



The Exam is in two Pages

Answer the following questions. Full credit is 60.

Question (1) (15 points) Answer the following questions

- A. (6 points)** Consider the problem of minimizing the waiting time for customers at an ATM bank machine.
 - (i) Suggest a simulation model, Explain the conceptual and the specification models and discuss what variables should be effective in the simulation.
 - (ii) Discuss whether the simulation model should be static or dynamic, deterministic or stochastic, continuous or discrete.
- B. (4 points)** What are the disadvantages of using simulation?
- C. (5 points)** Derive the first four random numbers generated by the Linear Congruential Generator with multiplier 5, increment 3, modulus 16, seed 7.

Question (2) (15 points) Answer the following questions:

- A. (3 points)** Why do we use simulation in operational systems (Systems that actually exist and running) ?
- B. (4 points)** In building a model for some system, what is the difference between Validation and Verification.
- C. (8 points)** Consider the Von Neumann's Midsquare Method for generating random numbers between 0.01 and 0.99. Using 12 as your seed (the starting number), List all generated numbers. Then use these numbers to generate sequences of random variates:
 - (i) uniformly distributed on (2, 5].
 - (ii) exponentially distributed with $\lambda = 3.8$

Question (3) (16 points) Answer the following questions

- A. (5 points)** After an initial exam at the emergency room in a certain hospital, the patients are expected to go to the X-ray department with probability 45%, and to the operating room with probability 15%, the observation room 10%, and the out processing clerk 30%. Write a procedure to simulate the entrance of patients to this emergency room.

B. (6 points) Outline a procedure to generate 10 random numbers normally distributed with mean of 27 and standard deviation 3.

C. (5 points) Use Monte Carlo Simulation to explain how you can estimate the area under the following function and bounded by the vertical lines $x=b$ and $x=c$. (Use the height of the rectangle h_{max}

$$f(x) = \frac{1}{1+x^2}$$

Question (4) (16 points) Answer the following questions

A. (6 points) Mention and **explain** the stages of the Model Development Life Cycle.

B. (5 points) Give the inverse transform algorithm for generating the Weibull Distribution. Where the CDF of the Weibull is

$$F(X) = 1 - e^{-\left(\frac{x}{\alpha}\right)^\beta}$$

C. (5 points) For the following multiplicative LCG,
 $Z_i = (13 Z_{i-1} + 12) \pmod{16}, Z_0 = 1,$

- Compute Z_i for enough values for $i=1$ to cover the entire cycle.
- What is the length of this cycle ?
- Why it does not have a full period?

Best Wishes
Areeg Abdalla