WORKSHEET: COMPARING MEANS (AND MORE!)

Problem 1. Chicken farming is a multi-billion dollar industry, and any methods that increase the growth rate of young chicks can reduce consumer costs while increasing company profits, possibly by millions of dollars. An experiment was conducted to measure and compare the effectiveness of various feed supplements on the growth rate of chickens. Newly hatched chicks were randomly allocated into five groups, and each group was given a different feed supplement. Below are some summary statistics about the weight in grams of chickens from each group. Weight distribution within in each group was roughly normal.

	mean	sd (g)	n
casein	323.58	64.43	12
horsebean	160.20	38.63	10
linseed	218.75	52.24	12
meatmeal	276.91	64.90	11
soybean	246.43	54.13	14

(a) Does this data provide strong evidence that the average weights of chickens that were fed linseed and horsebean are different? Use $\alpha = 0.05$.

(b) What type of error might we have committed in part (a)? Explain.

(c) Would your conclusion in part (a) change if you used $\alpha = 0.01$?

(d) Test the hypothesis that the average weight of chickens that were fed casein is different than the average weight of chickens that were fed soybean. If your hypothesis test yields a statistically significant result, discuss whether or not the higher average weight of chickens can be attributed to the casein diet.

Problem 2. Kenya has two official languages: English and Swahili. These languages coexist with numerous other languages spoken in smaller, more localized communities. The following command should load a dataset about attitudes towards Swahili among 480 Kenyan schoolchildren into R.

```
swahili <- read.csv("https://sagrawalx.github.io/teaching/sp20-b6_ma117/swahili.csv")
```

This dataset records the following 4 variables about each child in the study.

- `province` where the child lives (either `NAIROBI` or `PWANI`)
- `sex` of the child (either `female` or `male`)
- `attitude.score` measures how positively the child feels about Swahili (from 40 (most negative) to 200 (most positive).
- `school` is a code for a specific school the child attends (`A` through `L`)

Conduct hypothesis tests to determine if the average `attitude.score` of a child is associated with each of the following variables. Be sure to state your hypotheses and conclusions clearly in the context of the data.

(a) `province`. Possible hint: you might decide to use the `subset` function. (Once you've figured out one way to do it, show me! Depending on how you did it, I might be able to suggest a quicker way.)

(b) `sex`.

(c) `school`. Possible hint: to run ANOVA, use `summary(aov(attitude.score ~ school, data=swahili))`

Problem 3. The following command should load a dataset about 53940 diamonds into R.

```
diamonds <- read.csv("https://sagrawalx.github.io/teaching/sp20-b6_ma117/diamonds.csv")
```

This data set records information on the following 10 variables about each diamonds.

- `price`: price in US dollars
- `carat`: weight of the diamond in carats (1 ct = 200 mg)
- `cut`: quality of the cut (`Fair`, `Good`, `Very Good`, `Premium`, `Ideal`)
- `color`: diamond color (from `D` (best) to `J` (worst))
- `clarity`: a measurement of how clear the diamond is (`I1` (worst), `SI2`, `SI1`, `VS2`, `VS1`, `VVS2`, `VVS1`, `IF` (best))
- `x`: length in mm
- `y`: width in mm
- `z`: depth in mm
- `depth`: total depth percentage (ie, `z / mean(x, y)`)
- `table`: width of top of diamond relative to widest point

(a) Classify each variable as numerical or categorical. If it is categorical, determine if it is ordinal.

(b) The "standardized price" of a diamond is its price divided by 100 times its weight in carats.

(i) Conduct a hypothesis test using p-values with significance level 0.05 to determine if there is a difference between the average standardized prices of 0.99 carat diamonds and 1 carat diamonds.

(ii) Construct a 95% confidence interval for the difference in average standardized price for 0.99 carat diamonds and 1 carat diamonds.

(c) Conduct hypothesis tests to answer the following questions. Be sure to state your hypotheses and conclusions clearly in the context of the data. Make sure you're using the right kind of hypothesis test for the variables involved!

(i) Does the average `depth` of diamonds vary according to `cut`?

(ii) Does the average weight of a diamond in carats vary according to `clarity`?

(iii) Does the average standardized price of diamonds vary according to `color`?

(iv) Is there a difference on average between the length and the width of a diamond?

(v) Are the `cut` and `clarity` of a diamond associated?