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KIRIRI WOMEN'S UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION FOR 2024/2025 ACADEMIC YEAR
THIRD YEAR, SECOND SEMESTER EXAMINATION
(SPECIAL EXAMINATION)
KCS 308: TEST OF HYPOTHESIS

DATE: 9TH DECEMBER,2024
TIME: 11:30AM-1:30PM

INSTRUCTIONS TO CANDIDATES
ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS
QUESTION ONE: COMPULSORY (30 MARKS)

a) Distinguish between the following
   i) Hypothesis and hypothesis testing. **(2 Marks)**
   ii) Level of significance and power of a test. **(2 Marks)**
   iii) Simple and composite hypothesis. **(2 Marks)**

b) A researcher is interested in testing whether $H_0: P = \frac{1}{2}$ or $H_1: P = \frac{2}{3}$ where P is the probability of obtaining a tail when a coin is tossed. She decides to throw a coin six times and to reject H_0 if the number of tails obtained is more than three. Find
   i) The level of significance. **(3 Marks)**
   ii) Probability of type II error. **(3 Marks)**
   iii) Power of the test. **(2 Marks)**

c) A random sample of size seven drawn from a population with variance 324 were as follow

   57, 35, 78, 60, 65, 48 and 72.

   Test the whether the population mean is more than 60 at 5% level of significance. **(5 Marks)**

d) A drug trial is attempted using a real drug and a pill made of just sugar.18 people are given the real drug in hopes of increasing the production of endorphins. The increase in endorphins is found to be on average 8 micrograms per person, and their standard deviation is 5.4 micrograms. 11 people are given the sugar pill, and their average endorphin increase is 4 micrograms with a standard deviation of 2.4. from previous research on endorphins it is determined that it can be assumed that the variances within the two samples can be assumed to be the same. Test at 5% to see if the population mean on production of endorphins for the real drug is significantly different from that of sugar bill. **(6 Marks)**

e) To test whether there is a correlation between the husband's age and wife's a random sample of 25 couples was selected. Form this sample the computed correlation coefficient was found to be r = 0.939. Test the appropriate hypothesis at 1% level of significance. **(5 Marks)**

QUESTION TWO (20 MARKS)

a) Let $x_1, x_2, \ldots, x_n$ be a random sample of size n obtained from a random variable X which is normally distributed with mean μ and known variance σ_0^2. Suppose that the hypothesis $H_0: \mu = \mu_0$ is to be tested against $H_1: \mu < \mu_0$. Determine

i) The likelihood function under H_0. **(4 Marks)**

ii) The likelihood function under H_1. **(2 Marks)**

iii) Size α best critical region for testing H_0 against H_1 using Neyman Pearson Lemma. **(8 Marks)**

b) Boys of a certain age are known to have a mean weight of μ=85 pounds. A complaint is made that the boys living in a municipal children's home are underfed. As one bit of evidence, n=25 boys (of the same age) are weighed and found to have a mean weight of $\bar{x}$ = 80.94 pounds. It is known that the population standard deviation σ is 11.6 pounds (the unrealistic part of this example!). Based on the available data, what should be concluded concerning the complaint? **(6 Marks)**

QUESTION THREE (20 MARKS)

Let $x_1, x_2, \ldots, x_m$ be a random sample of size m obtained from a random variable X which is normally distributed with mean μ_1 and variance σ_1^2 both unknown. Also let $y_1, y_2, \ldots, y_n$ be a random sample of size n obtained from a random variable Y which is normally distributed with mean μ_2 and variance σ_2^2 both unknown. Suppose that the hypothesis $H_0: \sigma_1 = \sigma_2$ is to be tested against $H_1: \sigma_1 \neq \sigma_2$. Determine

a) The maximum likelihood function under the whole parameter space Ω. **(4 Marks)**

b) The maximum likelihood function under the whole parameter space Ω_0. **(4 Marks)**

c) The likelihood ratio and write it in terms of Fisher's random variable F. **(8 Marks)**

d) Size α likelihood ratio test for testing H_0 against H_1. **(4 Marks)**

QUESTION FOUR (20 MARKS)

a) To test whether two teaching methods differ, a class of students was divided into two groups. Group I was taught by method A while Group II was taught by method B. At the end of the teaching period, the same examination was administered to the two groups. The scores were as follows;

Group I: 50, 48, 38, 65, 70, 80, 60, 55, and 59

Group II: 28, 40, 37, 55, 40, 60 and 30

The past research showed that the population standard deviation for method A is 10 while that of method B is 15. Test at 5% level of significance whether the two teaching methods differ significantly. **(6 Marks)**

b) A certain company would wish to test whether an advertising its product through a newspaper would actually increase sales. A sample of monthly sales before and after the advert was made showed the following observations

Before: 57, 66, 50, 80, 75, 73, 44, 55

After: 100, 120, 98, 80, 87, 93, 124, 136, 100, 110

i) Compute the mean and variance for each set of data. **(4 Marks)**

ii) Let μ_1 and μ_2 be the mean sales for before and after the advert was made. Test whether advertising through the newspaper improved mean sales. Take $\alpha = 0.05$. [**Hint:** Variances are unknown and not equal]. **(4 Marks)**

c) A psychologist was interested in exploring whether or not male and female college students have different driving behaviors. The psychologist conducted a survey of a random m=34 male college students and a random n=29 female college students. Here is a descriptive summary of the results of her survey.

Males (X)	Females (Y)
m=34	n=29
$\overline{X} = 105.5$	$\overline{X}$=90.9
S_x=20.1	S_y=12.2

Is there sufficient evidence at the $\alpha = 0.05$ level to conclude that the variance of the fastest speed driven by male college students differs from the variance of the fastest speed driven by female college students? **(6 Marks)**

QUESTION FIVE (30 MARKS)

a) Differentiate between type I and type II errors in hypothesis testing. **(3 Marks)**

b) Let X be an exponential random variable with p.d.f given by $f(x) = \begin{cases} \theta e^{-\theta x}, & x > 0 \\ 0, & otherwise \end{cases}$. Suppose the hypotheses to be tested are $H_0.\theta = 2$ against $H_1.\theta = 1$ and H_0 is rejected whenever $x > 3$. Determine

i) Level of significance. **(4 Marks)**

ii) Power of the test. **(4 Marks)**

c) The data below shows the score of 10 students in English and mathematics

Subject	Marks									
English	56	75	45	71	62	64	58	80	76	61
Math	66	70	40	60	65	56	59	77	67	63

i) Compute the Pearson's correlation coefficient. **(5 Marks)**

ii) Test t 1% level of significance whether English and mathematic score is independent of each other. **(4 Marks)**