



(Knowledge for Development)

KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR
FOURTH YEAR FIRST SEMESTER
MAIN EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: STA 447

COURSE TITLE: SURVIVAL ANALYSIS

DATE: 14/7/2021

TIME: 9 AM - 11 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

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QUESTION 1: (30 marks)

(a) i) What do you understand by the term Censoring? (2 marks)

ii) Distinguish right Censoring from left censoring (3 marks)

(b) Illustrate how you would determine that a given data of survival time T come from an exponential distribution (4 marks)

(c) Given the Survival function,

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

Derive the probability density function and the hazard function. (4 + 4 marks)

(d) 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? (6 marks)

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

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

Find,

(i) Mean and (3 marks)

(ii) Variance survival time (4 marks)

QUESTION 2: (20 marks)

Consider the survival data below

Year of follow-up	Number alive at beginning of interval	Number dying in the 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>Time, t (in 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 the corresponding binomial estimate. (10 + 2 marks)
- (ii) Find $Var[\hat{S}(5)]$ and hence the estimated standard error (5 + 3 marks)

QUESTION 4: (20 marks)

- (a) Let $t_1, t_2, t_3, \dots, t_n$ 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 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? (2 marks)

(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. (6 marks)