MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2023/2024ACADEMIC YEAR
FOURTH YEAR SECOND SEMESTER

SCHOOL OF PURE, APPLIED, AND HEALTH SCIENCES
BACHELOR OF APPLIED STATISTICS WITH COMPUTING

COURSE CODE: STA 4245
COURSE TITLE: SURVIVAL ANALYSIS

DATE: 19 TH APRIL,2024 **TIME: 1100-1300HRS**

INSTRUCTIONS TO CANDIDATES

- **Question One is Compulsory**
- **Answer Any Other TWO QUESTIONS**

This paper consists of 5 printed pages. Please turn over.

Question One (20 Marks)

a) Explain any two goals of survival analysis **(2marks)**

b) For 3 selected individuals described below, discuss in detail the types of censoring and/or truncation that is represented by the following individuals.

i. The first individual, enrolled in the study at age 45, entered the study with the symptom already present. **(2marks)**

ii. The next two healthy (without the symptom present) individuals enrolled in the study at ages 30 and 42 and never showed the symptom. **(2marks)**

iii. The next two healthy individuals, enrolled in the study at ages 35 and 40, exhibited the symptom at the second and fifth exam after enrollment (6 years and 15 years after enrollment), respectively. The symptom (which could only be identified by a clinical exam and clinical testing) may have appeared between exams. **(2marks)**

c) One wants to test the null hypothesis that the lifetime distribution for the brake pads is the same for the two-year models Year=0 and Year=1, when the other factors are ignored.

i. Formulate a null hypothesis and alternative hypothesis for this in terms of hazard function **(2marks)**

ii. Formulate the hypothesis in terms of cox model **(2marks)**

iii. This test was performed, and the p-value was 0.206. Using this information can we conclude that the lifetime of the brake pads is independent of the car's year model(Year). Explain your answer **(2marks)**

c) Describe how a graph of either estimate or the cumulative hazard might be used to select a suitable parametric model for the data from a set of possible candidates. **(3marks)**

d) What are typical causes leading to a censored observation **(3marks)**

Question Two (15 Marks)

a) Consider the following sequence of survival times for a set of individuals measured from
birth: 0.1+, 0.3, 0.3, 0.5+, 0.6, 0.9, 0.9, 1+, 1.4 where numbers followed by a "+" indicate
right-censored values.

i. Calculate the Nelson-Aalen estimate of the cumulative hazard function for these data, presenting the results in a table. Sketch a graph of the estimated function. **(5marks)**

ii. Calculate a linear 95% confidence interval for H (0.6). **(4marks)**

b) The below data is on time to death for breast cancer patients who were classified as being on drug A and drug B. Test the hypothesis that there is no difference in survival between the two groups using the log-rank test.
Drug A: 15, 18, 19, 19, 20
Drug B: 16+, 18+, 20+, 23, 24 **(6 marks)**

Question Three (15 Marks)

a. Sixteen patients with advanced stomach carcinoma were randomized to receive one of two chemotherapies (Group A or Group B). The survival times from treatment (in weeks) are (+denotes a censored observation): Group A: 63+, 59+, 57+, 40, 37, 33, 21+, 11 Group B: 57+,51+, 44+, 32, 27, 27+, 10+, 6.

i. Calculate the Kaplan -Meier estimate of the survival function for Group B, presenting the results in a table then sketch a graph of the estimated function. **(6marks)**

ii. Calculate a linear 95% confidence interval for S (27) using Group B. **(4 marks)**

iii. Test the hypothesis that there is no difference in survival between the two groups using the log-rank test. **(5 marks)**

Question four (15 marks)

a) You are given that mortality follows Gompertz with B=0.01 and C= 1.1, calculate;
i) μ_{10} **(2marks)**
ii) The probability of a person aged 20 to attain age 30 **(2 marks)**

iii) The probability of a person aged 20 to die within 10 years.

(3 marks)

b) Consider a discrete random variable x with p(X=xj) = $\frac{1}{3}$: for j=1,2,3. Determine the corresponding hazard function **(4marks)**

c) let x be a discrete random variable such that p ($X = x_j$) = $\frac{1}{5}$: for j=1,2,3,4,5 and 0 , elsewhere. Determine the survival function and hence plot a step function graph of S(x) against x **(4marks)**

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