The big picture focus of Exam 2 is the basic idea of **statistical inference**, or the tools statisticians use to interpret descriptive statistics in the face of *sampling variability*, which is the recognition that conclusions drawn from a sample of data may not perfectly mirror what is true of a population.

Specific topics you should be familiar with:

- **Sampling from a population**
    - What is the difference between a sample and a population?
    - What challenges when working with a sample
        - Sampling bias
            - Be familiar with random sampling methods as a way to obtain a representative sample
            - Be familiar with convenience sampling and its strengths/weaknesses
        - Sampling variability
            - Contributing factors: sample size, amount of variability in the population
    - Know what "standard error" or SE is, and how it relates/differs from standard deviation
- **Confidence interval estimation**
    - Point estimates vs. interval estimates
        - Why sampling variability makes interval estimates more useful
    - What is meant by the "confidence level" in a confidence interval estimate
    - Know the generic formula "Point Estimate +/- c*SE"
        - Know the roles of each component in this formula (ie: "c" calibrates the interval in terms of confidence level, while "SE" expresses the sampling variability of the point estimate).
    - Bootstrapping as a method for evaluating sampling variability
        - Know what bootstrapping is and how it is done (ie: resampling the original sample with replacement, calculating a bootstrapping statistic, etc.)
        - Be familiar using bootstrapping to estimate the standard error to use in the formation of a confidence interval estimate
        - Know how to find a percentile bootstrap confidence interval when given a bootstrap distribution
    - Know how to calculate a confidence interval using a Normal approximation and Central Limit theorem formula (given on our formula sheet) for 1 proportion or a difference in 2 proportions, and for 1 mean or a difference in 2 means
        - Know when to use the t-distribution and why it must be used in certain situations
        - Know when a Normal approximation based approach is not appropriate (ie: sample size conditions, etc.)
    - Know how to properly interpret a confidence interval
- **Hypothesis testing**
    - Know how to set up an appropriate null hypothesis and alternative hypothesis given a written description of a scenario
        - Know when a scenario involves a single proportion (ie: H0: $p = 0.5$) or a difference in proportions (ie: H0: $p1 - p2 = 0$)

        - Know the relationship between the null hypothesis and the scientific conclusion that the researchers would like to establish
    - Know how to interpret a p-value as a measure of evidence against a null hypothesis
        - Be familiar with common p-value misconceptions as illustrated in our lecture slides
        - Understand the concept of a “decision threshold” for statistical significance and its relationship with the likelihood of Type 1 errors and Type 2 errors
        - Be familiar with the problems that come with performing multiple different hypothesis tests within a single experiment
    - Know how to perform a hypothesis test using a randomization distribution
    - Know how to perform a hypothesis test using a Normal approximation and Central Limit formula for 1 proportion or a difference in 2 proportions, and for 1 mean or a difference in 2 means
        - Know when to use the t-distribution and why it must be used in certain situations
        - Know when a Normal approximation based approach is not appropriate (ie: sample size conditions, etc.)
    - Know the relationship between confidence intervals and hypothesis testing and how they provide complimentary information