MA 323 Lab-01 report

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Q1)

Sequence for a=6, b=0, m=11:

Sequence / Seeds	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
0	0	0	0	0	0	0	0	0	0	0
1	1	6	3	7	9	10	5	8	4	2
2	2	1	6	3	7	9	10	5	8	4
3	3	7	9	10	5	8	4	2	1	6
4	4	2	1	6	3	7	9	10	5	8
5	5	8	4	2	1	6	3	7	9	10
6	6	3	7	9	10	5	8	4	2	1
7	7	9	10	5	8	4	2	1	6	3
8	8	4	2	1	6	3	7	9	10	5
9	9	10	5	8	4	2	1	6	3	7
10	10	5	8	4	2	1	6	3	7	9

Sequence for a=3, b=0, m=11:

Sequence / Seeds	1st	2nd	3rd	4th	5th
0	0	0	0	0	0
1	1	6	3	7	9
2	2	1	6	3	7
3	3	7	9	10	5
4	4	2	1	6	3
5	5	8	4	2	1
6	6	3	7	9	10
7	7	9	10	5	8
8	8	4	2	1	6
9	9	10	5	8	4
10	10	5	8	4	2

- In case 1 where a=6, 10 values appear before repeating, and in case 2 where a=3, 5 values appear before repeating.
- <u>Best Choice:</u> the full period of m-1(=10 in this case) happens when a=6 so it is clearly the better choice over a=3 as its period is only 5.
  Therefore a=6 is the better choice for random numbers.

Output:

```python
print("sequence for a=6, b=0, m=11, and,")
for i in range(0, 11):
    print("seed =", i, end=": ")
    print(gener1(6, 0, 11, i))
```

```
sequence for a=6, b=0, m=11, and,
seed = 0: [0]
seed = 1: [1, 6, 3, 7, 9, 10, 5, 8, 4, 2]
seed = 2: [2, 1, 6, 3, 7, 9, 10, 5, 8, 4]
seed = 3: [3, 7, 9, 10, 5, 8, 4, 2, 1, 6]
seed = 4: [4, 2, 1, 6, 3, 7, 9, 10, 5, 8]
seed = 5: [5, 8, 4, 2, 1, 6, 3, 7, 9, 10]
seed = 6: [6, 3, 7, 9, 10, 5, 8, 4, 2, 1]
seed = 7: [7, 9, 10, 5, 8, 4, 2, 1, 6, 3]
seed = 8: [8, 4, 2, 1, 6, 3, 7, 9, 10, 5]
seed = 9: [9, 10, 5, 8, 4, 2, 1, 6, 3, 7]
seed = 10: [10, 5, 8, 4, 2, 1, 6, 3, 7, 9]
```

```python
print("sequence for a=3, b=0, m=11, and,")
for i in range(0,11):
    print("seed =", i, end=": ")
    print(gener1(3, 0, 11, i))
```

```
sequence for a=3, b=0, m=11, and,
seed = 0: [0]
seed = 1: [1, 3, 9, 5, 4]
seed = 2: [2, 6, 7, 10, 8]
seed = 3: [3, 9, 5, 4, 1]
seed = 4: [4, 1, 3, 9, 5]
seed = 5: [5, 4, 1, 3, 9]
seed = 6: [6, 7, 10, 8, 2]
seed = 7: [7, 10, 8, 2, 6]
seed = 8: [8, 2, 6, 7, 10]
seed = 9: [9, 5, 4, 1, 3]
seed = 10: [10, 8, 2, 6, 7]
```

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Q2)

a=1597, b=1, m=244944:

Seeds / Ranges	$x_0=1$	$x_0=3$	$x_0=4$	$x_0=6$	$x_0=7$	$x_0=9$
0-0.05	496	498	450	474	555	460
0.05-0.1	455	491	501	524	509	570
0.1-0.15	544	572	468	534	486	510
0.15-0.2	516	503	586	508	495	466
0.2-0.25	476	459	502	463	455	501
0.25-0.3	496	497	465	494	549	481
0.3-0.35	451	485	490	526	507	565
0.35-0.4	554	567	488	535	476	500
0.4-0.45	518	499	558	497	500	477
0.45-0.5	477	460	505	481	455	499
0.5-0.55	494	501	448	467	562	455
0.55-0.6	462	465	503	524	526	568
0.6-0.65	554	548	478	535	468	512
0.65-0.7	505	493	557	491	512	466
0.7-0.75	488	462	501	486	452	509
0.75-0.8	485	485	448	467	562	445
0.8-0.85	468	477	506	496	503	543
0.85-0.9	554	565	468	526	470	510
0.9-0.95	511	517	575	505	497	456
0.95-1	496	456	493	467	471	507

a=51947, b=1, m=244944:

Seeds / Ranges	$x_0=1$	$x_0=3$	$x_0=4$	$x_0=6$	$x_0=7$	$x_0=9$
0-0.05	195	194	195	195	193	195
0.05-0.1	194	193	194	194	197	195
0.1-0.15	195	196	194	194	192	192
0.15-0.2	193	193	195	194	197	195
0.2-0.25	195	196	194	195	193	195
0.25-0.3	195	194	195	195	193	195
0.3-0.35	194	193	194	194	197	195
0.35-0.4	194	196	194	194	192	192
0.4-0.45	194	193	195	194	197	195
0.45-0.5	195	196	194	195	193	195
0.5-0.55	195	194	195	195	193	195
0.55-0.6	194	193	194	194	197	195
0.6-0.65	195	196	194	194	192	192
0.65-0.7	193	193	195	194	197	195
0.7-0.75	195	196	194	195	193	195
0.75-0.8	195	194	195	195	193	195
0.8-0.85	194	193	194	194	197	195
0.85-0.9	194	196	194	194	192	192
0.9-0.95	194	193	195	194	197	195
0.95-1	195	196	194	195	193	195

Bar Diagram for a=1597, b=1, m=244944, x$_0$=1:

a = 1597, b = 1, m = 244944, seed = 1

Bar Diagram for a=51749, b=1, m=244944, x$_0$=1:
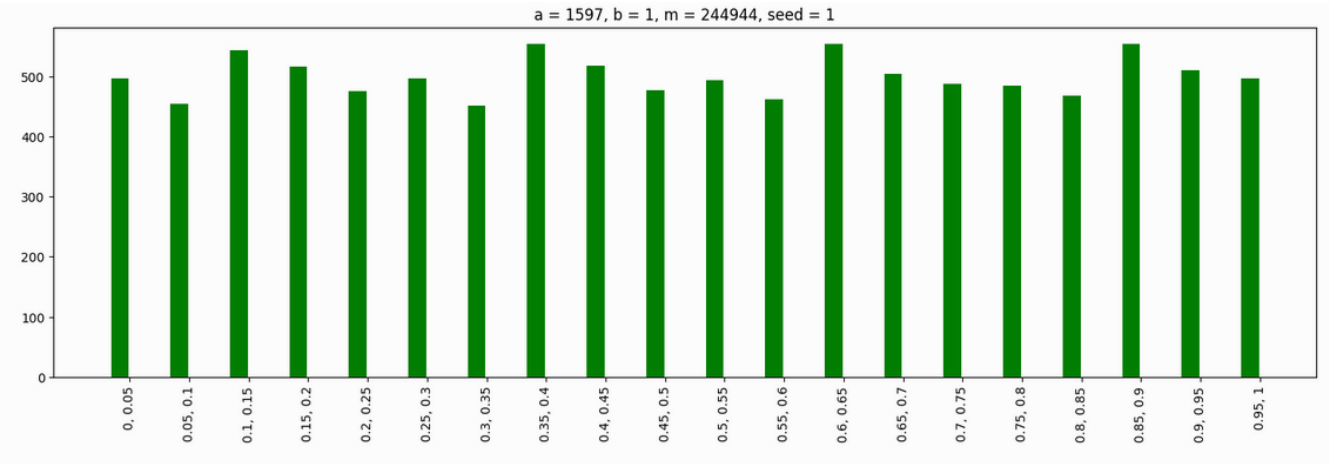
a = 51749, b = 1, m = 244944, seed = 1
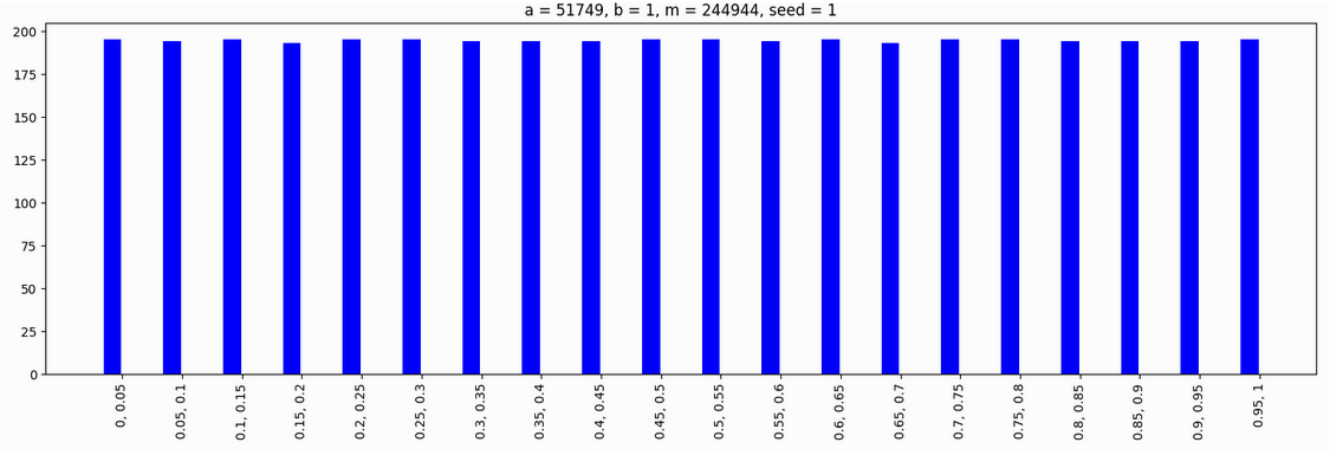
Bar Diagram for a=1597, b=1, m=244944, x$_0$=3:
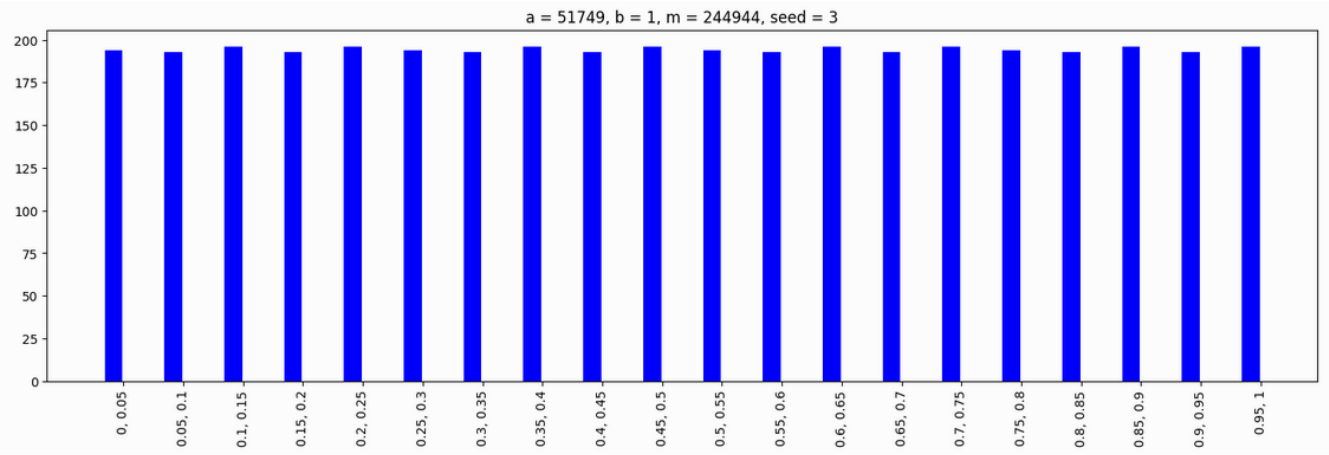

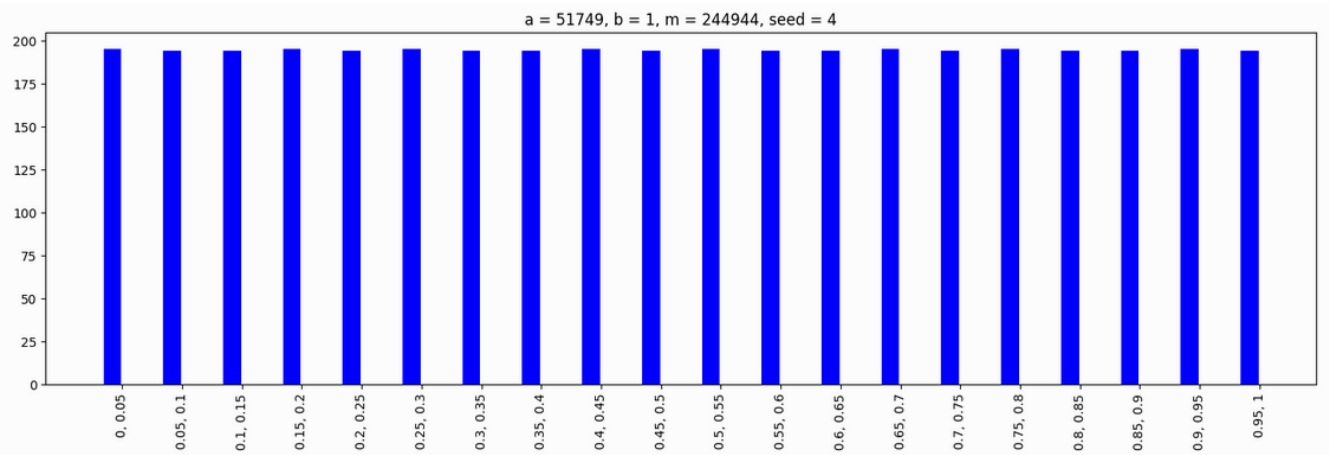a = 1597, b = 1, m = 244944, seed = 3
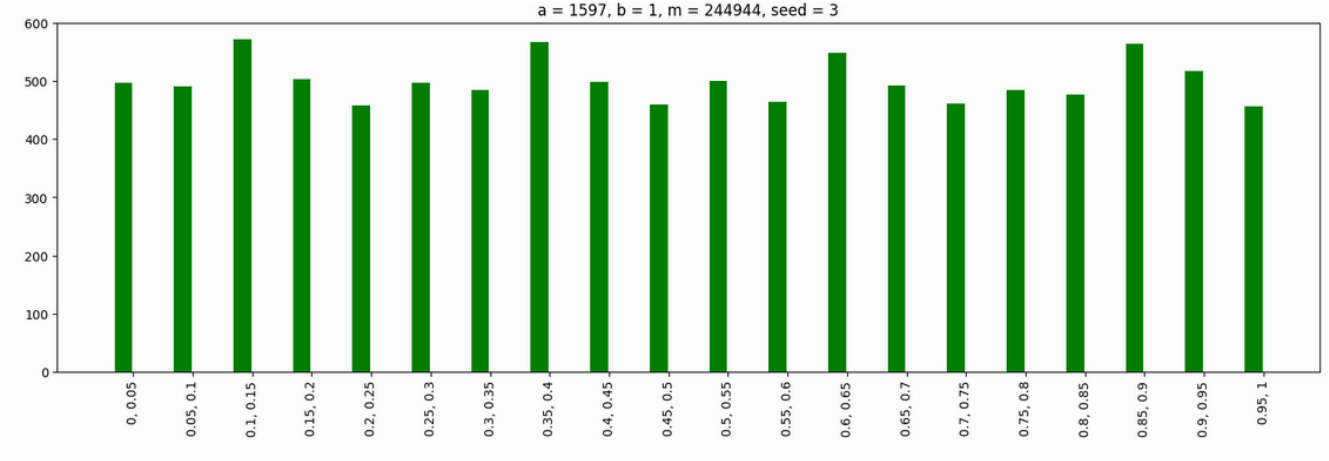
Bar Diagram for a=51749, b=1, m=244944, x_0=3:

Bar Diagram for a=1597, b=1, m=244944, x_0=4:
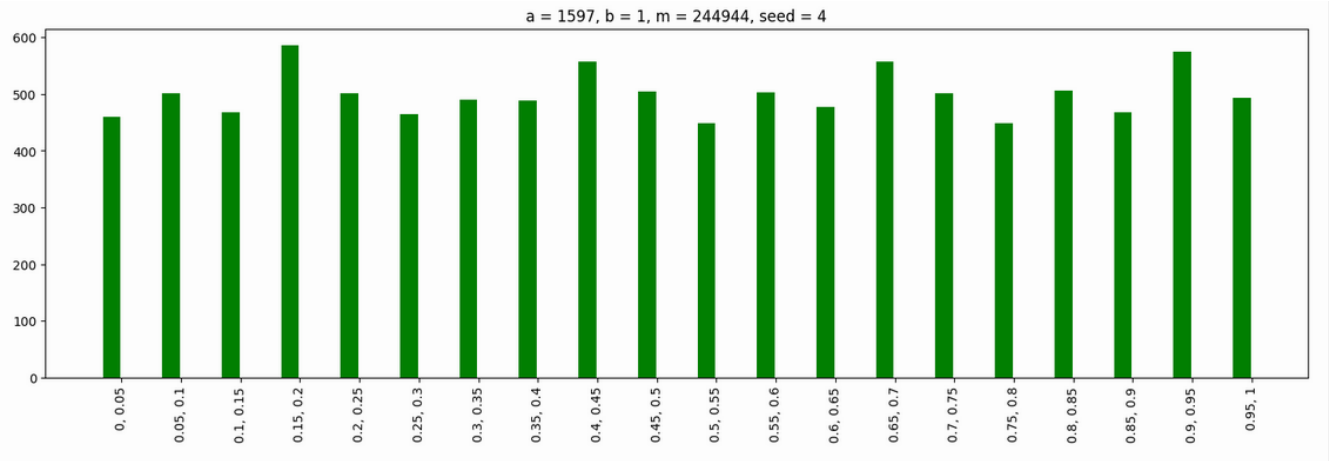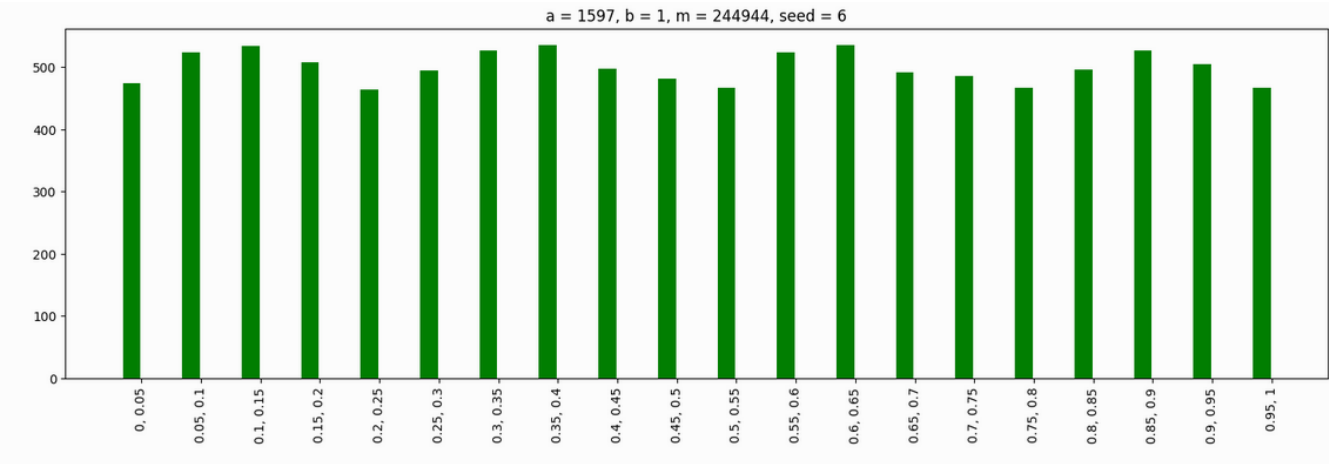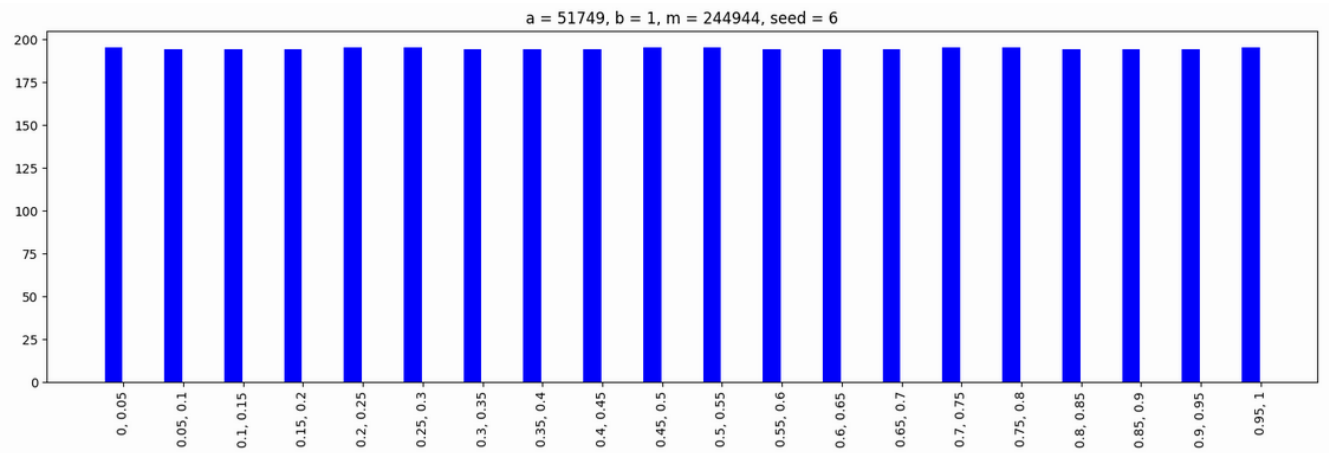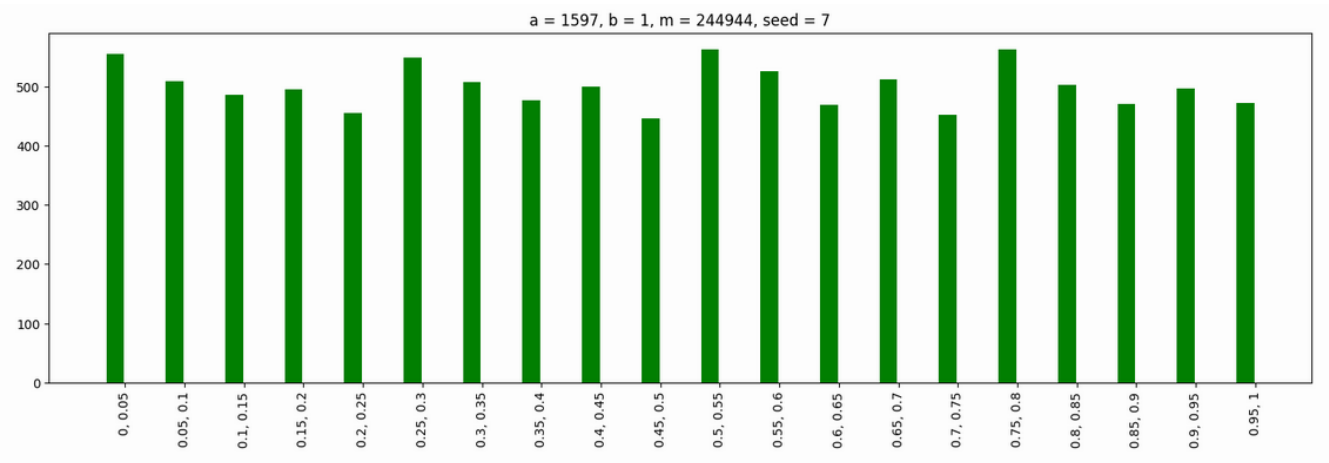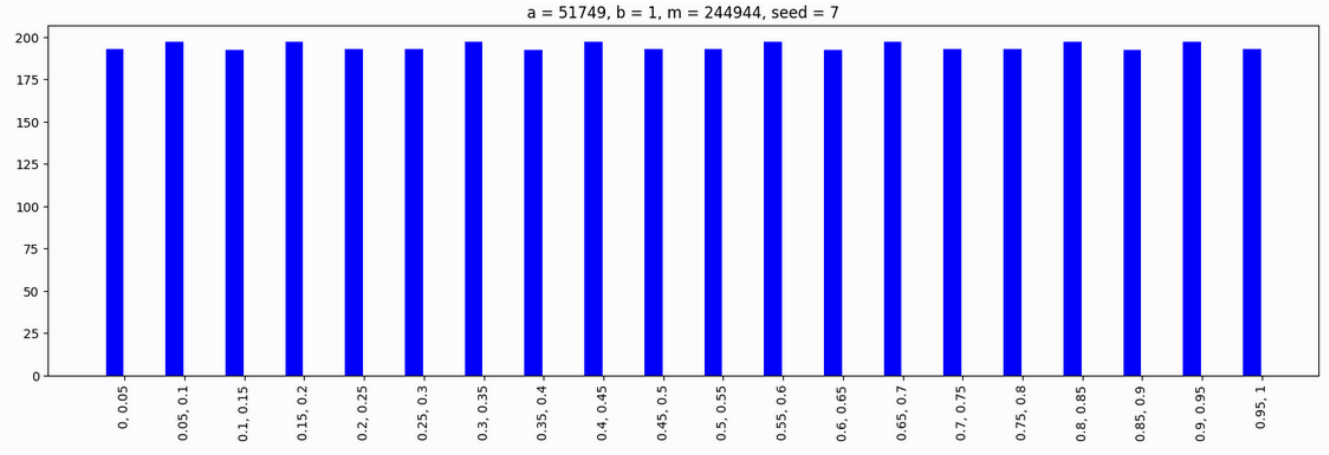

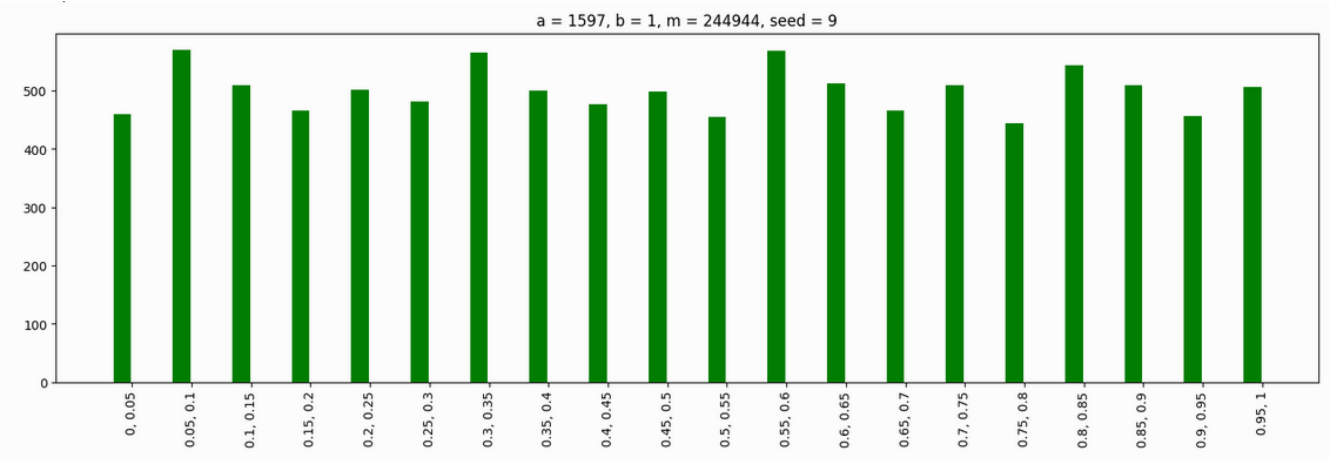**Bar Diagram for a=51749, b=1, m=244944, x_0=4:**
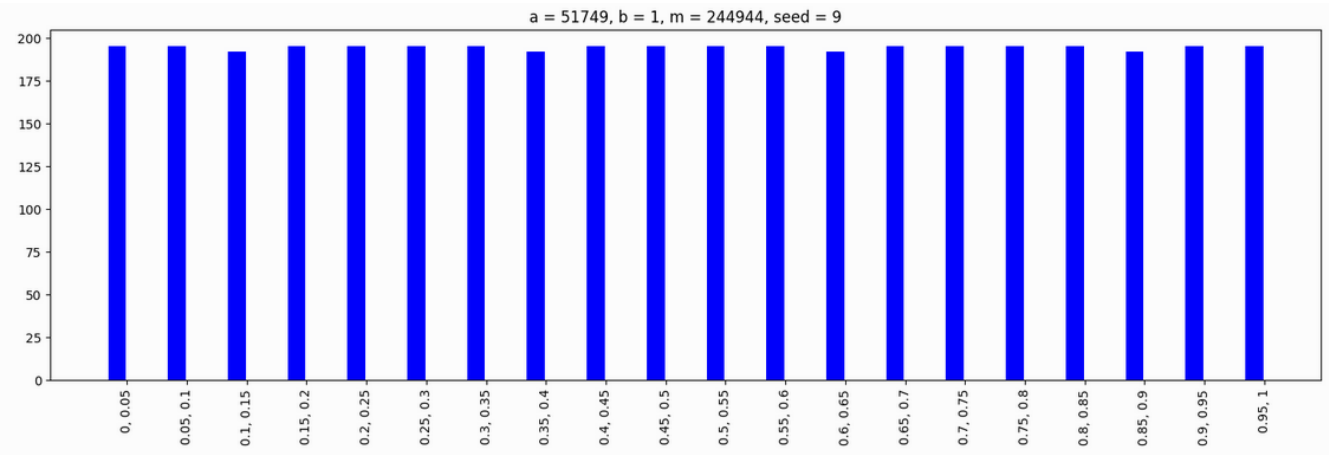
Bar Diagram for a=1597, b=1, m=244944, x₀=6:

a = 1597, b = 1, m = 244944, seed = 6

Bar Diagram for a=51749, b=1, m=244944, x₀=6:

a = 51749, b = 1, m = 244944, seed = 6

Bar Diagram for a=1597, b=1, m=244944, x₀=7:

a = 1597, b = 1, m = 244944, seed = 7

Bar Diagram for a=51749, b=1, m=244944, x_0=7:

a = 51749, b = 1, m = 244944, seed = 7

Bar Diagram for a=1597, b=1, m=244944, x_0=9:

a = 1597, b = 1, m = 244944, seed = 9

Bar Diagram for a=51749, b=1, m=244944, x_0=9:

a = 51749, b = 1, m = 244944, seed = 9

Observations:
- For different values of seed(x_0), the frequencies are almost same and so the bar graphs are also identical.
- When a=1597, the sequence has full period of m-1, while when a=51749 the sequence does not achieve its full period.

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Q3)

Scatter plot of (u_{i-1}, u_i) when a=1229, b=1, m=2048, and seed(x_0)=1: