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**KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**UNIVERSITY EXAMINATIONS, 2024/2025 ACADEMIC YEAR**  
**FOURTH YEAR, FIRST SEMESTER END OF SEMESTER EXAMINATION**  
**FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS**  
**(SPECIAL EXAMINATION)**  
**KMA 308 TEST OF HYPOTHESIS**

**Date: 14<sup>TH</sup> AUGUST, 2024**

**Time: 8:30 AM – 10:30 AM**

**INSTRUCTIONS TO CANDIDATES**

**ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS**

**QUESTION ONE COMPULSORY (30 MARKS)**

- a) Fill in the following table with the correct phrases from the following list (with reference to the null hypothesis)

Decision	When	
	$H_0$ is true	$H_1$ is true
Reject $H_0$		
Accept $H_0$		

(4 marks)

- b) Let  $P$  be the probability that a coin will fall as a head in a single toss in order to test  $H_0: P = 0.5$  versus  $H_1: P = 0.75$ . The coin is tossed 4 times and  $H_0$  is rejected if more than 2 heads are obtained. Find the Probability of
- Type I error. (3marks)
  - Type II error. (3 marks)
- c) A company wants to test the claim that on average their lifetime batteries last more than 40 hours. A random sample of 15 batteries yielded a mean of 44.9 hours, with a standard deviation of 8.9 hours. Test this claim at 5% significance level. (5marks)
- d) A commercial freezer must hold the selected temperature with little variation. Specifications call for a standard deviation of no more than 2 degrees. A sample of 10 freezers is tested and yields a sample variance of  $s^2 = 25$ . Test to see whether the standard deviation specification is exceeded. Use  $\alpha = .05$ . (5marks)
- e) In a study on Serum uric acid levels of individuals with Down's syndrome and normal individuals, the following data was obtained  $n_1 = 12$ ,  $\bar{x}_1 = 4.5$ ,  $S_1^2 = 1$ ,  $n_2 = 15$ ,  $\bar{x}_2 =$

3.4  $S_2^2 = 2.25$  Is there a difference between the variances of individuals with Down's syndrome and normal individuals? (5 marks)

f) Summary of six pairs of observations is obtained from bivariate data are as follows;

$$\sum X = 179, \quad \sum Y = 449, \quad \sum XY = 14012, \quad \sum X^2 = 5809, \quad \sum Y^2 = 34485$$

Test whether the variables X and Y are dependent. Take  $\alpha = 0.05$ . (6 marks)

### **QUESTION TWO (20 MARKS)**

a) Suppose you are doing research that involves testing a hypothesis on a certain claim.

Discuss the steps you will follow in testing the associated hypotheses. (6 marks)

b) A potential buyer wants to decide which of the two brands of electric bulbs he should buy as he has to buy them in bulk. As a specimen, he buys 200 bulbs of each of the two brands; A and B. On using these bulbs, he finds that brand A has a mean life of 1,400 hours with a standard deviation of 60 hours and brand B has mean life of 1,250 hours with a standard deviation of 50 hours. Do the two brands differ significantly in quality? Use  $\alpha=0.05$ .

(6 marks)

c) Two independent random samples were obtained from two independent random variables  $X \sim N(\mu, 100)$  and  $Y \sim N(\mu_2, 100)$ . The observations are as follows;

X: 20, 33, 57, 22, 44, 31, 33, 40

Y: 44, 55, 36, 65, 38, 45, 54, 50, 48, 62

Test whether the mean of Y is greater than the mean of X by 10 units. (8 marks)

### **QUESTION THREE (20 MARKS)**

a) Suppose  $x_1, x_2, \dots, x_{16}$  is a random sample of size  $n = 16$  from a normal population with mean  $\mu$  and variance 16. Find the test with the best critical region of size  $\alpha=0.05$  for testing the simple null hypothesis  $H_0: \mu = 10$  against the simple alternative hypothesis  $H_A: \mu = 15$  and hence find the power of the test obtained. (12 marks)

b) Suppose we want to know whether or not a certain training program is able to increase the max vertical jump (in inches) of college basketball players. To test this, a simple random sample of 10 college basketball players are recruited and measured each of their max vertical jumps. Then, each player is allowed to use the training program for one month and then their max vertical jump is measured again at the end of the month as shown in the table below.

Player	1	2	3	4	5	6	7	8	9	10
Before	22	20	19	24	25	25	28	22	30	27
After	24	22	19	22	28	26	28	24	30	29

Determine whether or not the training program actually had an effect on max vertical jump at significance level  $\alpha = 0.05$ . (8 marks)

### **QUESTION FOUR (20 MARKS)**

- a) Let  $x_1, x_2, \dots; x_m$  and  $y_1, y_2, \dots; y_n$  be independent samples from two independent populations. Obtain a test procedure for testing.

$$H_0: \sigma_1^2 = \sigma_2^2 \text{ vs } H_a: \sigma_1^2 \neq \sigma_2^2$$

Given  $X \sim N(\mu_1, \sigma_1^2)$  and  $Y \sim N(\mu_2, \sigma_2^2)$ .

(10 marks)

- b) A Choral Society divides male singers up into four categories from highest voices to lowest: Tenor1, Tenor2, Bass1, Bass2. In the table are heights of the men in the Tenor1 and Bass2 groups. One suspects that taller men will have lower voices, and that the variance of height may go up with the lower voices as well. Is there evidence that the variance of the heights of singers in each of these two groups are different?

Tenor1	69	72	71	66	76	74	71	66	68	74	71	66	68	68	66
	67	64	67	70	65	72	70	68	64	73	66	68	64	73	
Bass2	70	70	72	74	70	66	68	75	68	70	72	75	68	70	72
	72	75	67	75	74	72	72	74	72	72	72	74	72	67	

(10 marks)

### **QUESTION FIVE (20 MARKS)**

- a) A food processing company packages honey in small glass jars. Previous experience suggests that the volume (X) in randomly selected jar of the company's honey is normally distributed with mean  $\mu$  and variance  $\sigma^2$ , both unknown. Derive the likelihood ratio test for testing, at a significance level of  $\alpha=0.05$ , the null hypothesis  $H_0: \sigma^2 = \sigma_0^2$  against the alternative hypothesis  $H_A: \sigma^2 \neq \sigma_0^2$ . (12 marks)
- b) To measure the relationship between anxiety and test performance, a researcher asked his students to come to the lab 15 minutes before they were to take an exam in his class. The researcher measured the students' heart rates and then matched these scores with their exam performance after they had taken the exam. Use the data below conduct a hypothesis test for the correlation between anxiety and test performance in the population. Use  $\alpha = .05$ .

student	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Heart rate	76	81	60	65	80	66	82	71	66	75	80	76	77	79
exam score	78	68	88	80	90	68	60	95	84	75	62	51	63	71

(8 marks)