Indian Statistical Institute

M.S.(QMS) First Year

Second Semester – Reliability, Maintainability and Safety - II

Mid Term Exam   Date: 22/02/2023   Time: 2 hours   Maximum Marks: 50

1. How does accelerated life testing (ALT) work? Explain any two types of ALT plans.   [10]

2. Describe any three ALT models used in reliability studies.   [5]

3. Assuming exponential distribution, obtain the MLE of λ for type – 1 censored data. Use the usual notations.   [5]

4. Write down the likelihood function in the simplified form for type – 2 interval censoring model, assuming exponential distribution.   [4]

5. Explain the role of FMEA & FTA in improving the reliability of a system. $[3 + 3 = 6]$

6. a) Consider a series system with n components. Suppose the ith component has reliability function $R_i(t) = exp\left(-\lambda_i t^{\frac{3}{2}}\right), i = 1(1)n$. Check whether the hazard function of the system is IFR or DFR.

   b) Assume that the hazard rate for a device is given by
   $$\lambda(t) = \frac{\theta}{1+e^{-t}} \quad . \quad t > 0, \ \theta > 0 .$$

   Assume n identical devices are put on a life test at time $t = 0$. The life test is continued until a pre-specified number $r \ (1 \leq r \leq n)$ of devices have failed (the remaining are censored at the rth failure time). Find the maximum likelihood estimator of reliability of a unit at time t_0. $[5 + 5 = 10]$

7. Consider a system with 4 components with the following structure function.
   $$\varphi(x) = min\{x1, x2, max(x3, x4)\}$$

   Draw the reliability block diagram. Also find minimum cut sets and minimum path sets.

   Let T_i be the lifetime of component $i, i = 1, 2, 3, 4$, and $T_1 \sim Weibull(2, \lambda_1), T_2 \sim Weibull(3, \lambda_2), T_3 \sim Exp(\lambda_3)$ and $T_4 \sim Exp(\lambda_3)$.
   Assume that the lifetimes are independently distributed. Check whether the system lifetime distribution is IFR or DFR. $[2 + 3 + 5 = 10]$

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