JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL, PHYSICAL, MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY EXAMINATION FOR DIPLOMA IN APPLIED STATISTICS

2ND YEAR 1ST SEMESTER 2024/2025 ACADEMIC YEAR

MAIN CAMPUS

COURSE CODE: WAB 2219

COURSE TITLE: STATISTICAL INFERENCE

EXAM VENUE: **STREAM:**

DATE: **EXAM SESSION:**

TIME: 2.00 HOURS

Instructions:

1. **Answer question one (compulsory) and any other THREE 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.**

Section A

Question 1 [40 marks]

a) Define statistics and list two key objectives of statistical investigation. (4 Marks)
b) What is the difference between a population and a sample in statistics? (2 Marks)
c) List four properties of the normal distribution curve. (4 Marks)
d) Using standard normal tables find the following probabilities by drawing the sketches to illustrate your answer.
   i. Pr. ($Z < 1.377$) (2 Marks)
   ii. Pr. ($Z < -1.377$) (2 Marks)
   iii. Pr. ($|Z| < 1.433$) (3 Marks)
e) A survey finds that in a sample of 200 people, 120 prefer brand A over brand B. Calculate the point estimate for the proportion of the population that prefers brand A (4 Marks)
f) If a dataset follows a normal distribution with a mean of 100 and a standard deviation of 15, what percentage of data lies between 85 and 115? (4 Marks)
g) A sample of 25 items has a mean weight of 10.5 grams with a sample standard deviation of 1.2 grams. Calculate the 90% confidence interval for the population mean. (4 Marks)
h) The heights of students in a school are normally distributed with a mean of 160 cm and a standard deviation of 10 cm. What percentage of students have a height greater than 170 cm?

(4 Marks)

i) The speeds of cars passing a certain point on a motorway can be taken to be normally distributed, observations show that of cars passing the point 95% are travelling at less than 85mm.p.h and 10% are travelling at less than 55m.p.h.
   i. Find the average speed of the cars passing the point (4 Marks)
   ii. Find the standard deviation of the cars passing the point (4 Marks)
j) Two samples have means of 50 and 53, with respective standard deviations of 4 and 5, and sample sizes of 30 and 35. Calculate the 95% confidence interval for the difference in means.

(4 Marks)

k) In a survey, 25% of respondents preferred option A. If the sample size is 400, calculate the margin of error for a 95% confidence level for this proportion. (3 Marks)
l) A researcher collects a sample and finds that the sample mean is 45 with a population standard deviation of 5. Calculate the z-score for a value of 50**.** (4 Marks)
m) Find the probability of obtaining 4,5,6, or 7 heads when a fair coin is tossed 12 times, using a normal approximation to the binomial distribution (4 Marks)

Question 2 [20 marks]

a. The masses of boxes of oranges are normally distributed such that 30% of them are greater than 4.00kg and 20% are greater than 4.53kg. Estimate the mean and the standard deviation of the masses (10 Marks)
b. Consultant employed by a large library reported that the time spent in the library by a user could be modelled by a normal distribution with mean 65 minutes and standard deviation 20 minutes. Assuming that this model is adequate, what is the probability that a user spends

i. Less than 90 minutes in the library (4 Marks)
ii. Between 60 and 90 minutes in the library (6 Marks)

Question 3 [20 marks]

a. A company wants to analyse how its revenue is influenced by investments in two areas: marketing and sales. Let X represent the company's monthly revenue increase from marketing efforts, and Y represent the monthly revenue increase from sales efforts. Assume X and Y are independent random variables with the following properties:

μ_x=10,000 and σ_x=2,000

$\mu_{y=}$8,000 and $\sigma_{y=}$1,500

The company is interested in the total monthly revenue increase Z from both marketing and sales, where Z= X+Y.

i. Calculate the expected value μ_z and the standard deviation σ_z hence find the probability that the monthly increase is more than 20,000 (5 Marks)

ii. Suppose the company decides to allocate 1.5 times as much budget to marketing as it does to sales. Define a new total monthly revenue increase W=1.5X+Y. Calculate the expected value μw and the standard deviation σw for this new allocation. (5 Marks)

b. In a cafeteria, baked beans are served either in ordinary portions or in children's portions. The quantity given with mean 90g and standard deviation 3g and the quantity given for a child's portion is a normal variable with mean 43g and standard deviation 2g. What is the probability that Tom , who has two children's portions is given more than his father who has an ordinary portion? (10 Marks)

Question 4 [20 marks]

a. A radioactive disintegration gives counts that a Poisson distribution with a mean count of 25 per second. Find the probability that in one second interval the count is between 25 and 30 inclusive (4 Marks)

b. The distribution of the random variable X is N (25,340). The mean of the random sample of size n is drawn from distribution is $\overline{X}$. Find the value of n correct to 2 significant figures given that $P(\overline{X}>28)$. (6 Marks)

c. The lifetimes of Econ light bulbs are normally distributed with mean 1000h and the standard deviation 25h.

i. Find, to 3 decimal places, the probability that an Econ light bulb will have a lifetime between 975h and 1020h. (4 Marks)

ii. Calculate, to 3 decimal places, the probability that the sum of the lifetime of 8 Econ light bulbs will exceed 7930h. Indicate clearly the stage in your calculations when an assumption concerning independence is essential.

(6 Marks)

Question 5 [20 marks]

i. Obtain the regression of Y on X and X on Y from the following table and estimate the blood pressure when age is 50.

Age X	Blood Pressure Y
52	147
42	125
72	160
36	118
63	149
47	128
55	150
49	145
38	115
42	140
68	152

Question 6 [20 marks]

A retail company wants to assess customer satisfaction regarding its new line of products. After launching the new products, the company conducts a survey among its customers. Out of a random sample of 500 customers, 320 reported that they were satisfied with the new products.

i. Calculate the sample proportion of satisfied customers, denoted as p^. (5 Marks)

ii. Construct a 95% confidence interval for the true proportion of satisfied customers.

(10 Marks)

iii. Interpret the confidence interval in the context of the company's assessment of customer satisfaction. What can the company conclude about customer satisfaction based on this interval? Discuss whether this information is sufficient for the company to make decisions about its new product line (5 Marks)