**STAT-614 HW4 Yunting Chiu**

STAT 614 - HW 4 Due: Thursday, October 22, 2020 in Blackboard by 11:59pm.

Instructions: Please type your solutions and upload the document as a pdf file in Blackboard. There is only one file to submit for this assignment. As part of this assignment, please take the completely anonymous Midterm Course Evaluation under the Survey tab in Blackboard.

Notes:

* For this HW you will need some concepts from chapter 3 on checking assumptions and transformations and chapter 4 on nonparametric methods.
* You will also be revisiting the “big ideas” around confidence intervals and hypothesis tests.

The food-frequency questionnaire (FFQ) is an instrument often used in dietary epidemiology to assess consumption of specific foods. A person is asked to write down the number of servings per day typically eaten in the past year of over 100 individual food items. A food-composition table is then used to compute nutrient intakes (protein, fat, etc.) based on aggregating responses for individual foods. The FFQ is inexpensive to administer but is considered less accurate than the diet record (DR) (the gold standard of dietary epidemiology). For the DR, a participant writes down the amount of each specific food eaten over the past week in a food diary and a nutritionist, using a special computer program, computes nutrient intakes from the food diaries. This is a much more expensive method of dietary recording. To validate the FFQ, 173 nurses participating in the Nurses’ Health Study completed 4 weeks of diet recording about equally spaced over a 12-month period and an FFQ at the end of diet recording. Data are in Blackboard in the file valid.txt.

Consider the data on total alcohol consumption for both the DR and FFQ, **alco\_dr** and **alco\_ffq**, respectively. You are to assess whether the two methods, diet record and the food-frequency questionnaire, are comparable for total alcohol consumption. In particular, is there evidence that FFQ underestimates total alcohol consumption, in general? **Estimate by how much the FFQ generally underestimates total alcohol consumption.**

1. Explain why the initial model needed to address these research goals is a matched-pairs t- procedure.

The matched-pairs t- procedure is test for difference in paired mean (In this case, there are 173 nurses have tested, they are from the same group). So, we need to define a new variable, which is based on the difference between paired values from alco\_dr and alco\_ffq.

Note: Two-sample t-test is used when the data of two samples are statistically independent, while the paired t-test is used when data is in the form of matched pairs. To use the two-sample t-test, we need to assume that the data from both samples are normally distributed and they have the same variances. The opposite of a matched sample is an independent sample, which deals with unrelated groups.

1. Use both the model notation we developed in class and a brief written description of the model (you may also use pictures) to illustrate the model. (Be careful! The matched-pairs procedure works on the difference in the two measures on each individual. Start with y = alco\_dr – alco\_ffq and describe the model for y!).

We set DIFF = y = alco\_dr – alco\_ffq

A screenshot of a cell phone screen with text

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Because of the alco\_dr and alco\_ffq is paired, so the initial analysis would be a matched pairs t-procedure. Each observation is taken one ID.

Diagram

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1. What are the model assumptions?

Assumptions of the matched pairs t-procedure:

* Sample of independent observations (study design)
* From a normally distributed population (plot)
* No influential outliers (plot)

Matched pairs assumptions are on the difference (DIFF)!!!

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• Sample of independent observations (The observations are independent of one another)

Because of the paired design we focus on the difference in total alcohol consumption with two different record method. The first assumption of the matched pairs procedure is that we have a sample of independent observations (i.e. consumptions are independent of one another).

1. Which of the model assumptions are not met? Give and refer to specific output.

Chart, box and whisker chart

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Chart, line chart

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• From a normally distributed population (The dependent variable should be approximately normally distributed)

There are many points that deviate from others in the qq plot. The sample size (n = 173) in this study is enough. Therefore, we cannot consider the difference of total alcohol consumption is follower a normal distribution.

• No influential outliers

When reviewing a box plot, an outlier is defined as a data point that is located outside the whiskers of the box plot. Based on the above boxplot we can see many outliers, that is, we need to check if outliers are impacting our conclusions.

1. Consider a square root transformation of the alcohol data: salcoDR = √alco\_dr and salcoFFQ = √alco\_ffq. Are the model assumptions met for the transformed data? Give and refer to specific output.

* Assumption1: Sample of independent observations (study design)

Still not change, yes.

* Assumption 2: From a normally distributed population (plot)

we cloud see the points forming a line that's roughly straight. As the normal distribution is symmetric, so the below qqplot has no skew (the mean is approximately equal to the median).

Chart, line chart

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Graphical user interface, website

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* Assumption 3: No influential outliers (plot)

After we square root transformed the data, the below boxplot and histogram show that no outliers are apparent in the histogram or boxplot, which follows the assumption 3.

Chart, histogram

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1. Conduct the appropriate test on the square root transformed data and interpret the results. Be sure to address the research questions stated above.

Because we will be using a nonparametric method. Therefore, we need to formulate our hypothesis:

H0: The population distribution of total alcohol consumption **the same** between the FFQ and DR method.

Ha: The population distribution of total alcohol consumption in the diet record (DR: the gold standard of dietary epidemiology) is **greater than** food-frequency questionnaire (FFQ).

Text

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1. Consider a nonparametric method for addressing the research questions. What null and alternative hypotheses are addressed by the appropriate nonparametric method? Carry out and interpret the results of the nonparametric method. Include and interpret the confidence interval estimate.
2. Which of the results in (6) or (7) do you prefer to use to draw conclusions for this study and why?