MA 323 | Quiz I
Monte Carlo Simulation | 09:00–10:00 IST
IIT GUWAHATI | September 27, 2021

Instructions

1. Attempt **all** the questions.
2. There is **no credit** for a solution if the appropriate work is not shown, even if the answer is correct.
3. Notations are standard and same as used during the lectures.
4. No question requires any clarification from the instructor. Even if a question has an error or incomplete data, the students are advised to write answer according to their understanding or write reasons for why it is not possible to solve the question partially or completely by citing errors/insufficient data.
5. Write the answers on blank papers (preferably white). You must write your name and roll number on the first page. Every page (both sides) must be self-attested and numbered. Please scan all the pages and make a single PDF file. It is your responsibility to check quality of the PDF file so that it is easily readable. Upload the file through Microsoft Teams against the assignment. The portal will remain active till 10:03 hours and you need to complete the submission procedure by 10:03 hours. If you submit through any other means, **a penalty of 15 marks will be imposed**.
6. The question paper has **1** page. This examination has **3** questions, for a total of **10** points.

Questions

1. (3 points) Generate the complete cycle for the linear congruent generators below and state the observed period.
   (a) $x_{i+1} = 5x_i + 3 \bmod 16$, $x_0 = 7$.
   (b) $x_{i+1} = 5x_i + 3 \bmod 16$, $x_0 = 5$.
   (c) $x_{i+1} = 5x_i \bmod 16$, $x_0 = 5$.
2. (4 points) Devise an acceptance-rejection algorithm to generate a random number from the probability density function

$$f(x) = \sqrt{\frac{2}{\pi}}\, e^{-\frac{x^2}{2}} \quad \text{for } x > 0$$

   using an $Exp(\lambda)$ as proposal distribution. Which λ gives the largest acceptance probability?
3. (3 points) Devise an algorithm to generate a random number from the probability mass function

$$f(x) = cp(1-p)^{x-1} \quad \text{for } x = 1,\, 2,\, \ldots,\, n,$$

   where $0 < p < 1$, $n > 1$ is an integer, and c is a normalizing constant.