

# Monte Carlo, Exercise Session 3

Alexey Sofiev, 013573003

March 1, 2017

## 1 Exercise 1

Files: Ex1.\*.

**Answer:** Figure 1.

```
Exercise 1
N= 10^2
<E> = 0.041826
<Rrms> = 0.035347
N= 10^3
<E> = 0.0400146
<Rrms> = 0.0313272
N= 10^4
<E> = 0.0376474
<Rrms> = 0.0305431
N= 10^5
<E> = 0.0383512
<Rrms> = 0.0310065
N= 10^6
<E> = 0.0388437
<Rrms> = 0.0316816
N= 10^7
<E> = 0.0388288
<Rrms> = 0.031746
N= 10^8
<E> = 0.0387774
<Rrms> = 0.0316724

Process returned 0 (0x0)   execution time : 437.306 s
Press ENTER to continue.
□
```

Figure 1: Ex1 answer.

The other main question is log- plot, visualized in Figure 2.

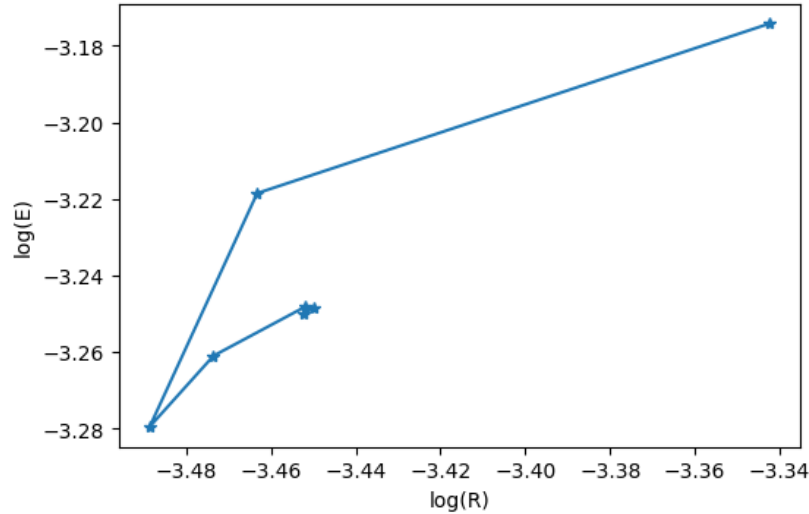


Figure 2: Ex1 log plot.

And point in the upper right corner is obtained at the smallest  $N=100$ . (line connects to  $N=10^3 \rightarrow 10^4 \dots$ ) Therefore, the maximal absolute value of  $\log(E)$  allowed should be 3.29.

**Solution details:**

1. Algorithm is done basing on page 8 from Lecture notes on MCMC.
2.  $V$  is set to 1.
3. Setting the range and  $\Delta X_{max}$

First let's take a look at the function without zooming. Figure 3

It can be noticed, that it is pretty flat, so now let's zoom into interesting part, Figure 4.

From Figure 4 it can be seen that setting  $x_0$  to vary from 0 to 0.1, and  $\Delta X_{max}$  to 0.05 is enough to generate most values. From lecture notes, it is told that  $x_0$  doesn't really matter, on a long run, all the generated values will be distribution based distributed.

After generating random values and plotting them, the distribution obtained is presented in Figure 5.

The shape looks pretty much according to the theory presented in earlier figures.

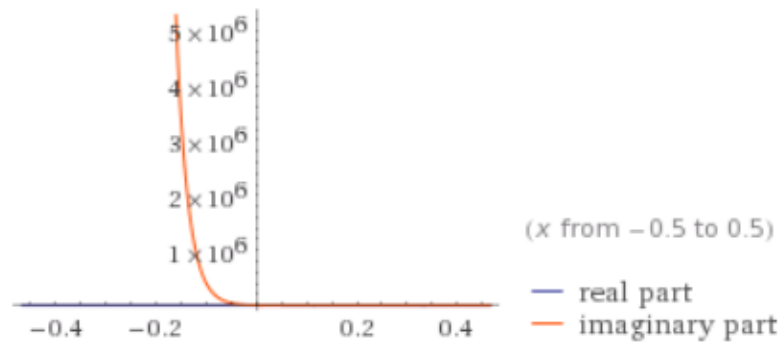


Figure 3: Ex1, view on the function with 0.5. Function plotted with wolframalpha.

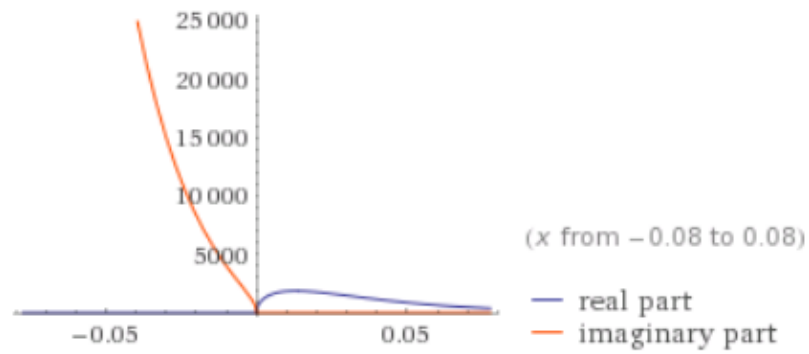


Figure 4: Ex1, autozoom into real part. Function plotted with wolframalpha.

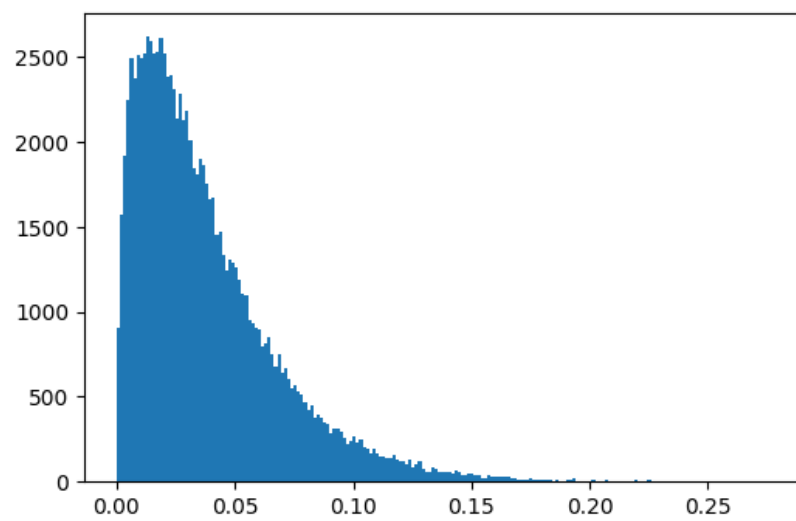


Figure 5: Ex1, histogram of random values provided by the code.

## 2 Exercise 2

This exercise requires a lot of plotting, so will be done in Python using the Mersenne twister. File: Ex2.py

### **Synthetic data:**

Using the lecture notes, the synthetic data, two of which are visualized in Figures 6 and 7, is generated.

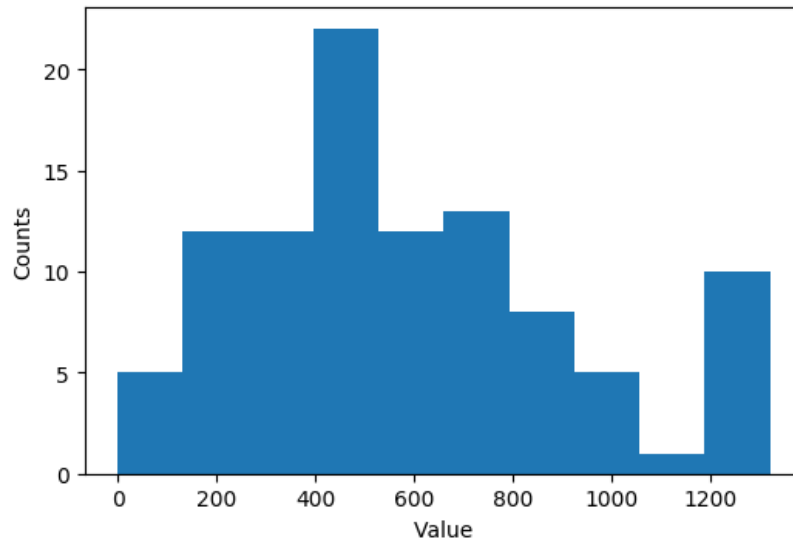


Figure 6: Ex2, an example of generated synthetic data.

The generated synthetic data of 100, is has some sort of similarity, but they are still different.

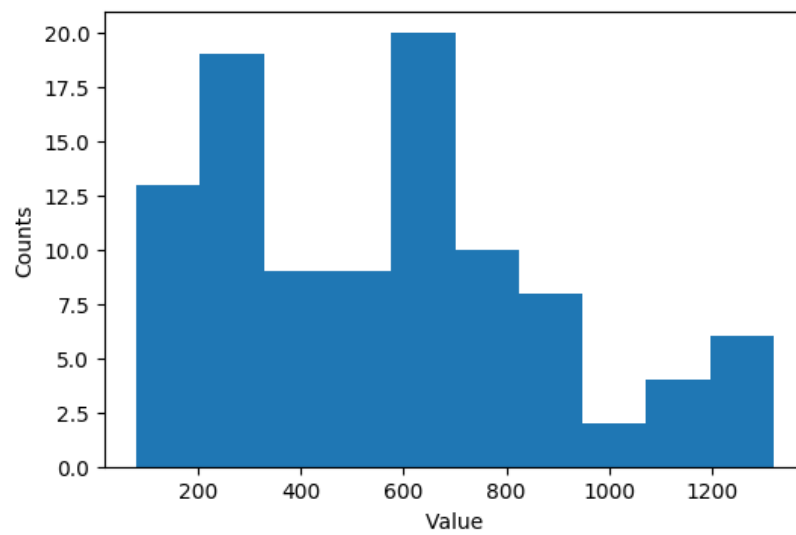


Figure 7: Ex2, an example of generated synthetic data.