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(The University Of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

MAIN CAMPUS

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF MATHEMATICS AND IT

COURSE CODE: STA 817

COURSE TITLE: SURVIVAL AND CLINICAL DATA ANALYSIS

DATE: **TIME:**

Instructions to candidates:

ANSWER ANY THREE QUESTION

Time: 3 hours

QUESTION ONE (20 MARKS)

a) Complete the following table by determining the probabilities of epidemic chain listed assuming

   i. The Reed-Frost model (6marks)

   ii. The Greenwood model (6marks)

Epidemic chain	Household size	
	4	3
2		
$2 \rightarrow 1$		
$2 \rightarrow 1 \rightarrow 1$		
$2 \rightarrow 2$		

b) List the Chain Binomial model assumptions (3marks)

c) Given the results in 1(b) or otherwise show that

$$prob\{i_0 \rightarrow i_1 \rightarrow \ldots \rightarrow i_r\} = \frac{S_0!}{i_1! i_2! \ldots i_r! S_r!} \prod_{k=0}^{r} p_{i_k}^{i_{k+1}} q_{i_k}^{S_{k+1}}$$ (4marks)

d) Describe the epidemic chain $i_0 \rightarrow i_1 \rightarrow \ldots \rightarrow i_r$ (1mark)

QUESTION TWO (20 MARKS)

a) Consider a discrete random variable X with probability mass given by

$$prob[X = j] = \begin{cases} \frac{1}{3} & j = 1,2,3 \\ 0 & otherwise \end{cases}$$

Determine

   i. The Survival function (5marks)

   ii. The Hazard function (5marks)

b) Briefly outline the main features with examples of

   i. Type I censoring

   ii. Type II censoring

   iii. Right Truncation (10marks)

QUESTION THREE (20 MARKS)

a) Give the survival rate function for each of the following parametric models

   i. Weibul distribution

   ii. Log logistic distribution

   iii. Log normal distribution (10marks)

b) Suppose that the time to event X has a Geometric distribution. Find the following rates

   i. Survival rate of X

   ii. Hazard rate of X (10marks)

QUESTION FOUR (20 MARKS)

a) Show that the survival function S(x) can be given by

$$S(x)=\frac{Mr(0)}{Mr(x)}\exp-\int_{0}^{x}\frac{du}{Mr(u)}$$ (3marks)

b) Let X be a random variable that has a Uniform distribution on interval $(0,\theta)$, $\theta>0$.

Find

   i. The Survival function of X

   ii. The Hazard function of X

   iii. The Mean Residual –life function of X (9marks)

c) Consider a random variable W that has probability density function

$$f_w(w)=\exp-ew$$

Show that the Survival function of W is

$$S_w(w)=\exp-ew$$ (8marks)

QUESTION FIVE (20 MARKS)

a) Define the Kaplan- Meier estimate of the survival function (2marks)

b) Define the Nelson-Aalen estimator for cumulative hazard function (3marks)

c) Define COX's PH model for hazard rate (3marks)

d) If the i^{th} covariate can take positive value only (e.g. age). What is the significance of

   i. The sign of the i^{th} regression parameter

   ii. The magnitude of the i^{th} regression parameter (6marks)

e) Show that the proportion $\frac{h(t\mid \underline{z})}{h(t\mid \underline{z}^{*})}=\exp\beta_1$ (6marks)

f) The covariate for the i^{th} observed life are (56, 183, 40) respectively (age, height in cm, daily dose of a drug A in mg). Using regression parameter $\underline{\beta}^T = (0.0172, 0.0028, -0.0306)$. Calculate $h(t \mid \underline{z_i})$ in terms of $h_0(t)$ (6marks)