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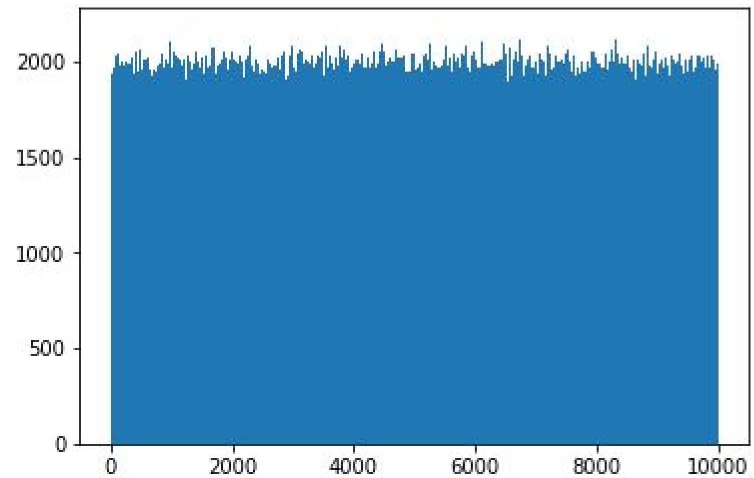
MA 323 - Monte Carlo Simulation
Assignment - 3

Ques 1:
A Random Variable with the given distribution was generated with the help of a random sample from Uniform[0, 1]. The Random Variable has been represented via a Bar Graph, in which 10,000,000 were considered.



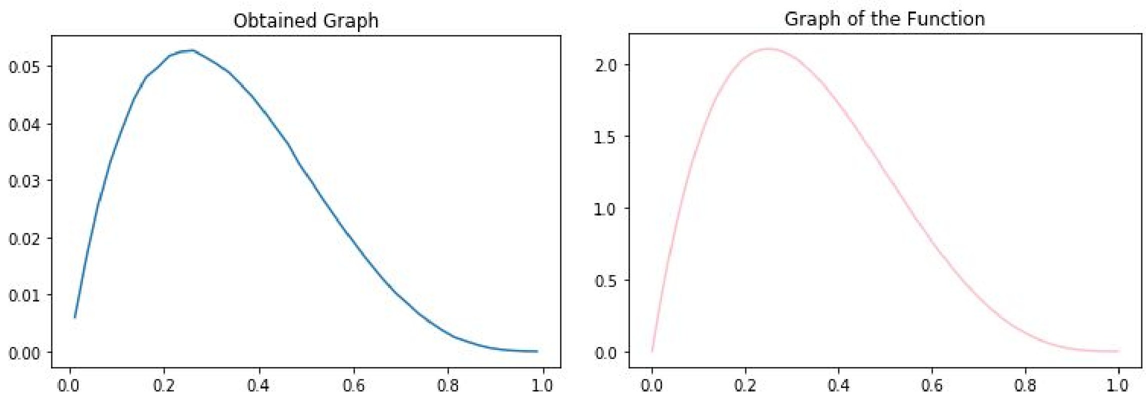
The frequency of elements appearing for a particular value of the Random Variable are distributed Uniformly, with some anomalies.

Ques 2:
The density function g will be a constant function equal to 1, since it's the PDF of Uniform[0, 1]. For the given function, since its integral from 0 to 1 gives a value of 1, we shall consider it for all values of x in [0, 1]. For the given interval, the maximum value is attained at x = ¼.
The least value of c = 5*27/64 = 2.1093

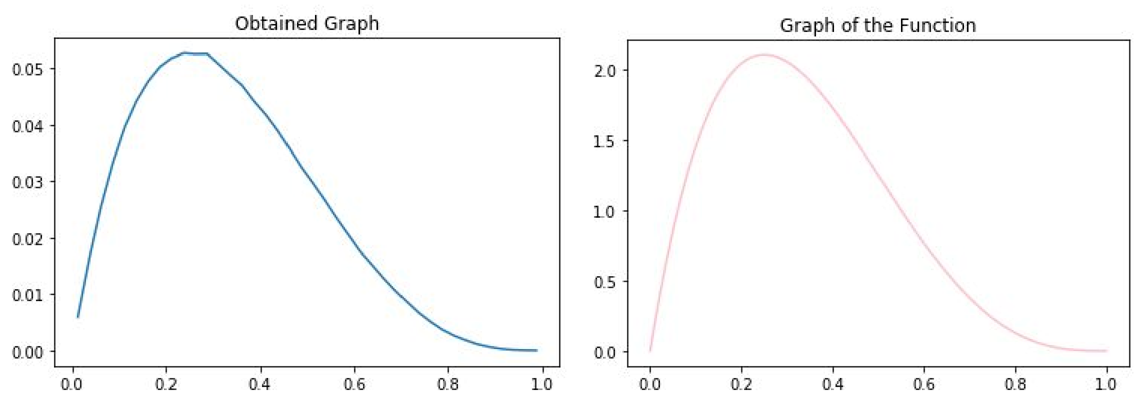
After the generation of random variables of f(x), the distribution graphs were created to check for the effect of different values of c. The no. of elements considered equals 1,000,000. The samples were obtained using the Acceptance Rejection Method.

Graph obtained for:

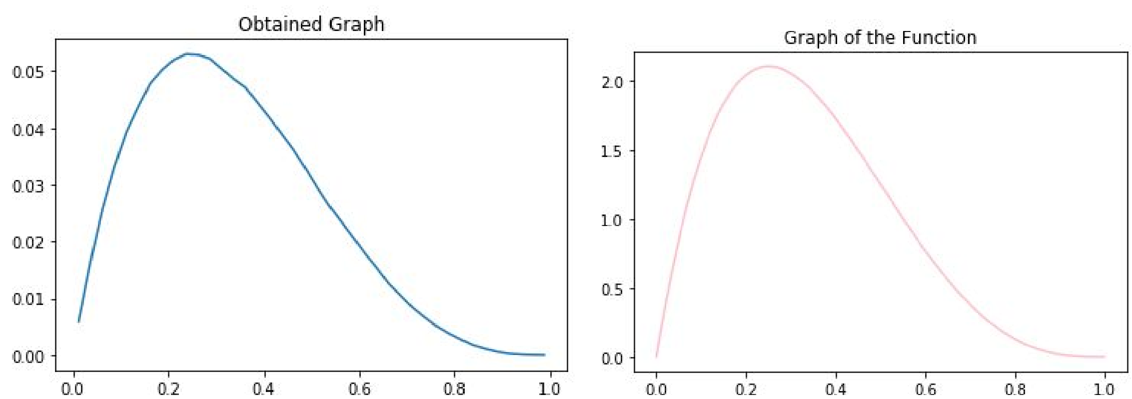
- c = 2.1093
  The mean of the iterations taken per element = 2.10714



- c = 12.1093
  The mean of the iterations taken per element = 12.103406



- c = 42.1093
  The mean of the iterations taken per element = 42.



For such a great value of n, the graph of the obtained sample is matching the graph of the function. Hence we can say that the values from the generated sample converges to the distribution function.

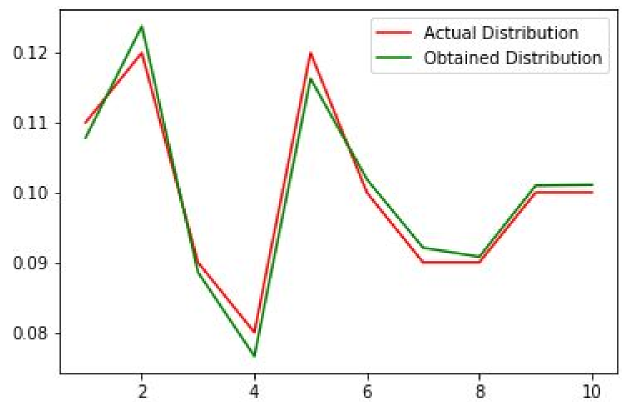
After repeating the experiment with 2 greater values of c, the mean of the iterations needed to generate each random number is almost equal to c.
Differing the value of c doesn't seem to affect the shape of the obtained graph

Ques 3:
The distribution function (PMF) g will be equal to 0.1 for all values in {1, 2, … , 10}.
Using a random sample generated from g, obtained a random sample of distribution f by applying the Acceptance Rejection Method.

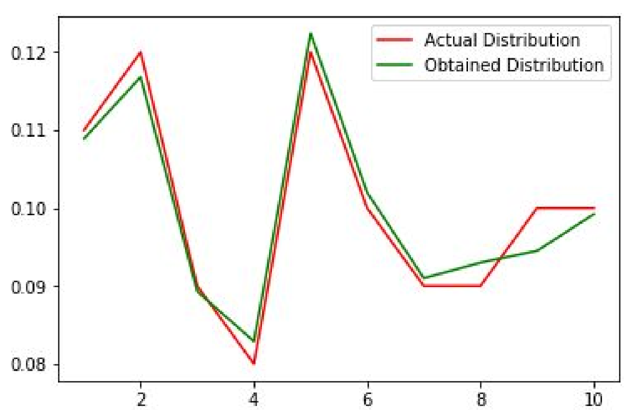
For applying the Method, the least value of c satisfying the condition comes out to be 1.2.

Plotted graphs for 3 values of c, and calculated the Standard Deviation of the difference between the obtained and actual distribution of f (10,000 elements were)

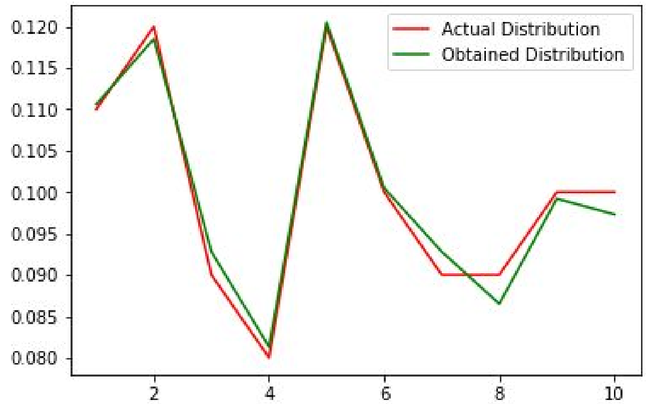
- c = 1.2
  Std. Dev = 0.00239



- c = 10.2
  Std. Dev = 0.00266



- c = 102.0
  Std. Dev = 0.00202



Increasing the value of c doesn't seem to have an effect on the Standard Deviation. The mean of the iterations again is very close to the value of c considered