[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 280

Unique Paper Code : 2373010011

Name of the Paper : Bio-Statistics (NEP-UGCF)

Name of the Course : **B.Sc. (H) Statistics**

Semester : VI

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions in all. Question **1** is compulsory and **five** questions from the remaining questions.
3. Use of non-programmable scientific calculator is allowed.

1. (a) Obtain the death density function and survival function when $h(t) = c + \exp(-ct)$.

(b) Consider that pain relief time follows the gamma distribution with λ =1.5 and γ =0.5. Find the mean survival time, variance, and coefficient of variation.

(c) Explain randomly progressive type 1 censoring with an example.

(d) Define genotype and phenotype with an example.

(e) For the piecewise exponential density, given

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

Estimate S(t) and f(t). (5×3=15)

2(a) Define the components of survival analysis. The table below presents survival data for 70 patients with CVD. Compute the estimated survival function, hazard function and death density function.

Year	Number of patients surviving at beginning of interval	Number of patients dying in the interval
0-2	70	12

P.T.O.

2-4	58	8
4-6	50	15
6-8	35	5
8-12	30	7

(b) Show that $\widehat{p_i}$ and $\widehat{Q_{i\delta}}$ are unbiased estimators of p_i , $Q_{i\delta}$ respectively. Also, find $var(\widehat{Q_{i\delta}},)$ *and* $cov(\widehat{Q_{i\delta}}, \widehat{Q_{i\epsilon}})$.

(7, 8)

3(a) Survival time T follows the Weibull distribution with parameters γ and λ. Derive the mean survival time, variance, and coefficient of variation. Also, find these expressions when the shape parameter =1.

(b) Define net probability type-A and estimate this probability of death using the maximum likelihood method.

(7, 8)

4(a) Define the segregation matrix and construct a segregation matrix for gamate Ab. Compute g_1 , g_2 , g_3 and g_4 for the sixth and seventh generation for given $g_1 = 0.38$, $g_2 = 0.2$, $g_3 = 0.27$, $g_4 = 0.15$ and $\lambda = 0.38$.

(b) Suppose there are two linked loci A and B, each with two alleles. Let λ be the recombination fraction. Suppose the gametic probabilities of the initial population are γ: $g_1 = P(AB) = P(\gamma_1)$, $g_2 = P(Ab) = P(\gamma_2)$, $g_3 = P(aB) = P(\gamma_3)$, $g_4 = P(ab) = P(\gamma_4)$. Obtain the appropriate segregation matrix for the gamete γ_1. Hence, derive the distribution of the gametic output for γ_1 =AB in the n^{th} generation.

(7, 8)

5(a) A team of researchers started their study on 22 patients to test the efficacy of a drug for the remission of stomach infection. Researchers terminated the study after the recovery of the 12th patient. The remission times (in days) are:

Remission	6	7	9	11	15	16	19	22	17	12	21
Time (in days)	25	27	8	4	28	32	31	13	26	14	20

Assuming times of remission follow an exponential distribution. Explain the type of censoring to obtain the mean survival time and the variance of the estimated mean survival time.

(b) Explain Type-I censoring. Also. obtain the estimate of the mean survival time ($\hat{\mu}$) and its variance Var($\hat{\mu}$) assuming the sample is taken from an exponential population.

(7, 8)

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

(b) Consider a clinical trial in which 13 patients are observed to have the following survival pattern (in months):

6.5	2.3	3	3.5+	4	4.5+	5.5	5+	8+	11	12+	6	7.5

Estimate the survival function and standard error of its estimated survival function at each uncensored survival times.

(7, 8)

7(a) Define partially crude probability of death. Given below the survival history of 600 patients and deaths due to cancer (R_1), CVD (R_2), and road accident (R_3). Compute the probability of death due to road accidents when the risk of CVD was eliminated 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 CVD	Number of deaths due to road accidents
30-40	600	100	14	8	22
40-50	500	70	8	10	8
50-60	430	55	11	5	6
60-70	375	40	7	6	5

(b) A team of doctors carried out their study on 18 patients at Apollo Hospital to test the efficacy of a drug for the remission of blood infection. The hospital terminated the study after one month (1 month=30 days) . The remission times (in days) are:

Remission	6	7	9+	11	15	16	19	22	17	12	21+
Time (in days)	25	27	8	4	32	31	13+				

Assuming times of remission follow an exponential distribution. Explain the type of censoring to obtain the mean survival time and the variance of the estimated mean survival time.

(9, 6)