STAT 8010 Statistical Methods I
Homework 3

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Due Date: June 9, 11:59pm via Canvas

Problem 1

The transportation department of a city remodeled one of its parking garages and increased the hourly parking rates. From the city's records, the average parking time over the past 5 years was 180 minutes. The department wants to know whether the remodeling and rate increases have changed the mean parking time. Over a 3-month period after the changes were made, a random sample of 100 cars had an average parking time of 168 minutes with a standard deviation of 45 minutes.

(a) State the null and alternative (research) hypotheses for the study?

(b) Construct a 95% confidence interval for the average parking time after the changes were made to the garage.

(c) What is the p-value of the test?

(d) Do the data support the research hypothesis if $\alpha = 0.05$?

Problem 2

Answer "true" or "false" for each question.

(a) Given one particular random sample, if we form the 95% confidence interval for the sample mean, there is a 95% chance that the population mean lies in this confidence interval.

(b) If a larger number of random samples are selected and we form the 95% confidence interval for each sample mean, the population mean will lie in about 95% of these confidence intervals.

(c) The 95% confidence interval around a given sample mean is wider than the 90% confidence interval around that mean.

(d) If we reject the null hypothesis at the $\alpha = 0.05$ level, then we should also reject it at the $\alpha = 0.01$ level.

Problem 3

Answer "true" or "false" for each question. If your answer is "false," change the statement to make it true. Change only the underlined words.

(a) A Type I error is committed when we fail to reject the null hypothesis H_0 when H_0 is actually false.

(b) If we make a Type II error, we have missed detecting an event or effect when there actually was one.

(c) The probability of making a Type I error is equal to β

(d) If we increase the probability of making a Type II error, we increase the probability of making a Type I error.

Problem 4

A researcher wanted to test the hypotheses $H_0 : \mu \leq 38$ against $H_a : \mu \geq 38$ with $\alpha = 0.05$. The researcher knows in advance that $\sigma = 6$. A random sample of 50 measurements from a population yielded $\bar{X} = 40.01$.

(a) What conclusions can you make about the hypotheses?

(b) What sample size is required to yield a power of 0.8 with a significance level of 0.05 if the actual value of μ is 40?

Problem 5

This data set, `InvisibilityCloak.csv`, provides the number of mischievous acts committed by two groups of people, those with and those without and invisibility cloak. The variables in this data set are:

- `Participant`: Identification number of a participant.
- `Cloak`: Experimental group (0 = withouth a cloak of invisibility, 1 = with a cloack of invisibility).
- `Mischief`: the number of mischievous acts committed by a participant.

Suppose a researcher would like to examine if invisibility cloak affects the number mischievous acts committed.

a. State the null and alternative hypotheses.

b. Perform an appropriate test and state the assumption(s) for that test.

c. What is the p-value of the test? What is the conclusion if $\alpha = 0.05$?

Problem 6

The data file, `Stereograms.csv`, records the time it took two groups of participants to see a figure hidden in a stereogram - one group received advance information about the scene, the other group did not. The variables in this data set are:

- `V1`: Participant number.
- `fuseTime`: the time (in seconds) it took the participant to see the hidden figure.
- `condition`: experimental condition (NV = without information, VV = with information).
- `logFuseTime`: the log transformation of the fuseTime.

Suppose a researcher would like to investigate whether providing advance information about the hidden figure shortens the time participant needs to see the figure.

a. Should we use `fuseTime` or `logFuseTime` to perform a test. Justify your answer.

b. State the null and alternative hypotheses.

c. Perform an appropriate test and state the assumption(s) for that test.

d. What is the p-value of the test? What is the conclusion if $\alpha = 0.05$?

Problem 7

The file `WeightGain.csv` contains data from a study where weights of 16 participants before and after an eight-week period of 1000 excessive calorie intake were recorded. The variables in this data set are:

- `Weight Before`: Weight in pounds (lb) measured before eight weeks of excessive calorie intake.
- `Weight After`: Weight in pounds (lb) measured after eight weeks of excessive calorie intake.
- `Difference`: `Weight After` - `Weight Before`

Suppose a researcher would like to investigate whether 1000 excess calorie intake per day over 8 weeks results in, on average, 16 pounds weight increase.

a. Define the parameter(s) of interest and state the null and alternative hypotheses.

b. Construct a 95% confidence interval for the average weight increase.

c. What is the p-value of the test in a.? What is the conclusion if $\alpha = 0.05$?