Modeling and Simulation -

Lab Assignment 5

Modeling with randomness

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Problem 1

In this problem you are supposed to use Monte carlo method for your calculation. You can use the inbuilt random number generator. You are supposed to do the problem in two ways (i) through a single run and increasing values of the number of random numbers (ii) run the simulation many times and then calculate the average. In each of the cases you should show through a single figure how the estimate improves/converges as the length of the runs is increased or the number of runs increases. Using Monte Carlo Method calculate

Part A:

Area between the curve for $f(x) = x^2$ and the x-axis from x = 0 to x = 2.

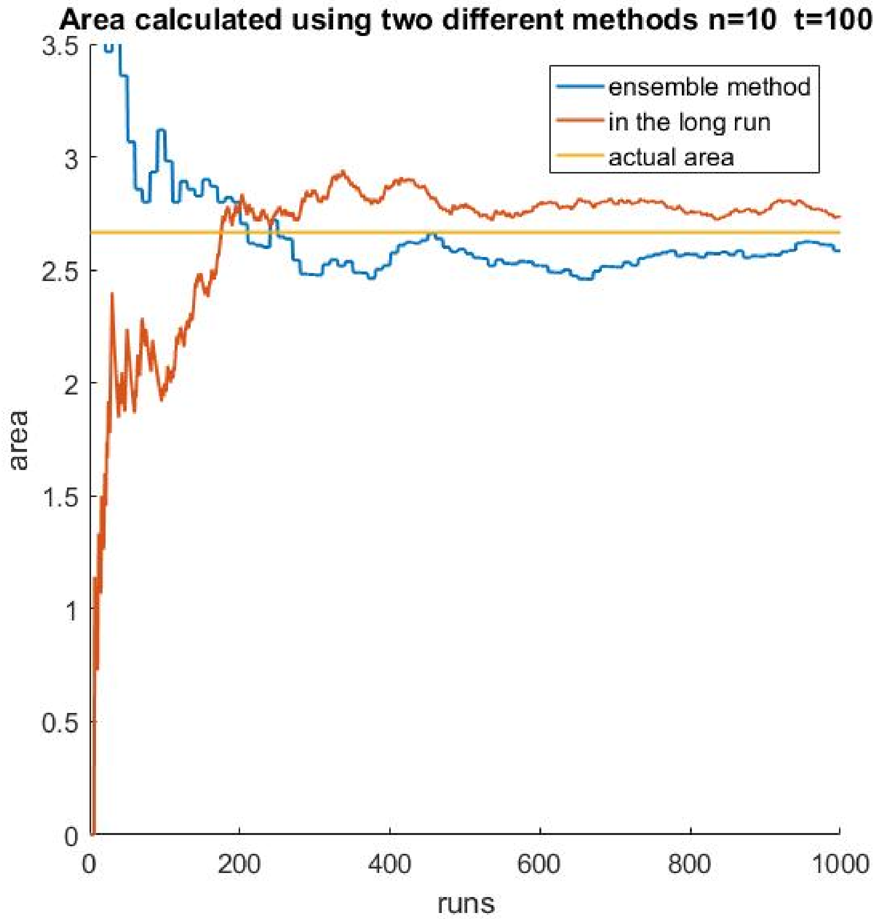

Figure 1: ensemble size=10, t=100. (ensemble method values are linearly interpolated for visualization)

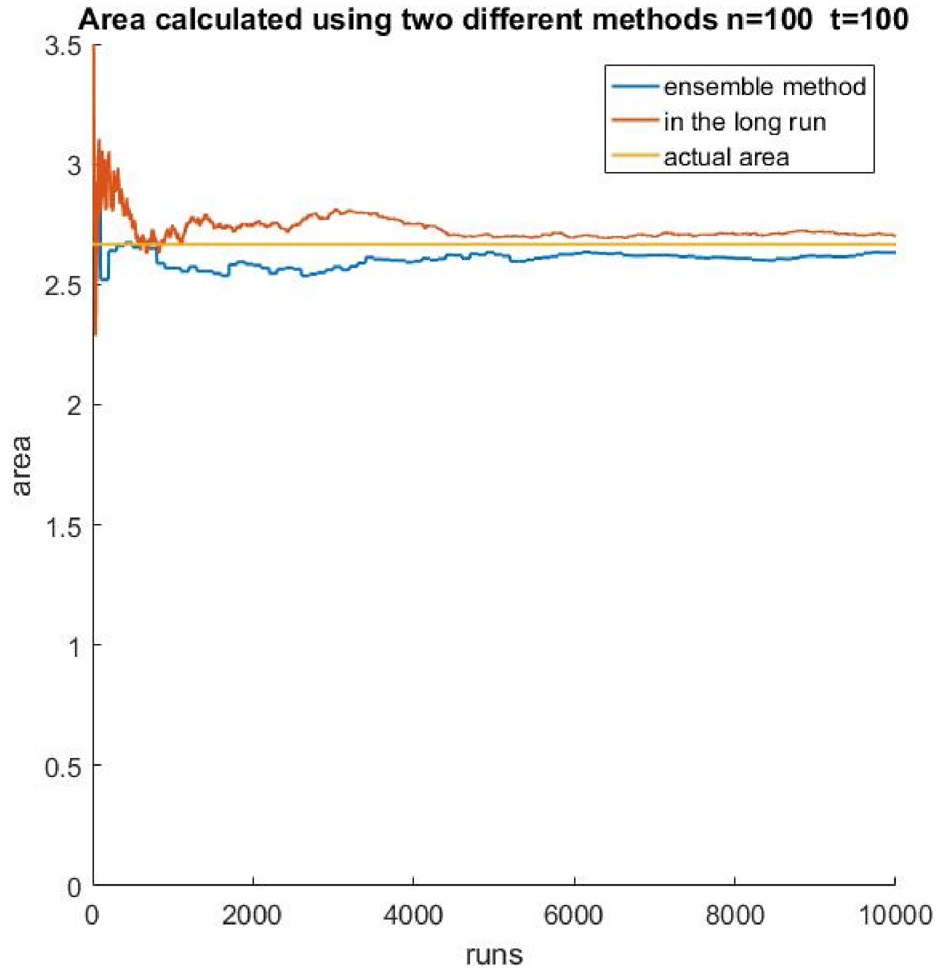

Figure 2: ensemble size=100, t=100. (ensemble method values are linearly interpolated for visualization)

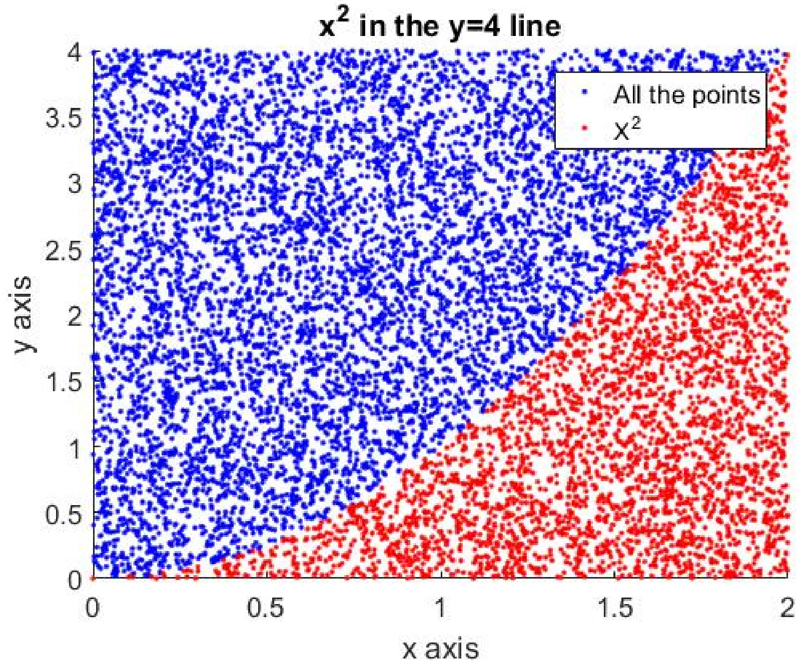

Figure 3: generated points (n=10000)

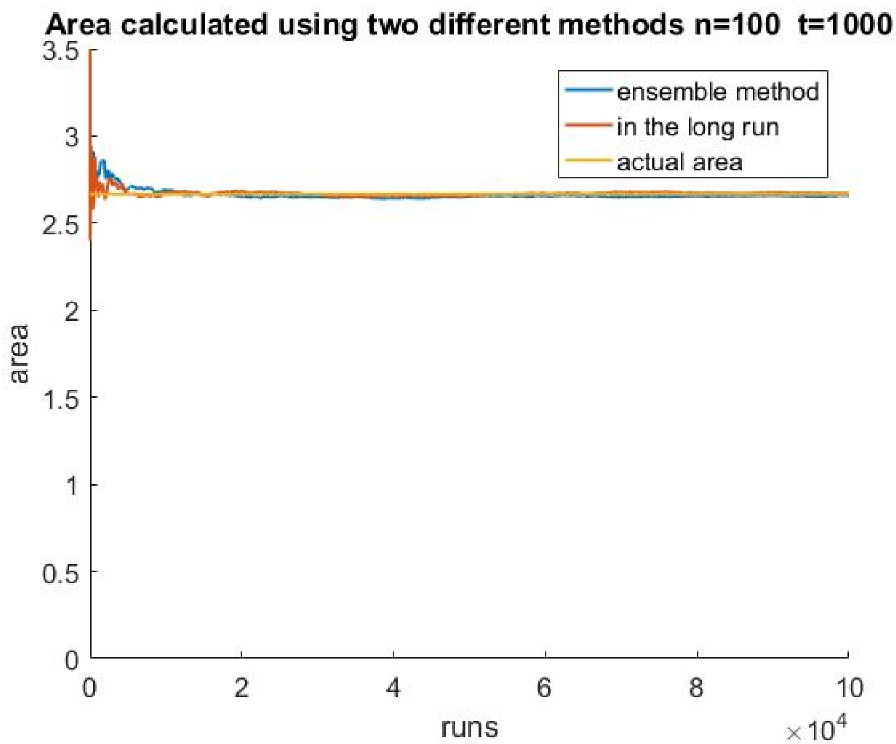

Figure 4: ensemble size=100, t=1000. (ensemble method values are linearly interpolated for visualization)

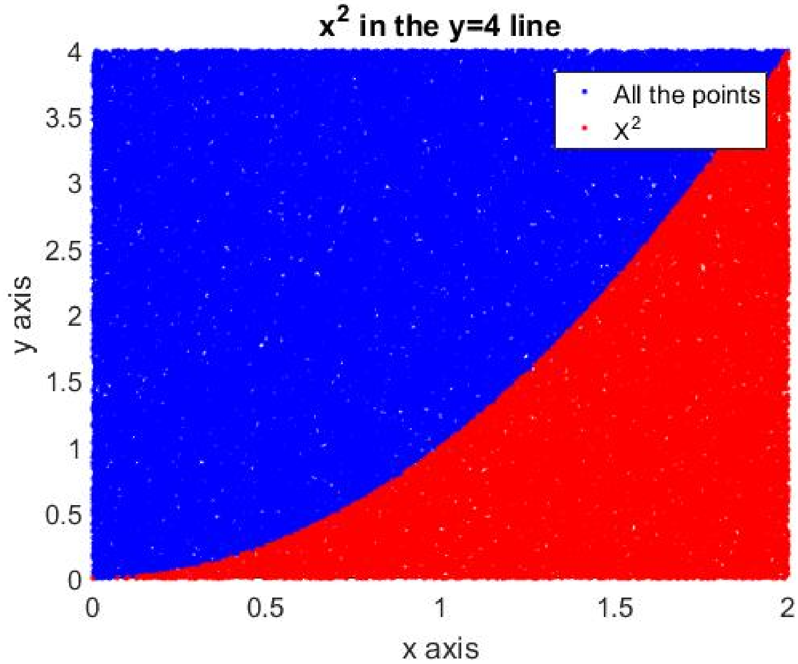

Figure 5: generated points (n=100000)

Part B:

An estimate of π.

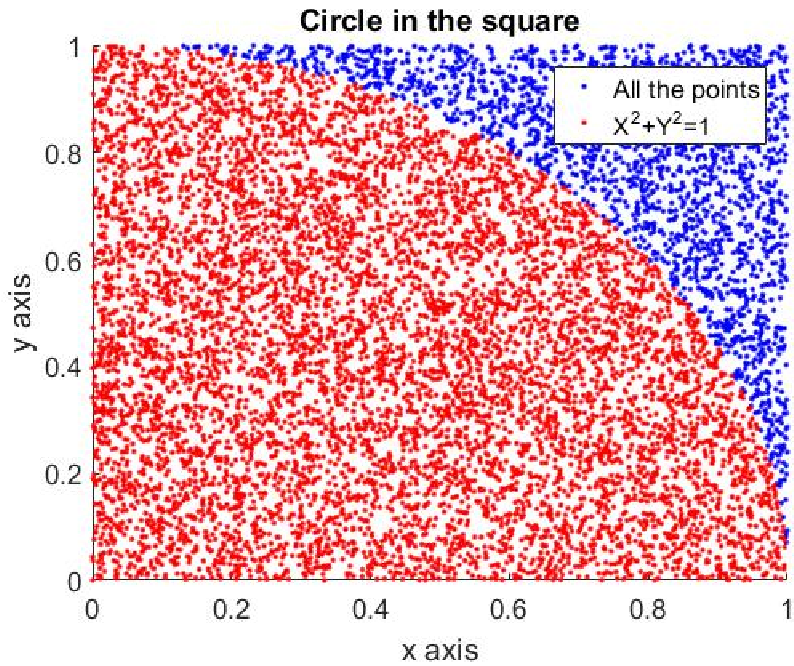

Figure 6: generated points (n=10000)

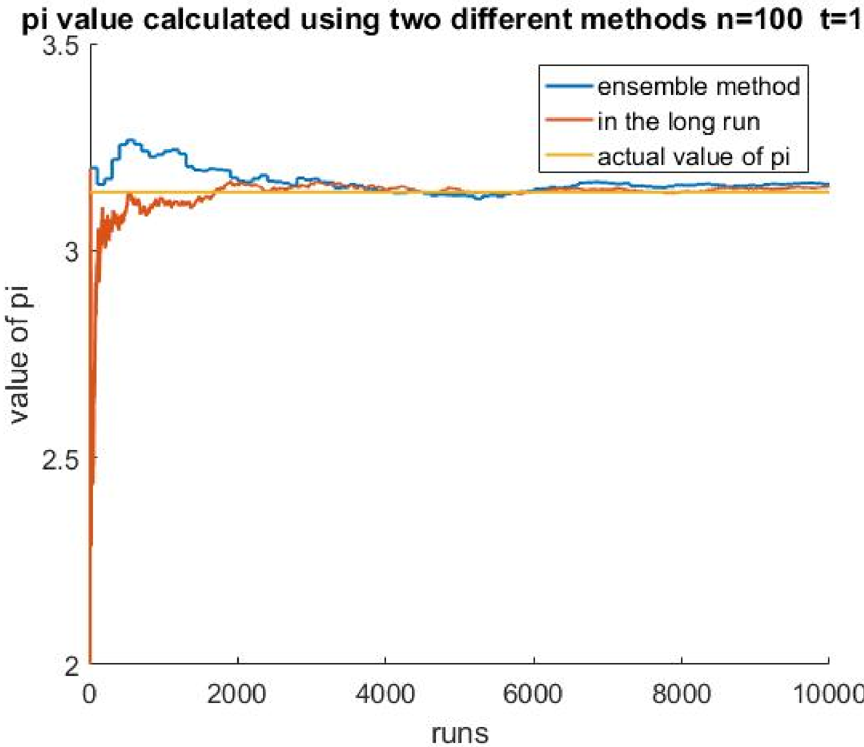

Figure 7: ensemble size=100, t=100. (ensemble method values are linearly interpolated for visualization)

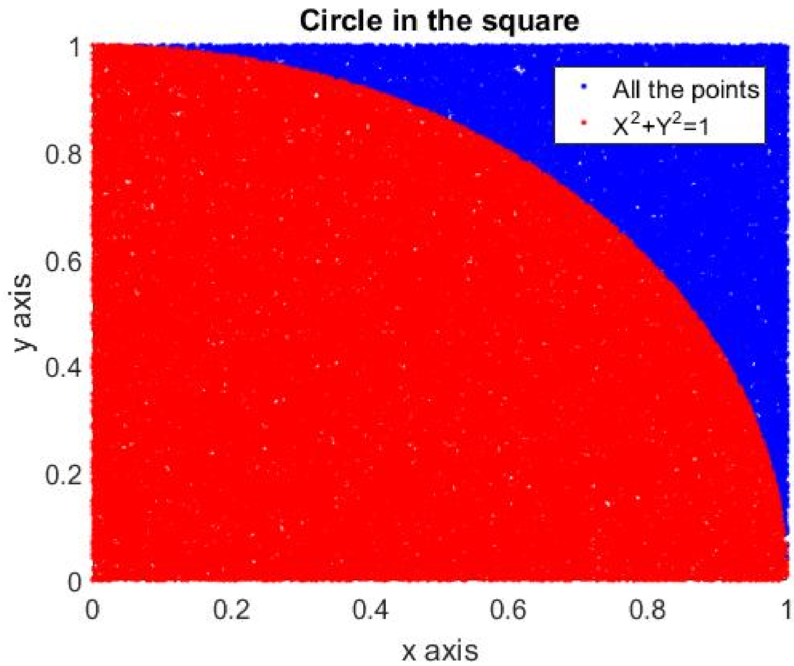

Figure 8: generated points (n=10000)

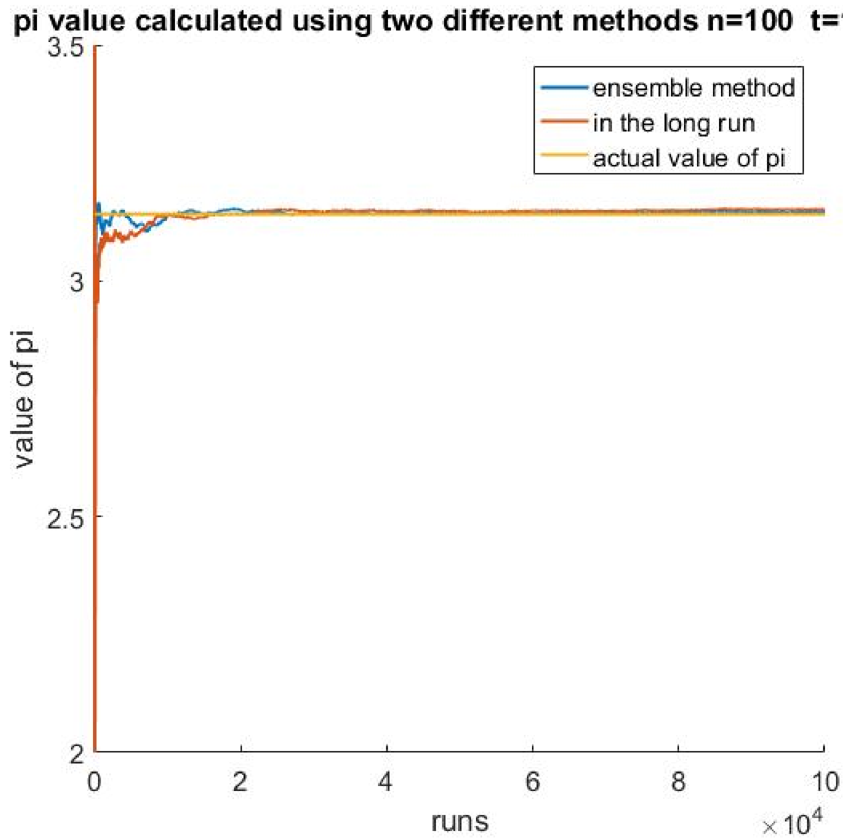

Figure 9: ensemble size=100, t=100. (ensemble method values are linearly interpolated for visualization)

Part C:

Volume of a Sphere.

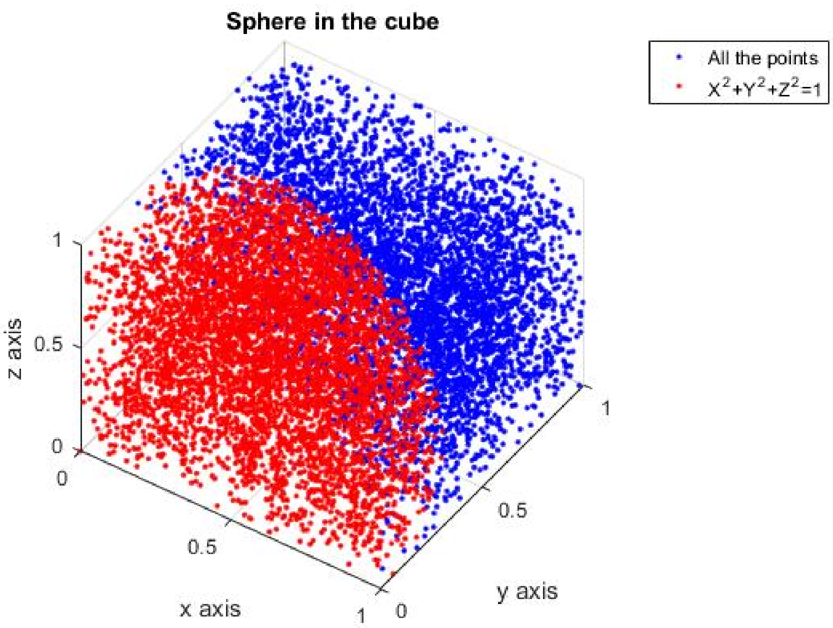

Figure 10: generated points (n=10000)

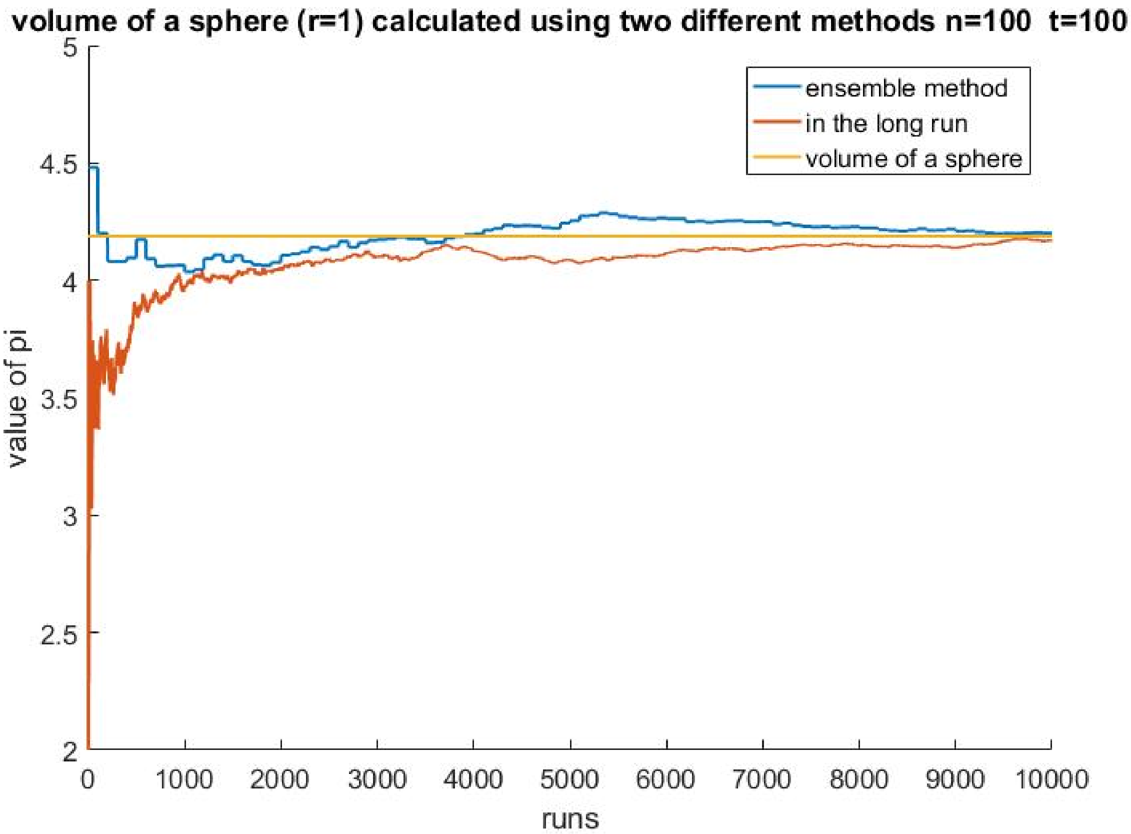

Figure 11: ensemble size=100, t=100. (ensemble method values are linearly interpolated for visualization)

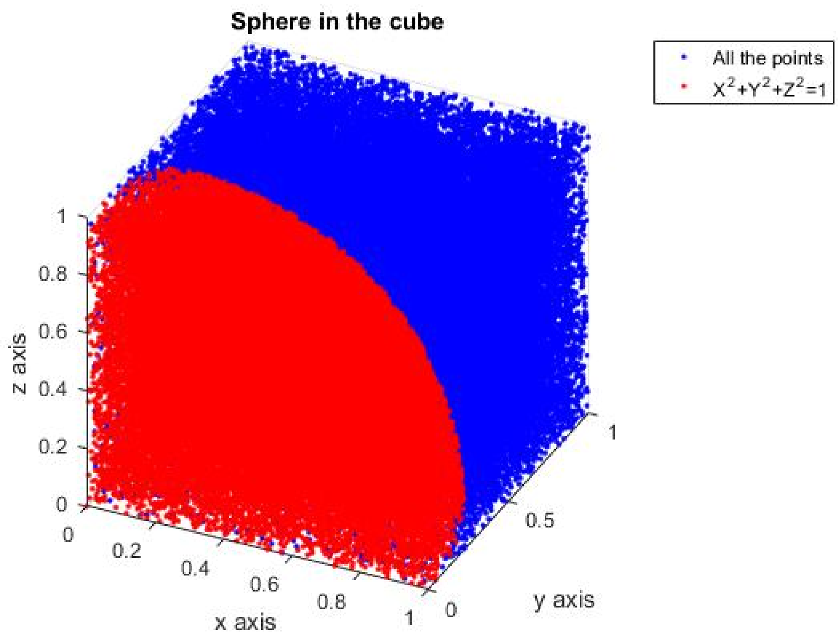

Figure 12: generated points (n=10000)

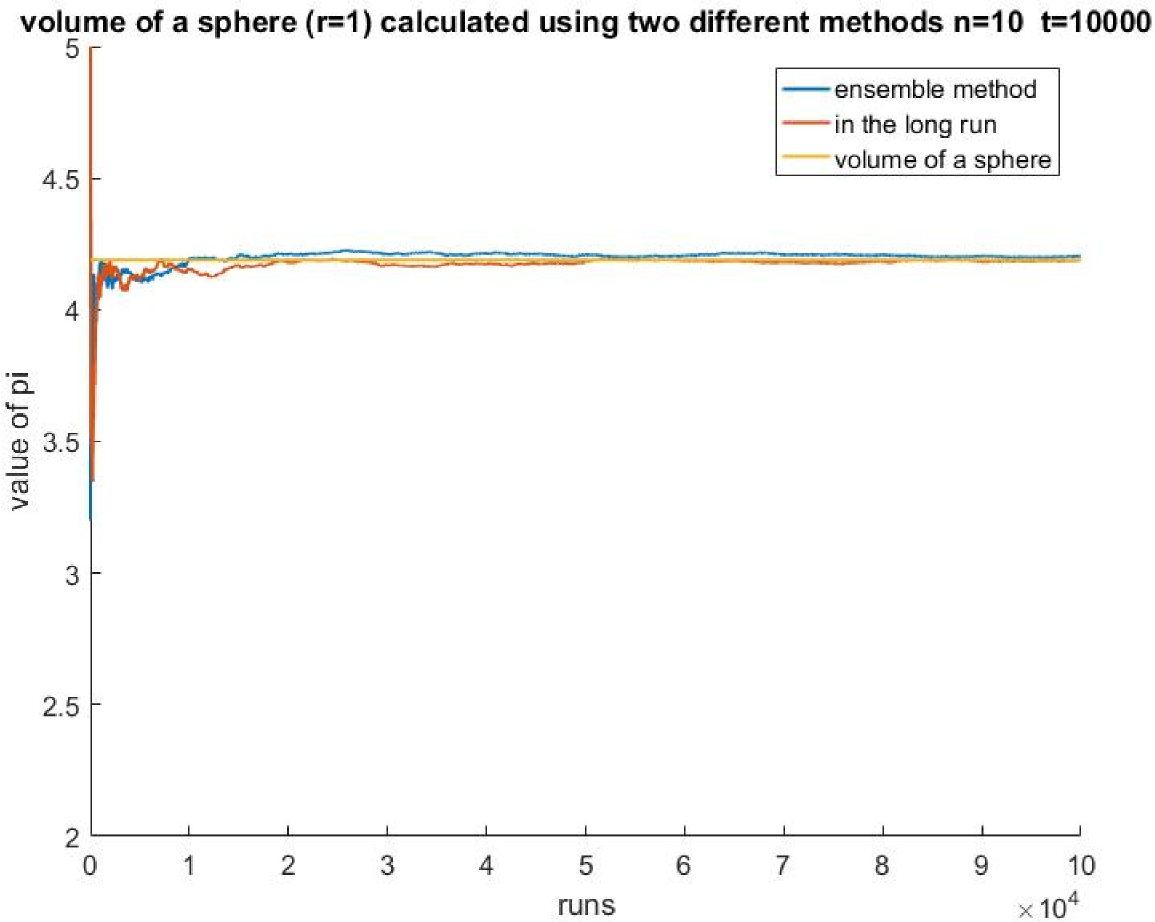

Figure 13: ensemble size=100, t=100. (ensemble method values are linearly interpolated for visualization)

Problem 2

Starting from uniformly distributed random numbers between 0 and 1, generate random numbers which are distributed as

Part A:

Normal $N(\mu, \sigma^2)$ **(Use Box-Muller Algorithm).**

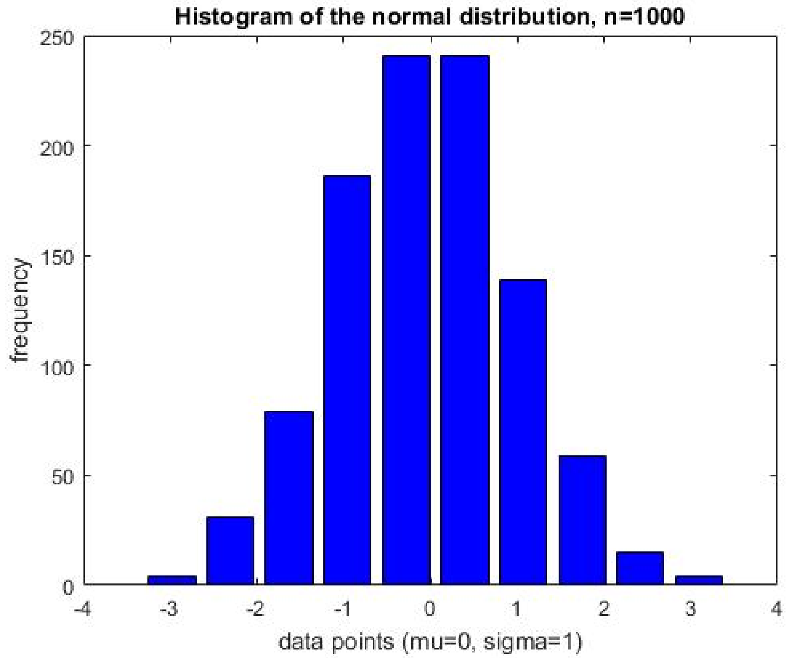

Figure 14: Histogram of the distribution generated

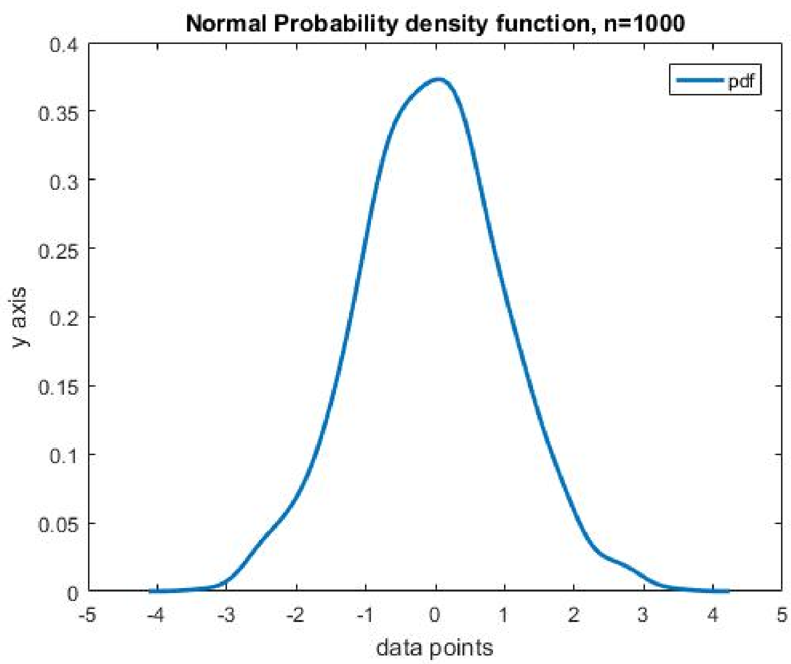

Figure 15: Probability density function

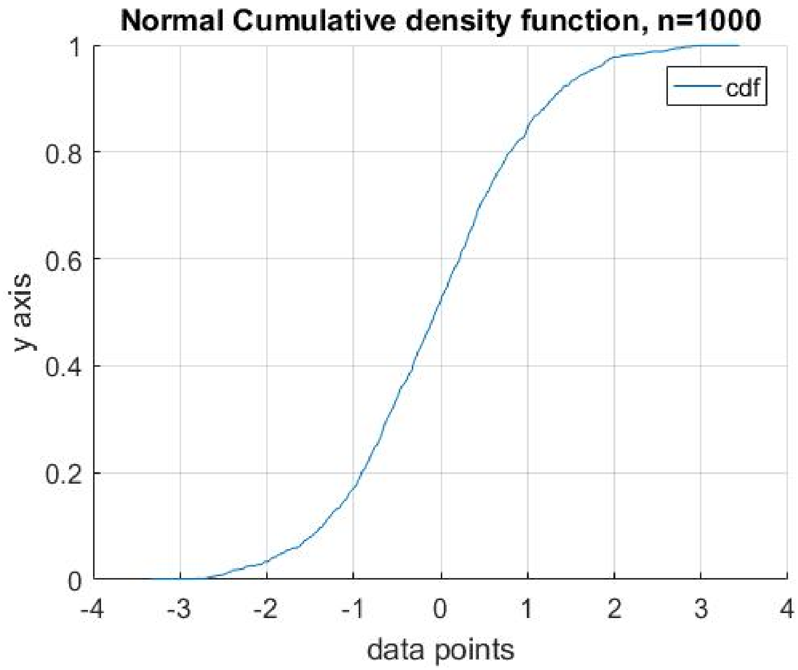

Figure 16: Cumulative density function

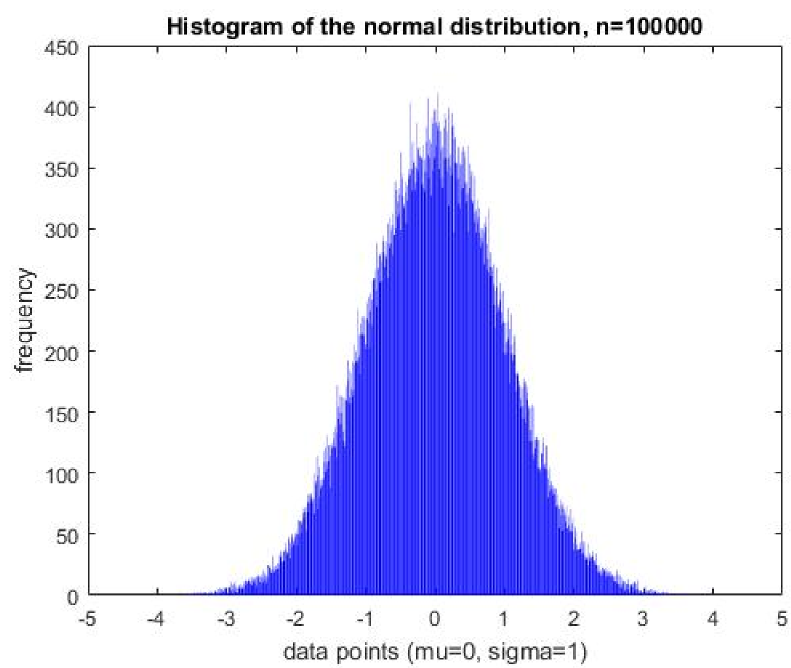

Figure 17: Histogram of the distribution generated

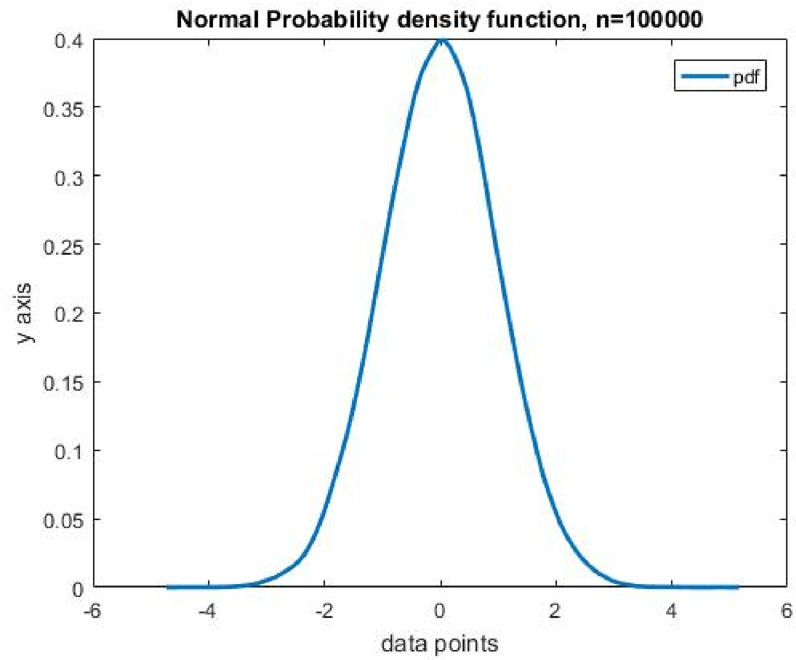

Figure 18: Probability density function

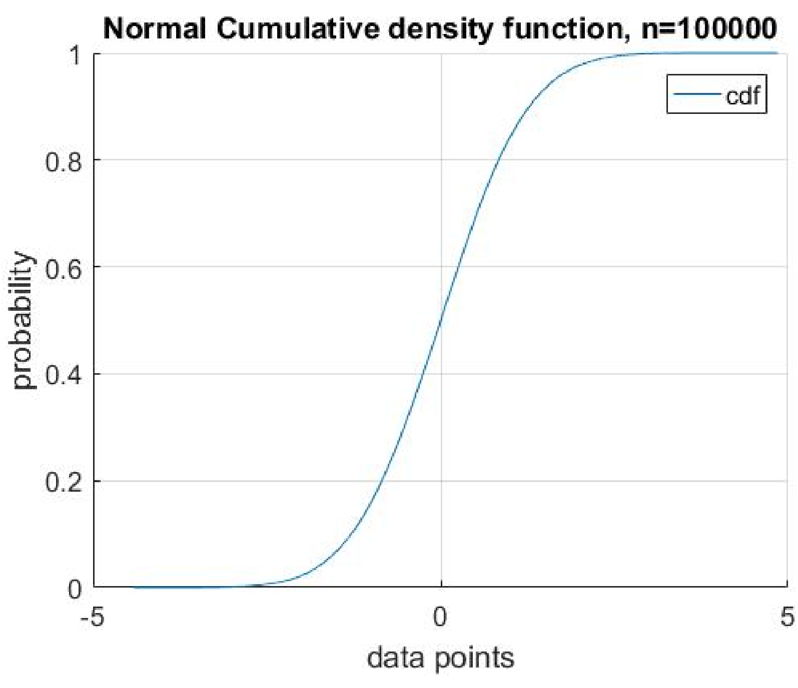

Figure 19: Cumulative density function

Part B:

Exponential $F_X(x) = 1 - e^{-\lambda x}$ (Use inverse transfer method)

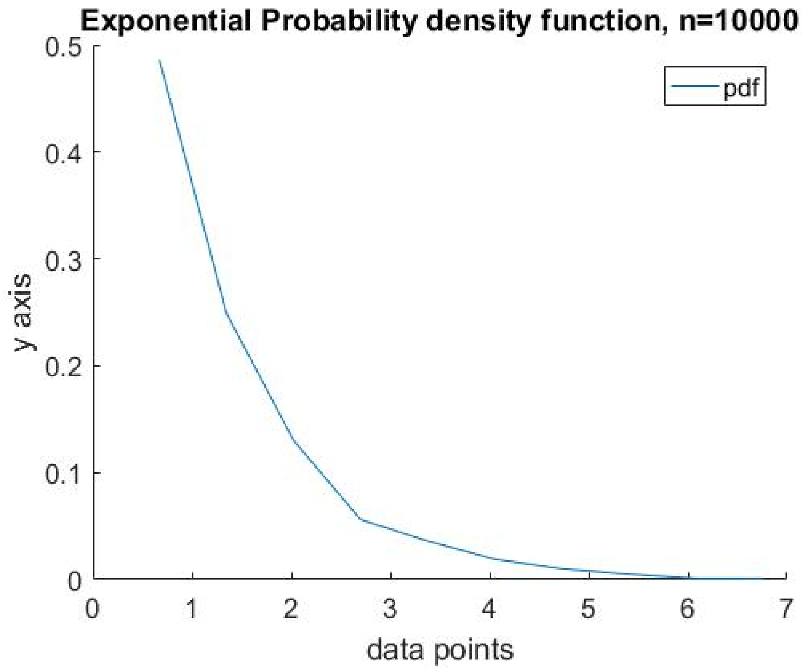

Figure 20: Probability density function

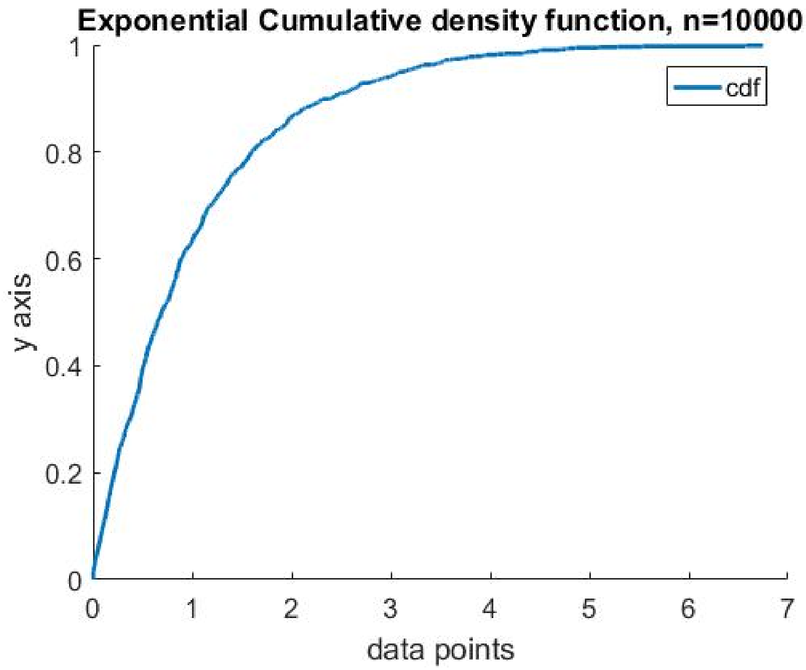

Figure 21: Cumulative density function

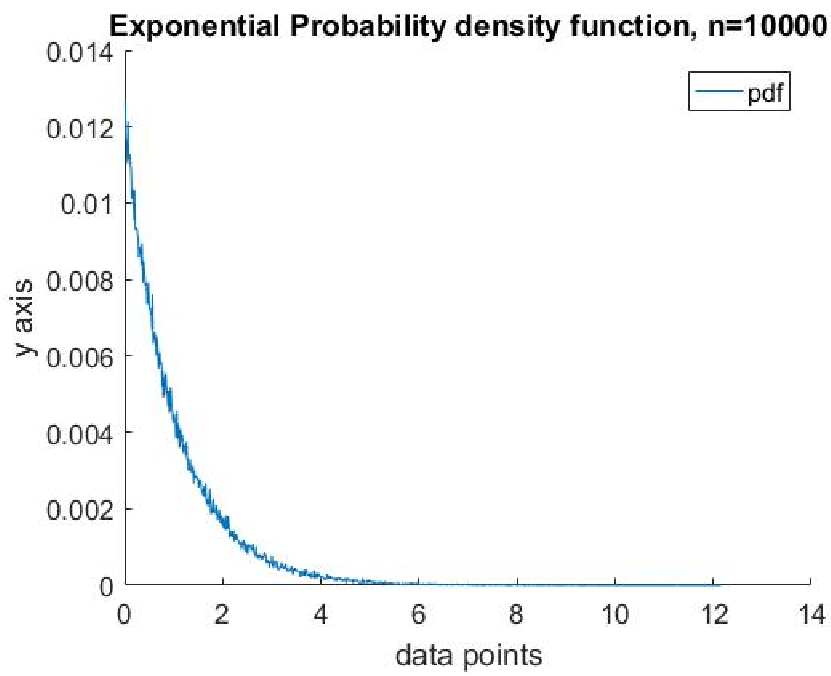

Figure 22: Probability density function

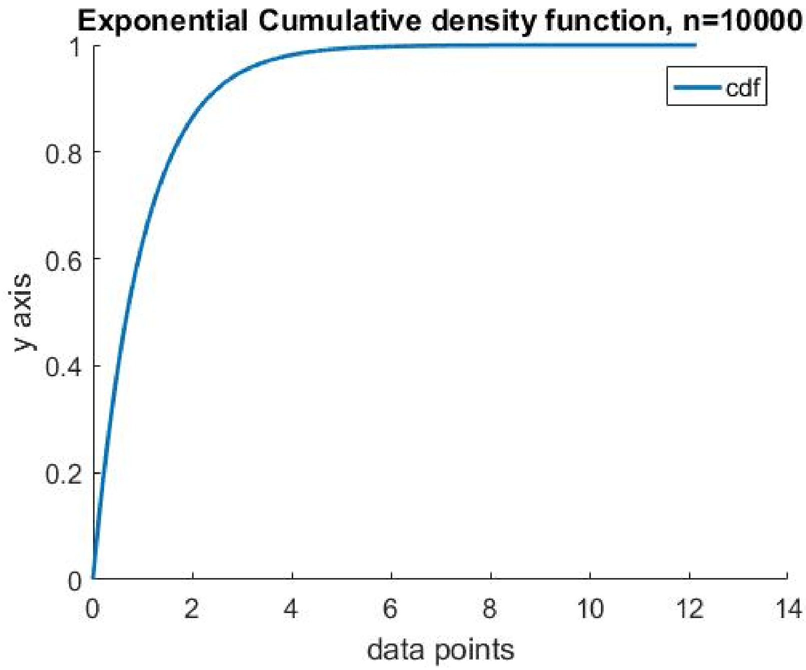

Figure 23: Cumulative density function

Part C:

Weibull $F_X(x) = 1 - e^{-(x/\lambda)^k}$, for $x > 0$, (Use inverse transfer method)

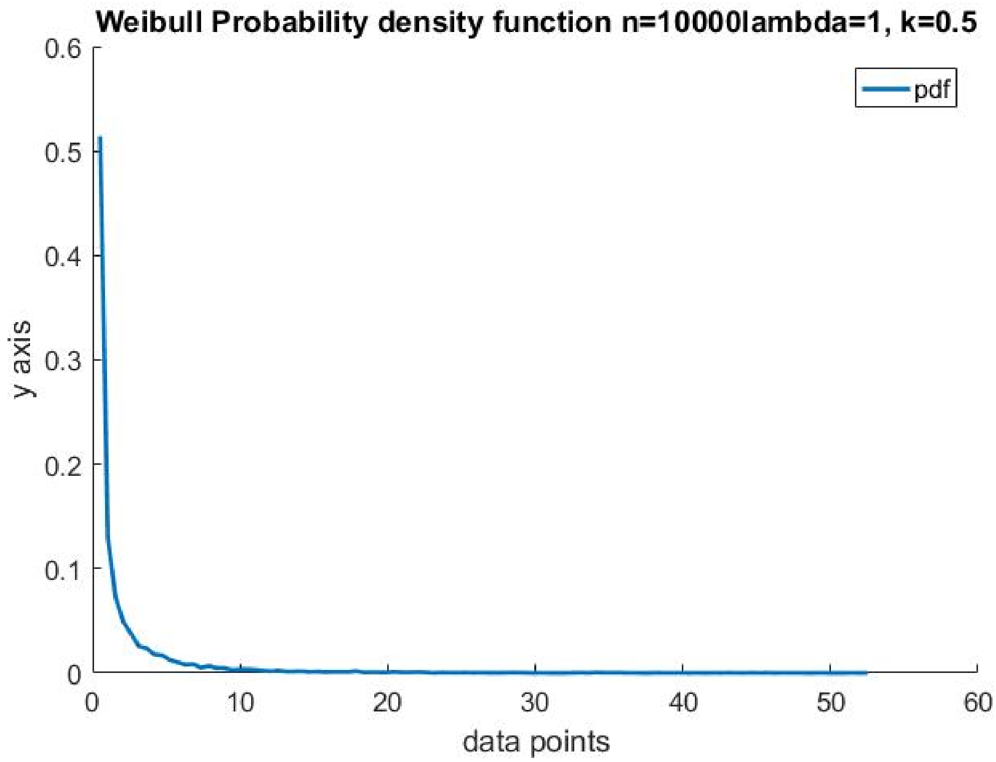

Figure 24: Probability density function

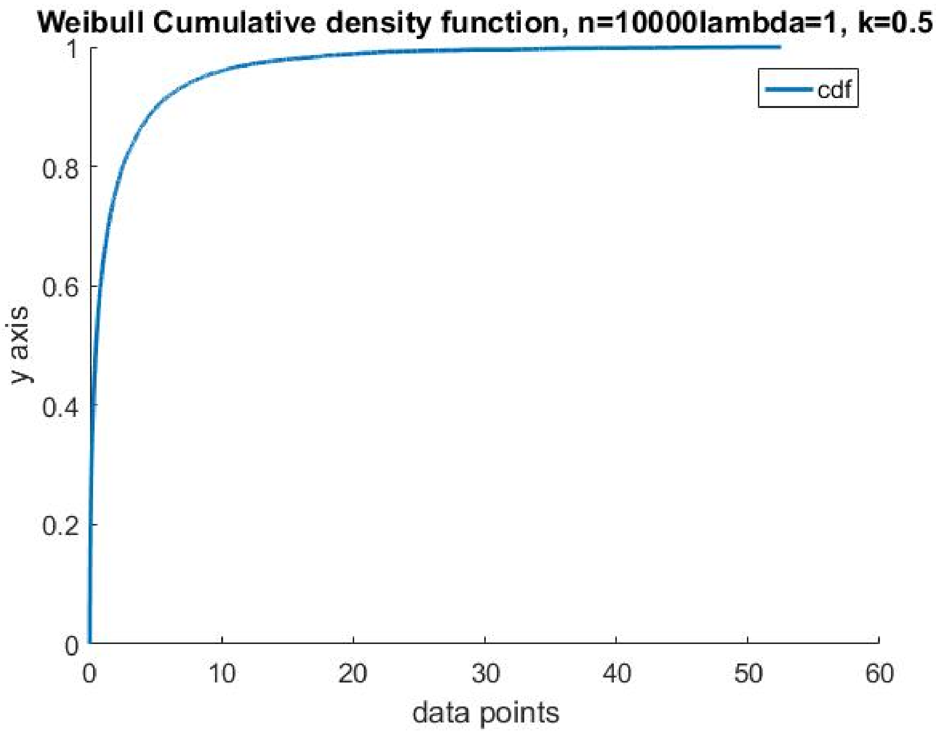

Figure 25: Cumulative density function

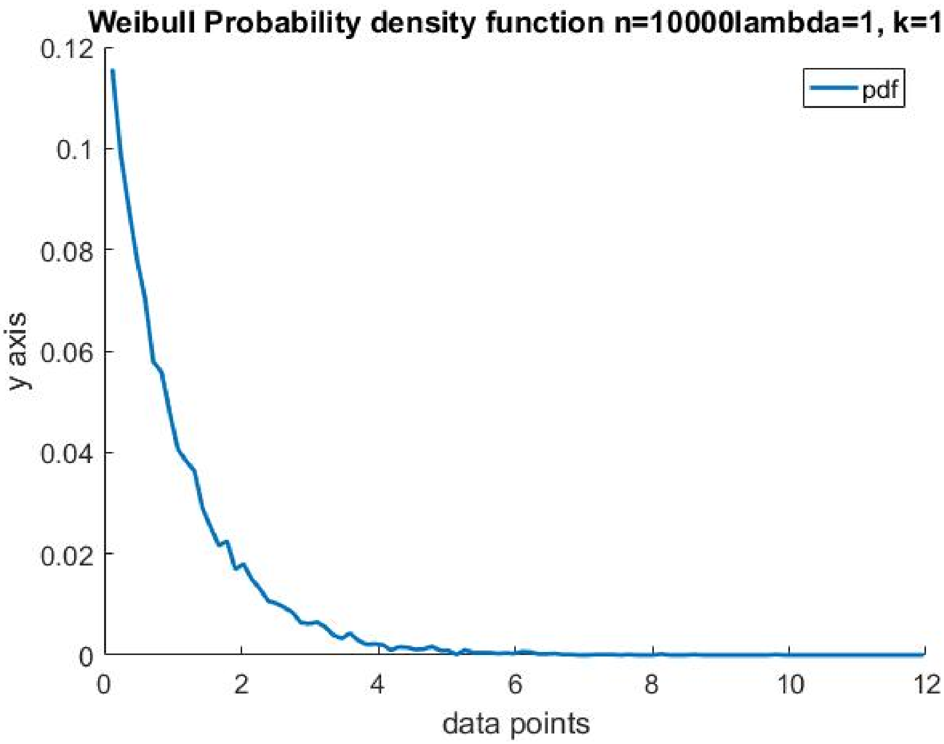

Figure 26: Probability density function

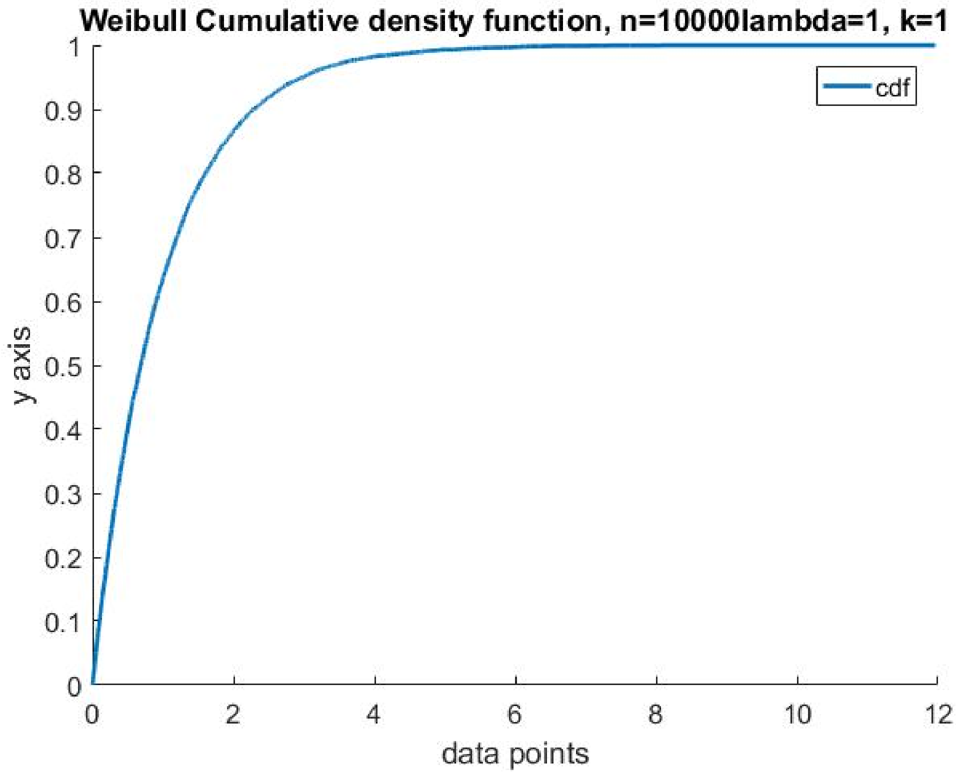

Figure 27: Cumulative density function

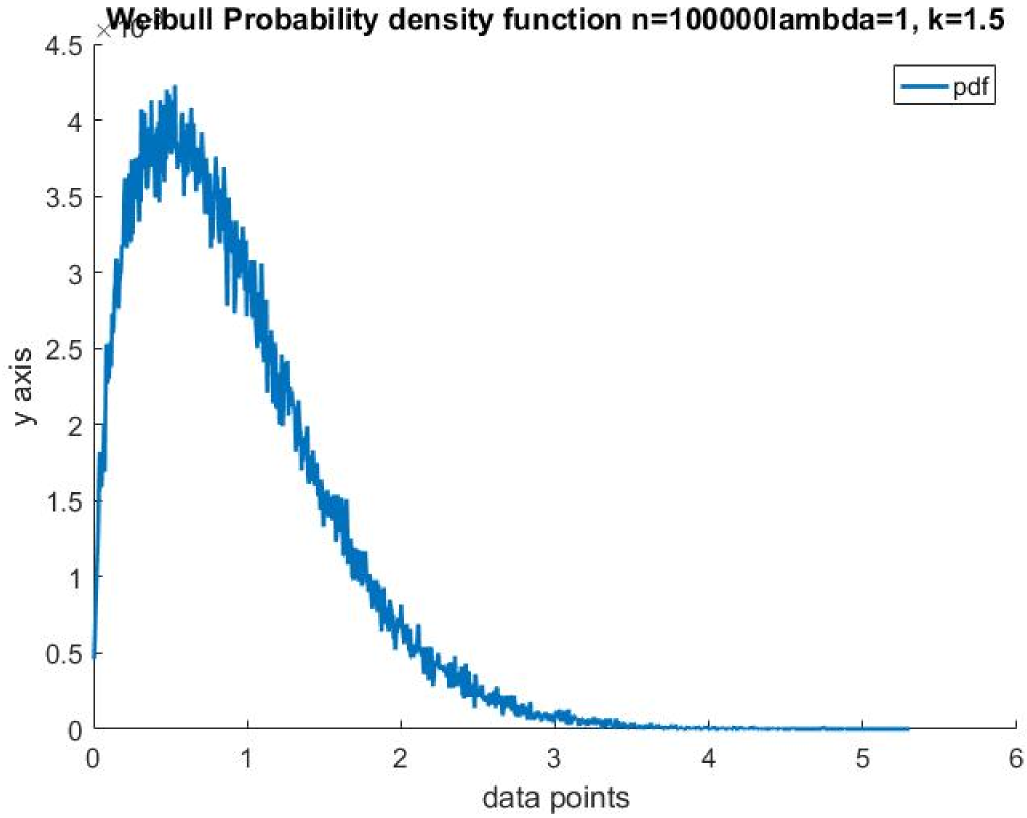

Figure 28: Probability density function

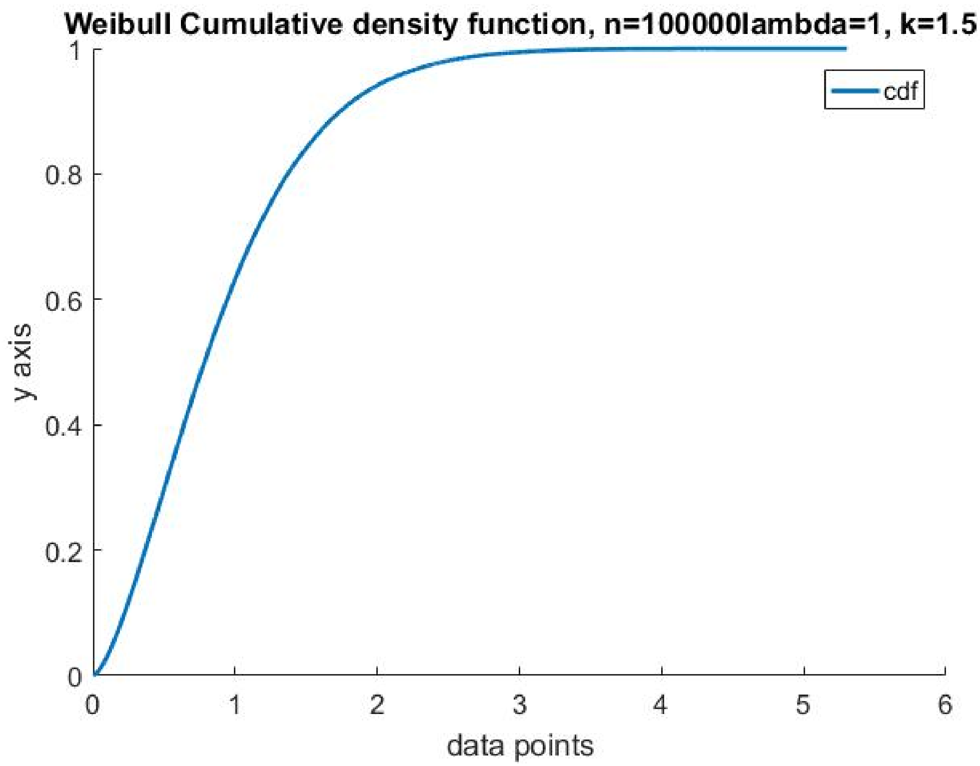

Figure 29: Cumulative density function

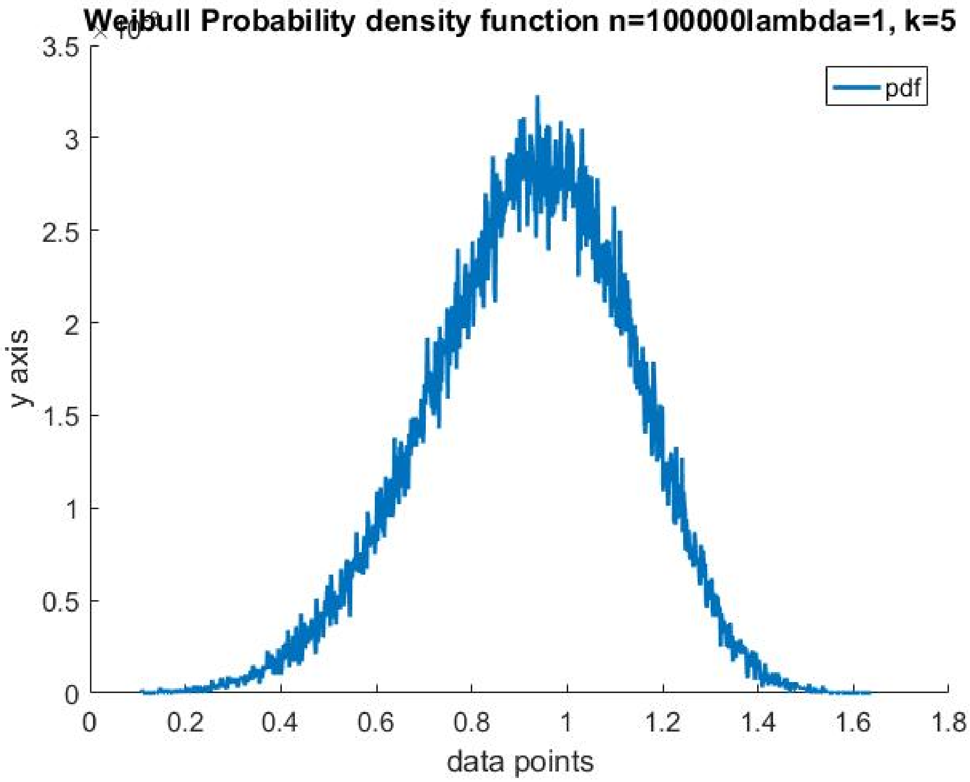

Figure 30: Probability density function

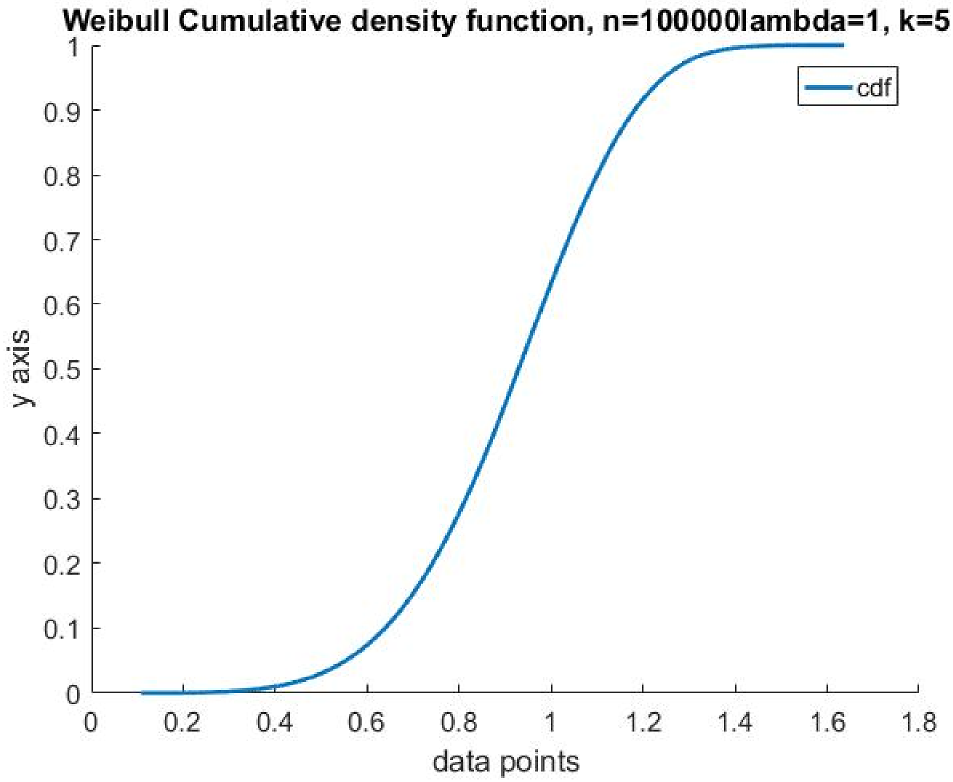

Figure 31: Cumulative density function

Problem 3

Using Acceptance-Rejection Method obtain random numbers whose probability density function is given by $f(x) = 2\pi\sin(4x)$ in the range 0 to 0:25. Generating sufficient number of values plot the histogram.

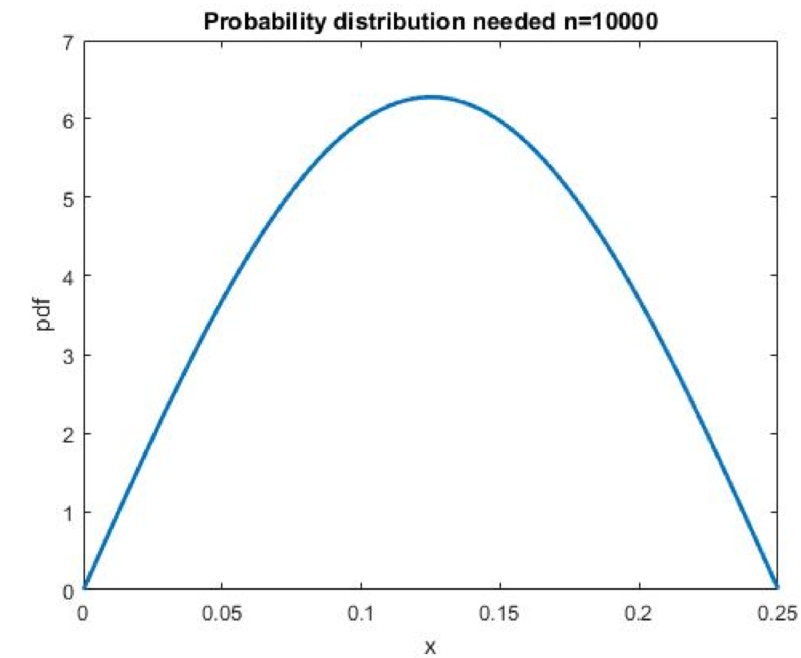

Figure 32

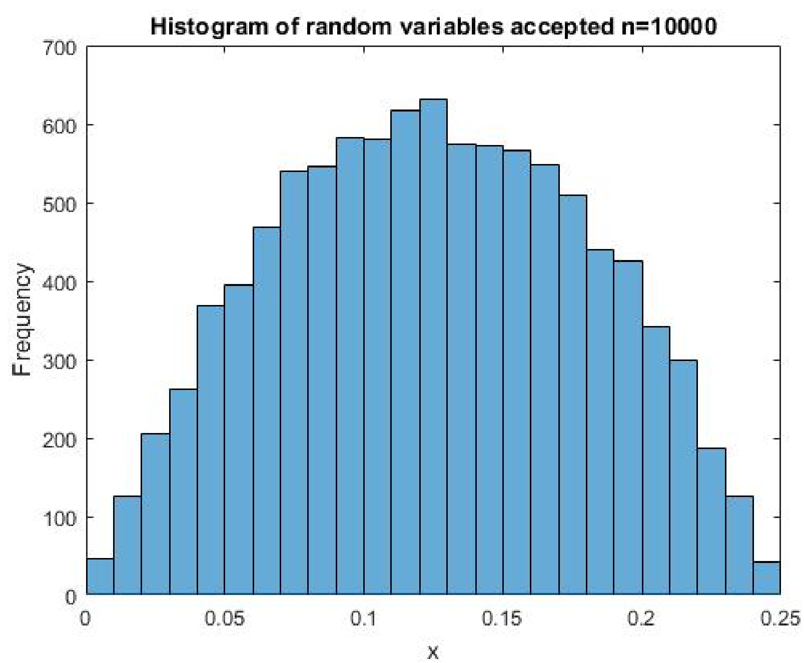

Figure 33

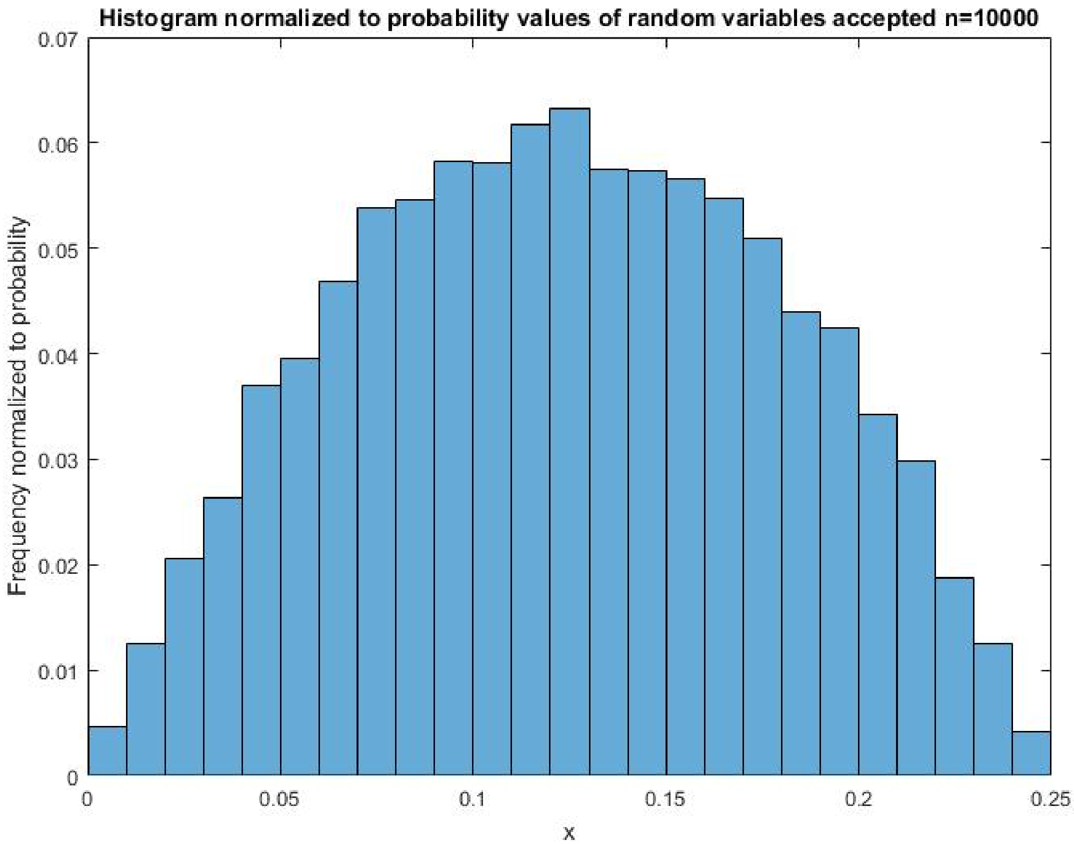

Figure 34

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