MA 323 : MONTE CARLO SIMULATION

LAB 11

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Discrepancy of point sets

The Linear Congruence Generator used for generating the point set

$$\{ x_0 , x_1 , x_2 , x_3 , \ldots\ldots\ldots , x_n \}$$

is specified by parameters:

a = 1229, b = 1, m = 2048, x_0 = 213.

$$X_{n+1} = (a*X_n + b) \% m$$

$$u_{n+1} = X_{n+1} / m$$

The value of n i.e. number of elements in sequence is taken as **(m-1)** which is equal to the full period of LCG used.

For different values of N, the discrepancy of the point set $\{x_0 , x_1 , x_2 , \ldots , x_{2047} \}$ relative to A is calculated. For each $\mathcal{A}$ in A the **vol($\mathcal{A}$) = 1/N** and any two subintervals are disjoint.

$$\textbf{Discrepancy} = \sup_{\mathcal{A}\in A} \left| \left(\#\{x_i \in \mathcal{A}\}/2048 \right) - (1/N) \right|$$

The values of discrepancy of point set as obtained are as follows:

N Values	Discrepancy
10	0.00034196
20	0.00031754
50	0.00045921
100	0.00071812

The discrepancy obtained in each case is very low, of the order of 10^{-4} , which implies that the pseudo random uniform distribution generated using specified LCG above is very close to perfect uniformity. The value of the discrepancy being low even at higher values of N signifies the granularity of the distribution.