Exam III will cover primarily Sections 5.3, 5.4, 7.1, and 7.2, however, there are also problems from Chapter 4 (related to the previous exam) that will be on this next exam. 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 4.1 Probability Density Functions
  - Know the definition and properties of the *pdf* for a continuous random variable.
  - Given a *pdf*, $f(x)$, for a continuous random variable, X, be able to calculate $P(a \leq X \leq b)$.
  - Be able to calculate percentiles for a continuous random variable.
- Section 4.2 Cumulative Distribution Functions and Expected values
  - Given a *pdf*, $f(x)$, be able to calculate the associated cdf , $F(x)$.
  - Given a *pdf*, $f(x)$, be able to calculate the expected value $E(X)$, of the continuous random variable X
- Section 4.3 - In this section we discussed the basic properties of the normal distribution and the standard normal distribution. You should be familiar with calculating the probability of a normal variable X being in various intervals, i.e.
  - be able to calculate expressions of the form $P(a \leq X \leq b)$, $P(X \leq b)$, $P(a \leq X)$, etc.
  - be able to calculate the value of X that cuts off the the top or bottom $r\%$ of a normally distributed population, i.e. be able to calculate percentiles for a normal distibution.
- Section 5.3 - Here we talked about the distributions of statistics. Many of the examples used distributions of discrete variables and as in the homework, if you are given a distribution of X (where X is a discrete random varyou should be able to construct the distribution of $\overline{X}$ and of S^2, where the sample size is small. Note: we did not cover Simulation Experiments.
- Section 5.4 - This section covers the distribution of $\overline{X}$ specifically, and you should be familiar with the ideas presented in first two propositions of this section (p. 213, 214). . You should also be familiar with the implication of the Central Limit Theorem, (i.e. know that the distribution of $\overline{X}$ is approximately normal for sufficiently large n. These ideas allowed us to calculate probabilities of the form $P\left(a \leq \overline{X} \leq b\right)$, $P\left(\overline{X} \leq b\right)$, $P\left(a \leq \overline{X}\right)$, etc. where n is large.
- Section 7.1 - Basic ideas of confidence interval construction. Given sample information, $\overline{X}$, n and given σ be able to construct a confidence interval for a specified confidence level $1 - \alpha$.

  $$\left(\overline{X} - z_{\alpha/2}\frac{\sigma}{\sqrt{n}} \ , \ \overline{X} + z_{\alpha/2}\frac{\sigma}{\sqrt{n}}\right)$$

  Note: If we wish to construct a $(1-\alpha)$ confidence interval with a specified maximum error $E = z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$ or width $W = 2z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$ then we could do so by choosing a large enough value of n calculated by

  $$n = \left(\frac{2z_{\alpha/2}\sigma}{W}\right)^2 = \left(\frac{z_{\alpha/2}\sigma}{E}\right)^2$$

- Section 7.2 - Here we continued the idea of constructing confidence intervals for μ, however we do not assume to know the population standard deviation σ. However if $n > 40$, we assume that σ can be closely approximated by the sample standard deviation, s, so we calculate a $(1-\alpha)$ confidence interval as

  $$\left(\overline{X} - z_{\alpha/2}\frac{s}{\sqrt{n}} \ , \ \overline{X} + z_{\alpha/2}\frac{s}{\sqrt{n}}\right)$$

We also use the fact that if $n\hat{p} > 10$ and $n\hat{q} > 10$ then $\hat{p}$ is a normally distributed unbiased estimator for the population proportiton p. This allows us to construct $(1-\alpha)$ confidence intervals by

$$\left(\frac{\widehat{p} + \frac{z^2_{\alpha/2}}{2n} - z_{\alpha/2}\sqrt{\frac{pq}{n} + \frac{z^2_{\alpha/2}}{4n^2}}}{1 + \left(z^2_{\alpha/2}\right)/n}, \frac{\widehat{p} + \frac{z^2_{\alpha/2}}{2n} + z_{\alpha/2}\sqrt{\frac{pq}{n} + \frac{z^2_{\alpha/2}}{4n^2}}}{1 + \left(z^2_{\alpha/2}\right)/n} \right)$$