



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS (MAIN PAPER)
2023/2024 ACADEMIC YEAR**

FIRST YEAR FIRST SEMESTER EXAMINATIONS

**FOR THE DEGREE
OF
DOCTOR OF PHILOSOPHY IN PUBLIC HEALTH/MEDICAL
LABORATORY SCIENCES/BIOMEDICAL SCIENCES**

COURSE CODE: BML 912 /PHC 915

COURSE TITLE: ADVANCED BIOSTATISTICS

DATE: 8TH DECEMBER 2023

TIME: 2.00-5.00PM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY THREE. DO NOT WRITE ON THE QUESTION PAPER.

TIME: 3 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE -COMPULSORY**25 MARKS**

Suppose you are conducting a study to determine whether a new weight loss program is effective in helping individuals lose weight. You collect data from two groups: one group follows the new weight loss program, and the other group does not. You want to test whether there is a significant difference in weight loss between the two groups.

- a) Explain what the z-test is and when it is appropriate to use it in hypothesis testing.
- b) State the null and alternative hypotheses for this study, and specify the significance level you choose.
- c) If the sample mean weight loss in the program group is 3.5 kilograms with a standard deviation of 1.2 kilograms, and the sample mean weight loss in the non-program group is 2.8 kilograms with a standard deviation of 1.0 kilograms, calculate the z-test statistic.
- d) Using the z-test statistic you calculated in part (c), perform the hypothesis test and determine whether there is a significant difference in weight loss between the two groups. State your conclusion and interpret the result.

CHOOSE ANY THREE QUESTIONS**QUESTION TWO****25 MARKS**

A researcher wants to determine if there is a significant difference in the mean test scores of students from three different schools. The three schools are School A, School B, and School C. The researcher collects the test scores of 30 students from each school. The null hypothesis is that there is no difference in the mean test scores among the three schools, while the alternative hypothesis is that at least one school has a significantly different mean test score. The significance level is set at $\alpha = 0.05$.

The test scores for the 30 students from each school are as follows:

School A:

85, 90, 88, 92, 87, 91, 89, 86, 83, 84, 92, 88, 90, 87, 85, 89, 86, 84, 91, 92, 87, 88, 85, 86, 83, 92, 87, 90, 84, 88

School B:

78, 80, 82, 79, 75, 77, 83, 79, 80, 78, 82, 76, 79, 81, 78, 85, 80, 81, 82, 79, 77, 78, 80, 83, 82, 79, 75, 76, 83, 78

School C:

91, 88, 95, 93, 89, 94, 92, 91, 90, 89, 95, 92, 93, 90, 92, 94, 91, 95, 89, 92, 90, 93, 94, 92, 91, 95, 89, 94, 92, 90

What are the key steps and assumptions involved in conducting a one-way ANOVA for this study, and how would you interpret the results?

Please outline the necessary steps, assumptions, and the interpretation of the results in your response.

QUESTION THREE**25 MARKS**

The data above for 10 individuals who were subjected to a diet to see if it altered their weights.

Person	wt. Before	wt. After
1	150	156.5
2	155	156.3
3	158	159.6
4	160	161.4
5	163	164.5
6	167	166.8
7	175	176.3
8	180	181.5
9	185	186.1
10	191	192.6

- a) Formulate a null hypothesis (2Marks)
 b) Assuming that the data is normally distributed, test the null hypothesis (18 Marks)

QUESTION FOUR**25 MARKS**

In a clinical study focused on the effects of a new drug on patients with a certain medical condition, the researchers collected data on the dosage of the drug administered and the improvement in patients' symptom severity after one month of treatment. The dataset consists of 10 patients. Using Spearman's rank correlation, analyze the data and answer the following questions:

Calculate the Spearman's rank correlation coefficient for the dataset and show all the necessary calculations. (10 marks)

Interpret the value of the Spearman's rank correlation coefficient in the context of this medical study. Is there a significant relationship between the dosage of the drug and symptom improvement, and if so, is it positive or negative? (8 marks)

Provide a 95% confidence interval for the Spearman's rank correlation coefficient. (4 marks)

Discuss the advantages of using Spearman's rank correlation in a medical research context, particularly when dealing with ordinal or non-normally distributed data. (3 marks)

Patient	Dosage (mg)	Symptom Improvement
1	10	5
2	20	8
3	15	6
4	5	3
5	30	10
6	25	9
7	10	4
8	15	5
9	5	2
10	20	7

QUESTION FIVE**25 MARKS**

A medical researcher is investigating the effect of three different drug treatments (Drug A, Drug B, and Drug C) on reducing blood pressure in patients with hypertension. The study involves 4 groups of patients, each receiving one of the three drugs or a placebo. The systolic blood pressure reduction levels (in mmHg) after one month of treatment are recorded for each group as follows:

Drug A (n = 15): [10, 8, 12, 9, 11, 14, 13, 7, 10, 11, 12, 9, 8, 10, 11]

Drug B (n = 15): [7, 6, 5, 8, 9, 6, 7, 8, 10, 6, 9, 7, 8, 6, 5]

Drug C (n = 15): [12, 14, 13, 15, 11, 14, 12, 13, 14, 10, 15, 13, 12, 11, 14]

Placebo (n = 15): [3, 2, 5, 4, 3, 2, 1, 4, 3, 2, 6, 5, 4, 3, 2]

Conduct a Kruskal-Wallis H test to determine if there is a significant difference in the systolic blood pressure reduction levels among the four groups. Answer the following:

a) State the null hypothesis (H_0) and the alternative hypothesis (H_1) for the Kruskal-Wallis H test in the context of this medical study. (4 marks)

b) Calculate the Kruskal-Wallis H statistic for the given data. Show all your calculations. (10 marks)

c) Interpret the Kruskal-Wallis H statistic and provide a conclusion regarding the effect of different drug treatments on systolic blood pressure reduction levels. (6 marks)