



MOSHOD ABIOLA POLYTECHNIC

ABEOKUTA, OGUN STATE.

DEPARTMENT OF STATISTICS & MATHEMATICS

1st SEMESTER EXAMINATION

2023/2024 SESSION

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COURSE TITLE: STATISTICAL THEORY III

COURSE CODE: STA 311

LEVEL: HND I COMPUTER SCIENCE (Full Time & Part Time)

UNIT: 3

TIME ALLOWED: 3HR5

INSTRUCTIONS: (i) Answer **Question 1** and any other **FOUR (4)** questions.
(ii) Write **ONLY** your matriculation number on your question paper.

1. (a) MAPOLY Academic Staff (MACADES) guest house has studied its lodging customers to determine how much money they spend on concessions. The study revealed that the spending distribution is approximately normally distributed with a mean of ₦2877 and a standard deviation of ₦959. What spending amount corresponds to the top 87th percentile?
- (b) At Ibara area of Abeokuta, 2500 electric lamps are installed for street lightning. The lamps come from a different manufacturer and have a mean burning life of 1050 hours. We know from past experience that the distribution of burning lives approximate a normal distribution. The 250th lamp fails after 819 hours. Approximately what is the standard deviation of burning lives for this set of lamps?
- (c) Prove convincingly that the density of the Normal (μ, σ) distribution integrates to 1. ✓
2. Cost of data among Nigerians for streaming this year UCL second leg semifinal football match between Real Madrid and FC Bayern Munich has an exponential distribution with mean ₦250.
 - (i) Define the probability density function (pdf) for the streaming cost of data.
 - (ii) Show convincingly that the total area under the pdf defined in (i) is unity.
 - (iii) What is the probability that the streaming cost of data among Nigerians is between ₦235 and ₦290?
 - (iv) What is the probability that the streaming cost of data among Nigerians is more than ₦275?
 - (v) Assuming that 5,000,000 Nigerians bought data to stream the match live, approximately how many Nigerians spent ₦185 or less on data to stream the match?
3. The current (in mA), X , measured in a piece of copper wire is known to follow a uniform distribution over the interval $[0, 25]$.
Find:
 - (i) the semi interquartile range of the current.
 - (ii) the cumulative distribution function, $F(x)$, of the current. ✓
 - (iii) using the result in (ii), the probability that the current is less than 20mA.
 - (v) the value of k so that $P(X \geq k) = 0.8$ ✓

4. (a) The distribution of data usage in the school library is given by

$$f(x) = \begin{cases} x^2(b - ax) & 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$

where x is in thousands of Gigabytes. Find the values of a and b if the mean data usage is 600 Gigabytes.

- (b) The time, in minutes, it takes to reboot a certain computer system is a continuous variable with the density

$$f(y) = \begin{cases} 2(1 - y) & 0 < y < 1 \\ 0 & \text{elsewhere} \end{cases}$$

Show that $E(Y^r) = \frac{2}{(r+1)(r+2)}$ ✓

5. (a) Define a random variable.

- (b) Differentiate between the following

(i) Discrete random variable and Continuous random variable.

(ii) Continuous density function and Continuous distribution function.

- (c) A continuous random variable X has a probability density function given by:

$$f(x) = \begin{cases} k2x^2 & -2 < x < 4 \\ 0 & \text{otherwise} \end{cases}$$

Find: (i) $P(x > 1)$

(ii) $P(x < 0)$ ✓✓

6. (a) Prove convincingly the following

(i) $E(aX^r + b) = aE(X^r) + b$

(ii) $Var(X) = E(X^2) - [E(X)]^2$

- (b) The density function of a continuous random variable X is given by

$$f(x) = \begin{cases} \frac{1}{\ln 3^{x^2}} & \text{for } 1 < x < 3 \\ 0 & \text{otherwise} \end{cases}$$

Find (i) $Var(X)$

(ii) $E(X^2 + 2X - 1)$

7. Given the pdf below,

$$f(x) = \begin{cases} 2e^{-2x} & x \geq 0 \\ 0 & \text{elsewhere} \end{cases}$$

Obtain the semi-interquartile range ✓✓

$$\frac{128 - \frac{2}{3}}{3} = \frac{128 - \frac{2}{3}}{3}$$

$$\frac{2 - \frac{2}{2} - \frac{2}{2}}{1 - \frac{2}{2} - \frac{2}{2}} = \frac{2 - 1 - 1}{1 - 1 - 1} = \frac{0}{-1} = 0$$