Cumulative Exam Material and Expectations

For the cumulative 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 of events 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.
- From a joint mass function or joint density function, compute covariance, marginal distributions, and determine independence 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 formula for the joint probability mass function of a multinomial distribution.
- 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 distributed.

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 Table III of 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.