MATH 512 - Project 2

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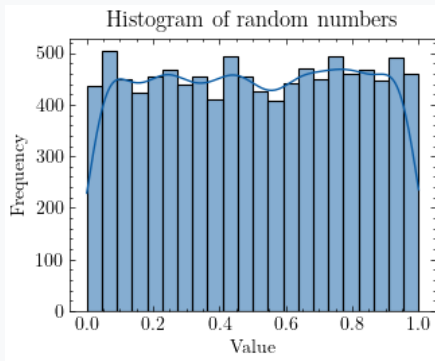
Question 1 (a)

We use the Kolmogorov-Smirnov test to test for the uniformity of the random numbers generated by the LCG. The test statistic is given by

$$D_n = \max_{1 \leqslant i \leqslant n} \left(\frac{i}{n} - U_{(i)} \right) \vee \max_{1 \leqslant i \leqslant n} \left(U_{(i)} - \frac{i-1}{n} \right)$$

where $U_{(i)}$ is the i-th order statistic of the U_i's.

- Our null hypothesis is that the random numbers are uniformly distributed.

- We find that $D_n = 0.0105$ and a p-value of 0.208. This means that we fail to reject the null hypothesis at the 5% significance level, and conclude that the random numbers are uniformly distributed.

Question 1 (a)

Question 1 (b)
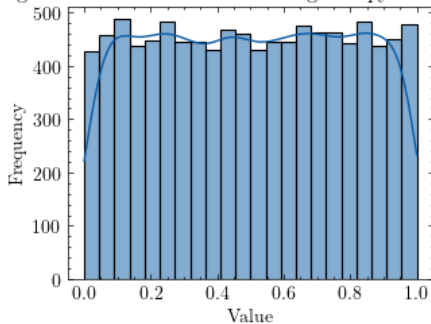
Parameters: $a = 6, m = 11, x_0 = 3, c = 1$

- The sequence is $[3, 7, 9, 10, 5, 8, 4, 2, 1, 6]$
- The period is 1

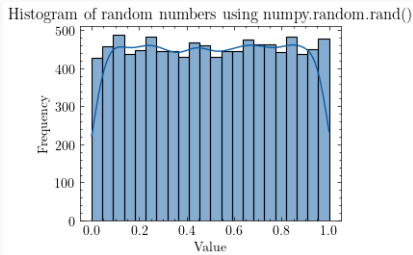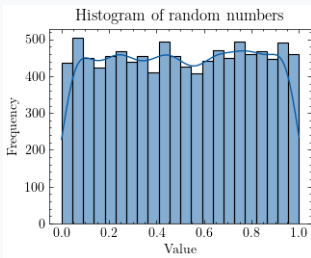Parameters: $a = 6, m = 10, x_0 = 3, c = 1$

- The sequence is $[3, 8, 8, 8, 8, 8, 8, 8, 8, 8]$
- The period is 2

Question 1 (c)

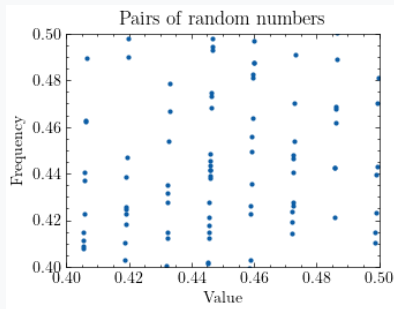Histogram of random numbers using numpy.random.rand()

Question 1 (d)

- The two histograms look relatively similar, meaning both look relatively uniform.

Question 1 (e)
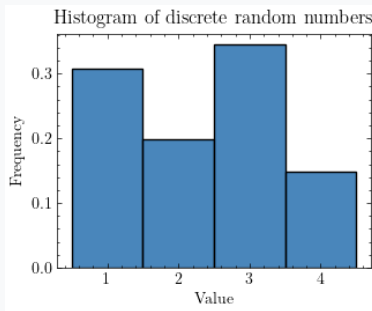

Pairs of random numbers

- I'm not seeing much of a pattern...

Question 1 (f)

Disadvantages of LCG:

- It can appear to be random with the right set of parameters, but as we saw, it can get "stuck" in a loop.

- The randomness depends on the bit position of the seed.

- The randomness depends on the choice of parameters.

Histogram of discrete random numbers

In combination with *plain*,
it makes a nice thank-you slide!

https://github.com/piazzai/arguelles
https://ctan.org/pkg/beamertheme-arguelles