



MAASAI MARA UNIVERSITY

**REGULAR UNIVERSITY EXAMINATION
2023/2024 ACADEMIC YEAR
FIRST YEAR FIRST SEMESTER**

**SCHOOL OF SCIENCE AND INFORMATION
SCIENCES
MASTER OF SCIENCE (APPLIED STATISTICS)**

**COURSE CODE: STA 8105
COURSE TITLE: THEORY OF ESTIMATION**

DATE: 2/2/2024

TIME: 0830-1130 HRS

INSTRUCTIONS TO CANDIDATES

- i. Question **ONE** is compulsory
- ii. Answer any other **TWO** questions

QUESTION ONE (20 MARKS)

a. State three properties of probability density function (3marks)

b. Consider the problem of DC level in white Gaussian noise with one observed data

$x(0) = \Theta + w(0)$ where $w(0)$ has the pdf $N(0, \sigma^2)$. Find the PDF of $x(0)$ (3marks)

c. Consider $x(0) = A + w(0)$ with $W(0) \sim N(0, \sigma^2)$ find the variance (5marks)

d. Define an efficient estimator (2marks)

e. Consider DC level WGN with unknown variance $x(n) = A + w(n)$. Suppose that $A > 0$ and $\sigma^2 = A$. Find its PDF (6marks)

QUESTION TWO (20MARKS)

a. State and explain four asymptotic properties of estimators (8marks)

b. Consider DC level in WGN with known variance σ^2 . Find its maximum likelihood estimation (12marks)

QUESTION THREE (20MARKS)

a. If x and y are distributed according to a bivariate Gaussian PDF

$$P(x, y) = \frac{1}{2\pi\sqrt{\det(C)}} \exp \frac{1}{2} \begin{bmatrix} X & -E(x) \\ Y & -E(Y) \end{bmatrix}^T C^{-1} \begin{bmatrix} X & -E(x) \\ Y & -E(y) \end{bmatrix}$$

Find the conditional PDF $p(Y/X)$ (10marks)

b. State three properties of MMSE Estimator (6marks)

c. State four problems with general Bayesian estimator (4marks)

QUESTION FOUR (20MARKS)

Generate the innovation $x^2[n] = x[n] - x^{\wedge}[n/n-1]$ which is uncorrelated with previous samples $X[n-1]$. Then use $x^2(n)$ instead of $X(n)$ for estimation $X[n]$ is equivalent to $(X[n-1], X^2[n])$ (20marks)

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