Exam 4 will cover Sections 7.3, 7.4 8.1, 8.2, and 8.3. The following is an outline of concepts from each of these sections with a short description of what you will be expected to know from each section.

- Section 7.3 - In this section we no longer use large samples, and although s approximates σ, it introduces more variance to the expression $\frac{\overline{X}-\mu}{S/\sqrt{n}}$. However, we assume that X is normally distributed. This garantees that $\frac{\overline{X}-\mu}{S/\sqrt{n}}$, although not having a standard normal distribution, has a bell shaped distribution similar to a standard normal distribution. We assign it a T-distribution based on the degrees of freedom, ν. Critical values ($t_{\alpha/2}$ instead of $z_{\alpha/2}$) are found in a table similar to that of a standard normal Z-distribution and we construct confidence intervals in a similar manner. (Note: we did not discuss Prediction Intervals for a Single Future Value, nor did we discuss Tolerance Intevals)

- Section 7.4 - Here we introduce another p.d.f, the chi-square (χ^2) distribution which describes the random variable

$$\frac{(n-1)S^2}{\sigma^2}$$

  By looking up critical values on an appropriate χ^2 distribution table we can construct confidence intervals for the population variance. Using the chi-square distribution table, you should be able to calculate percentiles for a chi-square distribution with $n-1$ degrees of freedom.

- Section 8.1
  - Main ideas of hypothesis testing. Although you will not be specifically asked to recite the definitions of Type I Error or Type II Error, you should be familiar with the terms.
  - Given a hypothesis test with given critical values and rejection regions you should be able to calculate the Type I Error (α).

- Section 8.2 Hypthesis testing of μ. Given any of the following types of sample data and significance level (α), be able to construct an appropriate hypothesis test, finding critical values and calculating a test statistic. Then based upon this, decide to reject or not reject the null hypothesis H_0.
  - Case I, Population is normally distributed. Population standard deviation σ is known. Use α and z-distribution to find critcal value(s). Calculate test statistic as

$$z = \frac{\overline{X}-\mu_0}{\frac{\sigma}{\sqrt{n}}}$$

  - Case II, Population distribution is not known. Population standard deviation σ is not known. Sample size is large ($n > 40$). Use α and z-distribution to find critcal value(s). Calculate test statistic as

$$z = \frac{\overline{X}-\mu_0}{\frac{s}{\sqrt{n}}}$$

- Case III, Population is normally distributed. Population standard deviation σ is not known. Use α and t-distribution (with degrees of freedom) to find critcal value(s). Calculate test statistic as

$$t = \frac{\overline{X} - \mu_0}{\frac{s}{\sqrt{n}}}$$

- Section 8.3 Hypothesis test of Population proportion. If the sample size is large ($np_0 \geq 10$ and $n(1 - p_0) \geq 10$) then $\hat{p}$ is approximately normal with standard deviation $\sqrt{\frac{p_0(1 - p_0)}{n}}$ and you find the critical values based on $\alpha$and the z-distribution. Calculate the test statistic as

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_o(1-p_0)}{n}}}$$

- Section 8.4 P-Values. For any of the tests in which we calculated a z test statistic, you should be able to calculate the P-value of the the test and be able to compare that with the level of significance, α, and then correctly decide whether or not to reject H_0. You should be able to perform a test of hypotheses using the P-value, similar to what we did in class.

- Section 9.1 Difference of two population means (where test statistic has a standard normal distribution).

  - Be able to perform a hypothesis test of the the form $H_0 : \mu_1 - \mu_2 = \Delta_0$where the population distributions are assumed to be normal with known standard deviations, or the sample sizes are large enough to assume $\overline{X}$ and $\overline{Y}$ are normally distributed.
  - Be able to construct confidence intervals for $\mu_1 - \mu_2$.

- Section 9.2 Difference of two population means (where test statistic has a t-distribution).

  - Be able to perform a hypothesis test of the the form $H_0 : \mu_1 - \mu_2 = \Delta_0$where the population distributions are assumed to be normal standard deviations are not known, but the sample sizes are too small to allow s_1 or s_2 to be used in place of σ_1 and σ_2.
  - Be able to construct confidence intervals for $\mu_1 - \mu_2$ under these same assumptions of the populations distributions and same given data.