Exam 1 Study Guide:

The exam will consist of 3 major sections:

1. A set of true/false questions worth 0.5 points each without any partial credit
2. 3 or 4 conceptual questions requiring a 1-3 sentence answer each worth 1.5 points with the possibility of partial credit
3. A multi-part application where each component is worth 1 point

The posted practice exam provides an example of this format, but it is important to note that you shouldn't expect the real exam to be an exact copy of the practice exam with the numbers changed. Instead, you should expect a similar style but some different topics.

Below is a tiered list of things you should study to prepare for the exam, ordered from highest priority (most likely to appear) to lowest priority (least likely to appear). Anything that is not mentioned on this list won't be on the exam:

Highest priority:

- Definition of a p-value, both in words (ie: probability of a result at least as extreme as the one observed given the null hypothesis is true) and in conditional probability notation for a specific scenario, for example: Pr($\hat{p} \geq 14/16 | p = 0.5$))
  - What this definition *is not* - for example, the p-value is not the probability of the null hypothesis being true.
- Appropriate null hypotheses, using statistical symbols, for one-sample/two-sample categorical/quantitative data
- Logical framework of a hypothesis test
  - The null hypothesis is a strawman that the researchers don't actually believe, but they would like to disprove it to establish an alternative
  - The p-value is a measure of how much evidence the data provides against the null hypothesis.
  - The p-value can be found using a simulation (ie: StatKey) or a probability model (ie: the Z test or T test)
- How to write a proper one-sentence conclusion using both the p-value and descriptive statistics (example: "There is strong evidence (p<0.001) that daytime tables have a higher proportion of female customers (51.47%) relative to nighttime tables (29.55%) for this individual.")
- The appropriate graphs (histograms, boxplots, bar plots, scatter plots, etc.) and descriptive statistics (means, medians, proportions, correlation, etc.) for various combinations of variables.

Medium priority:

- What is a "null distribution"? How does the null distribution relate to the p-value?
  - Example: StatKey simulation creates sample proportions that could have been seen had p=0.5 (the null distribution), the p-value is the proportion of these simulated values at least as extreme as the sample proportion.
- How to use the Z-score transformation to create the test statistic for a Z test or T test when given a formula for the standard error (SE) of the descriptive statistic involved in the test (ie: sample proportion, difference in proportions, etc.)
  - Know the generic formula: Test Statistic = (Observed – Expected under H0)/SE
- When to use a Z or T test, and when to these "default tests" are not appropriate (ie: assumption checks).
  - Z-test for categorical data, T-test for quantitative data
  - Count condition for categorical data (at least 10 expected outcomes of every type)
  - T-test works for small, Normally distributed samples, or large samples (n>30) from any distribution. It is *only* inappropriate for small samples from highly skewed/non-Normal populations.
- How to judge correlation from a scatter plot, including when to use Spearman's vs. Pearson's correlation coefficient
- How to interpret the estimated coefficients in a regression model
- The influence of outliers on certain statistics (ie: outliers on the mean/standard deviation, or outliers on the regression line)

Lowest priority:

- How the Z test and T test are related, including why the T test is a necessary modification of the Z test for quantitative data, and how the p-values of each test would compare for quantitative data
- Names of R functions and their syntax for Z and T tests
- Names of the alternative tests that can be used when the assumptions of our "default" tests are not met
  - Exact binomial and Fisher's exact test for categorical data
  - Wilcoxon signed rank and rank sum tests for quantitative data

- Paired study designs and how they relate to hypothesis testing results
- R^2 and the relationship between correlation and simple linear regression