**Part 1. (13.5 points)**

The microbeersS22.csv dataset is a representative sample of 100 microbrews from around the United States. The variable abv represents the percent of alcohol by volume for each craft beer. According to the National Institute of Health, one standard serving of alcohol is 12 ounces of regular beer, which is usually about 5% alcohol by volume (abv).

*Does the sample of microbrews provide evidence the average alcohol by volume of all craft beers is different from a standard serving of beer at 5% abv?*

Use this dataset and the R script t\_procedures.R to complete the following:

1. (1 point) What is the parameter of interest in this scenario? Provide the symbol and context.

The parameter of interest is the average alcohol by volume of all craft beers.

1. (1 point) State the null and alternative hypothesis to answer the question of interest.

**Null Hypothesis:**

the average alcohol by volume of all craft beers is the same as a standard

serving of beer ().

**Alternative Hypothesis:**

: the average alcohol by volume of all craft beers is different from a standard

serving of beer ().

1. (1 point) Make a histogram or boxplot to visualize the variable abv. Is there visual evidence the average alcohol by volume is different than 5%?

Chart, histogram

Description automatically generated

The mean is situated around 6%. So, there is visual evidence that the average alcohol by volume is between 5% and 7%.

1. (1 point) Calculate the sample mean and standard deviation using R. State the values.

Text

Description automatically generated with medium confidence

1. (1 point) Check the conditions for inference. State them and whether they are met.

The sample is a representation of the population (random sampling). The sample size is sufficiently large (100). So, the conditions are met.

1. (1 point) Calculate the test statistic by hand. Show work.

1. (1 point) State the p-value. Is it one or two sided?

p = 1 - pt(6.144, 99) =

The p-value is two-sided because the average alcohol by volume of all craft beers is different from a standard serving of beer. So, () \* 2 = .

1. (1.5 points) Calculate the 95% Confidence Interval by hand. Show work.

5.902 1.96 () = (5.614, 6.189).

1. (1 point) Use the t.test() command in R to verify the results of the t test. For details on the t.test() function, please read the comments written in the DA6\_t\_procedures.R script. How do your answers compare?

Text

Description automatically generated

Both my answers are very similar and close to each other.

1. (4 points) From the R output, write a four-part conclusion describing the results. Use . Provide a statement in terms of the alternative hypothesis. State whether (or not) to reject the null. Give in context an interpretation of the point and interval estimate. Include any other information you might feel to relevant.

Since the p-value is , there is convincing evidence that the average alcohol by volume of all craft beers is different from a standard serving of beer at 5% abv. We reject the null hypothesis at the 0.05 significance level. We are 95% confident that the average alcohol by volume of all craft beers is between 5.614% and 6.189% with a point estimate of 5.902%.

**Part 2. (9.5 points)**

A winery bottles 1000’s of bottles of wine per season. The winery has a machine that automatically dispenses the amount of wine per bottle. Each season the wine maker randomly samples **35 bottles** of wine to ensure the amount of wine per bottle is **750 ml.** If there is evidence that the amount is **different than** (less or more than) 750 ml the winery will need to evaluate the machine and perhaps rebottle or consider selling the wine at a discount. The ***sample*** yields a mean of **746.4 ml** and standard deviation  **7.7** ml. Use a significance level of 0.05.

**State: Is there sufficient evidence that the average fill of the wine bottles is different than 750 milliliters?**

**Plan:**

1. (1 point) State the null and alternative hypotheses to answer the question of interest.

**Null Hypothesis:**

the average fill of wine bottles is the same ().

**Alternative Hypothesis:**

: the average fill of wine bottles is different ().

1. (1 points) Check conditions for inference. List the conditions and state whether they are met.

The sample is a representation of the population (random sampling). The sample size is sufficiently large (35). So, the conditions are met.

**Solve:**

1. (1 point) Calculate the test statistic and degrees of freedom. **Show work**.
2. (1 point) What is the p-value for the test?

This is a two-sided test, so p = 2 \* pt(-2.766, 34) = 0.009.

(When test statistic is negative, we don’t need to do 1 – pt(). For a two-sided, simply multiply the result of the pt() function on the arguments by 2.)

1. (1.5 points) Calculate a 95% confidence interval for µ. **Show work**.

µ = 746.4 1.96 () = (743.849, 748.951)

**Conclude:**

1. Write a four-part conclusion describing the results.

* (1 point) Provide a statement in terms of the alternative hypothesis.
* (1 point) State whether (or not) to reject the null.
* (1 point) Give an interpretation of the point and interval estimate.
* (1 points) Include context.

Since the p-value is 0.009, there is convincing evidence that the average fill of wine bottles is different than 750 milliliters. We reject the null hypothesis at the 0.05 significance level. We are 95% confident that the average fill of wine bottles is between 743.849 ml and 748.951 ml with a point estimate of 746.4 ml.

**Gradescope Page Matching (2 points)**

When you upload your PDF file to Gradescope, you will need to match each question on this assignment to the correct pages. Video instructions for doing this are available in the Start Here module on Canvas on the page “Submitting Assignments in Gradescope”. Failure to follow these instructions will result in a 2-point deduction on your assignment grade. Match this page to outline item “Gradescope Page Matching”.