Linear Congruential Method

$X_{i+1} = (a\ X_i + c) \bmod m$ and $R_i = X_i / m$

Where a and c are constants & X_0 is the intial seed. We select them or they are mentioned beforehand. M is taken usually as power of 2 ($2^1, 2^2 \ldots$) as it equals computer word capacity

Eg:- let $a = 13$
$m = 2^6$ $X_0 = 2$ and $c = 0$.
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so,

$X_1 = (a X_0 + c) \bmod m$

$= (13 \times 2 + 0) \bmod 64$

$= 26$

$R_1 = \frac{26}{64}$

$X_2 = (a x_1 + c) \bmod m$

$= (13 \times 26 + 0) \bmod 64$

$= 18$

$R_2 = \frac{18}{64}$

$X_3 = (a x_2 + c) \bmod m$

$= (13 \times 18 + 0) \bmod 64$

$= 42$

$R_3 = 42/64 =$

$X_4 = 34$ $X_6 = 50$

$X_5 = 58$ $X_7 = 10$

$X_8 = 2$

Here $X_9 = 26$ and values of X_i will be in loop

So, the period of Random Number Generator is 8.

Numerical 2

Generate a sequence of random number with initial seed $X_0 = 27$, $a = 17$, $c = 43$ & $m = 100$

$X_i = (aX_i + c) \mod m$

$X_1 = (17 \times X_0 + 43) \mod 100$

$= (17 \times 27 + 43) \mod 100$

$X_1 = 2$ $R_1 = \frac{X_1}{m} = \frac{2}{100} = 0.02$

$X_2 = (17 \times 2 + 43) \mod 100$

$X_2 = 77$ $R_2 = 77/100 = 0.77$

$X_3 = (17 \times 77 + 43) \mod 100$

$= 52$ $R_3 = 0.52$

$X_4 = (17 \cdot 52 + 43) \mod 100$ $R_4 = 27/100 = 0.27$

$= 27$

$X_5 = (17 \cdot 27 + 43) \bmod 100$
$= 2$

Since, $\because X_5$ & X_0 is same so after this random number generator goes in a loop. So we stop & the period of length is ~~5~~ 4.

Numerical 3 $a = 5$ $c = 1$ $m = 8.$ & $X_0 = 3$

Numerical 4 Max m period

$m = 2^b = 2^3 = 8$

$c = 7$

$a = 5 = 1 + 4 \times 1$

$X_0 = 17$

$X_1 = \cancel{(5 \times X_0} \; (5 \cdot 17 + 7) \bmod 8$
$= 4$

$X_2 = (5 \times 4 + 7) \bmod 8$
$= 3$

$\cancel{X_8}$ $X_3 = (5 \times 3 + 7) \bmod 8$
$= 6$

$X_4 = (5 \times 6 + 7) \bmod 8$
$= 5$

$X_5 = (5 \times 5 + 7) \bmod 8$
$= 0$

$x_6 = 7 \bmod 8$
$= 7$

$x_7 = (5 \times 7 + 7) \bmod 8$
$= 2$

$x_8 = (5 \times 2 + 7) \bmod 8$
$= 1$

$x_9 = (5 + 7) \bmod 8$
$= 4$

Here the period is 8.