**Your name:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Names of your group members:**

* Name 1
* Name 2
* ….
* …..

**Name of your group's freshwater stickleback population: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Please directly fill out and submit this document. Each group member must complete this assignment using *your own words and figures*, although you are encouraged to work together to master concepts. As long as you answer questions in complete sentences, bullet-point or paragraph-form answers are both acceptable.

**Questions**

1. Compare the physical similarities differences you *observed* between the marine stickleback fish and your group's freshwater stickleback population. Specifically compare the four traits of interest for this lab: number of plates, body depth, body length, and pelvic girdle expression, as well as any other traits you wish to discuss. (3-6 sentences).
2. Give an alternative and corresponding null hypothesis that might explain a *difference* (of your group's choosing) in physical features between your group's freshwater population and the marine population.
3. Using Excel or a tool of your choice, calculate *summary statistics* for the marine population and for the freshwater population, and fill in the table below. When filling in the table…

* Replace the two population labeled "Freshwater" your group's freshwater population names.
* Modify the column "N" to contain the actual number of individuals measured from each population, if different from 20.
* Fill in all other columns with information pertaining the the given measurement. Note, the two columns about data type will be repetitive - this is ok!
* The complete table will have eight rows showing the summary for each of the four measurements recorded from the two populations. *Do not add more rows or columns*.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Population** | **N** | **Measurement** | **Quantitative or Categorical?** | **If quant., discrete or continuous?** | **Mean (mm)** | **Standard Deviation (mm)** | **Standard Error (mm)** |
| Marine | 20 | Body Length |  |  |  |  |  |
| Marine | 20 | Body Depth |  |  |  |  |  |
| Marine | 20 | Number of plates |  |  |  |  |  |
| Marine | 20 | Pelvic expression |  |  |  |  |  |
| Freshwater | 20 | Body Length |  |  |  |  |  |
| Freshwater | 20 | Body Depth |  |  |  |  |  |
| Freshwater | 20 | Number of plates |  |  |  |  |  |
| Freshwater | 20 | Pelvic expression |  |  |  |  |  |

1. Based on your summary statistics table aboev, answer the following questions in 1-2 sentences each.
   1. Considering body length, which stickleback sample mean (freshwater or marine) is likely more representative of its entire stickleback population? Which summary statistic did you use to answer this question?
   2. Considering body length, which stickleback population (freshwater or marine) generally has *longer bodies*? Which summary statistic did you use to answer this question?
   3. Considering body depth, which stickleback population (freshwater or marine) contains *least variation*? Which summary statistic did you use to answer this question?
   4. Considering the number of plates, which stickleback population (freshwater or marine) contains *most variation*? Which summary statistic did you use to answer this question?
   5. Considering pelvic girdle expression, which stickleback population (freshwater or marine) contains *most variation*?
2. Using Excel, the class plotting website, or a tool of your choice, make the figures below. For all figures, you must include accurate X- and Y-axis labels, and make sure populations are easily distinguished. Note that you will lose points for excessively large figures or figures with distorted aspect ratios - ensure that each figure is less than ⅓ of a page and look professional!
   1. Make **five histograms** displaying body depth distributions for all measured populations (one histogram each, either as separate figures or one figure containing all histograms). Be sure to choose an appropriate number of bins (called "buckets" in Google Sheets).
   2. Make **five boxplots** displaying body length distributions for all measured populations (one boxplot each, either as separate figures or one figure containing all boxplots).
   3. Make a **barplot** displaying the mean and standard deviation of the number of left-side plates for all measured populations. The barplot should have five bars, one for each population.

* 1. Make a **barplot** displaying pelvic expression distributions for all measured populations. The barplot should have five bars, one for each population.
  2. Make **two scatterplots** displaying the relationship between body length and body depth, one for your group's freshwater population and one for the marine stickleback population. Your scatterplots must include the **line of best fit**. For this question, you should consider body length on the X-axis and body depth on the Y-axis.

1. Analyze the figures you made in Question #5 according to the following prompts (a-e correspond to plots a-e above):
   1. Based on your **histograms**, which population had the largest and smallest mean body depth? The largest and smallest standard deviation for body depth? If populations are too similar to compare for any of these statistics, explain your reasoning accordingly.
   2. Based on your **boxplots**, which population had the largest and smallest mean body length? The largest and smallest standard deviation for body length? If populations are too similar to compare for any of these statistics, explain your reasoning accordingly.
   3. Based on your **barplots**, which population had the largest and smallest mean number of plates? The largest and smallest standard deviation for number of plates? If populations are too similar to compare for any of these statistics, explain your reasoning accordingly.
   4. Based on your **barplots**, which population most commonly experienced *pelvic girdle reduction* compared to the marine population? If populations are too similar to compare, explain your reasoning accordingly.
   5. Based on your **scatterplots**, describe the relationship between body depth and body length for your freshwater population and the marine population. Are correlations positive or negative? Are correlations weak, moderate, or strong? Additionally, which population had the *stronger* correlation between body length and body depth?