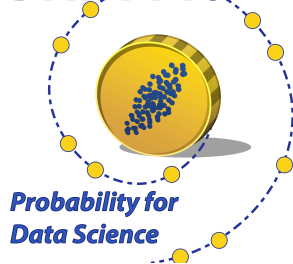**DATA 140**

Probability for Data Science

Spring 2025
WEEK 3 STUDY GUIDE

The Big Picture

The week starts with another connection between the binomial and Poisson families, and moves on to **the most important concept of the course,** which is expectation. This can be thought of as a kind of center of the distribution of a random variable, or a good guess for the variable. All probabilities are expectations, the variance of a random variable is an expectation, and least squares predictors are expectations. So please pay attention!

- Randomizing parameters can have dramatic effects on dependence and independence. A Poisson number of i.i.d. success/failure trials has beautiful and powerful properties.
- Expectation is the average of the possible values, weighted by their probabilities. Care is needed for variables that have infinitely many values.
- The definition helps us calculate some expectations, but almost always we calculate expectation using its properties, just as we calculate derivatives using properties of derivatives instead of the definition.
- A simple but powerful method helps us find the expectation of a function of a random variable.

Week At a Glance

Mon 2/3	Tue 2/4	Wed 2/5	Thu 2/6	Fri 2/7
	Lecture	Sections	Lecture	Mega Sections
Lab 2 due Lab 3A (Due Mon 2/10)			Lab 3A Party 9-12	
HW 2 Due HW 3 (Due Mon 2/10)				HW 3 Party 2pm - 5pm
Skim 7.1, 7.2	Work through Ch 7	Finish Ch 7, skim 8.1	Work through 8.1-8.2	Finish 8.1-8.3

Reading, Practice, and Class Meetings

Book	Topic	Lectures: Michael	Sections: TAs	Optional Additional Practice
Ch 7	**Poissonization** - 7.1 has properties of the Poisson distribution - 7.2 asks the same questions as 6.1, but with a Poisson number of trials - 7.3 extends this to trials with more than two categories, analogous to 6.3	Tue 2/4 Poissonization: - Beautiful calculations with surprising results - Pay attention to the math because you'll need the methods again	Wed 2/5 - Ch 7 Ex 2, 7, 8	Chapter 7 All the exercises
Ch 8	**Expectation** - 8.1 has the definition, interpretation, and a note on existence - 8.2 calculates the expectations of some of the famous distributions, in one case by introducing a new way of calculating expectation - 8.3 shows how to calculate expectations of linear and nonlinear functions of random variables	Thu 2/6 - Focused on 8.1-8.3 - Fine points, nonlinear functions, and some surprises	Fri 2/7 - Ch 8 Ex 2, 10, 6, 4	Chapter 8 Wait till next week; you need the remaining sections of Ch 8 for the remaining exercises in the chapter