Assignment # 2: Generating Random Numbers - 1.
Point: 50

1. Generate all possible random numbers by the LCG (103, 11, c, X_0). For X_0 use the day number of your birthday. For c value, add the digits of your birth year. You can use Excel for calculations and copy it into your report, but you must explain what the numbers are and how they are calculated. Identify the period of LCG and if it is not a full period identify the random numbers that are missing. Use only three digits of decimals. Find U_{240307} for this LCG without using Excel.

2. Repeat the same steps for problem 1 but assuming that you have a MLCG.

General Grading Scheme

Points are assigned to presence of following items:
1. Correct solution
2. Explanation of how the solution was generated and how the values are calculated with sample calculations
3. Extra research to add to the quality of report (bonus points)

Points are deducted for following items:
1. Late submission
2. Not following submission guidelines
3. Lack of explanation

Solution

1. Assume that birthday is Feb. 5, 1998. Then X0 = 5 and c = 1+9+9+8 = 27. a = 11 and m = 103 are already provided. Therefore, the LCG is $X_i = (11X_{i-1} + 27) \bmod 103$.
An EXCEL sheet was used to do the calculation. Xi values were calculated using the recursive formula. MOD function of EXCEL was used to calculate the vallues.
Sample calculation: For i =5, we have the following information,
$X_4 = 51$, a = 11, c=27 and m=103. Thus $X_5 = (11*51 + 27) \bmod 103 = 588 \bmod 103$. There are five 103s in 588, so 588 - 5*103 = 588 - 515 = 73.
The formula used in EXCEL is: =MOD((I$47*E53+J$47),K$47).
A period of 102 was accomplished which is remarkable (only 1 less than a full period of 103).

To calculate U_{240307} you simply need to find out what 240307 mod 102 is. That is how many periods are in 240307 and whatever the answer of the mod function is that will be used to find the value for U_{240307}. 240307 mod 102 = 97, so the 97th value of 0.74757 is the answer.

2. A Multiplicative Linear Congruential Generator (MLCG) is calculated the same as an LCG but with c = 0. MLCG period is 102 again. So the 97th value of 0.24272 is the answer for U_{240307}.

5	11	27	103

LCG		
i	X_i	$U_i = X_i / m$
0	5	
1	82	0.796117
2	2	0.019417
3	49	0.475728
4	51	0.495146
5	73	0.708738
6	6	0.058252
7	93	0.902913
8	20	0.194175
9	41	0.398058
10	66	0.640777
11	32	0.31068
12	70	0.679612
13	76	0.737864
14	39	0.378641
15	44	0.427184
16	99	0.961165
17	86	0.834951
18	46	0.446602
19	18	0.174757
20	19	0.184466
21	30	0.291262
22	48	0.466019

PERIOD = 102

23	40	0.38835	
24	55	0.533981	
25	14	0.135922	
26	78	0.757282	
27	61	0.592233	
28	80	0.776699	
29	83	0.805825	
30	13	0.126214	
31	67	0.650485	
32	43	0.417476	
33	88	0.854369	
34	68	0.660194	
35	54	0.524272	
36	3	0.029126	
37	60	0.582524	
38	69	0.669903	
39	65	0.631068	
40	21	0.203883	
41	52	0.504854	
42	84	0.815534	
43	24	0.23301	
44	85	0.825243	
45	35	0.339806	
46	0	0	
47	27	0.262136	
48	15	0.145631	
49	89	0.864078	
50	79	0.76699	
51	72	0.699029	
52	98	0.951456	
53	75	0.728155	
54	28	0.271845	
55	26	0.252427	
56	4	0.038835	
57	71	0.68932	
58	87	0.84466	
59	57	0.553398	
60	36	0.349515	
61	11	0.106796	
62	45	0.436893	
63	7	0.067961	
64	1	0.009709	
65	38	0.368932	
66	33	0.320388	
67	81	0.786408	
68	94	0.912621	
69	31	0.300971	

PERIOD = 102

PERIOD = 102

70	59	0.572816	
71	58	0.563107	
72	47	0.456311	
73	29	0.281553	
74	37	0.359223	
75	22	0.213592	
76	63	0.61165	
77	102	0.990291	
78	16	0.15534	
79	100	0.970874	
80	97	0.941748	
81	64	0.621359	
82	10	0.097087	
83	34	0.330097	
84	92	0.893204	
85	9	0.087379	
86	23	0.223301	
87	74	0.718447	
88	17	0.165049	
89	8	0.07767	
90	12	0.116505	
91	56	0.543689	
92	25	0.242718	
93	96	0.932039	
94	53	0.514563	
95	95	0.92233	
96	42	0.407767	
97	77	0.747573	
98	50	0.485437	
99	62	0.601942	
100	91	0.883495	
101	101	0.980583	
102	5	0.048544	
103	82	0.796117	
104	2	0.019417	
105	49	0.475728	

PERIOD =102

5	11	0	103

LCG		
i	X_i	$U_i = X_i / m$
0	5	
1	55	0.533981
2	90	0.873786
3	63	0.61165
4	75	0.728155
5	1	0.009709
6	11	0.106796
7	18	0.174757
8	95	0.92233
9	15	0.145631
10	62	0.601942
11	64	0.621359
12	86	0.834951
13	19	0.184466
14	3	0.029126
15	33	0.320388
16	54	0.524272
17	79	0.76699
18	45	0.436893
19	83	0.805825
20	89	0.864078
21	52	0.504854
22	57	0.553398
23	9	0.087379
24	99	0.961165
25	59	0.572816
26	31	0.300971
27	32	0.31068
28	43	0.417476
29	61	0.592233
30	53	0.514563
31	68	0.660194
32	27	0.262136
33	91	0.883495
34	74	0.718447
35	93	0.902913
36	96	0.932039
37	26	0.252427
38	80	0.776699
39	56	0.543689
40	101	0.980583
41	81	0.786408
42	67	0.650485

PERIOD = 102

PERIOD = 102

43	16	0.15534	
44	73	0.708738	
45	82	0.796117	
46	78	0.757282	
47	34	0.330097	
48	65	0.631068	
49	97	0.941748	
50	37	0.359223	
51	98	0.951456	
52	48	0.466019	
53	13	0.126214	
54	40	0.38835	
55	28	0.271845	
56	102	0.990291	
57	92	0.893204	
58	85	0.825243	
59	8	0.07767	
60	88	0.854369	
61	41	0.398058	
62	39	0.378641	
63	17	0.165049	
64	84	0.815534	
65	100	0.970874	
66	70	0.679612	
67	49	0.475728	
68	24	0.23301	
69	58	0.563107	
70	20	0.194175	
71	14	0.135922	
72	51	0.495146	
73	46	0.446602	
74	94	0.912621	
75	4	0.038835	
76	44	0.427184	
77	72	0.699029	
78	71	0.68932	
79	60	0.582524	
80	42	0.407767	
81	50	0.485437	
82	35	0.339806	
83	76	0.737864	
84	12	0.116505	
85	29	0.281553	
86	10	0.097087	
87	7	0.067961	
88	77	0.747573	
89	23	0.223301	

PERIOD = 102

102

90	47	0.456311	PERIOD =1
91	2	0.019417	
92	22	0.213592	
93	36	0.349515	
94	87	0.84466	
95	30	0.291262	
96	21	0.203883	
97	25	0.242718	
98	69	0.669903	
99	38	0.368932	
100	6	0.058252	
101	66	0.640777	
102	5	0.048544	
103	55	0.533981	
104	90	0.873786	
105	63	0.61165	