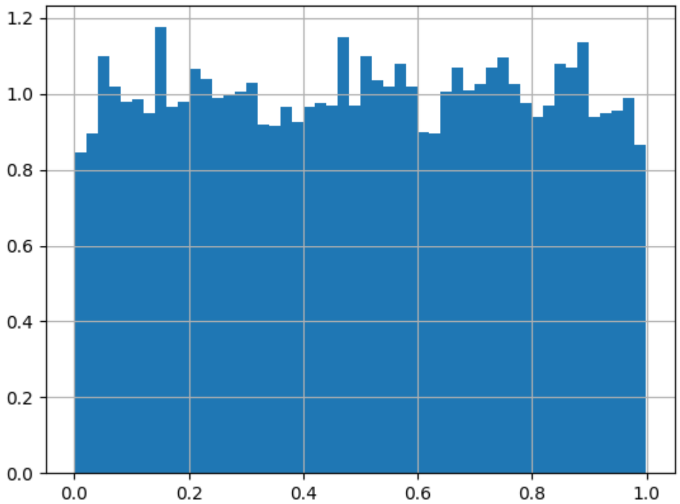
SOLUTIONS TO
COMPUTATIONAL PHYSICS: SPRING 2022

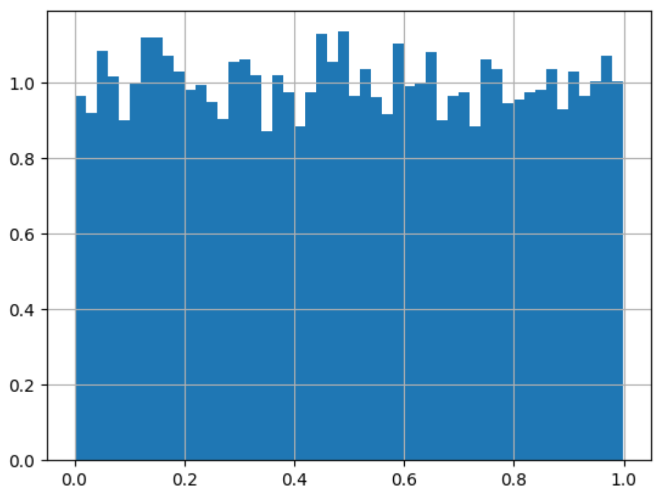
ASSIGNMENT:03

- NAME: Arghya Dutta
- DEPARTMENT: DCMP&MS
- EMAIL ID: arghya.dutta@tifr.res.in

Question 1 :
It is quiet similar to uniform PDF



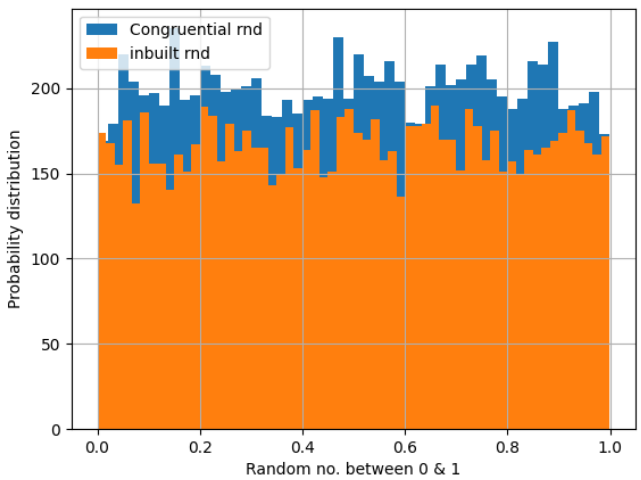
Question 2:
It is very similar to uniform PDF



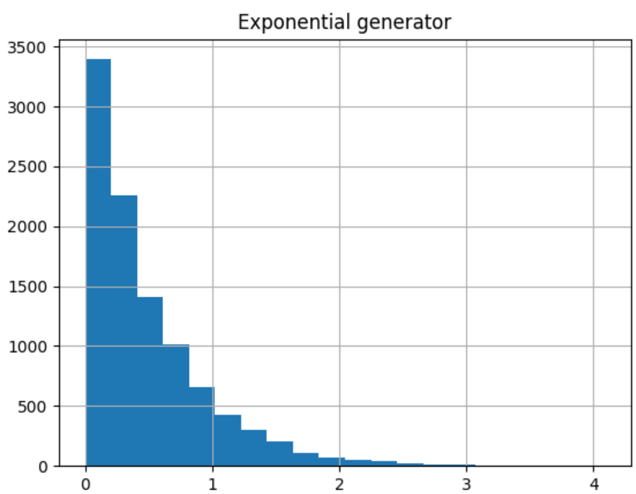
Question 3:

Congruential random number generator took 0.27117085456848145 seconds
The inbuilt random no. generator took 0.0005223751068115234 seconds

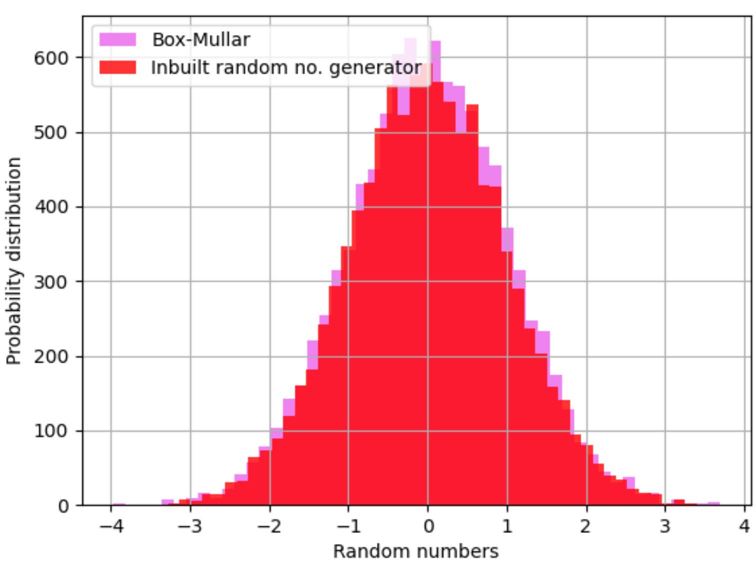
So , inbuilt rnd took much less time .



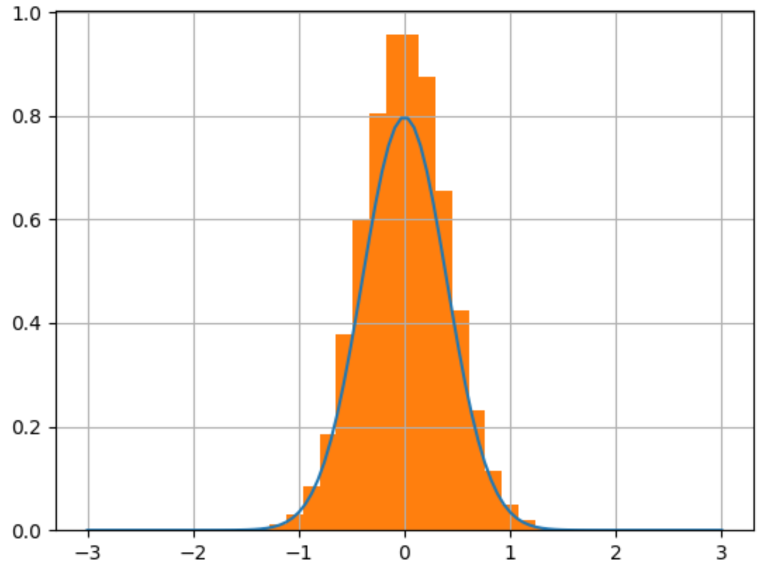
Question 4: At first I generated the random numbers using the answer of the 1st question and then here is the exponential PDF



Question 5:



Question 6:



Question 7:

For the 2nd distribution
chi square = 1.1416666666666666
0.00031493668421800884
It is 'Not sufficiently random

For the 1st distribution
chi square = 29.491666666666667
0.9989631111032784
It is 'Not sufficiently random
...

Question 8:

To find the volume of a sphere we'll generate random numbers over some "square" volume and count how many land inside the sphere...
Here for 2 D sphere, we take two uniform distribution of random variable of x_1 & x_2 between 0 to R.
Then the condition for taking count is $x_1^2 + x_2^2 < R^2$. (R is radius of sphere)

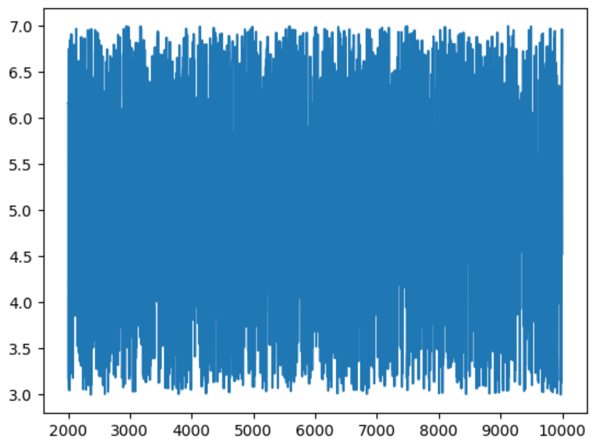
The volume of a 2 D sphere from the Monte Carlo simulation is 3.133 .#output
For higher (let n) dimensional case we use the same concept, we should take the uniform random variable for $x_1, x_2, x_3 \ldots x_n$ and the condition is $x_1^2 + x_2^2 + \cdots + x_n^2 < R^2$.
No. of points inside the sphere, $p = \frac{Z_n}{n} = \frac{V_{sphere}}{2^d}$ or $V_{sphere} = 2^d * \left(\frac{Z_n}{n}\right)$.

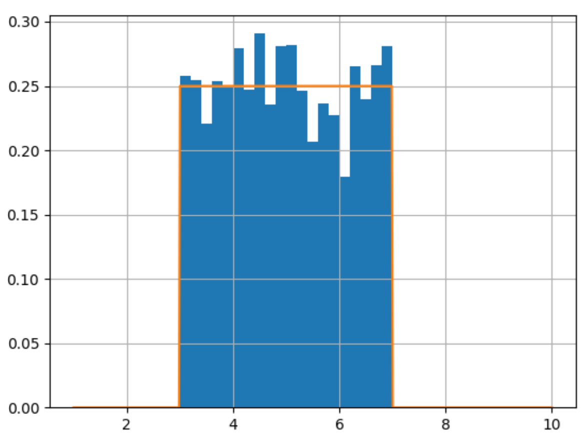
The volume of a 10 D sphere from the Monte Carlo simulation is 2.54976 .#output

Question 9:

Here we 1st define a ‘func,, which evaluates the given probability density. Then define a ‘density’ function . Here is the algorithm

1. Start with a **random** sample
2. Determine the probability **density** associated with the sample
3. Propose a **new**, arbitrary sample (and determine its probability density)
4. Compare densities (via division), quantifying the **desire** to move
5. Generate a random number, compare with desire to move, and **decide: move or stay**
6. Repeat the same



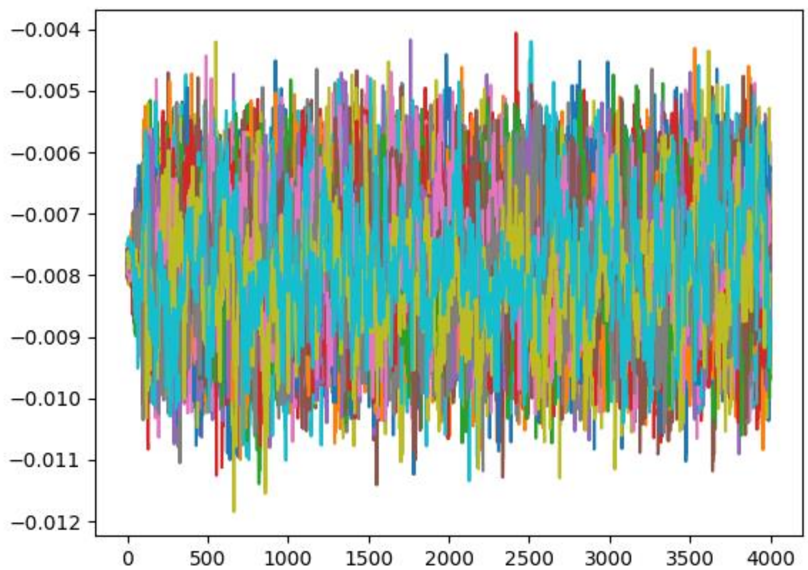


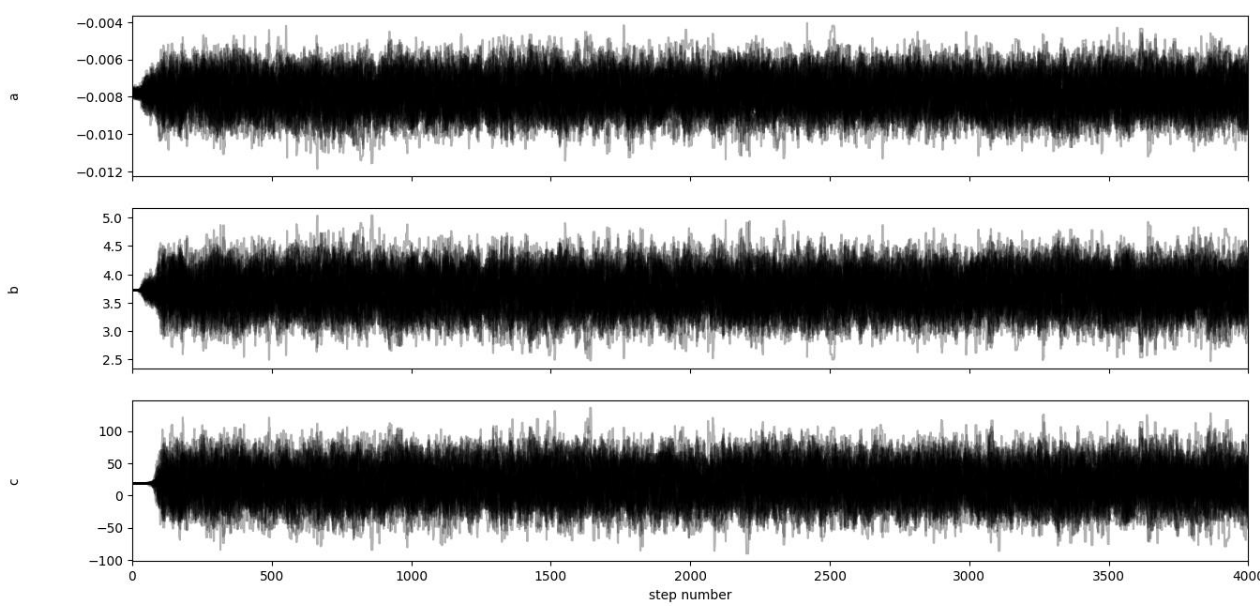
For this program I took help from-

https://towardsdatascience.com/bayesian-statistics-metropolis-hastings-from-scratch-in-python-c3b10cc4382

Question 10:

best fit parameters [-7.84593667e-03 3.71609178e+00 1.88347025e+01]





The github link for this assignment is here –
https://github.com/ArghyaDuttatifr/Windoze/tree/main/assignment