Monte Carlo Simulations (MA323) Lab 3

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Question 1

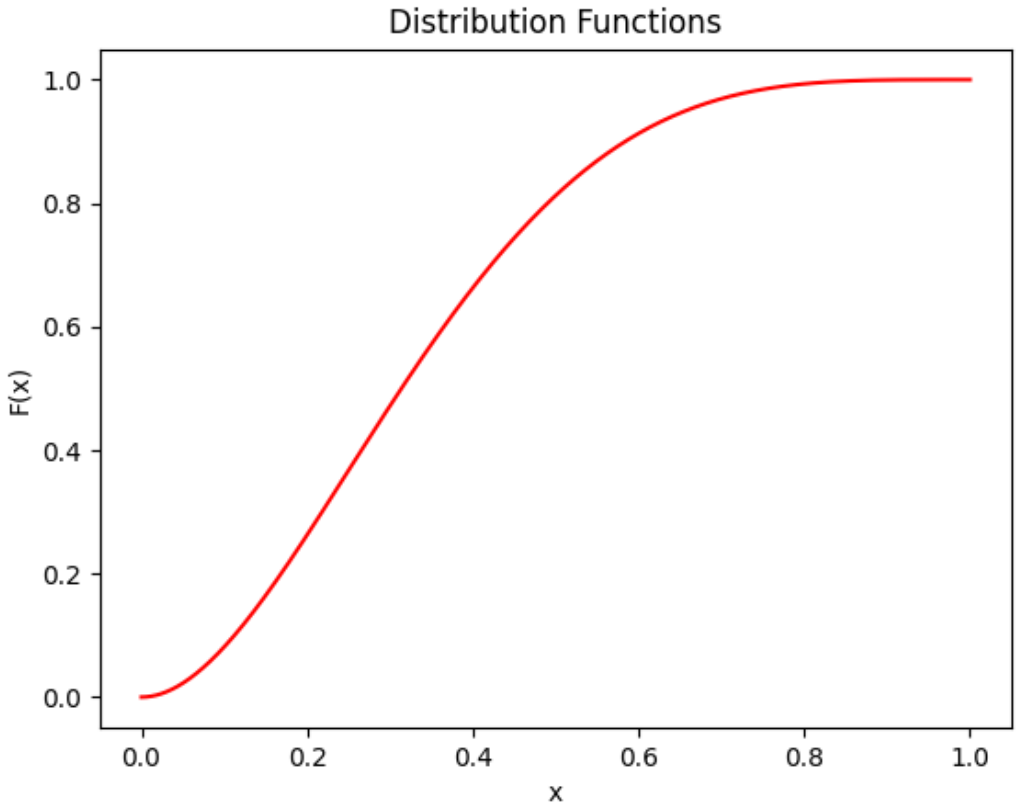
The probability of occurrence of each number is taken to be 1/5000 as we need to generate a uniform distribution. We are generating 100000 values, at each step a random number **u** in the interval (0,1) is generated, and the value k such that q[k-1] < U <= q[k] is found, and the number generated is c[k]. The generated numbers are present in the file q1_data.txt.

Question 2

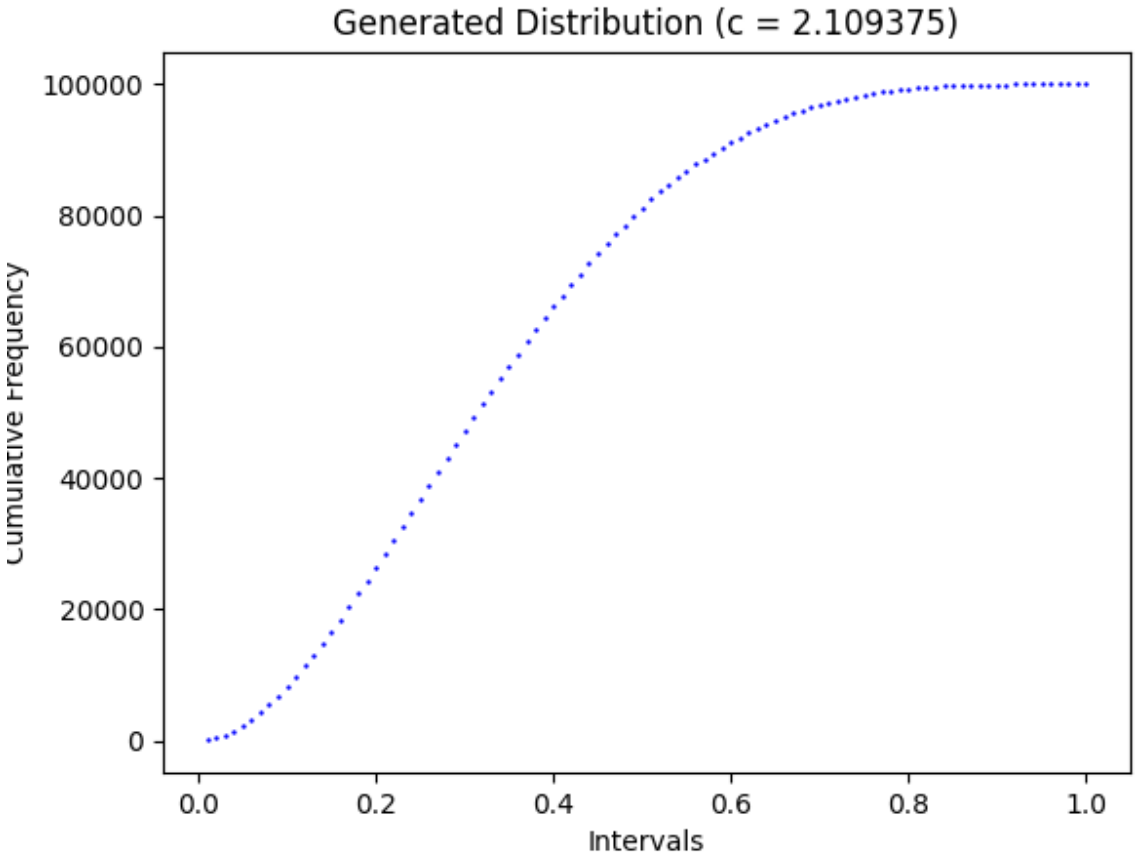
The distribution f(x) is generated using the acceptance-rejection method.

a) The **smallest constant c is 2.109375**, which can be calculated by finding the maximum value of f(x) over [0,1], $f(x) = 20x(1-x)^3$. so, f'(x) = 0 at x = 0.25 and f''(x) < 0 at x = 0.25, so the maximum of f(x) occurs at 0.25 => max(f(x)) = 2.109375. Now g(x) = 1 for all x in [0,1] as g ~ U[0,1] => c = 2.109375.

b) The actual distribution function is -



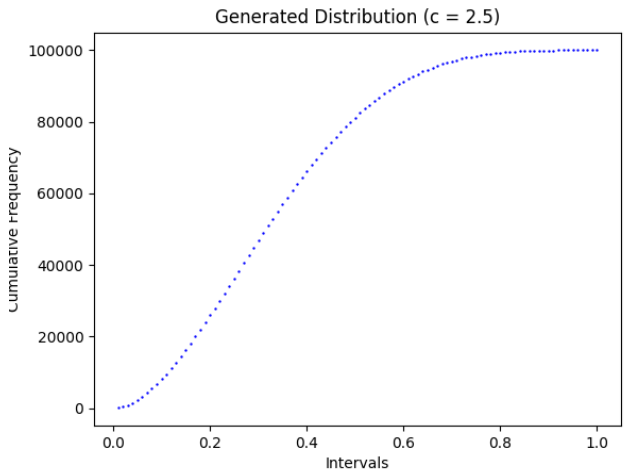
The distribution function generated by the acceptance-rejection method is -

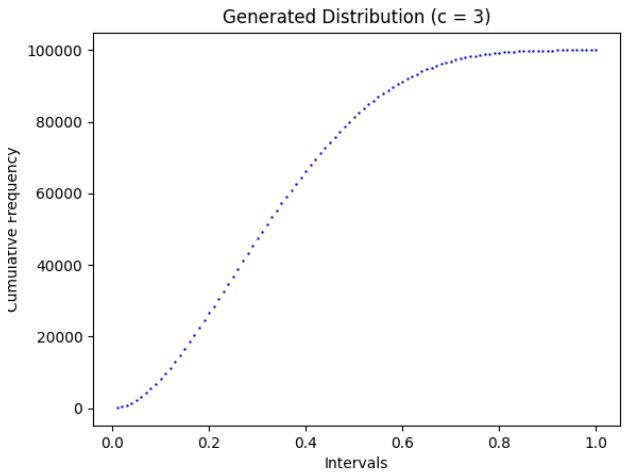


As we can see, the distribution functions are very close to each other, we can conclude that the acceptance-rejection method works well.

c) The average of the number of iterations = 2.11572 and c = 2.109375, we can observe that it takes approximately ‘c’ number of iterations to generate a value which is accepted. (As c and the average number of iterations is very close in the simulations)

d) The new values of c are chosen to be 2.5 and 3. The average number of iterations were 2.49359 and 3.00842 which is very close to c. The graphs obtained are -





Question 3

The value of c is taken to be 8 and 16, and the distributions are generated using the acceptance rejection method. Here g(x) is taken to be the uniform discrete distribution on {1,2, .. , 10} and f(x) is a discrete random distribution with given probabilities. The average number of iterations were 7.966 and 15.8167 which is very close to the values of c. The cumulative frequencies are plotted and are shown below -