BIOL 6305-0X Biometry: Project # 1
Frijol Soak-Off

It is time to investigate the effects of soaking temperature on the increase in bean (*Phaseolus vulgaris*) length (using pinto beans) over their dry length when soaked in water for 12 hours (h). Consider two soaking temperatures: room and refrigeration temperature. Note that because of the ongoing continuity plan resulting from the COVID-19 pandemic, your original task was to design and execute an experiment to address this question. For obvious reasons related to social distancing as recommended by the CDC and adopted by UTRGV, I can no longer provide you with calipers (precision $\pm$ 0.01 mm) needed to obtain the measurements. Thus, I have provided you with the data on an Excel file (Bean_Soak_Off_Spring_2021.xlsx) following the below protocol. Note the protocol is presented here so you can write part of your report even if I provided you with the data and you did not perform the experiment neither took the measurements.

Experimental protocol: Allocate 30 dry beans at random to each temperature treatment conditional on the constraint that we have equal numbers of short, medium, and long beans in each temperature treatment. Somehow label the beans so that you can keep track of them (*i.e*. you will need to match up dry and wet-lengths for each bean). Have the cold treatment's water chilled BEFORE immersing the beans. After soaking for 12 h, record each bean's soaked length.

Your data have been organized as follows (but the last column is not in the provided Excel file):

Temperature Treatment	Bean #	Dry length (mm)	Soaked length (mm)	Soaked - Dry length (mm)
1	1	10.5	12.0	1.5
1	2	.	.	.
.	.	.	.	.
.	.	.	.	.
1	30	.	.	.
2	1	.	.	.
2	2	.	.	.
.	.	.	.	.
.	.	.	.	.
2	30	.	.	.

Note: 1 = room temperature and 2 = chilled temperature (use the data label function in SPSS). Provided values in table are an example thus do not consider them as part of your data. Refer to aforementioned Excel file to access them.

Analyze your results using the t-test as follows:

$$t_s = \frac{\left(\bar{Y}_1 - \bar{Y}_2\right) - \left(\mu_1 - \mu_2\right)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$, d.f. = $n_1 + n_2 - 2$.

Calculate t_s manually first (show all results). That is, by plugging values into the above equation (you may use SPSS to calculate the $\bar{Y}_i$'s and the s_i^2's and turn in your output within an appendix). **Use** the probability calculator (previously provided Excel file) to determine the probability of t_s (two-tailed). Next, use SPSS to calculate t_s and the probability of t_s (Analyze → Compare Means → Independent Samples t-Test). Compare results.

Your task: When you are satisfied with your analysis, write it up in the form of a scientific journal article, but limited to a purpose statement (in lieu of the introduction), materials and methods section, and results section (no discussion section). Do not forget to include your annotated output in the appendix. It is ok to scan it and include the annotated output in your typed report so you do not have to re-type what the software has provided you with.

Purpose statement: simply state the purpose of performing the experiment.

Materials and Methods: write this in such a way that anyone could come in and duplicate your experiment. **Do not write** a list of items needed for the experiment neither that I provided you the data, assume you performed the whole task. The materials used should be evident from reading the text. Use the past tense, as you are describing work you did as opposed to work you will do. Also include a description of the statistical analysis (es) used to analyze your results (*e.g*. the change in bean lengths among the two groups were analyzed using a t-Test).

Results: this is where you report what your results were. Only results belong in this section! Do not interpret the data or draw major conclusions in this section. The expression of results may take 2 forms:

1. Written: write out what your results were. *For example*: In both tested temperatures, soaked beans increased from their initial dry lengths. Never state "For a listing of results see Table 1."

You should also provide evidence that the assumptions (normality and homoscedasticity) are satisfied suitably to support your inferences. If not, describe what you did to remedy the problem (*e.g*. was a transformation required?). Note that normality is examined within each treatment and not across treatments. Look for outliers. A Q-Q plot for normality, the simple test demonstrated in class for examining homoscedasticity, and a box plot for outliers are recommended. Bear in mind, this information belongs in the methods.

Statistics are only meant to support your results. **Avoid** making statements containing a lot of statistical jargon. For example, “the probability of the warm temperature group mean belonging to the same population as the cool temperature mean is less than 0.025 mm”. Instead, consider “the increase in bean length among the warm temperature group was significantly greater than that observed in the cool temperature group ($t_{0.05,34} = 5.13$, $p < 0.001$)”. It’s ok to use “means” in a sentence, but avoid using p, d.f., and t values.

2. Figures and tables: these are graphical representations of your data used to support your written results. **Not in lieu of**! Be sure to correctly label the axes and give them the proper units. The figures/tables should also be numbered (*e.g*. Figure 1, Figure 2, Table 1, etc.). These figures and tables should also have a caption describing their contents. The caption should be written so that the reader knows what the graph (or table) represents without having to refer to the text of the paper. These figures and tables should also be referred to in the text of the paper. *For example*: “In both tested temperatures, soaked beans increased from their initial dry lengths (Fig. 6)”. Never state “The effects of soak temperature on bean length are shown in Fig. 6”.

At the **very least**, a box plot comparing the two groups would seem appropriate as well as a table containing the means, standard error of the means and sample size.

All documents will be typed refer to the projects instructions also provided in Blackboard, and send to my e-mail address: carlos.cintra@utrgv.edu.