



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2018/2019 ACADEMIC YEAR

**SECOND SEMESTER EXAMINATION FOR B.SC. M & E, B.SC.M &
CS,B.SC. ASP (YR3) & B.SC. IN ACTUARIAL SCIENCE (YR2)**

AMS 313 – TESTS OF HYPOTHESIS

DURATION: 2 HOURS

DATE: 24/04/2019

TIME: 2:00PM-4:00PM

Instructions to candidates:

1. Answer question One and Any Other Two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) Define the following terms

i) Type II error (1mark)

ii) Power of a test (1mark)

iii) Critical region (1mark)

b) A study to determine the performance of a statistics class in a communication skills examination was conducted. A sample of 15 students was taken and it was found out that their mean score in the examination was 58.75%. From the past records, the mean score of statistics students in the same examination is 61.75% with a standard deviation of 2.75. Any mean score less than 61.75 % is considered unacceptable. Formulate the hypothesis and test the null hypothesis at 5% level of significance. (4 marks)

c) The owner of a sheep firm agrees to purchase the products of a factory if the produced items do not have a variance of 0.5 mm^2 in their lengths. To be sure of the specifications, the buyer selects a sample of 18 items for study. The length of each item was measured as follows: 18.32, 18.33, 18.46, 18.34, 18.57, 18.22, 18.57, 18.1, 18.61, 18.63, 18.43, 18.37, 18.64, 18.58, 18.34, 18.43, 18.63 and 18.71. On the basis of the sample data, should the buyer purchase the lot at 5% level of significance? (5marks)

d) Let x_1, x_2, \dots, x_n be a random sample from a normally distributed population, whose variance, σ^2 , is known. Derive a likelihood ratio test for testing $H_0: \mu = \mu_0$ versus $H_1: \mu \neq \mu_0$ (6 marks)

e) A random sample of 17 police officers in Nairobi has a mean monthly income of Kshs. 35,800 and a standard deviation of Kshs. 7,800. In Kisumu, a random sample of 18 police officers has a mean monthly income of Kshs. 35,100 with a standard deviation of Kshs 7375. Test the claim at 1% level of significance that the monthly incomes of police officers in the two counties are not the same. Assume the population variances are not equal. (5marks)

f) In 2012 a research study on “The impact of travel times to school on academic outcomes” was published. This work considered the relationship between daily time devoted to travel to school in minutes (x) and its impact on the results obtained by the students on standardized tests (y). A summary of the data is as given below:

$$\sum_{i=1}^{16} x_i = 678, \sum_{i=1}^{16} x_i^2 = 36,056, \sum_{i=1}^{16} x_i y_i = 4,369.5, \sum_{i=1}^{16} y_i = 104.5, \sum_{i=1}^{16} y_i^2 = 683.01 \text{ and } \sum_{i=1}^{16} e_i^2 = 0.024$$

i) Build the ANOVA table (2marks)

ii) is there enough sample evidence for the results depending linearly on the travel time?

Take $\alpha = 0.01$ (5marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) A tobacco company statistician wishes to know whether heavy smoking is related to longevity. From a sample of recently diseased smokers, the number of cigarettes is paired with the number of years that they lived:

Subject	Cigarettes	Years Lived
1	25	63
2	35	68
3	10	72
4	40	62
5	85	65
6	75	46
7	60	51
8	45	60
9	50	55

i) Formulate the hypothesis to test whether the correlation coefficient is significantly differently from Zero. (1mark)

ii) Test at 5% level of significance whether the correlation coefficient is significantly different from zero. (12marks)

b) The following data gives the difference in the level of discomfort (1 to 4) between treated and untreated breast for a particular treatment. There are 19 measurements in overall:

-0.525, 0.172, -0.577, 0.200, 0.040, -0.143, 0.043, 0.010, 0.000, -0.522, 0.007, -0.122, -0.040, 0.000, -0.100, 0.050, -0.575, 0.031, -0.061

Using Wilcoxon signed – ranked test, test at 5% level of significance whether the effect of the treatment is statistically significant. (7marks)

QUESTION THREE (20 MARKS)

a) Let x_1, x_2, \dots, x_n be a random sample from a normally distribute population whose variance is unknown. Derive the likelihood ratio test for testing $H_0: \mu = \mu_0$ versus $H_1: \mu \neq \mu_0$ (12 marks)

b) A reading centre claims that students will perform better on a standardized reading test after going through the reading course offered by their centre. The table below shows the reading scores of 6 students before and after the course.

Student	1	2	3	4	5	6
Score (before)	85	96	70	76	81	78
Score (after)	88	85	89	86	92	89

At $\alpha=0.05$, is there enough evidence to conclude that the students' score after the course are better than the scores before the course? (8 marks)

QUESTION FOUR (20 MARKS)

a) Faith groceries have two grocery stores located in Nairobi city. One store os located on city centre and the other on Upper Hill. Each store is run by a different manager. Each manager claims that her store's layout maximises the amounts customers will purchase on impulse. Both managers surveyed a sample of their customers and asked how much more they spend than they

had planned to i.e. how much they spent on impulse? The following table shows the sample data collected from the stores.

City Centre Upper Hill

15.78	15.19
17.73	18.22
10.61	15.38
15.79	15.96
14.22	21.92
13.82	12.87
13.45	12.47
12.86	13.96
10.82	13.79
12.85	13.74
	18.4
	18.57
	17.79
	10.83

The management at Faith groceries want to know if there is a difference in the mean amounts purchased on impulse at the two stores. Test at 5% level of significance whether there is a difference in the mean amounts purchased on impulse at the two stores. (14marks)

b) Let x_1, x_2, \dots, x_n be a random sample from Bernoulli distribution with probability of success P . Using the Neyman-Pearson Lemma, test : $H_0: P = P_0$ versus $H_0: P = P_1$ (6 marks)