This lab is the second half of a pair of labs designed to help you review for the final exam. The final exam is heavily weighted toward inference, but the exam will contain some earlier concepts too.

Learning Objectives for the Final: (Click the learning objectives below for a short clip on the topic.)

Calculate the Minimum Percentage of Data Inside a Symmetric Interval (3)
Calculate the Expected Value of a Discrete Random Variable (3)
Calculate the Value Corresponding to an Upper Percentile of the Normal Distribution (3)
Calculate the Value Corresponding to a Lower Percentile of the Normal Distribution (3)
Discuss the Central Limit Theorem (2)
Determine if a Sample Size is Large Enough to Employ the Central Limit Theorem (2)
Apply the Central Limit Theorem to Calculating Probabilities for the Sample Mean (3)
Define Interval Estimators (1)
Explain the Meaning of "Confidence Level" (2)
Know How to Find Critical Z Values (3)
Form the Margin of Error when the Sample Size is Large (3)
Construct a Confidence Interval for the Mean when the Sample Size is Large (3)
Interpret a Confidence Interval (2)
Discuss Factors Affecting the Margin of Error or Width of Confidence Intervals (2)
Explain the Special Rounding Rule for Sample Size Calculations (2)
Determine the Sample Size Needed to Estimate the Population Mean (3)
List the Similarities of the t Distribution and the Z Distribution (1)
List the Differences between the t Distribution and the Z Distribution (1)
Find Critical t Values (3)
Form the Margin of Error when the Sample Size is Small (3)
Construct a Confidence Interval when the Sample Size is Small (3)
Know the Meaning of "Hypothesis" in the Context of Statistics (1)
List the Characteristics of the Null Hypothesis (1)
List the Characteristics of the Alternative Hypothesis (1)
Determine the Null and Alternative Hypothesis (2)
Explain the Logic of the Test Statistic (2)
Calculate the Test Statistics from Sample Data (3)
Discuss the Four Possible Outcomes for a Hypothesis Test (2)
Describe a Type I Error (2)
Describe a Type II Error (2)
Classify an Error as Either Type I or Type II (2)
Discuss the Probability of Committing a Type I Error for a One-Tailed Test (2)
Discuss the Probability of Committing a Type I Error for a Two-Tailed Test (2)
Define the Critical Value (1)
Find the Critical Value for a One-Tailed Test when n is Large (3)
Find the Critical Values for a Two-Tailed Test when n is Large (3)
Determine a Decision Rule Based on Critical Values (2)
Use the Classical Approach of Hypothesis Testing to Determine the Initial Conclusion (3)

Express the Final Conclusion of the Hypothesis Test Based on the Initial Conclusion (3)
Use the Classical Approach to Conduct a Hypothesis Test of the Population Mean when the Sample Size is Large (3)
Calculate the P-value for a One-Tailed Hypothesis Test (3)
Calculate the P-value for a Two-Tailed Hypothesis Test (3)
Use a Given P-value and Significance Level to Form a Conclusion (3)
Test a Hypothesis Using the P-value Approach (3)
List the Ways to Reduce the Likelihood of a Type I Error (1)
Determine the Consequences of Increasing or Decreasing the Significance Level (2)
Carry Out the Procedure to Find the Critical Value for a One-Tailed Test when n is Small (3)
Carry Out the Procedure to Find the Critical Values for a Two-Tailed Test when n is Small (3)
Conduct a Test of a Hypothesis about the Population Mean when n is Small (4)

Exercises:

1. A school principle claims that the average age of night-school students is more than 27. A sample of 50 night-school students' ages was collected in order to estimate the mean age of night-school students. The sample mean for the group was 25.3 years, and the standard deviation was 4.0 years. Use the sample to create a 95% confidence interval to estimate the true mean age. Does the interval contradict the principle's claim? 24.19 to 26.41 It does not appear that the mean age is greater than 27.

2. McDonald's claims that the average time customers wait in the drive through is equal to 2.5 minutes. A sample of 50 wait times had a mean of 2.9 minutes and a standard deviation of 0.5 minutes. Calculate the test statistic for a test of McDonald's claim at the 5% significance level. What is the probability that the type I error occurs? $z = 5.66$, there is a 5% chance of a type I error

3. An insurance company claims the mean time it takes a fire truck to reach a set of homes is 15 minutes. It is safe to assume these travel times follow a normal distribution. The company randomly sampled 18 trips from the firehouse to the neighborhood from a set of city records. Those trips had an average time of 13.8 minutes and a standard deviation of 6.1 minutes. Use the data to test the company's claim at the 1% significance level.
   Claim: $\mu = 15$ Test Stat: $t = -0.83$
   Ho: $\mu = 15$ Critical Values: ± 2.898
   Ha: $\mu \neq 15$ Do not reject Ho, do not support Ha
   The sample data does not allow us to reject the claim that the mean is 15 minutes.

4. McDonald's claims that the average time customers wait in the drive through is less than 2.5 minutes. If this claim is tested at a 10% significance level instead of a 5% significance level, what will effect will this change have on the likelihood of committing a type I and type II error?
   Using a higher significance level, will increase the likelihood of a type I error, but it will decrease the chance of making a type II error.

5. The owner of a baseball team wants to know how much money fans spend at the ballpark when attending a game. From a previous study, the standard deviation for these spending amounts appears to be $15. If the owner wants to create a 95% confidence interval to estimate the true mean to within $3, how many fans must be randomly sampled? n = 97

6. A test of the hypothesis that the proportion of Americans that do not want children is 0.05 has been conducted. The p-value for the test is 0.1221. What is your initial conclusion? If that conclusion is an error, what type of error would it be? Do not reject the null since the p-value is large. If this is an error, it would have to be a type II error.

7. A researcher claims that the proportion of Americans that do not want children is 5%. A sample of data was used to create a 90% confidence interval for the proportion of Americans that do not want children. The interval is (0.03, 0.09). At a 10% significance level, use the interval to test the researcher's claim.
   Since 0.05 (5%) is part of the interval, the data does not allow us to reject the null hypothesis (the claim).

8. True or false: The random variable X has a left-skewed distribution. The distribution of the sample means for samples of size 36 can be reasonably assumed to be approximately normal.

9. Using a small significance level can make the likelihood of a type II error unacceptably high. When using a small significance level, what can be done to combat the increase in the likelihood of a type II error that would otherwise occur? We can increase the sample size.

10. A sample of 100 measurements was used to conduct a test of the following hypothesis at the 5% significance level: $\mu \geq 1.18$. Provide the rejection region for the test. Reject if Z is less than -1.645

11. A car dealer plans to purchase a fleet of used 2013 Toyota Camry's. There is a 50% chance a 2013 Camry will sell for a profit of $1,500, a 30% chance a Camry will sell for a profit of $2,000, a 15% chance it will sell for a profit of $2,500, and a 5% chance the car will be sold at a loss of $1,000. Find the expected value for these 2013 Toyota Camry's.

X	P(X)	X*P(X)
1500	0.50	750
2000	0.30	600
2500	0.15	375
-1000	0.05	-50
		$\mu = 1675$

12. A test of the hypothesis, $\mu > \$20,000$, produces a test statistic of $z = -1.20$. Find the p-value for the test. 0.3849+0.5000 = 0.8849 (note: it is a right-tailed test)

13. If all other things are held constant when constructing a 95% confidence interval, what general effect would using a sample size of 100 instead of using a sample size of 36 have on the margin of error? The larger sample size would reduce the margin of error.

14. Find the critical z-value for a 98% confidence interval to estimate the population mean. $z = 2.326$

15. The lengths of major league baseball games are approximately normally distributed. ESPN claims the average length of a MLB game less than 180 minutes. A random sample of 40 games has a mean of 170.1 minutes and a standard deviation of 7.2 minutes. Use a 5% significance level to test ESPN's claim.
Claim: $\mu < 180$ Test Stat: $t = -8.70$
Ho: $\mu \geq 180$ Critical Values: -1.645
Ha: $\mu < 180$ Reject Ho, support Ha
The sample data allows us to support the claim that the mean is under 180 minutes.

16. State the rejection region for a test of the hypothesis (at the 5% significance level) that the mean is equal to 0.59. The sample size for the test is $n = 12$.
Reject the null if t is less than -2.201 or more than 2.201.