M.Sc. Examination, 2019
Semester-IV
Statistics
Course : MSC-42
(Survival Analysis)

Time : 3 Hours **Full Marks : 40**

Questions are of value as indicated in the margin

Answer **any four** questions

1. Describe Kaplan-Meier estimator to estimate a survival function for censored data. Find an expression of the variance of the estimator. 5+5
2. Define Nelson-Aalen estimator for the cumulative hazard function

$$\Lambda(t) = \int_0^t \lambda(u)du$$

Show that the estimator is approximately unbiased. Find out the variance of the estimator. Also find out an unbiased estimator of $Var(\widehat{\Lambda}(t))$. 2+2+3+3
3. A. Describe in details how to construct likelihood for right censored data. How will you modify the likelihood, if data is left censored?
B. Suppose the underlying survival time T is from an exponential distribution with parameter λ and we have right censored data. Find the $100(1-\alpha)\%$ confidence interval for λ. (4+2)+4

4. Suppose we want to compare two survival functions. Define weighted log rank test statistic in this regard. How does it differ from log rank test? Find mean and variance of the statistic. Also derive the asymptotic distribution of the statistic. 2+1+4+3
5. A. What is a proportional hazard model? Why is it called proportional? Is it a parametric or nonparametric model?
B. What is partial likelihood? Describe the inferential procedure to estimate parameters involved in a Cox proportional hazard model using partial likelihood. (2+1+1)+(1+5)

6. Define cause specific hazard function and cumulative incidence function. Clearly stating all assumptions, derive the likelihood function for competing risks. Show that the overall survival function $S(t)$ can be expressed as

$$S(t) = \Sigma_j P(T > t, C = j)$$

(symbols having usual meaning) 3+3+4