Homework 3

DATA604 Simulation and Modeling

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March 6, 2016

1

Starting with $X_0 = 1$, write down the entire cycle for $X_i = 11X_{i-1}\ mod(16)$

```
fn1 <- function(x0)
{
  df <- data.frame(X=c(), R=c())
  x <- x0
  continue <- TRUE

  while(continue)
  {
    xi <- (11 * x) %% 16
    df <- rbind(df, data.frame(X=x, R=xi))
    x <- xi

    if(xi == x0)
    {
      break
    }
  }

  return(df)
}

res <- fn1(1)
```

X	R
1	11
11	9
9	3
3	1

2

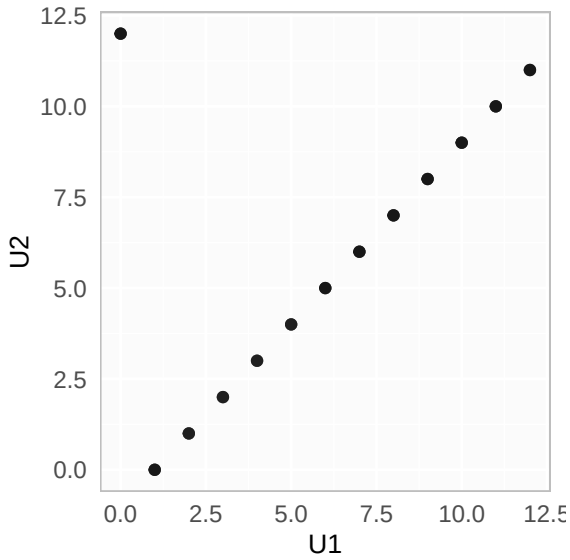
*Using the LCG provided below: $X_i = (X_{i-1} + 12)mod(13)$, plot the pairs $(U_1.U_2), (U_2, U_3), ...$ and observe the lattice structure obtained. Discuss what you observe.

```
fn2 <- function(x0, max=100)
{
  df <- data.frame(U1=c(), U2=c())
  x <- x0
  continue <- TRUE

  for(i in 1:max)
  {
    xi <- (x + 12) %% 13
```

```
    df <- rbind(df, data.frame(U1=x, U2=xi))
    x <- xi
  }

  return(df)
}
# Call the function starting at x0=1
res <- fn2(1)
```



The chart above suggests there are only 13 points, but actually the LCG cycle period is 13 and numbers are repeating.

U1	U2
1	0
0	12
12	11
11	10
10	9
9	8
8	7
7	6
6	5
5	4
4	3
3	2
2	1
1	0