

# DATA 140



Fall 2025

## WEEK 2 STUDY GUIDE

### The Big Picture

We continue to develop the basic toolkit: the rules of probability, how to work with numerical random quantities and collections of events.

- In Data 8 you saw a *statistic* defined as a number that you compute based on a sample. The more general concept is that of a *random variable*, which is a function on the outcome space.
- *Distributions* describe how probability is spread over a set of values. Every random variable has a distribution; pairs and larger groups have *joint distributions*.
- There is a formula for the chance of the union of overlapping events, with a famous application.
- If there is a complicated dependence structure, you might not be able to calculate exact or even approximate chances. Sometimes the best you can do is find *bounds* for a chance.
- *Symmetry* in random permutations and simple random samples greatly simplifies calculations.

### Week At a Glance

Mon 9/1	Tue 9/2	Wed 9/3	Thu 9/4	Fri 9/5
	Lecture	Sections	Lecture	Mega Sections
	<b>HW 1 Due 9 AM</b> HW 2 (Due 5 PM Mon 9/8)			HW 2 Party 2-5 in Evans
	<b>Lab 1 Due 9 AM</b> Lab 2 (Due 5 PM Mon 9/8)		Lab 2 Party 9-12 in Warren	
	Work through Chapter 3, skim Chapter 4	Work through Chapter 4, skim Sec 5.1	Work through Sec 5.1 and Sec 5.4, skim Sec 5.1 and Sec 5.2	Work through Ch 5

## Reading, Practice, and Class Meetings

Book	Topic	Lectures: Professor	Sections: TAs	Optional Additional Practice
Ch 3	Random variables - 3.1 has the definition - 3.2 defines the distribution of the random variable, and shows how to find probabilities of events based on the random variable - 3.3 shows how random variables can have two kinds of equality	<b>Tuesday 9/2</b>  - Some discussion about ideas seen in Chapter 2 - The key ideas in Chapters 3 and 4, focusing more on the math than the code	<b>Wednesday 9/3</b>  - Exercises selected to help with assignments:  Chapter 3 Ex 3, 5ab Chapter 4 Ex 4ab	<b>Chapter 3</b> 4, 7
Ch 4	Pairs of random variables - 4.1 is the two-variable version of 3.2: joint distributions, and finding probabilities  - 4.2 has examples you should study  - 4.3 shows how to extract the behavior of one random variable from the combined behavior of two  - 4.4 shows how to update chances for one random variable given the value of another  - 4.5 looks at how joint distributions help us understand dependence and independence; note the acronym "iid"			<b>Chapter 4</b> Do as much as you can of all five exercises.

Chapters 3-4 aren't difficult technically, but they contain many basic concepts and essential terminology.

(continued below)

## Reading, Practice, and Class Meetings

Book	Topic	Lectures: Professor	Sections: TAs	Optional Additional Practice
Ch 5	<ul style="list-style-type: none"> <li>- 5.1: Simple bounds for the chance of an overlapping union, to be used when we can't find the chances of the overlaps</li> <li>- 5.2: The exact chance of a union, overlapping or not. This is called the <i>inclusion-exclusion</i> formula and requires that we be able to find the chances of the overlaps.</li> <li>- 5.3: One of the most famous applications of inclusion-exclusion is to <i>fixed points of a random permutation</i>, also known as <i>matches</i></li> <li>- 5.4: Summary of results on symmetry in random permutations and simple random sampling, some of which we'll have used earlier</li> </ul>	<p>Thursday 9/4</p> <ul style="list-style-type: none"> <li>- Some discussion of bounds and symmetry</li> <li>- Main focus on inclusion-exclusion and the matching problem</li> </ul>	<p>Friday 9/5</p> <ul style="list-style-type: none"> <li>- Bounds, symmetry, and inclusion-exclusion:</li> </ul> <p>Chapter 5 Ex 3, 1, 9, 12; comparisons with other exercises</p>	<p>Chapter 5 5, 6, 10, 13</p>

Chapter 5 is more technically detailed than Chapters 3-4.