



## WEEK 4 STUDY GUIDE

### The Big Picture

**The most important week of the course.** It's about expectation, which 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 careful attention this week.

- 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.
- The two most powerful properties are additivity and the method for finding the expectation of a function of a random variable.
- Expectation is used in the definition of the bias of an estimator, and hence also in the construction of unbiased estimators.

### Week At a Glance

| Mon 9/13  | Tue 9/14             | Wed 9/15                        | Thu 9/16             | Fri 9/17           |
|---|----------------------|---------------------------------|----------------------|--------------------|
|   | Instructor's Session |                                 | Instructor's Session |                    |
|   |                      | GSIs' Sessions<br><b>Quiz 1</b> |                      | GSIs' Sessions     |
| HW 3 Party 12-2PM<br><b>HW 3 Due</b><br>HW 4 (Due Mon 9/20) |                      |                                 |                      |                    |
| <b>Lab 2A Due</b><br>Lab 2B (Due Mon 9/20)                  |                      |                                 |                      | Lab 2B Party 3-6PM |
| Read/watch 8.1, skim 8.2                                    | Read/watch 8.1-8.3   | Skim 8.4                        | Read/watch 8.4, 8.5  | Review Chapter 8   |

## Reading, Practice, and Live Sessions

| Sections | Topic   | Live Sessions:<br>Prof. Sahai  | Live Sessions: GSIs  | Recommended<br>Practice   |
|----------|---|--|--|---|
| Ch 8     | <b>Expectation</b> <ul style="list-style-type: none"> <li>- 8.1 has the definition, interpretation, and a note on existence</li> <li>- 8.2 calculates the expectations of some of the famous distributions, in one case by introducing a new way of calculating expectation</li> <li>- 8.3 shows how to calculate expectations of linear and nonlinear functions of random variables</li> <li>- 8.4 is about additivity: the expectation of a sum is the sum of the expectations, regardless of dependence or independence. Hugely powerful.</li> <li>- Additivity helps us construct unbiased estimators based on averages</li> <li>- 8.5 uses additivity to develop the method of indicators for finding expected counts</li> </ul> | <p><b>Tue 9/14</b></p> <ul style="list-style-type: none"> <li>- Focused on 8.1-8.3</li> <li>- Fine points, nonlinear functions, and some surprises</li> </ul> <p><b>Thur 9/16</b></p> <ul style="list-style-type: none"> <li>- Additivity and some consequences:</li> <li>- Constructing unbiased estimators</li> <li>- Finding expected counts</li> </ul> | <p><b>Wed 9/15</b></p> <ul style="list-style-type: none"> <li>- Ch 8 Ex 2</li> </ul> <p><b>Friday 9/17</b></p> <ul style="list-style-type: none"> <li>- Ch 8 Ex 6a, 7, 12, 11</li> </ul> | <p><b>Chapter 8</b></p> <p>All the exercises not covered in section</p> |

This is one of the few weeks in which we cover just one chapter.