SLIIT UNI
THE KNOWLEDGE UNIVERSITY

Faculty of Computing

Year 2 Semester 1 (2025)

IT2120 - Probability and Statistics Lab Sheet 09

Lab Exercise 9 (Statistical Inference)

Before starting the lab sheet, you need to create a folder in your desktop and save all your working inside the folder. Set the working directory to that folder using the following command:

```
setwd("paste the path of the folder")
```

Eg:- `setwd("D:\\2025 - Sem 2\\IT2120\\Lab Sessions\\Lab 09")`

1. Let's suppose that a student is interested in estimating how many memes their professors know and love. So they go to class, and every time a professor uses a new meme, they write it down. After a year of classes, the student has recorded the following meme counts, where each count corresponds to a single class they took:

   3, 7, 11, 0, 7, 0, 4, 5, 6, 2

   Test weather on average, professors know 3 memes at 5% level of significance.

```
setwd("D:\\2025 - Sem 2\\IT2120 - New\\Lab Sessions\\Lab 09")

##Question 01
#Since the true variance is unknown and sample size is less than 30,
#we can apply one sample t-test.
#Hypothesis: H0: μ = 3 Vs H1: μ ≠ 3
#Consider 5% level of significance
#To run the one-sample t test, "t.test" command can be used as follows.
x<-c(3, 7, 11, 0, 7, 0, 4, 5, 6, 2)
t.test(x, mu = 3)
#P value approach will be used to get the conclusion of hypothesis testing.
#Conclusion: Since p value (0.2012) is greater than 0.05, do not reject H0 at 5% level of
#significance. Therefore, we can conclude that the true average number of memes that
#professors know is not significantly different from 3 (exactly equal to 3).
```

2. Let's consider the weight of 10 mice in gram:

17.6, 20.6, 22.2, 15.3, 20.9, 21.0, 18.9, 18.9, 18.9, 18.2.

i. Test whether the true mean weight of mice is less than 25g at 5% level of significance.

```
##Question 02
#Part 1
#Since the true variance is unknown and sample size is less than 30,
#we can apply one sample t-test.
#Hypothesis: H0: μ ≥ 25 Vs H1: μ < 25
#Consider 5% level of significance
#To run the one-sample t test, "t.test" command can be used as follows.
Weight <- c(17.6, 20.6, 22.2, 15.3, 20.9, 21.0, 18.9, 18.9, 18.9, 18.2)
t.test(Weight , mu=25 , alternative= "less")
#P value approach will be used to get the conclusion of hypothesis testing.
#Conclusion: Since p value (3.977e-06) is less than 0.05, reject H0 at 5% level of significance.
#Therefore, we can conclude that the true mean weight of mice is significantly less than
#25 grams.
```

ii. Obtain the value of test statistic, p-value and confidence interval out of the test results separately using suitable R codes.

```
#Part 2
#To obtain each value separately, we need to store the results of the hypothesis testing
#into a variable. Accordingly, results were stored into "res" variable.
res <- t.test(Weight , mu=25 , alternative= "less")
#To extract test statistic, use "res$statistic" command as follows.
res$statistic
#To extract p value for the test, use "res$p.value" command as follows.
res$p.value
#To extract confidence interval for the test, use "res$conf.int" command as follows.
res$conf.int
```

3. The Sugar level of a Cookie follows a normal distribution with mean 9.8 and the standard deviation 0.05. Let's take a sample of size 30.

i. Generate 30 random numbers (sugar levels) from the above distribution.

```
##Question 03
#Part 1
#To generate random numbers from a Normal distribution, we can use "rnorm" command as follows.
y <- rnorm(30, mean = 9.8, sd = 0.05)
```

ii. Test whether the mean sugar level of the Cookies is greater than 10 at 5% level of significance.

```
#Part 2
#Since the true variance is known we can apply one sample z-test.
#Hypothesis: H0: μ ≤ 10 Vs H1: μ > 10
#Consider 5% level of significance
#To run the one-sample z test, "t.test" command can be used as follows.
#when samples are large enough, t distribution can be approximated into Normal distribution.
#So that same command ("t.test") can be used for one sample z test.
t.test(y , mu=10 , alternative= "greater")
#P value approach will be used to get the conclusion of hypothesis testing.
#Conclusion: Since p value (1) is greater than 0.05, do not reject H0 at 5% level of
#significance. Therefore, we can conclude that the true mean sugar level of a cookie is
#less than or equal to 10.
#Note that based on the random numbers you got as the sample, results of the test
#will be different.
```

Exercise

Instructions: Create a folder in your desktop with your registration number (Eg: "IT....."). You need to save the R script file and take screenshots of the command prompt with answers and save it in a word document inside the folder. Save both R script file and word document with your registration number (Eg: "IT....."). After you finish the exercise, zip the folder and upload the zip file to the submission link.

1. Assume that the time taken to bake a batch of cookies is normally distributed with mean 45 minutes and standard deviation 2 minutes.

    i. Generate a random sample of size 25 for the baking time.

    ii. Test whether the average baking time is less than 46 minutes at a 5% level of significance.