

Submission Deadline: July 31, 2024, 04:30 PM

Problems 1-3 are for the following general linear congruence generator:

$$\begin{aligned}x_{i+1} &= (ax_i + b) \bmod m \\u_{i+1} &= x_{i+1}/m.\end{aligned}$$

1. Generate the sequence of numbers x_i for $a = 6$, $b = 0$, $m = 11$, and x_0 ranging from 0 to 10. Also, generate the sequence of numbers x_i for $a = 3$, $b = 0$, $m = 11$, and x_0 ranging from 0 to 10. Observe the sequence of numbers generated and observe the repetition of values. Tabulate these for each group of values. How many distinct values appear before repetitions? Which, in your opinion, are the best choices and why?
2. Generate a sequence u_i , $i = 1, 2, \dots, 10000$ with $m = 244944$, $a = 1597$, $b = 51749$ (choosing x_0 as per your choice). Then group the values in the ranges

$$[0, 0.05), [0.05, 0.10), [0.10, 0.15), \dots, [0.95, 1)$$

and observe their frequencies (*i.e.*, the number of values falling in each group). For 5 different x_0 values, tabulate the frequencies in each case, draw the bar diagrams for these data and put in your observations. Write the choices of x_0 in the report.

3. Generate a sequence u_i , $i = 1, 2, \dots, 10000$ with $a = 1229$, $b = 1$, $m = 2048$ and choosing a value for x_0 . Plot in a two-dimensional graph the points (u_{i-1}, u_i) , *i.e.*, the points (u_1, u_2) , (u_2, u_3) , (u_3, u_4) , \dots . Write the choice of x_0 in the report.
4. Consider the recursion:

$$U_{i+1} = (U_{i-17} - U_{i-5}).$$

In the event that $U_i < 0$, set $U_i = U_i + 1$. Choosing seed appropriately, perform following parts.

- (a) Use linear congruence generator to generate the first 17 values of U_i .
 - (b) Then generate the values of $U_{18}, U_{19}, \dots, U_N$ for $N = 1000, 10000$, and 100000 based on the recursion above.
 - (c) For each N , plot histogram. What are your observations?
 - (d) For each N , plot (U_i, U_{i+1}) . What are your observations?
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