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**MST-021**

**M. SC. (APPLIED STATISTICS)**

**(MSCAST)**

**Term-End Examination**

**June, 2026**

**MST-021 : CLASSICAL AND**

**BAYESIAN INFERENCE**

*Time : 3 Hours*

*Maximum Marks : 50*

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**Note :** (i) *Question No. 1 is compulsory.*

(ii) *Attempt any **four** questions from the remaining Question Nos. 2 to 6.*

(iii) *Use of Scientific Calculator (non-programmable) is allowed.*

(iv) *Symbols have their usual meanings.*

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1. State whether the following statements are True or False. Give reasons in support of your answers : 5×2=10

- (a) An estimator  $T$  of a parameter  $\theta$  is said to be uniformly minimum variance unbiased estimator if  $E(T) = \theta$ .
- (b) Mann-Whitney  $U$  test is used for paired sampled data only.
- (c) The Neyman-Pearson lemma provides the most powerful test for testing a simple hypothesis against a composite hypothesis.
- (d) Squared error loss function  $L(\theta) = (\theta - a)^2$  is an example of an asymmetric loss function.
- (e) Rao-Blackwell theorem gives procedure to provide the best unbiased estimator.

2. Lifetime of an electronic component follows an exponential distribution whose pdf is given as follows :

$$f(x; \theta) = \frac{1}{\theta} e^{-\frac{x}{\theta}}; x > 0, \theta > 0$$

To estimate average lifetime of this electronic component, a researcher has noted lifetimes of  $n$  randomly produced components. 10

- (i) Determine Cramer-Rao lower bound for variance of an unbiased estimator of the parameter  $\theta$ .
- (ii) Show that the sample mean is the UMVUE of the parameter  $\theta$ .
3. A car manufacturing company produces steel rods that are used in a vehicle frame. The company claims that the average length of rod is 200 cm. However an external

quality control agency wants to verify whether the actual produced length is significantly different from their claim. Assuming that the length of the manufactured rods follow normal distribution with mean  $\mu = \mu_0 = 200$  and known variance  $\sigma^2$ , determine uniformly most powerful test for testing hypothesis  $H_0 : \mu = \mu_0 = 200$  against  $H_1 : \mu \neq \mu_0$  at  $\alpha\%$  level of significance. 10

4. A psychologist wants to test whether there is an association between social media usage and the users' mental health status. A survey of 360 individuals is, therefore, conducted and the responses are

summarized in the following contingency table :

| Social Media Usage | Depressed | Moderate Mental Health | Good Mental Health |
|--------------------|-----------|------------------------|--------------------|
| Low Usage          | 30        | 50                     | 80                 |
| Moderate Usage     | 40        | 60                     | 40                 |
| High Usage         | 50        | 30                     | 20                 |

Test whether there is a significant relation between social media usage and mental health status at 5% level of significance ?

(Given  $\chi^2_{(9),0.05} = 16.92$ ,  $\chi^2_{(4),0.05} = 9.49$ ) 10

5. (i) Generate a complete cycle for the following Linear Congruential Generator (LCG) : 10

$$X_i = (5 X_{i-1} + 3) \bmod 16, \text{ given } X_0 = 5$$

- (ii) For an unbiased coin that is tossed successively ten times, use the first ten random numbers generated by given LCG, to present a sample sequence of heads and tails.
- (iii) Generate two random numbers from the Binomial distribution  $B(5, 0.5)$  by using the sequence of heads and tails obtained in part (ii). 10
6. (a) Write a concept note on non-informative priors with focus on ideology of Jeffrey's prior.
- (b) Describe difference in approaches of Classical and Bayesian inference. Use mathematical notations wherever necessary.
- (c) Define and distinguish between Parametric and Non-Parametric Tests while stating underlying assumptions.

2+4+4

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