MANICALAND STATE UNIVERSITY

OF

APPLIED SCIENCES

FACULTY OF APPLIED SCIENCES & TECHNOLOGY

DEPARTMENT OF APPLIED STATISTICS

MODULE: HYPOTHESIS TESTING TECHNIQUES

CODE: ASTA213

SESSIONAL EXAMINATIONS

JUNE 2023

DURATION: 3 HOURS

EXAMINER: MRS S MANDIZVIDZA

INSTRUCTIONS

1. Answer **All** in Section A.

2. Answer **three** questions in Section B.

3. Start a new question on a fresh page.

4. Total marks: 100.

Additional material(s)

- Non-programmable electronic scientific calculator, List of formulae.

SECTION A [40 MARKS]

Answer **ALL** questions in this section

A 1 Define the following

(a) Sequential hypothesis testing (2)

(b) Hypothesis testing (2)

A 2 Compare and contrast each of the following concepts

(a) Type I error(α) and Type II error(β) (2)

(b) One and Two Tailed Tests (2)

(c) Simple hypothesis versus composite hypothesis. (2)

(d) Simple hypothesis versus simple alternative. (2)

A 3

Table below shows information for undergraduate and graduate students using face-to-face and online instruction method.

		Education level	
		Undergraduate	Graduate students
Instructional preference	Face-to-face	20	35
	Online instructiony	40	5

Table 1: Students preference.

(a) Using $\alpha = 0.05$ test if there an association between students preference for online or face-to-face instruction and their education level?. (7)

(b) What conclusions are drawn?. (2)

A 4 Given that $X_1, ..., X_n, \sim N(\theta, 100)$ that is

$$f(x/(\sigma, \mu)) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

.

Also $H_0 : \theta_0 = 75$ and $H_a : \theta_1 = 78$, $\alpha = 0.1$, $\beta = 0.1$.

(a) Find the sequential probability ratio test. (8)

(b) Give a conclusion. (2)

A 5

The marks obtained in a large public examination by 500 candidates from one centre and 671 candidates from another centre were summarised as Table 4.

Mark Range	10-19	20-29	30-39	40-49	50-59	60-69	70-79
Number of candidates from centre 1	19	50	47	125	132	100	27
Number of candidates from centre 2	30	60	102	140	189	89	61

Table 2: Marks obtained in a public examination

(a) Test at 5% significance level whether the distribution of the marks from the two centres follow the same normal distribution. (7)

(b) State the type of test that you have conducted. (1)

SECTION B [60 MARKS]

Answer any **THREE** questions in this section

A 6 A company has to choose among three health insurance plans. The opinions of a random sample of 500 employees are shown in Table 2. Management wishes to know whether the preference for plans is independent of job classification.

		Health insurance plans		
		1	2	3
Job Classification	Salared worker	160	140	40
	Hourly	40	60	60

Table 3: Health insurance plans.

(a) Carry out a hypothesis test using $\alpha = 0.05$. (8)

A manufacturer claims that the thickness of the spearmint gum it produces is 7.5 centimeters. A quality control specialist regularly checks this claim. On one production run, he took a random sample of $n = 10$ pieces of gum and measured their thickness. He obtained:

$$7.65, 7.60, 7.65, 7.70, 7.55, 7.55, 7.40, 7.40, 7.50, 7.50$$

(b) Test at a significance level $\alpha = 0.05$ whether the manufacturer claims is true. (10)

(c) What conclusions are drawn?. (2)

A 7

Given that $X_1, ..., X_n$ is a random sample of size n from an exponential distribution

$$f(x/\theta) = \frac{1}{\theta} e^{\frac{-x}{\theta}}$$

.

(a) Conduct the simple hypothesis testing. (7)

(b) Show that the likelihood ratio test of an exponential distribution is equivalent to the chisquare test. (6)

Given that $H_0 : \mu = 2$ and $H_a : \mu = 1$, with a random sample of size $n = 5$ from an exponential distribution.

(c) Perform the likelihood ratio test at a significance level of $\alpha = 0.05$. (7)

A 8 Two mark'smen fire five shots at a time at a target and record the numbers of bull's eyes hit, X. After a series of 100 such trials for each mark'smen, the scores were analysed giving the following results in Table 1.

X	0	1	2	3	4	5
$Marksman1_{ij}$	6	31	36	15	8	4
$Marksman2_{ij}$	2	25	29	20	16	8

Table 4: Marksman

(a) Do you think the distribution of X for both mark'smen is the same?. (9)

(b) State the type of test that you have conducted. (1)

A manufacturer of ball pens claims that a certain pen he manufactures has a mean writing life of 400 pages with a standard deviation of 20 pages. A purchasing agent selects a sample of 100 pens and puts them for test. The mean writing life for the sample was 390 pages.

(c) Should the purchasing agent reject the manufactures claim at 1% level? (8)

(d) What conclusions are drawn? (2)

A 9

The number of defects in printed boards is hypothesized to follow a Poisson distribution. A random sample of $n = 60$ printed boards was collected, and the following Table 5 shows the number of defects observed.

Number of defects	Observed frequency
0	32
1	15
2	9
3	2

Table 5: Printed boards

(a) Test at a significance level $\alpha = 0.05$. (8)

(b) What conclusions are drawn?. (2)

Given that $X_1, ..., X_n$ is a random sample of size n from a distribution

$$f(x/\theta) = \theta^x(1-\theta)^{1-x}$$

, $H_0 : \theta_0 = \dfrac{1}{3}$ and $H_a : \theta_1 = \dfrac{2}{3}$, $\alpha = 0.05$, $\beta = 0.05$.

(c) Find the sequential probability ratio test. (10)