Middle East Technical University — Department of Computer Engineering

CENG222

Statistical Methods for Computer Engineering

Spring 2021-2022

Homework 3

Due: May 29th, 2022, Sunday 23:59

Question 1 (15 points)

Using a measurement device that guarantees the population standard deviation to be $\sigma = 3$ the following sample of measurements are acquired:

$$20.1,\ 12.8,\ 18.9,\ 16.4,\ 20.3,\ 10.1,\ 15.4,\ 12.4,\ 24.7,\ 18.5$$

Assume that measurement errors have a Normal distribution.

a) **(10 pts)** Construct a 90% confidence interval and a 99% confidence interval for the population mean of these measurements.

b) **(5 pts)** What is the smallest required sample size to attain a margin of 1.55 with a confidence level of 0.98 for the population mean?

Question 2 (40 points)

A local food delivery company aims to provide information to the customers on the quality of restaurants in its network via user ratings. The customers can rate a restaurant with integer values from the range $[1, 10]$. Assume, for the sake of the question, that the customers that provide a rating are independent and identically distributed.

a) **(5 pts)** Are the mean rating and sample size enough as statistics about a restaurant? Explain.

b) **(20 pts)** You consider placing an order from a restaurant only if the rating of a restaurant is not significantly lower than 7.5 (you decide the significance at a 5% level of significance). Restaurant A has received a mean rating of 7.4 from 256 users with a sample standard deviation of 0.8. Would restaurant A be in your list of candidate restaurants to order food from?

c) **(10 pts)** Let the sample standard deviation of user ratings for restaurant A in part **b)** be 1.0. Would you include the restaurant in your list of candidate restaurants now?

d) **(5 pts)** Let the mean of user ratings for restaurant A in part **b)** be 7.6. Explain why you can include the restaurant in your list of candidate restaurant without resorting to a statistical test.

Question 3 (45 points)

A researcher wants to improve the run-time of an algorithm that takes too long in computer A. Hence, the researcher purchases a new computer, B. In order to compare the performances, the researcher makes 20 runs on computer A and 32 runs on computer B. The mean run-time on computer A is 211 minutes and the sample standard deviation is 5.2 minutes. On computer B, the mean run-time is 133 minutes and the sample standard deviation is 22.8 minutes. The researcher wants to know if a run-time improvement of **at least** 90 minutes can be claimed based on these measurements at a 1% level of significance. Assume that the measurements are approximately Normal.

a) **(20 pts)** Assuming that population variances are equal, can the researcher claim that the computer B provides a 90-minute or better improvement?

b) **(25 pts)** Assuming that population variances are **not** equal, can the researcher claim that the computer B provides a 90-minute or better improvement?

Note: In your submissions please clearly state your H_0s and H_As whenever applicable.

Regulations

1. Make sure that your solutions are cleanly written and well organized.
2. Do not cheat.
3. Late submission is allowed up to 3 days with a penalty of 20 points for each day.
4. You will submit a single PDF through odtuclass.
5. Follow odtuclass for possible updates and discussions.