sections 17.3-17.4	Work though Chapter 18

Reading, Practice, and Class Meetings

Book	Topic	Lectures: Prof. A.	Sections: GSIs	Optional Additional Practice
Ch 17	**Joint Densities** - 17.1-17.3 are the 2-dimensional counterparts of Ch 15 and the density version of Chapter 4. The examples in the videos aren't always the same as those in the text. - 17.4 is one of the "big name" families of densities	Tuesday 10/25	Wednesday 10/26 - **QUIZ 3** - Ch 17 Ex 4	Ch 17 - Ex 1, 5, 7, 9
Ch 18	**Normal and gamma families** - 18.1 establishes the normal density, mean, and variance, and in the process discovers an important fact about sums of squares of standard normals. You *have* to know the results even if you don't follow some of the proofs. - 18.2 observes by simulation that sums of independent normals are normal, and uses this in exercises - 18.3 observes by simulation that sums of independent gammas with the same rate are gamma, and studies one major branch of the gamma family - 18.4 studies the other major branch	Thursday 10/27 - Fundamental properties of the standard normal - The gamma family and its relation to squares of centered normals	Friday 10/28 - Ch 18 Ex 1abc - Ch 18 Ex 4 (crucial) - Ch 18 Ex 5	Ch 18 - Ex 3, 8