Stat 474W/574: Exam 1, Total Points: 50

Instructor: Dr. Islam

Due: Feb 24, 2022 BY 7:00PM Canvas Upload

Last Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ First Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Notes:**

* Submit the completed Exam in the Assignment unit named **SubmitExam1** located in Canvas site.
* Save your completed work as **Lastname\_firstname** before uploading/submitting.
* R codes must be provided where applicable.
* Providing any additional outputs not asked for may lead to the reduction of point.

**Problem 1**

Below is a dataset that refers to the population of time, in minutes, people waited on oil change of their cars, on a given day.

46 47 46 47 42 40 42 41 38 48 41 45 45 44 49

1. Read these data values into R as a variable named **time** and find the size of the population.
2. Find the number of people spending 44 minutes or less.
3. Find arithmetic mean, geometric mean and harmonic mean of the time. What is the relationship between the three means that you have computed?
4. Find the population variance of time spent.

**Problem 2**

Resting heart rate consistently above 100 beats a minute is sometimes interpreted as tachycardia. Two samples of patients diagnosed with tachycardia are treated with two different doses of medication. Given certain physical activity to two groups of patients during the treatment process, the data below refer to the heart rates for the two samples of patients:

x1  
 98 78 103 102 104 119 100 87 94 99 98 96 109 106 93 109 97 94 113  
111  
  
x2  
105 107 105 107 102 102 106 104 84 108 93 86 99 110 116

The two populations are assumed to have unknown but equal variances.

1. Find out the pooled sample mean defined by
2. Find out the pooled sample variance, for estimating the unknown but equal variance , defined by
3. Report an estimate of the pooled coefficient of variation defined by

**Problem 3**

A vector of population data is defined as follows:

x=c(15, 29, 16, 23, 26, 30, 24)

1. compute the population mean and the population variance .
2. Draw all possible permutation samples of size 3, without replacement, and and save these samples as a dataframe pswor. How many samples are there in the dataframe pswor?
3. Write the all possible combination samples of size 3, without replacement, and save these samples as a dataframe cswor. How many samples are there in the dataframe cswor?
4. Find mean and variances of all possible samples in (b) and (c). How are these mean and variances are related to those in (a)?

Notes: As a matter of fact, we have

* the population size and
* the sample size is .

Note that in case (b) and (c), permutations and combinations, WOR, variance of all possible means is .

**Problem 4**

Below we have a paired sample (x,y):

x: 44 56 40 42 42 40 46 45 36 43 38 49 41 51 59  
y: 38 46 39 44 39 36 37 37 38 41 42 42 42 38 50

where x and y refer to before-after measurements for the response in a paired sample. Let be the difference of means in the before-after populations. the means of the two populations the two samples x and y come from.

We wish to test against the two-sided alternative .

1. What do you call this test?
2. Perform a test with appropriate t.test() available in R. Report the p-value for the permutation test and make a conclusion about the acceptance or rejection of the null hypothesis at significance level against the given alternative .
3. Perform a permutation test by using 5000 permutations. Report the p-value for the permutation test and make a conclusion about the acceptance or rejection of the null hypothesis at significance level against the given alternative .

**Problem 5**

In reference to the two given samples x1 and x2 in *Problem 2*, we wish to test to see if there is any mean difference in mean heart rate in the two groups of patients. In other words, we wish to test , where refers to the difference of mean heart rate in the populations the two samples x1 and x2 come from.

1. Test against the two-sided alternative via a permutation t-test by using 5000 permutations. Report the p-value for the permutation test and make a conclusion about the acceptance or rejection of the null hypothesis at significance level against the given alternative .
2. Draw a histogram of all permutation mean differences.
3. Draw a vertical line at the value of mean difference of the observed data values.