

2021

## STATISTICS — GENERAL

Paper : DSE-B-1

(Survival Analysis)

Full Marks : 50

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

1. Answer **any five** questions : 2×5
- Define time to an event.
  - What is a survival function?
  - Define cumulative hazard function.
  - What is Increasing Failure Rate?
  - Define mean residual life.
  - Distinguish between Truncation and Censoring.
  - Why do we need non-parametric survival models?
  - What is random censoring?
2. Answer **any two** questions : 5×2
- Show that exponential distribution has a constant hazard function.
  - Derive the expression for the mean residual life of gamma distribution.
  - Discuss, using an example, the necessity of censoring in survival analysis.
3. Answer **any three** questions :
- Define hazard function.
    - Discuss its importance in survival analysis.
    - Assuming time (t) to be continuous, discuss the relationship between cdf, hazard function and survival function. 2+3+5
  - Discuss about the bathtub shaped failure rate life distributions,
    - If the distribution function of Weibull distribution is
 
$$F_{\alpha}(t) = 1 - e^{-(\lambda t)^{\alpha}}, \text{ for } t \geq 0, \text{ where, } \alpha, \lambda > 0,$$
 then show that Weibull is IFR for  $\alpha > 1$  and DFR for  $0 < \alpha < 1$ . 5+5

**Please Turn Over**

- (c) (i) Distinguish between left censoring and right censoring.  
(ii) Discuss a biological example of importance of random censoring.  
(iii) Derive the expression for the mean survival time of Type-I censoring. 3+3+4
- (d) (i) Derive the Kaplan-Meier Estimator of a survival function.  
(ii) Derive the expression for the standard error of Kaplan-Meier Estimator. 5+5
- (e) (i) Derive the expression for Greenwood's formula in the context of actuarial survival analysis,  
(ii) Discuss the practical applicability of the actuarial method. 7+3
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