Monte Carlo Simulations (MA323) Lab 2

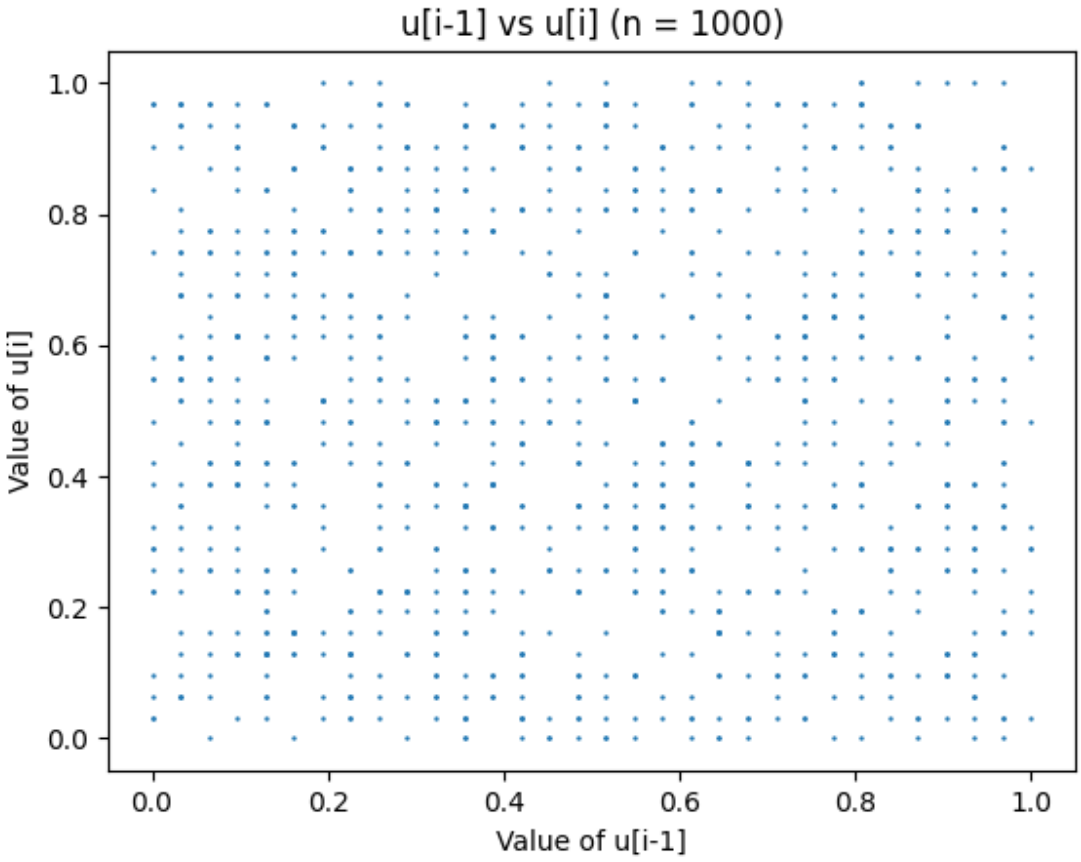
Name - Kartikeya Singh
Roll no - 180123021

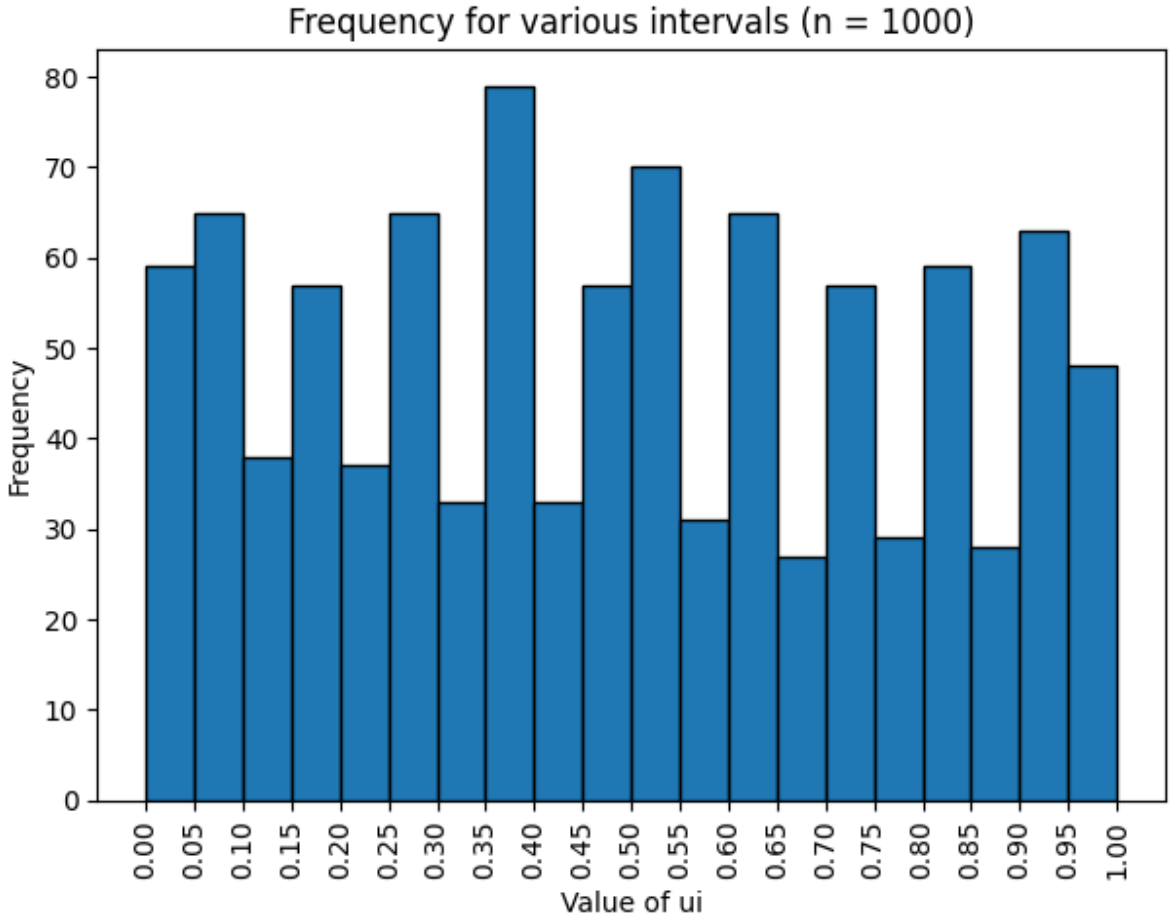
Question 1

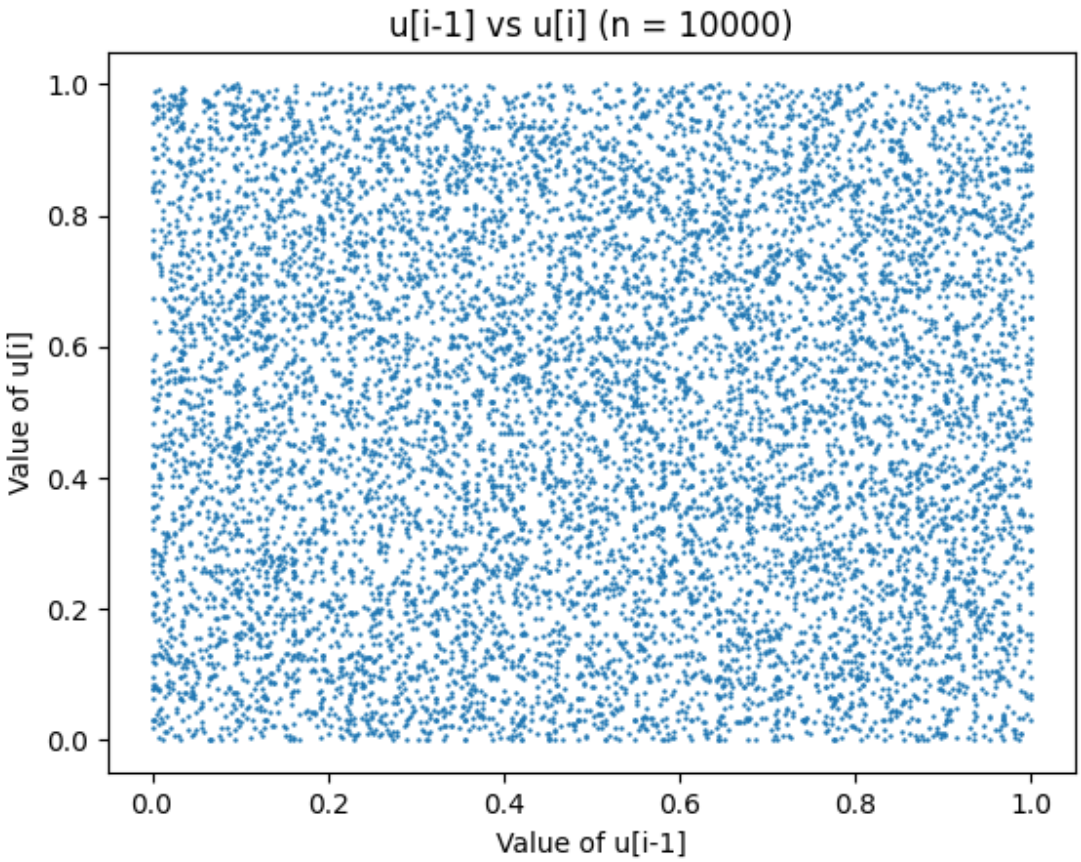
Outputs

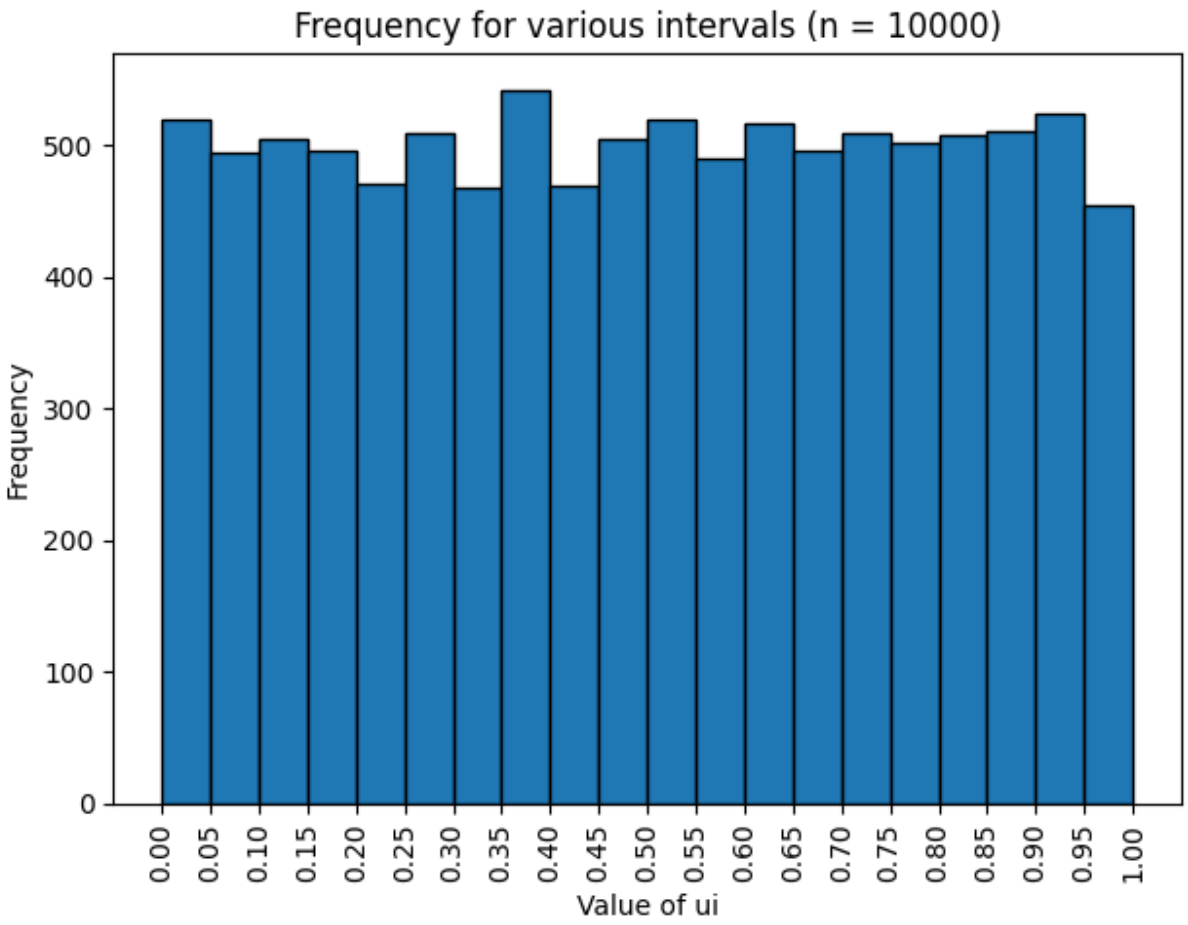
The first 17 values are generated using a linear congruence generator with a = 17,b = 1, m = 31 and x0 = 18. Subsequent values are generated using the recurrence relation.

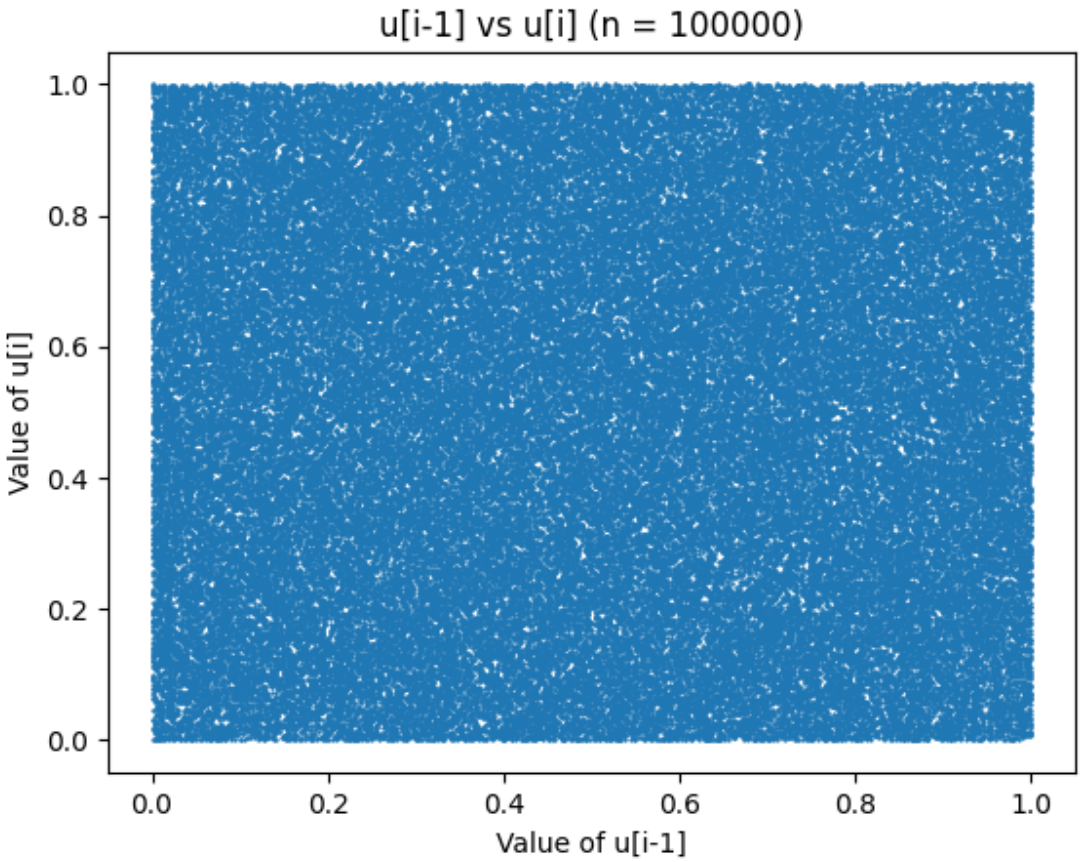
The graphs generated are :-

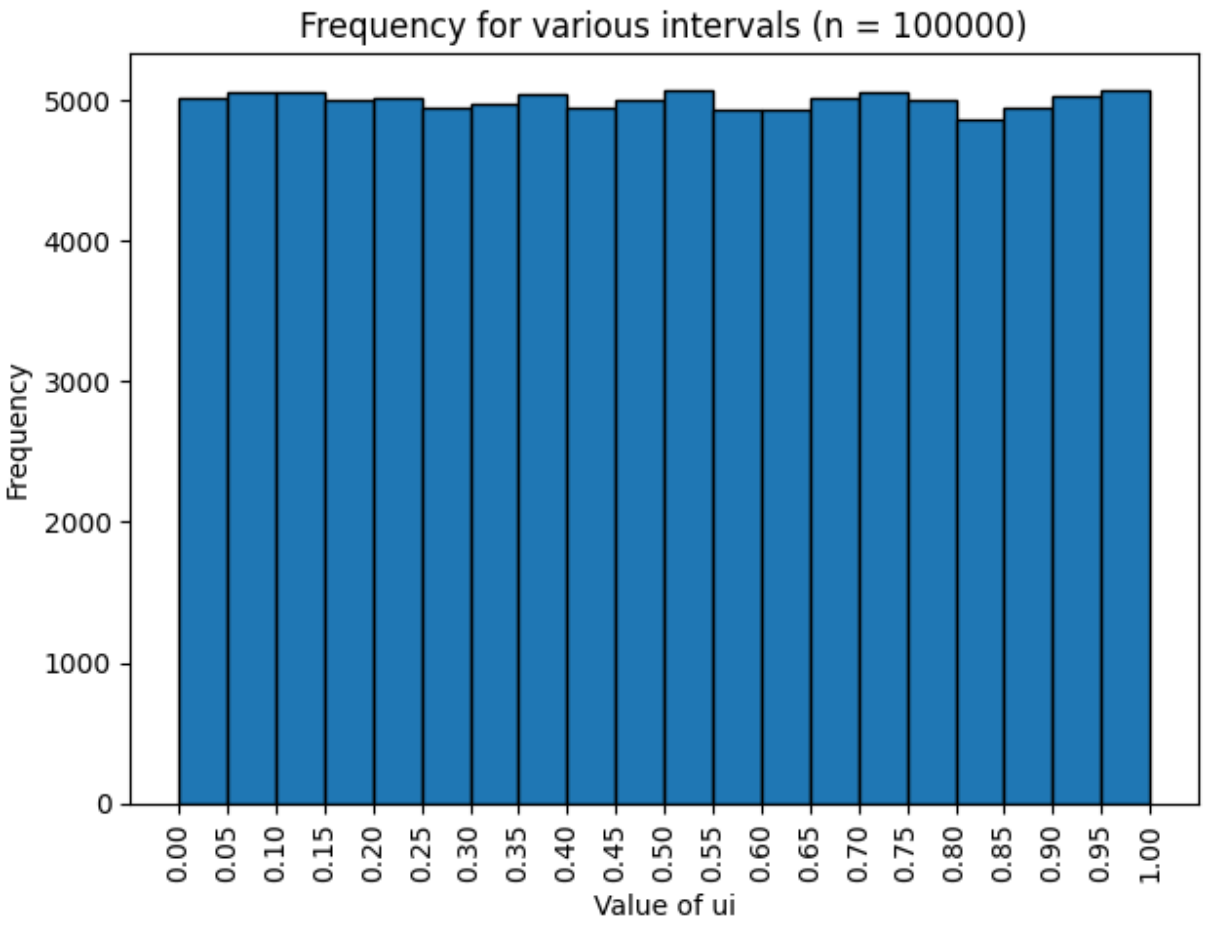



Frequency for various intervals (n = 1000)
Frequency
0
10
20
30
40
50
60
70
80
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00
Value of ui


u[i-1] vs u[i] (n = 10000)
Value of u[i]
Value of u[i-1]
0.0
0.2
0.4
0.6
0.8
1.0


Frequency for various intervals (n = 10000)
Frequency
0
100
200
300
400
500
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00
Value of ui


u[i-1] vs u[i] (n = 100000)
Value of u[i]
Value of u[i-1]
0.0
0.2
0.4
0.6
0.8
1.0



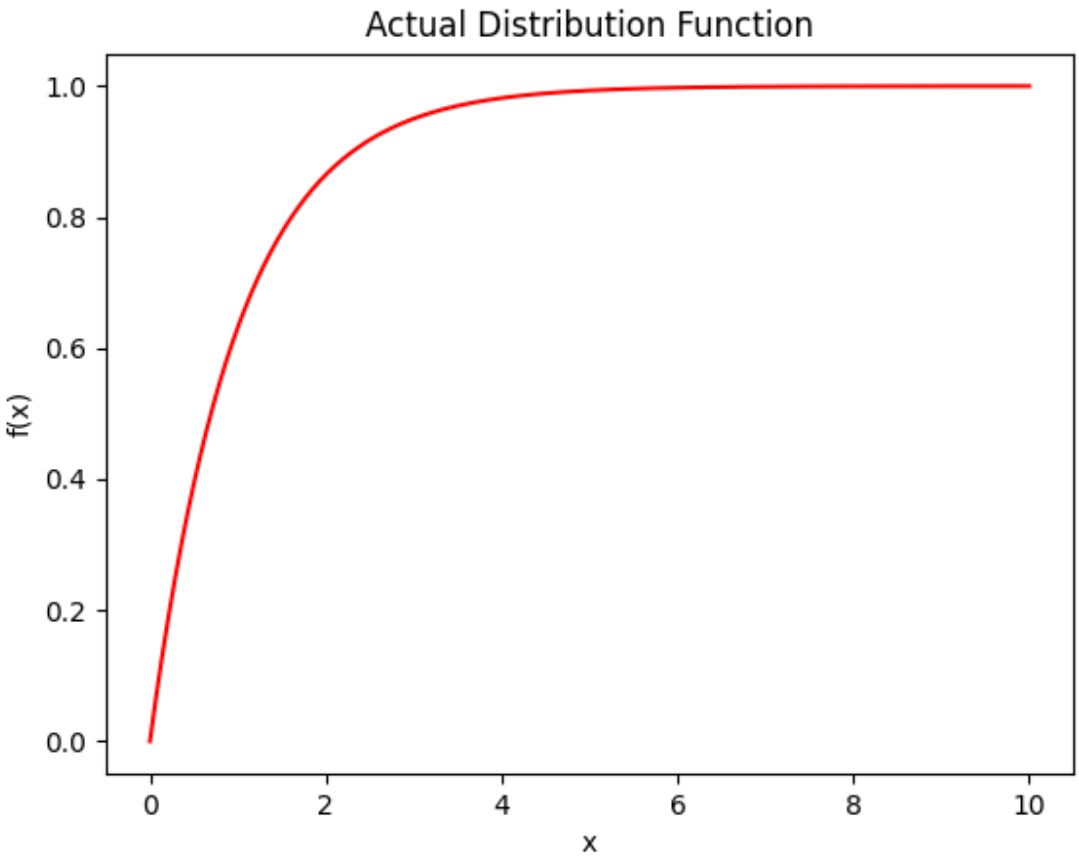
Observations

1) No clear pattern is present in the graphs between u[i-1] and u[i], and the frequency for various intervals is almost equal, so we can say that the Lagged Fibonacci Generator produces numbers randomly.
2) The uniformity and randomness increase with an increase in the number of simulations.

Question 2

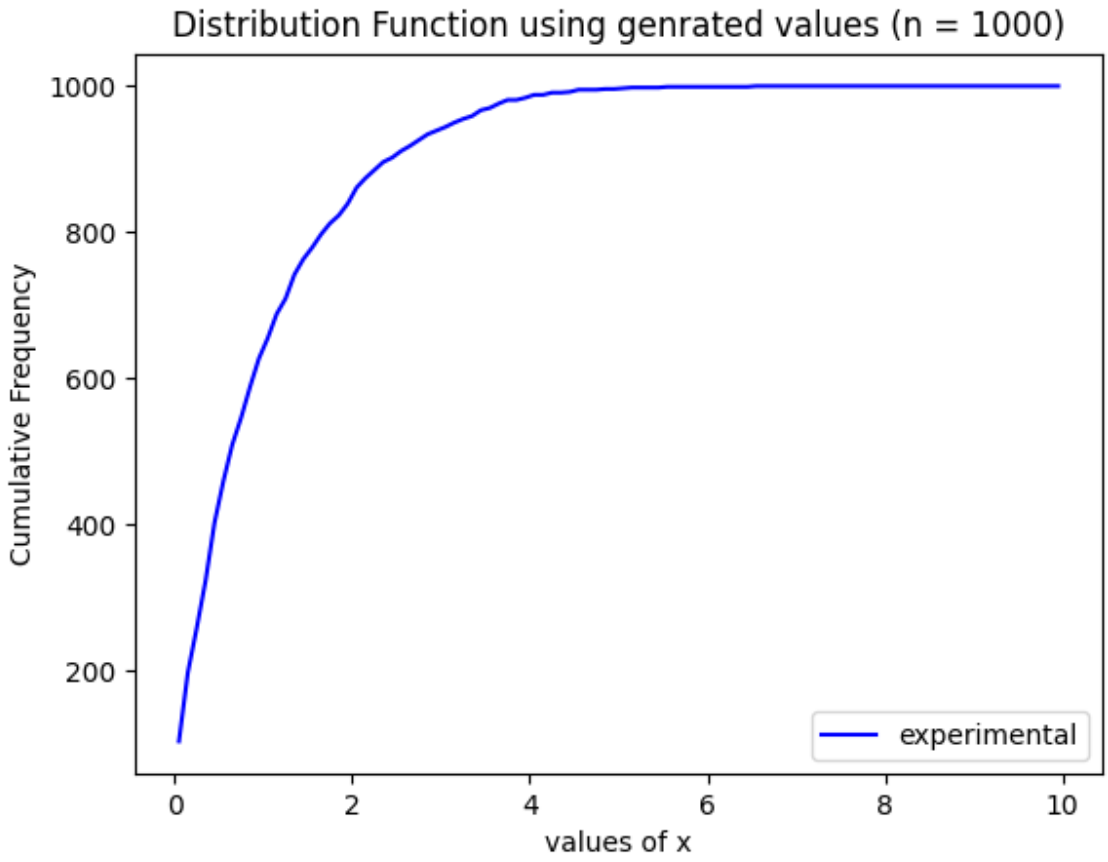
Outputs

The actual distribution function (using the formula) is:-



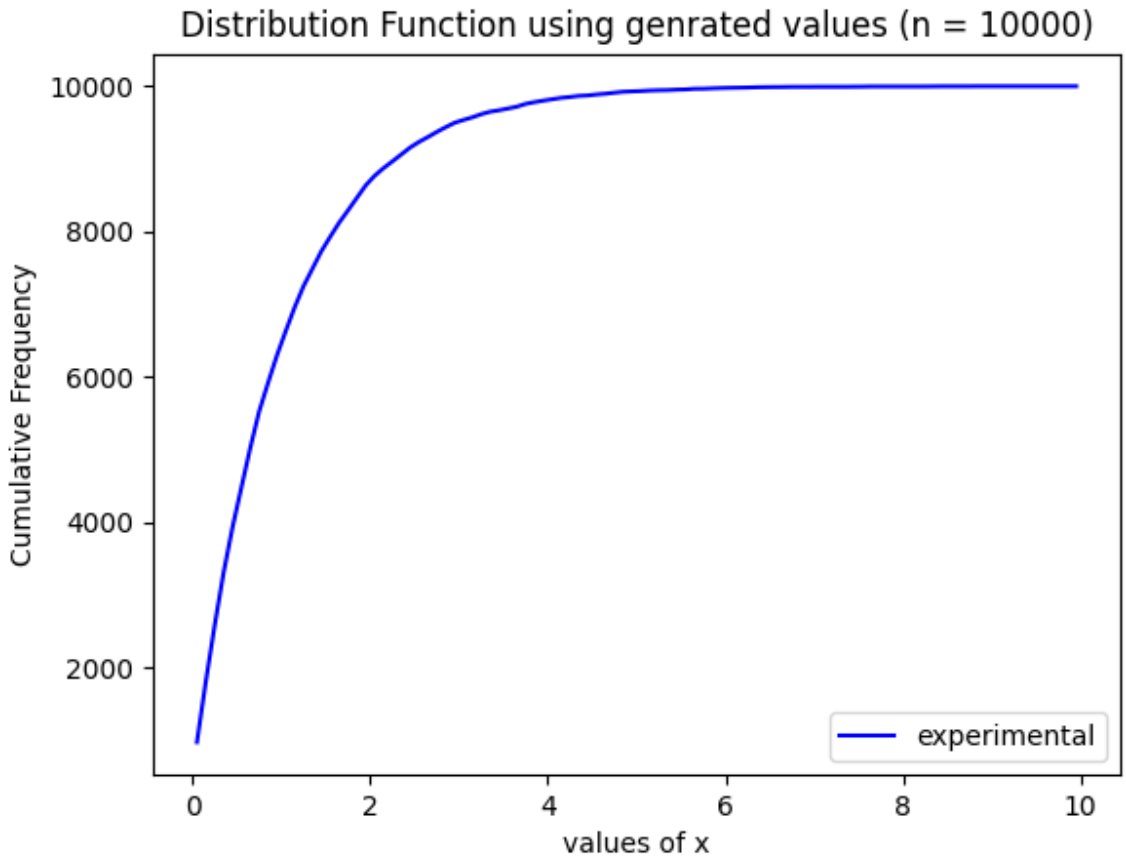
Now the functions are generated using simulating 1000, 10000 and 100000 times

1) 1000 simulations



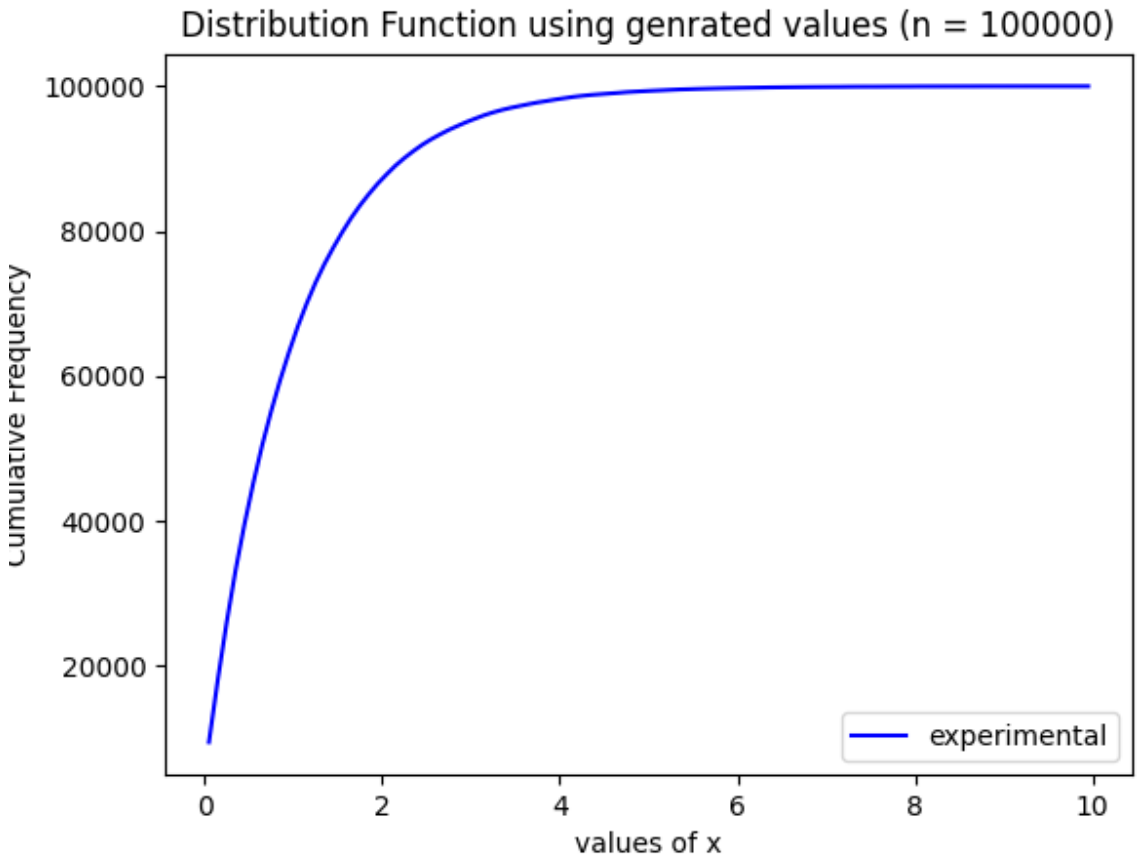
Actual Mean = 1
Experimental Mean = 1.025998069171225
Actual Variance = 1
Experimental Variance = 1.0118666898332882

2) 10000 simulations



Actual Mean = 1
Experimental Mean = 1.009446392475143
Actual Variance = 1
Experimental Variance = 1.026995877464247

3) 100000 simulations



Actual Mean = 1
Experimental Mean = 0.997202826844612
Actual Variance = 1
Experimental Variance = 0.9983246868622064

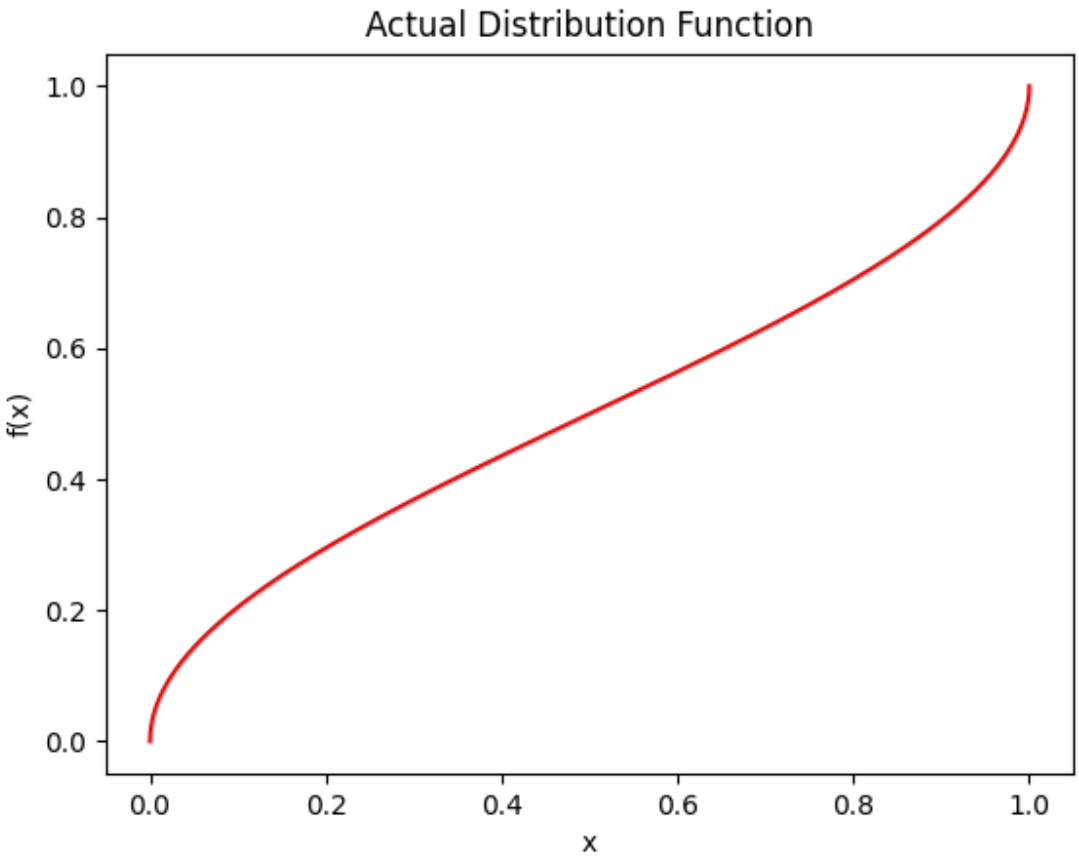
Observations

1) The plot for the distributed functions using generated values is similar to the actual distribution function and becomes nearly identical on increasing the number of simulations
2) The experimental mean and variance is very close to the actual mean and variance

Question 3

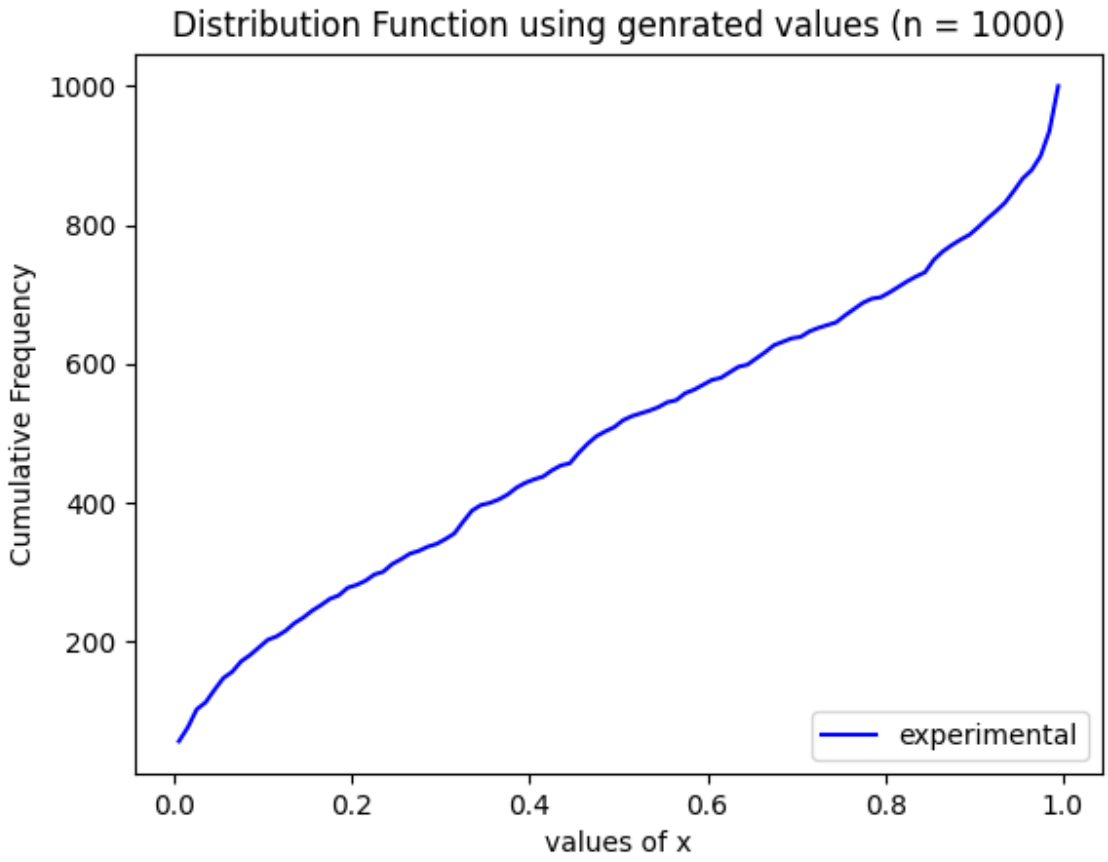
Outputs

The actual distribution function (using the formula) is:-



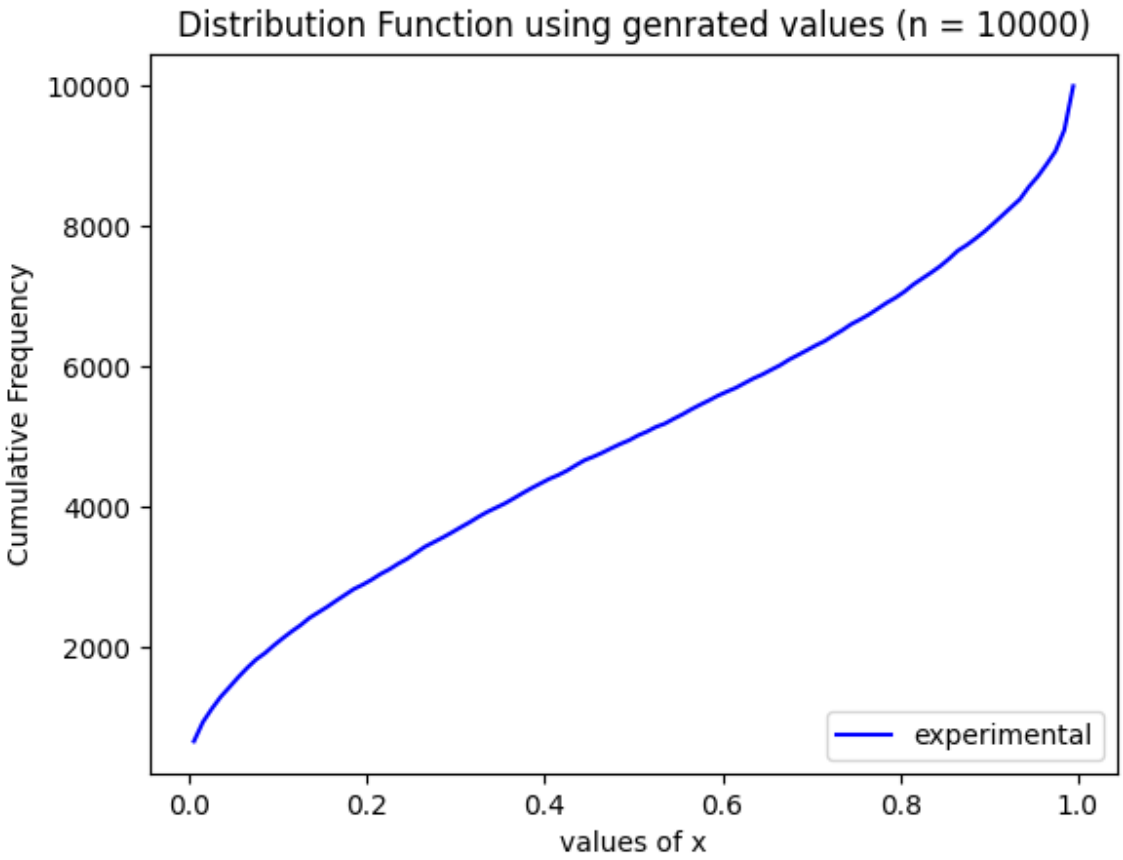
Now the functions are generated using simulating 1000, 10000 and 100000 times

1) 1000 simulations



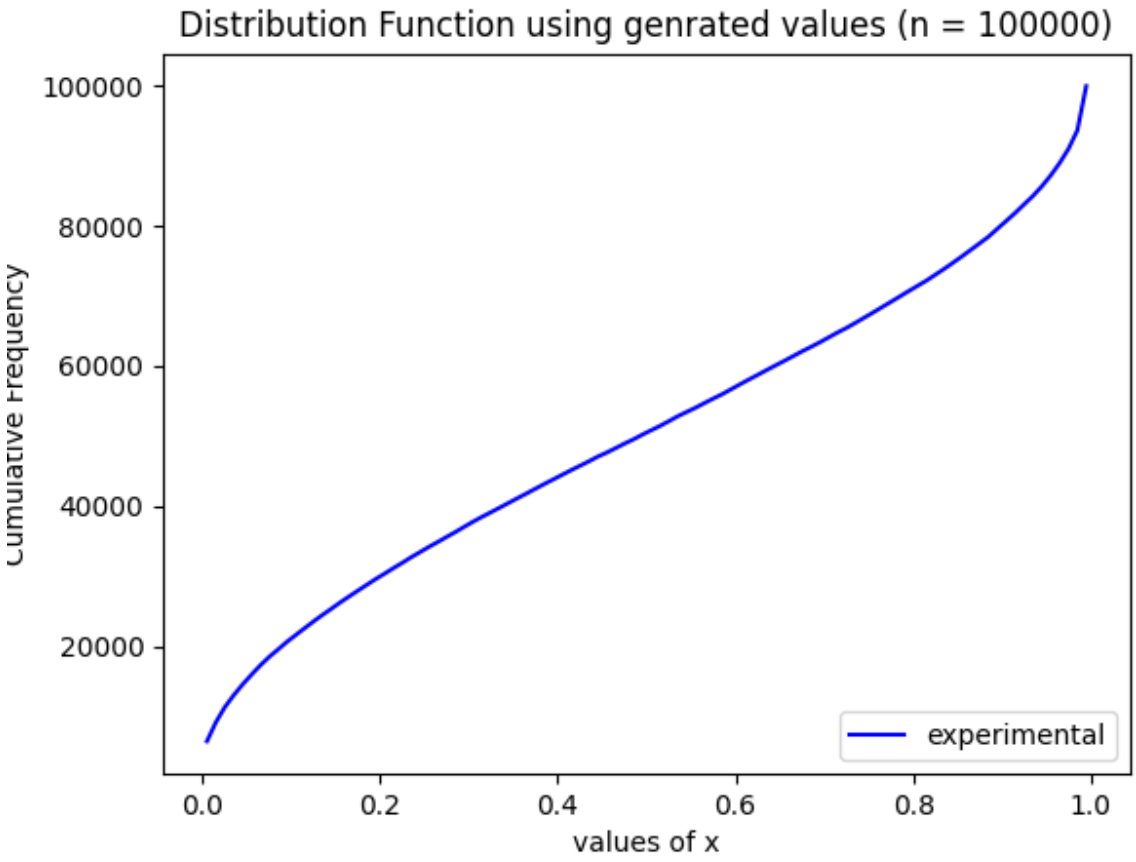
Experimental Mean = 0.50728833650772
Experimental Variance = 0.12225632131395184

2) 10000 simulations



Experimental Mean = 0.504099627872768
Experimental Variance = 0.12530079815927453

3) 100000 simulations



Experimental Mean = 0.49833714090718023
Experimental Variance = 0.12487962131515402

Observations

1) The plot for the distributed functions using generated values is similar to the actual distribution function and becomes nearly identical on increasing the number of simulations