EDUC 641 Assignment 03 Key

1. Dataset (20% point)

1.1. Open your RStudio, create a project and save it. Go to the root directory of the project and create a folder named “data”. Download the [cont.csv dataset](file:///C:\Users\clair\Documents\0_projects\educ-quant\641\assignments\data\cont.csv) and store it in the folder “data”. Create an Rmd/R file in the project root directory. Then read the data into your R environment. Make sure to check whether the variable treat is factor as well as whether coursework and vocabulary are double. Transform them into correct types if needed.

1.2. Write your own code to view the dataset and write 3-4 sentences about the structure of the data (how many variables are there, what type is each variable, how many rows/observations, etc.).

* There are five variables in the dataset: tchid, treat, coursework, vocabulary, and vocabulary\_random
* Currently, all variables are double, but tchid and treat should be factor
* There are 126 teacher-level observations

#### 2. Descriptive statistics of the outcome variable (40% point)

2.1. Central tendency

* 2.1.1 What are the mean and median of the outcome variable, vocabulary? Interpret the statistical meanings of these measures.
  + The mean of vocabulary is 88.12, which means that the average student score for the sampled teachers is 88.12
  + The median of vocabulary is 88.35, which means that half of the teachers have an average student score above or below 88.35
* 2.1.2. Create a binned frequency table (suggested bin width = 5) for vocabulary. Then create a plot to show the distribution of vocabulary and make sure to label the x- and y- axes. Is it normally distributed? If not, describe how and how much the distribution is skewed. Did you notice any outliers?

|  |  |
| --- | --- |
| (58.5,63.5] | 0 |
| (63.5,68.5] | 1 |
| (68.5,73.5] | 6 |
| (73.5,78.5] | 12 |
| (78.5,83.5] | 17 |
| (83.5,88.5] | 28 |
| (88.5,93.5] | 24 |
| (93.5,98.5] | 20 |
| (98.5,104] | 11 |
| (104,108] | 4 |

* Plot options:

Chart, histogram

Description automatically generated

Chart, line chart, histogram

Description automatically generated

* The distribution of vocabulary is approximately normal. No outliers are observed.

2.2. Variability

* 2.2.1. What are the variance and standard deviation of vocabulary? Interpret the statistical meanings of these measures.
  + The variance of vocabulary is 92.78, the standard deviation is 9.63.
  + The average squared deviation of each score from the mean (88.12) is 92.78 and its square root is 9.63.
* 2.2.2. List the quartiles, percentiles, interquartile range, and range of vocabulary.
  + The quartiles of vocabulary are 81.51, 88.35, 94.74
  + The percentiles are 74.84, 80.25, 83.76, 85.71, 88.34, 90.29, 93.34, 96.56, 100.25
  + The interquartile range is 13.24
  + The range is 58.50 - 111.44

#### 3. Compare observed mean of vocabulary to population mean (40% point)

3.1 Using the same type of plot you used for vocabulary, plot the distribution of vocabulary\_random and compare the two plots. You may choose one of the two ways to compare plots: (a) use base R code to produce two plots side-by-side, or (b) use {ggplot2} package to put the two into one plot. Compare these two distributions and write one sentence to describe what you have observed. Circle back to question 2.1.2, do you think now whether the distribution of vocabulary is approximately normal?

* Option (a)

Chart, line chart, histogram

Description automatically generated

Chart, histogram

Description automatically generated

* Option (b)

Chart, line chart

Description automatically generated

* The distributions of vocabulary (the score of the observed sample) and vocabulary\_random (the score of the random sample) are very similar.
* We can conclude now that the distribution of the observed variable, vocabulary, is approximately normal.

3.2. Despite what your answer is for 3.1, you have to assume normal distribution of *vocabulary* before conducting any one-sample t-test. Note that we cannot observe the population mean but let’s suppose it is 87, we want to know whether our observed mean of *vocabulary* is equal to the population mean.

* 3.2.1. What is your null-hypothesis?
  + The mean value of vocabulary is not significantly different from the population mean.
* 3.2.2. Run a one-sample t-test and provide your results.
  + The t-statistic is 1.31 (*df* = 125, *p* = 0.194).
* 3.2.3. Write 2-3 sentences to interpret your results.
  + The *t* statistic is 1.31 with a *p*-value of 0.194, indicating that *t* is not significantly different from zero. As a result, we fail to reject the null hypothesis and conclude that the mean of vocabulary is not significantly different from the population mean 87.