RAN-2403081803044001

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M. Sc. (Sem.-III) Examination October - 2025

Applied Statistics : STATISTICAL SIMULATION (3041)

Time: 3 Hours] **[Total Marks: 70**

સૂચના : / Instructions

(1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book

(2) Each question carries 14 marks.

(3) All questions are compulsory.

Seat No.:

Student's Signature

Q.1. **Attempt any two of the followings:** **14**

(a) What is random variable? Discuss the process of generate random variable using different distribution in simulation process.

(b) Compare any two algorithms to generate normal distribution.

(c) A researcher is trying to model student exam scores using Normal distribution.
i. Compare two different algorithms to generate Normal random numbers (e.g., Box-Muller vs Ziggurat).
ii. Which one would you recommend if speed is important?

Q.2. **Attempt any two of the followings:** **14**

(a) What is MCMC. Explain Gibbs sampler in detail.

(b) What is conditional distributions? and which method we can use if we have conditional distributions.

(c) i. Define Control Variates and Antithetic Variables.
ii. Discuss variance reduction technique.

Q.3. **Attempt any two of the followings:** **14**

(a) i. What is a Non-Homogeneous Poisson Process (NHPP)?
ii. State applications of NHPP.

(b) Explain the principle of simulated annealing with a suitable illustration.

(c) Describe optimization using Monte Carlo methods with a real-life example.

Q.4. **Attempt any two of the followings:** **14**

(a) Explain bootstrap resampling for estimation of sampling distribution.

(b) Discuss the jackknife technique and its applications.

(c) Explain bias and standard error estimation using resampling methods.

Q.5. **Attempt any two of the followings:** **14**

(a) Explain bootstrap methods for variance stabilizing transformation.

(b) Discuss simulation applications in real-life problems.

(c) You are managing a chain of cafes and want to optimize the price of coffee to maximize overall profit. The demand is uncertain and depends on how sensitive customers are to price changes.

i. How can MCMC methods help in solving this optimization problem of finding the best coffee price?

ii. Give one practical challenge (e.g., demand uncertainty, customer behavior variability) that MCMC can overcome compared to traditional trial-and error pricing methods.

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