



KIBABII UNIVERSITY COLLEGE (KIBUCO)

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2014 /2015 ACADEMIC YEAR**

FOURTH YEAR FIRST SEMESTER EXAMINATIONS

MAIN EXAMINATION

FOR THE DEGREE

OF

BACHELOR OF EDUCATION SCIENCE

COURSE CODE: STA 447

COURSE TITLE: SURVIVAL ANALYSIS

DATE: Tuesday 20th January 2015

TIME: 11.30-2.30 P.M.

INSTRUCTIONS TO CANDIDATES: 1

Answer Question ONE and any other Two Questions

TIME:3 Hours

QUESTION 1: (30 Marks)

(a) Define the following 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 illustrating how the three functions, $S(t)$, $h(t)$ and $f(t)$ are related (3 Marks)

State the uses of the Survivorship or Survival function. (3 Marks)

- (b) What do you understand by the term Censoring? (2 Marks)
Distinguish right censoring from left censoring. (3 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) Given the Survivorship function,

$$S(t) = \exp(-t^x)$$

Derive the corresponding probability density function and the hazard function. (6+4 Marks)

QUESTION 2: (20 Marks)

Consider the Survival data below;

Year of follow-up	Number alive at beginning of interval	Number dying in interval
0 - 1	1100	240
1 - 2	860	180
2 - 3	680	184
3 - 4	496	138
4 - 5	358	118
5 - 6	240	60
6 - 7	180	52
7 - 8	128	44

8 - 9	84	32
≥ 9	52	28

Compute and plot;

- (i) the estimated Survivorship function, (7 Marks)
- (ii) the probability density function and (7 Marks)
- (iii) the hazard function (6 Marks)

QUESTION 3: (20 Marks)

Consider a Clinical Trial in which 10 Lung Cancer patients are followed to death. The table is given below.

<u>t(months)</u>	<u>i</u>
4	1
5	2
6	3
8	4
8	5
8	6
10	7
10	8
11	9
12	10

- (i) Obtain the product limit (PL) estimate of the Survivorship function, $\hat{S}(t)$.
Comment on the result so obtained in relation to a corresponding binomial estimate. (10 +2 Marks)
- (ii) Find $\text{Var} [\hat{S}(5)]$ and hence the estimated standard error (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. (4 Marks)
- (b) Let the Survival time, T follow the Weibull distribution with Survivorship function, S(t) given as:

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

Where λ and α are parameters.

How do you ascertain the appropriate Weibull fit for a given Survival data ?.

(8 Marks)

(c) Consider the generalised form of the Weibull distribution with guarantee time, G whose specifications are as follows:

$$G=0, \quad \alpha = 1, \quad \lambda = 0.5$$

Find,

- (i) Mean and (4 Marks)
- (ii) Variance Survival time (4 Marks)

QUESTION 5: (20 Marks)

- (a) For the i^{th} individual, let values of p variables be $x_{1i}, x_{2i}, \dots, x_{pi}$. 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. (4 Marks)
- (b) Illustrate how you would estimate the coefficients of x_{ji} 's in (a) above. (8 Marks)
- (c) What are Accelerated failure time models? (3 Marks)
- (d) Assume Survival time T_i follows exponential distribution with a parameter λ . Under the assumption of right censored data, obtain the Likelihood function for the exponential model. (5 Marks)