Exam 3 covers Sections 5.1-4, 6.1, 7.1-4, and 8.1-5. As always, practice problems are on the web site: `http://web02.gonzaga.edu/faculty/axon/321/`. Some (but not all) of the things you should know:

Key concepts from chapter 5 are the distribution of the sample mean and the Central Limit Theorem. In particular, you should know that $\boxed{E(\overline{X}) = \mu \text{ and } Var(\overline{X}) = \frac{\sigma^2}{n}}$. The CLT tells us that the distribution of the sample mean is approximately normal when the sample size n is large (usually $n \geq 30$) regardless of the population distribution. We can then estimate probabilities associated with $\overline{X}$ by standardizing using the mean and standard deviation above.

Chapter 6 introduces the idea of estimation of population parameters.
We call a random variable $\hat{\Theta}$ an *unbiased estimator* of parameter θ if $E(\hat{\Theta}) = \theta$.

Formulas for confidence intervals and test statistics will be provided, as will relevant statistical tables. You should know how to apply and interpret the formulas. You should also remember how to calculate confidence bounds (as opposed to confidence intervals).

The following formulas will all be provided.
Confidence intervals:

- $100(1-\alpha)\%$ **confidence interval for** μ: $\overline{x} \pm z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$;
- $100(1-\alpha)\%$ **confidence interval for** μ: $\overline{x} \pm t_{\frac{\alpha}{2}, n-1} \frac{s}{\sqrt{n}}$;
- **Approximate** $100(1-\alpha)\%$ **confidence interval for** θ: $\hat{\theta} \pm z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{\theta}(1-\hat{\theta})}{n}}$;
- $100(1-\alpha)\%$ **confidence interval for** σ^2: $\left(\frac{(n-1)s^2}{\chi^2_{\frac{\alpha}{2}, n-1}}, \frac{(n-1)s^2}{\chi^2_{1-\frac{\alpha}{2}, n-1}} \right)$.

For **tests about the mean** ($H_0 : \mu = \mu_0$) test statistics are:

- $z = \frac{\overline{x} - \mu_0}{\frac{\sigma}{\sqrt{n}}}$ for samples from a population with a known variance σ^2 (all sample sizes if the population is normal, otherwise just for large samples);
- $z = \frac{\overline{x} - \mu_0}{\frac{s}{\sqrt{n}}}$ for large samples;
- $t = \frac{\overline{x} - \mu_0}{\frac{s}{\sqrt{n}}}$ for small samples ($n \leq 30$ or as big as your t-table goes) from a normally distributed population. The test statistic has a t distribution with $n-1$ degrees of freedom.

For **tests about a population proportion** ($H_0 : \theta = \theta_0$) use the sample proportion $\hat{\Theta}$ or the sample total $X = n\hat{\Theta}$. Test statistics:

- x (X is binomial with parameters n and θ_0, works best for small samples);
- $z = \frac{\hat{\theta} - \theta_0}{\sqrt{\frac{\theta_0(1-\theta_0)}{n}}} = \frac{x - n\theta_0}{\sqrt{n\theta_0(1-\theta_0)}}$ for large samples (both $n\theta_0 \geq 10$ and $n(1-\theta_0) \geq 10$).

For **tests about the variance** ($H_0 : \sigma^2 = \sigma_0^2$) the test statistic is

- $\chi^2 = \frac{(n-1)s^2}{\sigma_0^2}$ for samples from a normally distributed population. The test statistic has a chi-square distribution with $n-1$ degrees of freedom.

For **tests about the standard deviation**, square the standard deviations and do a test for the variance.