(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: **STA 414**

COURSE TITLE: **SURVIVAL ANALYSIS**

DATE: 19/05/2022 **TIME:** 9:00 AM - 11:00 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION 1: (30 marks)

a) Define the following terms as used in Survival analysis:

(i) survivorship function, S(t) (2 marks)

(ii) Hazard function, h(t) (2 marks)

(iii) Probability density function, f(t) (2 marks)

Write down a mathematical expression relating S(t) and h(t) (3 marks)

b) i) What do you understand by the term Truncation? (3 marks)

ii) Using suitable examples distinguish right from left Truncation (5 marks)

c) The mean is usually used to describe the central tendency of a distribution, but in survival distributions the median is often better, why? (3 marks)

d) A model for lifetime with a bathtub shaped hazard rate is the exponential power distribution with the survival function

$$S(x)=\exp\{1-\exp(\lambda x)^{\alpha}\}$$

If $\alpha=0.5$, obtain the hazard function and find the time at which the hazard rate changes from decreasing to increasing (10 marks)

QUESTION 2: (20 marks)

An investigator describes a clinical trial of 49 patients for the treatment of Colorectal cancer. The data for the two treatments, linoleic acid or Control are given in Table below.

Table 12.1 Survival in 49 patients with Dukes' C colorectal cancer randomly assigned to either γ linoleic acid or control treatment

Treatment	Survival time (months)
γ linoleic acid (n=25)	1+, 5+, 6, 6, 9+, 10, 10, 10+, 12, 12, 12, 12, 12+, 13+, 15+, 16+, 20+, 24, 24+, 27+, 32, 34+, 36+, 36+, 44+
Control (n=24)	3+, 6, 6, 6, 6, 8, 8, 12, 12, 12+, 15+, 16+, 18+, 18+, 20, 22+, 24, 28+, 28+, 28+, 30, 30+, 33+, 42

Obtain the Kaplan-Meier survival estimates for this patients and perform the Log-rank test. Comment on the results so obtained. (20 marks)

QUESTION 3:

(a) Let $t_1, t_2, t_3, \ldots\ldots, t_n$ be the exact survival times of n individuals under study. State how you would find an estimate of the survivorship function S(t) from such a sample.

(2 marks)

(b) Suppose the following remission durations are observed from 10 patients (n=10) with solid tumors. Six patients relapse at 3.0, 6.5, 6.5, 10, 12 and 15 months; 1 patient is lost to follow up at 8.4 months; and 3 patients are still in remission at the end of study after 4.0, 5.7, and 10 months.

(i) Calculate the estimate of the survival time, S(t) for this study (10 marks)

(ii) Plot S(t) verses t and estimate the median remission time (5+3 marks)

QUESTION 4: (20 marks)

(a) Illustrate how you would determine that a given data of survival time T come from an exponential distribution

(b) Let the survival time, T follow the Weibull distribution with survivorship function, S(t) given as:

$$S(t) = e^{-(\lambda t)^{\gamma}}$$

Where γ and λ are parameters.

How do you ascertain the appropriate weibull fit for a given survival data?

(C) Consider the generalized form of the weibull distribution with guarantee time, G whose specifications are as follows:

$G = 0$, $\lambda = 1$, $\gamma = 0.5$

Find Mean and Variance survival time

QUESTION 5 (20 marks)

(a) For the i^{th} individual, let values of P variables be $x_{1i}, x_{2i}, \ldots\ldots x_{pi}$. If $h_i(t)$ is the hazard function of the i^{th} individual, write an expression relating $h_i(t)$ and the baseline hazard, $h_0(t)$, making cox proportional hazards assumption.

(b) Illustrate how you would estimate the coefficients of x_{ji}'s in (a) above

(c) What are accelerated failure time models?

(d) Assume survival time T_i follows exponential distribution with a parameter λ. Under the assumption of right Censored data, obtain the likelihood for the exponential model.