MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

THIRD YEAR SUPPLEMENTARY EXAMINATIONS FOR

BACHELOR OF SCIENCE (MATHEMATICS

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

BACHELOR OF SCIENCE (STATISTICS & PROGRAMMING)

BACHELOR OF EDUCATION

BACHELOR OF STATISTICS AND ECONOMICS)

SMA 361: THEORY OF ESTIMATION

DATE: 26/7/2019 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND OTHER TWO QUESTIOS

QUESTION ONE (COMPULSORY)

a) Explain the meaning of the following terms as applied in theory of estimation

(i) Population

(ii) An estimator 4 marks

b) Let $x_1, x_2, .. x_n$ be a random sample of size n from a distribution with mean from a population with mean μ and variance δ^2 both unknown.Detemine the maximum likelihood estimator (MLE) of δ^2 . (6 marks)

$c)$ $Let\ x_1, x_2, .. x_n$be a random sample drawn from a population with mean μ (unknown).Show that if $y = \sum_1^n a_i x_i$ is unbiased estimator for μ if $\sum_1^n a_i = 1$ (5 marks)

d) Consider a normal distribution N(μ, δ^2).Let $\mu_1 = \bar{x}_n = \sum_1^n \frac{x_i}{n}$ and $\mu_2 = \bar{x}_m = \sum_1^m \frac{x_i}{m}$ where m>n, be estimators of μ. Determine which estimator is more efficient (6 marks)

e) Given a population with a distribution whose pdf is

$$\left[f(x,\theta) = \frac{1}{\theta}, 0 \le x \le \theta, 0 \; otherwise \right.$$

Using the method of moments obtain the estimator for θ. (9marks)

QUESTION TWO

a) Let $x_1, x_2, .. x_n$ denote a random sample from a pdf

$$f(x) = \begin{bmatrix} (\lambda+1)x^{\lambda}, & 0 < \mathrm{x} < 1, \; \lambda > 0 \\ 0 & elsewhere \end{bmatrix}$$

Obtain the moment estimator of λ and test for unbiasedness (10 marks)

b) Given a random sample of size n from a population whose pdf is

$$f(x) = \frac{1}{2\sqrt{2\pi\theta}} e^{\frac{-1}{4\theta}(x-5)^2}$$

Obtain the maximum likelihood estimator (MLE) of θ and show that it's unbiased.

(10 marks)

QUESTION THREE

Three objects P, Q and R with weights Z_1, Z_2, and Z_3 respectively are weighed on a spring balance P and Q together weigh 75g, P and R weigh 45g and Q and R weigh 100g. Assuming the weights are independent with constant variance δ^2, find the least square estimates of Z_1, Z_2, and Z_3 (20 marks)

QUESTION FOUR

a) Let $x_1, x_2, .. x_n$ be a random sample of size n from a population whose pdf if $f(x,\theta)$ where θ is unknown. Let $T = t(x_1, x_2, \dots x_n)$ be the necessary and sufficient condition for T to be the Minimum variance unbiased estimator (MVUE) of θ expressed in the form

$$\frac{\partial LogL}{\partial \theta} = \frac{T-\theta}{\lambda}$$

Show that T is MVUE of θ and $Var(T) = \lambda$ (10 marks)

b) A random sample of size n is drawn from a normal population with $(0,\delta^2)$. Determine the minimum variance unbiased estimator (MVUE) of δ^2 and its variance. (10 marks)

QUESTION FIVE

a) A population has a known mean μ and a standard deviation δ of 2.45. If a sample of 900 has a mean of 3.15cm and the population is normal obtain a 98% confidence intervals for the true mean. (8 marks)

b) If $x_1, x_2, .. x_n$ is a random sample of size n from a population whose pdf is given by

$$f(x,\lambda) = \frac{e^{-\lambda}\lambda^x}{x!}, x = 0, 1, 2, ...$$

Determine the uniformly minimum variance unbiased estimator (UMVUE) of $e^{-\lambda}$ (12 marks)

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SCHOOL OF COMPUTING AND APPLIED SCIENCES

DEPARTMENT OF COMPUTING AND APPLIED SCIENCES

SCO 212: PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE – CAT 1

Instruction:
Answer ALL the questions

1. (a) Explain the meaning of the following terms as applied in sampling
   - (i) Data
   - (ii) Sample
   - (iii) Population (3 marks)

   (b) Differentiate between a discrete and continuous variable. (4 marks)

2. The following table shows distribution of examination marks

Marks	Percentage of Candidates
0 – 9	3
10 – 19	1
20 – 29	6
30 – 39	13

40 – 49	25
50 – 59	27
60 – 69	14
70 -79	5
80 – 89	6

Estimate:

(i) Arithmetic mean (4 marks)

(ii) Standard deviation (4 marks)

3. (a) Consider the probability distribution of a discrete variable below

X	1	2	4	5	8
P(x=x	0.2	0.25	-	0.3	0.1

Determine *(i) Pr (x = 4)* (3 marks)

(ii) the mean of the distribution (3 marks)

(b) (i) The result of an experiment is a discrete random variable which has the binomial distribution with mean 1.2 and variable 1.08. Determine the sample size of the distribution.

(6 marks)

(ii) A discrete random variable x follows the poisson law. Determine p(x is at most 1) If it is given that $E(x) = 2.5$ and $e^{-2.5} = 0.0821$. (3 marks)

Instructions:

Answer ALL questions

1. (a) Explain the meaning of the following terms
   - (i) A set
   - (ii) Venn diagram
   - (iii) Definite integral (6 marks)

   (b) Use a venn diagram to show that the following statement is true

   $(A \cup B)^1 = A^1 \cap B^1$ (5 marks)

2. (a) Given that $\in = \{x : x \in \omega, x < 20\}$

   A = (2, 6, 8, 14, 18, 19)

   B = (3, 6, 9, 12, 15, 18)

   Determine (i) $A \cap B$

   (ii) $A \cup B$

   (iii) A^1, B^1

   (iv) $n(A), n(B)$ $n(A \cup B)$, $n(A \cap B)$ *and* show that

   $$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

   (10 marks)

3. (a) Differentiate the following function

   $y = \sqrt{\theta^5}\, sin2\theta$ (5 marks)

   (b) Evaluate $\int_3^4 \frac{3}{x} dx$ (4 marks)

CAT

SMA 361 THEORY OF ESTIMATION

1) (i) Explain the meaning of the following terms as applied in estimation theory

   (i) Statistic

(ii) Estimation (2 marks)

(ii) A random sample of five values are taken from a normal population with mean μ and variance δ^2both unknown. The values are: 1.07, 1.02, 1.04, 1.06, 1.05. Estimate the population mean and population variance. (3marks)

(2) Let $x_1, x_2, --x_n$ be a random sample of size n from a normal distribution with μ and δ^2 both unknown show that:

(i) $\overline{X}$ is an unbiased estimator μ

(ii) $S^2 = \frac{1}{n}\Sigma(x_2 - \bar{x})^2$ is a biased estimator of δ^2 (7 marks)

3) (i) Define Consistency (2 marks)

(ii) Given that $x_1, x_2,$ and x_3 is a random sample from a normal population with mean μ and variance δ^2 both unknown. Consider the following 3 estimators for μ

$$t_1 = x_1 + x_2 - x_3$$

$$t_2 = 2x_1 + 3x_3 - 4x_2$$

$$t_3 = \frac{\lambda x_1 + x_2 + x_3}{2}$$ where λ is such that t_3 is

unbiased. Find λ and choose the best estimators among t_1, t_2 and t_3 . (10 marks)

ii) Let $x_1, x_2, .. x_n$ be a random sample of size n from a distribution with mean from a population with mean μ and variance δ^2 , show that $\bar{x}$ is a consistent estimator of μ.

(6 marks)

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BMS 100 – MANAGEMENT MATHS I - CATS

Instructions:

Answer ALL questions

4. (a) Explain the meaning of the following terms
   - (iv) A set
   - (v) Venn diagram
   - (vi) Definite integral (6 marks)

   (b) Use a venn diagram to show that the following statement is true

   Z (5 marks)

5. (a) Given that $\in = \{x : x \in \omega, x < 20\}$

   A = (2, 6, 8, 14, 18, 19)

   B = (3, 6, 9, 12, 15, 18)

   Determine (i) $A \cap B$

   (ii) $A \cup B$

   (iii) A^1, B^1

   (iv) $n(A), n(B)$ $n(A \cup B)$, $n(A \cap B)$ *and* show that

   $$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

   (5 marks)

6. (a) Differentiate the following function

   $$y = \sqrt{\theta^5 . \sin 2\theta}$$ (5 marks)

(b) Evaluate $\int_3^4 \frac{3}{x} dx$ (4 marks)

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HTM 209: INTRODUCTION TO STATISTICS - CATS

Instructions:
Answer ALL questions

1. (a) Explain the meaning of the following terms as used in statistics
(i) Population
(ii) Sample
(iii) Nominal Measurement
(iv) Data (4 marks)

(b) Distinguish between the following terms
(i) Categorical and Numerical data
(ii) Discrete and Continuous variable. (4 marks)

2. (a) The data below shows the number of hours worked in one week by employees in a certain Hotel.

46.3	39.2	44.2	41.3	45.1	42.3	43.5	40.0
45.6	40.6	42.0	42.6	45.6	39.5	43.1	39.7
46.1	38.9	42.4	42.1	45.0	44.4	42.4	40.8

(i) Tabulate a frequency distribution table with class interval of 38.9 – 40.4, ~~~ etc (6 marks)

(ii) Use the table in 2(a)(i) above to estimate
- Arithmetic Mean (4 marks)
- Mode (4 marks)
- Median (4 marks)

(b) Plot a histogram and frequency polygon on the graphs for table in 2(a)(i) above. (4 marks)

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BMS 102 – MANAGEMENT MATHS II CAT

Examination Irregularity is punishable by expulsion

Instructions:
Answer ALL questions

1. (a) Explain the meaning of the following terms as applied in Management Mathematics
    - (i) Identity matrix
    - (ii) Input-output matrix
    - (iii) Slack variables
    - (iv) Pivot column
    - (v) An Event (5 marks)

   (b) Given the following matrices

$$A = \begin{bmatrix} 1 & -2 \\ 4 & -1 \end{bmatrix}, \quad B = \begin{bmatrix} 1 & -1 \\ 0 & 2 \\ 1 & 3 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \end{bmatrix}$$ (5 marks)

   Determine:
    - (i) A^{-1}
    - (ii) BC
    - (iii) 2A-B

2. (a) State any THREE requirements of a linear programming problem. (3 marks)

   (b) Given the following input-output table

From	To		
	A	B	Final demand
A	80	120	200
B	160	100	250

   (i) From a technical coefficient matrix A. (2 marks)

   (ii) Determine the total output given that the consumer demand from industry A increased by 50 and that from industry B decreased by 50. (5 marks)

3. (a) Define the terms
    - (i) Permutations
    - (ii) Combinations (4 marks)

   (b) Two true six-sided dice are rolled. What is the probability of a total score of 10? (6 marks)