Stats 314, Data Analysis #3

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Part I

Scenario 1

C. One sample t test
We want to use a one sample t test because we know the population average of 38 hours. Because we know the population average, we can compare the sample mean with the population mean to make a decision as to whether or not the sample mean if better or worse than the population mean.

Scenario 2

D. Matched pairs t test We have two sets of sample means, before and after, and we want to determine if there was an improvement or not. This is perfect for a matched pair t test.

Scenario 3

B. Two sample t test The two sample t test is used to see if two sets of averages are equal, or if one is better than the other.

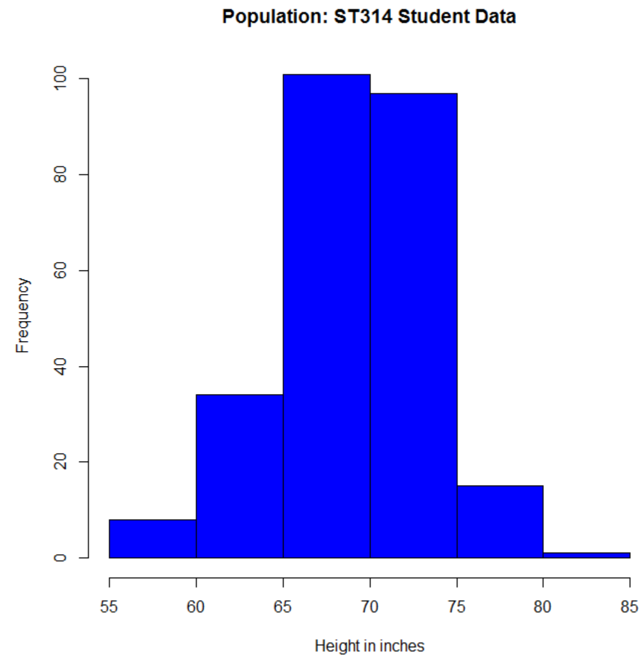
Scenario 4

A. One sample z test for a mean Given the information we have, we can see that the sample mean is relatively close to the population mean, with a low standard deviation. This is usually indictive of a normal distribution. But we want to use this test to see if a given null hypothesis holds or is rejected. In this case, the null hypothesis would be weight = 77 lbs.

Part II

a

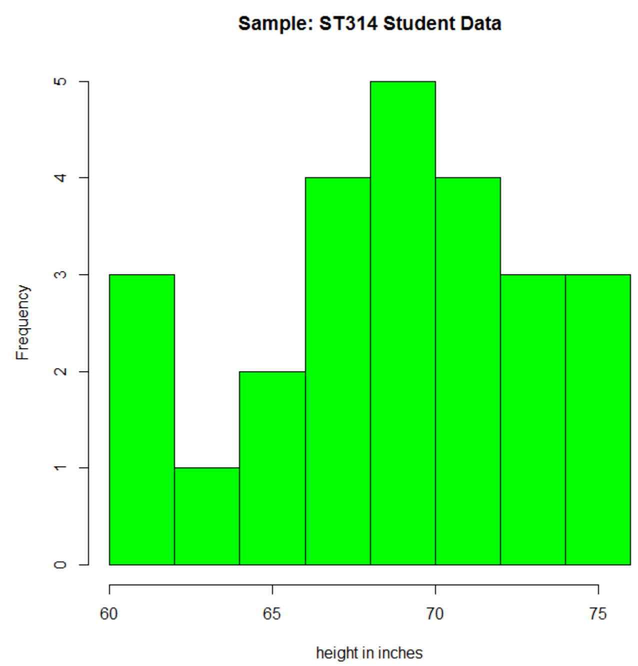
$\mu = 69.63938$
$\sigma = 4.066723$
The population is 256



The majority of the population falls between 65 inches and 75 inches in height.

b

$\bar{x} = 69.036$
$s = 4.71241$



The sample distribution isn't as radical as the population distribution was. Most members of the sample lie in the 65-75 range, with some grouping around 60-63. The sample mean was almost exactly the same as the population mean, and the sample standard deviation was a little bit higher.

c

$CI = 69.036 \pm 1.96 * \frac{4.71324}{\sqrt{25}}$

$= 70.8836$ and $= 67.1884$

The 95% confidence interval for the height of the class is estimated to be between 67.1884 and 70.8836 inches, with a point estimate of 69.036.

d

To calculate the t confidence interval for mean height, we do use the following formua:
$CI = \bar{x} \pm t^* * \frac{s}{\sqrt{n}}$

$69.036 \pm 2.064 * \frac{4.71324}{\sqrt{25}}$

$= 70.9816$ and $= 67.0904$

The 95% confidence interval for the height of the sample from class is estimated to be between 67.0904 and 70.9816 inches, with a point estimate of 69.036.
This interval does include the true population mean of 69.036.

e

The difference between parts c and d are that, in one, we're taking the CI of the sample knowing what the population standard deviation is, while in part d, we're taking the CI without knowing the population SD. The two answers we got are not too different from each other.

Part III

a

I would anticipate that we would reject the null hypothesis as our sampled data from our previous measurements had a different mean. The mean difference was small, but I think it was enough to reject.

b

To find the t statistic with the formula:

$t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}}$

Using the values we found in part II:

$t = \frac{69.036 - 69.639}{\frac{4.7124}{\sqrt{256}}}$

$t = \frac{-.603}{\frac{4.7124}{16}}$

$t = -2.0474$

Using this test statistic, we can find our t-value with a $DF = n - 1 = 255$, with a confidence interval of 95%, and a significance level of .05. From this information, we know that if our p-value (t in this case) is greater than the degrees of freedom at 95% then we should reject. In this case:
$DF = 255$

The value at that value is: $critical(100) < p < critical(1000) = 1.962 < p < 1.984$

Knowing this, we can say that in order to reject the null hypothesis, the value would have to be less than -1.984

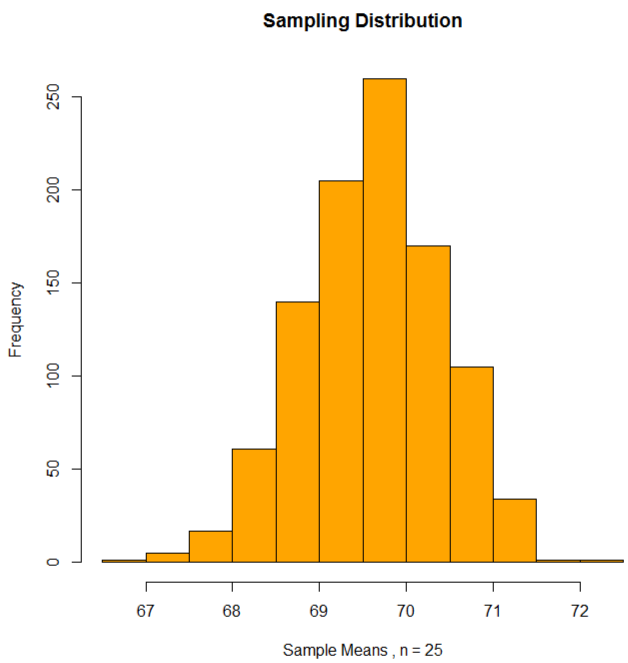
or greater than 1.984. We can see that the value of -2.0474 falls outside that range, so we should reject the null hypothesis.

c

There is convincing evidence the average height of the students in the class differ from 69.6393. The sample estimates the average height to be be 69.036 with a 95% confidence interval of 67.0904 to 70.9816 inches. The null hypothesis is rejected at a significance level of .05. The average height of the students in the class is not 69.6393 inches.

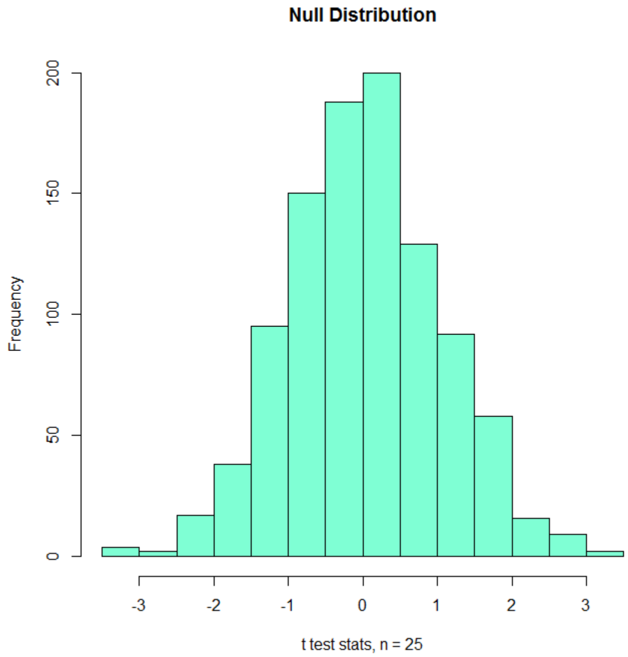
Part IV

a



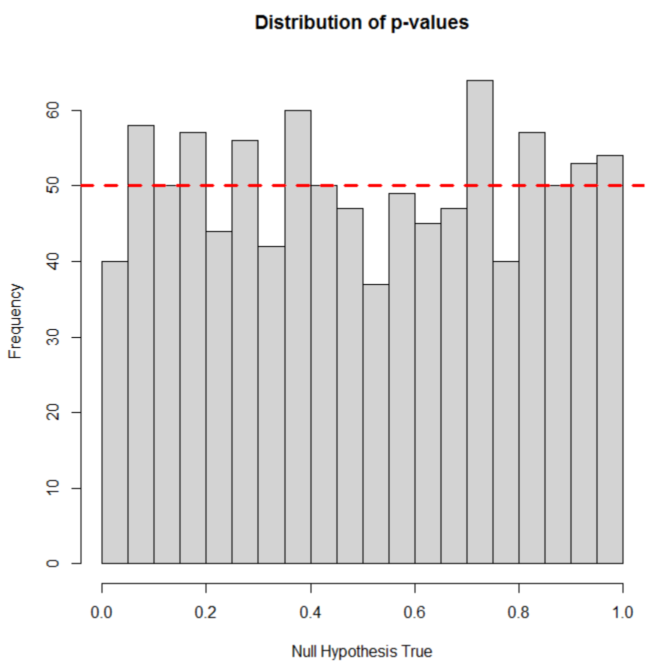
The mean is 69.62365 and the standard deviation is .7984.
The central limit theorem states that any sampling distribution of the mean of any independent, random variable will be normal or nearly normal, if the sample size is large enough. For our case here, this seems to be the case. The distribution is nearly normal.

b



A normal distribution would model this set of data well. It is nearly normal.

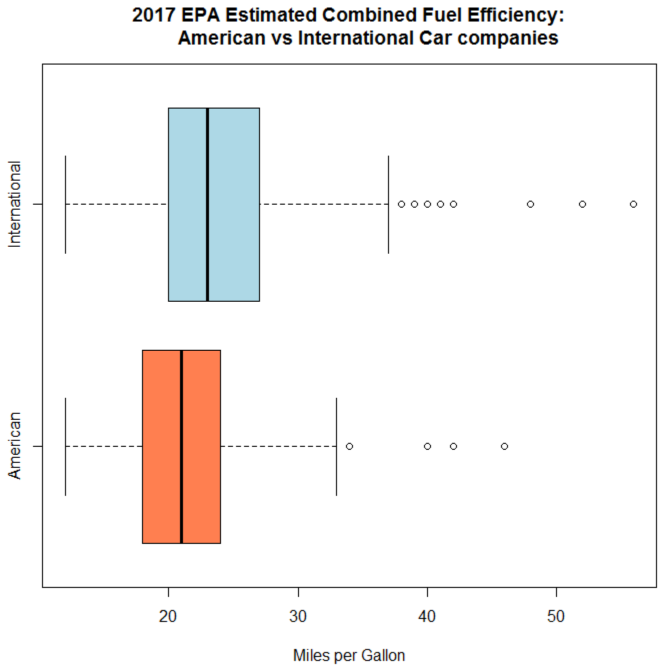
c



This does not seem to be the case. The null hypothesis is falsely rejected about 4% of the time. This represents type 1 error, which is the incorrect rejection of true null hypothesis, or a false positive.

Part V

a



There is some visual evidence that the average combined fuel efficiency for the international car companies is slightly higher than the american average. We can look at the beginning and ends of the first and third quartiles and see that the international companies have a slightly higher average value for the majority of the data points in those ranges.

b

	Mean CFE	SD	Sample Size
International	23.502	5.766	581
American	21.79	4.84	267

c

Null Hypothsis: Average CFE American = Average CFE International
Alt. Hypothesis: Average CFE American ≠ Average CFE International

d

n_1 and n_2 are Random Sample: yes
Populations and samples are independent: yes, American and International
Populations are normal or sample sizes are large: large population size

e

To find the test statistic, we can use the formula:

$t = \frac{\bar{X_1} - \bar{X_2} - (\delta_0)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$

$\delta_0 = \mu_1 - \mu_2 = (23.502 - 21.79) - (21.79 - 23.502) = 3.424$

$\bar{X_1} = 23.502$
$\bar{X_2} = 21.79$

$DF = min(n_1 - 1, n_2 - 1) = min(581 - 1, 267 - 1) = min(580, 266) = 266$

Knowing the above variables, we can plug them in:

$t = \frac{(23.502 - 21.79) - (3.424)}{\sqrt{\frac{5.766^2}{581} + \frac{4.84^2}{267}}}$

$t = -4.496$

f

Looking up the p-value on the t table, we find that it's less than .001. We will use this value as it is the one we have.

g

To find the confidence interval, we use the formula:

$\bar{X_1} - \bar{X_2} \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$

$23.502 - 21.795 \pm .001 * \sqrt{\frac{5.766^2}{581} + \frac{4.84^2}{267}}$

$= 1.71258$ and 1.71182 Then our confidence interval of 99% lies between $(1.71192, 1.71258)$

h

They got different confidence interval because they can calculate the exact DF, we only used the value at 100, the rounded value, and they can also get the exact p-value, which came out to .000008328 compared to my .001 value.

i

There is convincing evidence that the average combined fuel efficiency of American cars versus International have a difference not equal to zero. The sample estimates the average combined fuel efficiency of International Cars to be 1.71 MPG higher, with a 99% confidence interval of 1.71192 to 1.71258 MPG. The null hypothesis is rejected at a significance level of .01. The average international car has a higher average fuel efficiency of about 1.71 MPG.

There is convincing evidence the average height of the students in the class differ from 69.6393. The sample estimates the average height to be be 69.036 with a 95% confidence interval of 67.0904 to 70.9816 inches. The null hypothesis is rejected at a significance level of .05. The average height of the students in the class is not 69.6393 inches.

j

There is a practical difference here. About two miles per gallon difference can add up over a long period. If the difference was much lower, then the value would be less significant.