Final Exam Material and Expectations

For the final exam, you should be able to do the following things:

Chapter 1.

- Know what sample spaces, outcomes, and events are.
- Compute probabilities of events given information about probabilities of some outcomes, using probability rules for unions, intersections, and complements.
- Compute conditional probabilities with the definition.
- Use the Law of Total Probability.
- Use Bayes' Theorem to compute posterior probabilities.
- Use independence of events to compute probabilities, and use probabilities to determine independence.
- Count the size of an event or sample space using counting techniques such as the multiplication rule, permutations, and combinations.
- Use counting to compute probabilities in sample spaces with equally likely outcomes.

Chapter 2.

- Find the probability mass function of a discrete random variable when given a description of the experiment.
- Given a probability mass function of a discrete random variable, determine the cumulative distribution function of the random variable.
- Given a cumulative distribution function of a discrete random variable, determine the probability mass function of the random variable.
- Given the probability density function of a continuous random variable, determine the cumulative distribution function of the random variable.
- Given the cumulative distribution function of a continuous random variable, determine the probability density function of the random variable.
- Compute expected value, variance, and standard deviation of random variables.
- Know rules for computing expected value and variance for linear combinations of random variables.

Chapter 3.

- Recognize a binomial random variable by a description of the experiment.
- Use formulas for the expected value, variance, and probability mass function of a binomial random variable.
- Recognize a geometric random variable by a description of the experiment.
- Use formulas for the expected value, variance, and probability mass function of a geometric random variable.
- Use formulas for the expected value, variance, and probability mass function of a Poisson random variable.
- Use the fact that the sum of independent Poisson random variables is also Poisson.

Chapter 4.

- Use formulas for the probability density function, cumulative distribution function, expected value, and variance of a uniformly distributed random variable.
- Use formulas for the probability density function, cumulative distribution function, expected value, and variance of an exponentially distributed random variable.
- Use Poisson processes to translate between waiting times between occurrences and number of occurrences.

Chapter 5.

- Compute probabilities for a normally distributed random variable by converting to a standard normal and using Table I to determine the cumulative distribution function of the standard normal distribution.
- Use that the sum or difference of normal random variables is still a normal random variable (and in particular, when they are independent, the variance of the sum is the sum of the variance).
- Approximate probabilities for a binomial random variable using the normal distribution, with the continuity correction.

Chapter 6.

- Given a data set, calculate the sample mean, sample median, sample variance, and sample standard deviation.
- Given a data set, sketch by hand a histogram or boxplot for the data set.

Chapter 7.

- Understand the difference between the sample statistics and the actual parameters of the underlying distribution.
- Calculate the bias and variance of a point estimate of the mean.
- Use Table I for the standard normal to approximate probabilities and critical values for the sample mean, $\bar{X}$, in the case when the population variance is known.
- Use Table III of critical values of the t-distribution to compute critical values for the sample mean, $\bar{X}$, in the case when the population variance is unknown, but the sample variance is known.

Chapter 8.

- Given a confidence level, sample mean, and sample standard deviation, construct a confidence interval for the population mean using Table III of critical values of the t-distribution.
- Given a confidence level and a desired interval length, give a reasonable estimation for the sample size required to construct a confidence interval with that length.
- Given a null hypothesis, state the alternative hypothesis.
- Compute p-values for hypothesis tests using critical values of the t-distribution.
- Given a significance level, perform a hypothesis test of that size and determine whether the null hypothesis should be accepted or rejected.

Chapter 9.

- Given data from paired samples, compute the pairwise differences to form confidence intervals and do hypothesis testing on the difference of the population means.
- Given statistics from two independent samples, use either the estimate for standard error assuming unequal variance or the pooled variance procedure assuming equal variance to form confidence intervals and do hypothesis testing on the difference of the population means.

Chapter 10.

- Given a confidence level and sample proportion, construct a confidence interval for the population proportion.
- Given a significance level, perform a hypothesis test of that size on a hypothesis about the population proportion, and determine whether the null hypothesis should be accepted or rejected.
- Given data on multiple categories and a significance level, perform a goodness of fit hypothesis test of that size, and determine whether the null hypothesis should be accepted or rejected.