

4770

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7. Explain the following :

- (a) Type-1 censoring and reasons for censored data,
- (b) Crude Probability of death,
- (c) General Epidemic model,
- (d) Single and triple blinding,
- (e) Net Probability of death. (3×5)

(1000)

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4770 E

Unique Paper Code : 32377910

Name of the Paper : Survival Analysis and Bio-Statistics (DSE-3(b))

Name of the Course : B.Sc. (Hons.) Statistics under CBCS (LOCF)

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. **Section A** is compulsory. Attempt **four** questions from **Section B**.
4. **All** questions carry equal marks.
5. Use of a non-programmable scientific calculator is allowed.

P.T.O.

## Section A

1. Answer each of the following :

(a) For the hazard function  $\lambda(t) = \lambda\gamma(\lambda t)^{\gamma-1}$ , compute the survival function and death density function.

(b) For the piecewise exponential density, given

$$\lambda(t) = \begin{cases} 0.2 & 0 \leq t < 1 \\ 0.4 & t \geq 1 \end{cases}$$

Estimate  $S(t)$  and  $f(t)$ .

(c) Give the objective of Phase-II of clinical trial. Also, give its importance.

(d) Find the death density function due to two risks  $R_1$  and  $R_2$  when risks are independent.

(e) Distinguish between linkage and recombination, with a suitable example. (3×5)

## Section B

2. (a) Given below is the survival history of 500 patients and deaths from cancer ( $R_1$ ), cardio-vascular ( $R_2$ ) and accidents ( $R_3$ ). Compute probability of death (i) when cancer was the only risk operating in the

- (b) Consider the following recovery times (in weeks) of 16 patients suffering from a lung infection. Estimate the remission time and variance of the estimated remission time at each time point.

4	5	6	7	8+	13	15	16	17	18	20+	25	22	26+	27	28+
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(7,8)

6. (a) Explain the Life table method for estimating survival function. Using this method, estimate the survival function and also compute the variance of the estimated survival function at each interval time.

- (b) Two researchers started their study on 22 patients to test the efficacy of drugs A for the remission of Covid. The first researcher terminated the study after one month and the second researcher terminated the study after the recovery of the 15<sup>th</sup> patient. The survival times (in days) are :

Remission Time	8	9	10	11	14	18.5	20	22	15	12	17
	28	24	22	19	18	35	32	26	27	28	37

Assuming that times of remission follow exponential distribution, obtain the mean survival time for both studies. Also, find their variance of the estimated mean survival time. Comment on your results. (7,8)

population, and (ii) when cancer risk was off from the population.

Age Interval	Number of patients alive at the beginning of the Interval	Number dying in the Interval	Number of deaths due to cancer	Number of deaths due to cardio-vascular	Number of deaths due to Accidents
20-30	500	80	20	8	16
40-50	420	70	8	15	6
50-60	350	55	20	8	5
60-70	295	35	7	5	5

(b) Show that  $\widehat{p}_i$  and  $\widehat{Q}_{i\delta}$  are unbiased estimators of  $p_i$  and  $Q_{i\delta}$ , respectively. Also, find  $\text{var}(\widehat{Q}_{i\delta})$  and  $\text{cov}(\widehat{Q}_{i\delta}, \widehat{Q}_{i\epsilon})$ , where, notations have their usual meaning. (7,8)

3. (a) Define and construct segregation matrix for the gamete AB. Also, compute  $g_1, g_2, g_3,$  and  $g_4$  for the fourth and seventh generation for  $g_1 = 0.4, g_2 = 0.2, g_3 = 0.3, g_4 = 0.1$  and  $\lambda = 0.38$ .

(b) Explain Type-II censoring. Also, obtain the estimate of mean survival time ( $\widehat{\mu}$ ) and its variance  $\text{Var}(\widehat{\mu})$  assuming that the sample is taken from an exponential population. (7,8)

4. (a) Define the Simple Stochastic epidemic model, and find the probability that there are  $r$  number of susceptible at time  $t$  given that there are  $n$  ( $n > r$ ) number of susceptible and one infective at time  $t=0$ .

- (b) Define all the components of survival analysis. The table given below gives the survival data of 50 patients with hypertension. The survival data are grouped into 2 years. Compute the estimated hazard function. Also, comment on the result for the last cell of hazard function.

Year	Number of patients surviving at beginning of interval	Number of patients dying in interval
0-2	50	10
2-4	40	5
4-6	35	10
6-8	25	2
$\geq 8$	23	5

(10,5)

5. (a) Using modified Chi- square method of estimation, obtain the estimate of probability of survival and crude probability of death for the given age interval,  $t$ .