# List of topics for STAT422 final exam

# Chapter 7

- State the Central Limit Theorem
- The variance of the sum of independent rvs is the sum of the variances
- Know the distribution of the sample mean for large samples
- To get a normal sample mean for **small samples**, what must be true?
- Know the distribution of the **sample variance** when the data are normal
- Know the definition of a t,  $\chi^2$  and **F** statistics and distributions

### **Chapter 8**

- MSE, bias, margin of error
- confidence intervals (CI) for a mean, proportion or variance for large *n*
- CIs for a mean, proportion or variance for small *n*
- pooled sample variance across multiple populations
- CIs for a difference in means using either un-pooled (Welch) or pooled procedures
- CIs for a difference in proportions using the correct test statistic given in class
- CIs for variances and ratio of variances
- Interpretations of CIs
- pivotal quantities, pivotal method for generating CIs
- sample size calculations to attain a CI with a specified margin of error for a mean or proportion

### Chapter 9

- Know the 4 desirable attributes of an estimator
- consistency
- The **General Weak Law of Large Numbers**: If the bias and variance of an estimator must go to zero, then the estimator is consistent for a parameter.
- State the Weak Law of Large Numbers (with respect to the sample mean).
- Be able to prove whether a given statistic is consistent for a parameter.
- sufficiency
- Likelihood function
- Determine sufficient statistics using the **Factorization Theorem**
- Rao-Blackwell theorem says that the MVUE is a function of a sufficient statistic
- A 1-1 function of a sufficient statistic is a sufficient statistic
- Know how to "typically" find MVUEs from a sufficient statistic
- Find **MOM** estimators
- Find MLEs
- An MLE is a function of a sufficient statistic (you will not have to prove this, but be able to use it)
- Know how to "typically" find an MVUE from an MLE
- Cramer-Rao lower bound
- Know the 7 beautiful properties of MLEs including invariance, consistency, sufficiency, asymptotically efficient, and asymptotically normal

# Chapter 10

- Hypothesis testing of a single population proportion, mean, or variance
- Hypothesis testing of two population proportions, means, or variances
- Know when to use an un-pooled (Welch) test or a pooled test of two means
- Know when to use a *z*, *t*,  $\chi^2$ , or F test
- Perform a hypothesis test using either a *p*-value, rejection region, or CI
- Type I and Type II errors, calculation and interpretation, and how they relate to confidence and power.
- Sample size calculation to control both Type I and Type II error rates (i.e., confidence and power) for a single proportion or mean
- Power, calculation and interpretation
- Simple hypothesis
- State the Neyman-Pearson Lemma
- Find a **most powerful test**
- Find a **uniformly most powerful test**
- Derive and perform an **likelihood ratio test** (LRT)
- Asymptotic distribution of -2ln(LRT test statistic)

### Chapter 16

- Know the differences between **frequentist** and **Bayesian** views and interpretations
- Find a **posterior** given a likelihood and **prior**
- Non-informative and conjugate priors
- Find Bayesian mean and MAP estimators and know when they are equal
- When is the MAP equal to the MLE?
- Show that a Bayesian estimator is consistent
- For the normal posterior of a population mean and the beta posterior for a population proportion covered in class, Bayesian means and MAPs can be biased yet consistent, with a smaller variance than the MVUE
- credible/probability intervals
- Know the posterior for a population proportion, using non-informative and conjugate priors
- Know the posterior for a population mean, when the variance either is known or unknown, using noninformative and conjugate priors