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Fun fact: the circles are shapes from Word. I did not draw those atrocities myself !

The purpose of this assignment is to gain some experience and background of some basic statistics that will be useful to you for analyzing your microfluidics data.

Read through this module and type your answers directly into this document. Where you are asked to circle responses, use Word's built in shapes feature found under the **Insert** tab. You will need the Excel file named **APP_N16_1_Caffeine** to complete problem 1. Submit as a PDF to Carmen according to the DAL. This is an individual assignment.

1. **Caffeine**

   You want to determine whether, on average, graduate students at The Ohio State University consume significantly more coffee than undergraduate students. You randomly sample 30 students. Set your significance level, α = 0.05. Record your null and alternative hypotheses below and circle whether these are 1-sided or 2-sided hypotheses:

   $$H_0: \mu_u \leq (=) \geq \mu_g$$

   $$H_1: \mu_u < / \neq / (>) \mu_g$$

   (1-Sided) / 2-Sided

   Run a t-test in Excel to calculate the p-value using the format below.

   `=ttest(data1,data2,tails,type)`

   `data1` and **`data2`** are the two sets of data. **`tails`** is either 1 or 2, specifying one-sided or two-sided. For **`type`** there are three choices. "Type 1" is a paired t-test (not needed in this course, it's used only for before and after treatment comparison, such as in medication evaluation), "Type 2" assumes equal variances, and "Type 3" does not assume equal variances. "Type 3" is the most conservative test, so if you are not sure, choose this one.

   Record the p-value below, compare to α, and draw a conclusion:

   p-value = 0.044086

   p-value (<) / = / > α

   Conclusion: *With a p-value of 0.044086 and an alpha level of 0.05, we <u>fail to reject the null hypothesis</u> that graduate students do not consume more caffeine than undergraduate students, with the alternative hypothesis that graduate students consume more caffeine than undergraduate students. Graduate students <u>do not</u> consume significantly more coffee than undergraduate students.*

2. Blood Pressure

Suppose a patient's blood pressure is measured once a day at the same time for seven consecutive days. An average systolic blood pressure greater than 120 mm Hg indicates that the patient should begin taking blood pressure medication.

Set your significance level, α = 0.01. Record your null and alternative hypotheses below and circle whether these are 1-sided or 2-sided hypotheses:

$$H_0: \mu (\leq) / = / \geq 120 mmHg$$

$$H_1: \mu < / \neq / (>) 120 mmHg$$

(1-Sided) / 2-Sided

The patient recorded the seven following measurements: 122, 131, 165, 140, 111, 155, 151.

Run a t-test in MATLAB to calculate the p-value using the format below.

>> [h, p] = ttest (x, m, 'alpha', value, 'Tail', 'both'/'right'/'left')

>> [h, p] = ttest2 (x, y, 'alpha', value, 'Tail', 'both'/'right'/'left', 'Vartype', 'equal'/'unequal')

This is a powerful tool, so it's important to understand the inputs. "ttest(x, m)" is a function to run a one-sample t-test to compare a sample array, x, to a number, m. "ttest2(x, y)" is a function to run a two-sample t-test to compare two sample arrays, x and y. In the return array, h will be a 1 if the null hypothesis is rejected or a 0 otherwise and p will be the p-value. The alpha level defaults to 0.05, however this can be changed by entering a number in place of value above. MATLAB also defaults to a 2-sided test. This can be changed to a 1-sided test where 'right' is for testing when the alternative hypothesis has a greater than sign and 'left' is for testing when the alternative hypothesis has a less than sign. Finally, whether or not the variances are assumed equal can be changed.

Record the p-value below, compare to α, and draw a conclusion:

p-value = 0.0188

p-value $< / = / (>)$ α

Conclusion: With a p-value of 0.0188 and an alpha level of *0.01,* we reject the null hypothesis that *(insert null hypothesis)*, with the alternative hypothesis that *(insert alternative hypothesis)*. The patient's mean systolic blood pressure (is / is not) significantly greater than 120 mmHg.

3. Conceptual Questions

- I perform a one-sided test, alpha=.05, with the alternative hypothesis that the population mean is greater than the value given by the null hypothesis, and calculate a p-value of .043. Do I reject my null hypothesis? **No, because the p-value 0.043 is < 0.05.**

- I perform a two-sided test, alpha=.05, with the alternative hypothesis that the population mean is greater than the value given by the null hypothesis, and calculate a one sided probability (ONLY the probability of obtaining a sample mean at least as large as my sample mean, assuming the null hypothesis is correct) of .043. Do I reject my null hypothesis? **Yes, because 0.043 is > than 0.025 (half the alpha value).**

- I obtain a p-value of 0.1 for a test where my alpha level was 0.05. Circle all that apply:
  I reject the null hypothesis / I fail to reject the null hypothesis / I accept the null hypothesis