

Assignment 7



Due: 22 April.

1 Testing a sequence of numbers¹

- (50 Points) Together with this assignment you will find a sequence of 100.000 numbers (“*Sequence.txt*”) generated with the brand new *Dean10's* algorithm. Your task will be to test if the algorithm passes the following tests:
 - Spectral Test. (In order to perform this test assume that the algorithm used is *MRG32k3a* by L’Ecuyer).
 - χ^2 Test.
 - KS Test.

Hint: For the Spectral test recall that the essential difference between periodic sequences and truly random sequences, that have been truncated, is that the *accuracy* of truly random sequences is the same in all dimensions. Thus, for the sake of simplicity, compare the results using only two and three dimensions for the lattice.

- (25 Points) The KS test may be used in conjunction with the χ^2 test. Using the data provided (“*Sequence2.txt*”) make 10 independent χ^2 tests on different parts of a random sequence, so that the values of

$$V_1, V_2, \dots, V_{10}$$

are be obtained. Plot the empirical distribution of these 10 values and compare then to the correct distribution, obtained from the table discussed in class for the χ^2 distribution with 10 degrees of freedom. Then compute the statistics K_{10}^+ and K_{10}^- in order to estimate the “goodness” of the sequence. What can you say about the sequence?

- (25 Points) Choose an empirical test from the list provided (e.g., *equidistribution test*, *serial test*, *gap test*, *poker test*, etc.) and explain it with great detail. Then generate a sequence of random numbers using a combined generator invented by you, and test its performance with the chosen empirical method.

¹Main reference: D. E. Knuth, “*The Art of Computer Programming*”, Addison-Wesley Professional, 2011