Computerized Simulation
Exercise No. 3
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By:

Assist. Prof. Dr. Amirhossein Tabatabaei

Department of Computer Science
University of Guilan

1. Write a program using the accept-reject method to generate random numbers following a custom probability distribution defined by a piecewise function as follows.

$$f(x) = \begin{cases} 2x & 0 \leq x \leq 0.5 \\ 2(1-x) & 0.5 < x \leq 1 \end{cases}$$

2. Simulate the distribution of angles at which particles scatter when the probability distribution of scattering angles is proportional to $\cos^2(x)$ Use the accept-reject method to generate the angles.

3. Simulate service times for customers in a queue. Assume service times follow a specific distribution (e.g., $f(x) = xe^{-x}$, and use the accept-reject method to generate the times. Analyze the average waiting time.

4. Generate random numbers for a triangular distribution defined on $[a, b]$ with mode c.

5. Implement a random number generator for the Rayleigh distribution with variance σ^2.

6. Imagine a bank with multiple counters where customers arrive randomly. The arrival times of customers are independent and can be modeled using an exponential distribution. Similarly, the time taken to service a customer at a counter (service time) is also random and follows an exponential distribution (NOTE: Please implement exponential random number generators by yourself with arbitrary parameters).

   Please:

   (a) Simulate customer arrivals and service times over a period.

(b) Analyze key metrics like: Average waiting time, Counter utilization (how busy they are),and total time customers spend in the system.

7. A logistics company operates a fleet of drones to deliver packages. Each package has a random destination within a defined area, and each drone has constraints like maximum payload and battery range. Packages arrive randomly over time, and drones are dispatched accordingly.

   Inputs:

   (a) Delivery area: A 2D space (e.g., a grid of 10 km x 10 km).

   (b) Drone characteristics: Speed, maximum payload, and battery range.

   (c) Package data: Randomly generated delivery locations, weights, and arrival times.

   Tasks:

   (a) Generate random package data

   (b) Drone dispatch logic

   (c) Simulate drone movements

   (d) Analyze metrics: Average delivery time, Total distance traveled by all drones