CENG 222

Statistical Methods for Computer Engineering

Spring 2022-2023

Homework III - Sample Solutions

Due date: 30-05-2023, Tuesday, 23:55

Introduction

In this assignment, there are three classical questions and one programming question related to the 9^{th} chapter and the 10^{th} chapter of your text book. While answering the questions, please **show your work** and the steps of your calculations. Give an explanation about what numbers mean in those steps. Otherwise, you may not get any points. When you are instructed to briefly comment, please avoid writing more than 2-3 sentences. Also, include the code for the programming question in your report.

Questions

Q1. (**30 pts.**)
Your car consumes 7.5 liters of gasoline per 100 km. Your friend suggested an improvement in the engine that would reduce the gasoline consumption of the car. After the improvement you measured the 100 km consumption of your car 16 times and obtained the following values;

8.4, 7.8, 6.4, 6.7, 6.6, 6.6, 7.2, 4.1, 5.4, 6.9, 7.0, 6.9, 7.4, 6.5, 6.5, 8.5

a) Construct a 98% confidence interval for the mean per 100 km gasoline consumption of your car after the improvement. *(10 pts)*
b) At a 5% level of significance, can you claim that the improvement is effective (i.e. there is a significant reduction in the gasoline consumption)? Indicate the null and the alternative hypotheses. *(15 pts)*
c) Assume that before the improvement your car was consuming 6.5 liters of gasoline per 100 km. In this case can you immediately accept or reject H_0 without any calculations? Why or why not? *(5 pts)*

NOTE: Please use two digits after . in your calculations.

Q2. (**35 pts.**)
Two students are arguing over the rent prices in Ankara. Ali claims that the prices are similar to those of the last year. Ahmet claims that there is an increase in the prices. They already knew that the last year average rent price was 5000TL with a standard deviation of 2000. For this year, they checked 100 houses and found out that the average is 5500TL. Assume that the standard deviation stays same.

a) What are the null and the alternative hypotheses? Whose claim should be considered as the null

hypothesis? *(5 pts)*
b) Ahmet tries to provide mathematical evidence for his claim. At a 5% level of significance, can he claim that there is an increase in the rent prices compared to the last year? *(10 pts)*
c) For part **b**, what is the P-value? Calculate it and briefly comment about what is means about Ahmet's claim. *(5 pts)*
d) They also want to compare the current rent prices in Ankara to Istanbul. They check 60 houses in Istanbul and observe an average rent price of 6500TL with a standard deviation of 3000. At a 1% level of significance, can they claim that the prices in Ankara is lower than the prices in Istanbul? *(15 pts)*

Q3.(**20 pts.**)
The number of rainy days in Ankara changes over different seasons. The following values are obtained from Meteoroloji Genel Müdürlüğü (Directorate General of Meteorology) and minor adjustments are made for the ease of computation.

	Winter	Spring	Summer	Autumn
Rainy	34	32	15	19
Non-Rainy	56	58	75	71

Use Chi-square test to analyze whether the number of rainy days in Ankara is dependent on the season or not. Obtain the P-value and briefly comment what it means.

Q4.(**15 pts.**)
Using Octave or MATLAB, make an analysis of **Q3**. Calculate the P-value using built-in Chi-square functions. Add your code and screenshot of the result to your report where X^2_{obs} and P-value can be seen. Make sure that your code is generic, i.e. it can yield the correct results by only changing the input. Note that your code might be subjected to black-box testing with a different input.

Specifications

- You are expected to write your answers in LaTeX format. You can use the given template.
- Please do not skip the calculation steps. Show every step of your work.
- You have a total of 2 late days for this homework. For each day you have submitted late, you will lose 25 points. If you submit your homework at least 2 days later than the deadline, you will get zero.
- Cheating is forbidden. The violators will be punished according to the department regulations.
- Follow the course page on ODTUClass for any updates and clarifications. Please ask your questions on ODTUClass instead of e-mailing if they do not contain some part of the solution. If they contain, you can send an email to "mduymus@ceng.metu.edu.tr".

Submission

Submissions will be done via ODTUClass. If you do not have access to ODTUClass for some reason, please send an email to assistants about that. You are expected to submit a single PDF file named "hw3.pdf".