JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL, PHYSICAL, MATHEMATICS AND ACTUARIAL SCIENCES

UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF EDUCATION SCIENCE, ARTS AND SPECIAL NEEDS

2ND YEAR 2ND SEMESTER 2024/2025 ACADEMIC YEAR

REGULAR (MAIN)

COURSE CODE: WAB 9210

COURSE TITLE: Probability Distribution Theory Ii

EXAM VENUE: **STREAM: (EDUCATION)**

DATE: **EXAM SESSION:**

TIME: 2.00 HOURS

Instructions:

1. **Answer question 1 (Compulsory) and ANY other 2 questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE [30 MARKS]

a) A random variable T has a t-distribution with 14 degrees of freedom, i.e $T\sim t(14)$. Find the value of t for which

i. $P(T < t) = 0.90$ [2 marks]

ii. $P(|T| < t) = 0.98$ [2 marks]

iii. Find $P(|T| < 1.076$ [2 marks]

b) You are provided with the sample data: 15,20, 18, 16, 17, 22, 29, 35, 10, 19

Find:

i. The sample mean [1 mark]

ii. The unbiased estimate of variance [3 marks]

c) Let $X_1, X_2, X_3, \dots, X_n$ be iid random variables from a population with mean μ and variance σ^2. Let $Y = \sum_{i=1}^{n} X_i$. Obtain the sampling distribution of Y. [6 marks]

d) Ball bearings are put in a container. 85% of them are light gauge while the rest are heavy gauge. Of the heavy gauge ball bearings 10% are defective. One picks randomly from this container a total of 150 ball bearings. Determine the approximate probabilities that of the bearings picked

i. At least 18 are heavy gauge [5 marks]

ii. Exactly 3 are heavy gauge and defective. [3 marks]

e) The heights of recruits for a military job are normally distributed with mean 250cm and variance 144 cm^2. A number of recruits n are sampled and it is found that $P(\bar{X} > 252) = 0.0778$. Find n the number of recruits who were sampled. [6 marks]

QUESTION TWO [20 MARKS]

a) A dummy population consists of five numbers 5, 7, 6, 8 and 9. Consider all the possible samples of size 2 which can be drawn without replacement. Find

i. μ_x : the population mean [2 marks]

ii. σ_x : the population standard error [3 marks]

iii. $\mu_{\bar{x}}$: the mean of sampling distribution of means [5 marks]

iv. $\sigma_{\bar{x}}$: the standard error of the sampling distribution of means [3 marks]

b) Observations from two random variables X and Y were summarized as follows;

$$\sum x = 125, \sum y = 100, \sum x^2 = 650, \sum y^2 = 436, \sum xy = 520, \; n = 25$$

One suspects that X and Y have a positive association. Obtain the Product Moment Correlation Coefficient hence test the Hypothesis

$H_o: \rho = 0$ against $H_1: \rho > 0$ at 5% level of significance [7 marks]

QUESTION THREE [20 MARKS]

a) Over a period of 50 weeks the numbers of road accidents reported to a police station were recorded as follows

No of accidents	0	1	2	3
No of weeks	23	13	10	4

Stating clearly any assumption that must be made, test at 5% level whether a Poisson model will fit this data. [10 marks]

b) Let $X \sim Bin(n, p)$. Further let $X \sim Poisson(\lambda)$. Show that if $\lambda = np$ then $P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}, n = 0,1,2, \dots, n$ is asymptotically Poisson distributed. [10 marks]

QUESTION FOUR [20 MARKS]

a) An arbitrary population consists of six members: 6, 9, 11, 12, 14, 8. Assuming that sampling is from a finite population,

i. List all the possible samples of size two

ii. Obtain for the samples drawn the mean $\mu_{\hat{s}^2}$ and variance ${\sigma^2}_{\hat{s}^2}$ of the sampling distribution of variance. [10 marks]

b) Observations were recorded from two samples A and B.

Sample A	12	19	16	17	14	20	16	17	19	13
Sample B	15	20	16	18	14	21	22	16	[redacted]	

One claims that generally the population from which observations in sample A were taken has a smaller mean than the population from which observations in sample B came from. By clearly stating the Null and alternative hypothesis and assuming that the samples came from normal populations, Use the t -Test at 5% level of significance whether or not the claim is valid. [10 marks]

QUESTION FIVE [20 MARKS]

a) The following data represent the time (in days) taken to process and disburse pension lump sum to retirees by two different pension fund administrators.

Octagon: 21, 14, 15, 10, 19, 8, 9, 8, 6, 15

Jubilee: 16, 15, 13, 24, 19, 10, 11, 9, 19, 13, 18

One suggests that the data appears to have the same variance with regard to pension disbursement time schedules. Use the F-Test to check this claim at $\propto = 0.05$level of significance. [10 marks]

b) The following data on 150 chicken divided into two groups according to breed and into three groups according to yield of eggs. There is a claim that the yield is not affected by the breed, Test this claim at 5% based on the contingency table provided.

	High Yield	Medium Yield	Low Yield
Breed A	46	29	28
Breed B	27	14	6

[10 marks]