LAB REPORT-2

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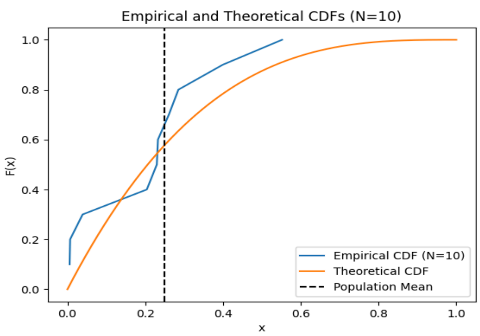
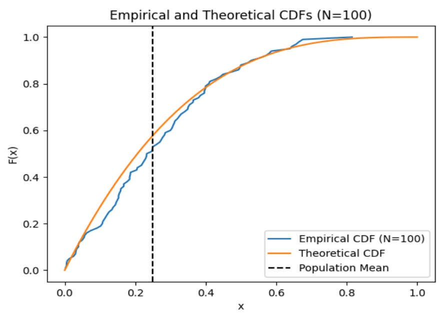
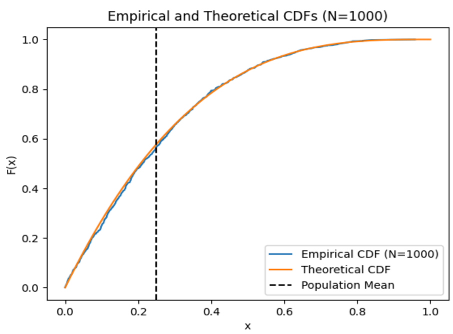
QUESTION-1:

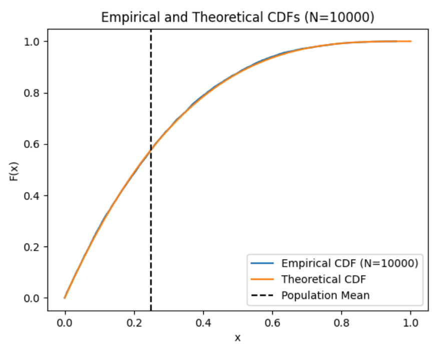
Defined a custom CDF function that returns the cumulative distribution function of the given distribution.

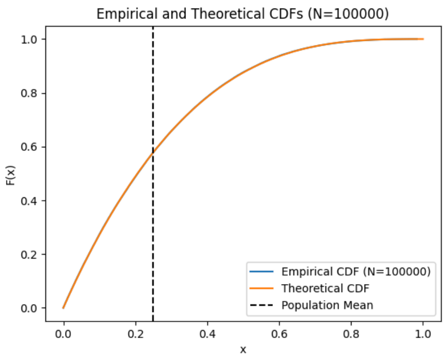
- Implemented a Linear Congruential Generator (LCG) to generate random samples from the distribution using the Linear congruence generator function.Generated random samples of sizes 10, 100, 1000, 10000, and 100000.
- Population mean and variance are calculated by the following formulae
- **$E(X) = \int x f(x) dx$**$= \int [0,1] xf(x)dx = 0.25$
- **$Var(X) = E(X^2)-[E(X)]^2$** $= 0.1-0.25^2 = 0.375$
- Plotted the empirical CDFs and the theoretical CDFs and compared them for each sample size.











N=10: mean=0.2216, var=0.0273

N=100: mean=0.2688, var=0.0340

N=1000: mean=0.2537, var=0.0372

N=10000: mean=0.2487, var=0.0370

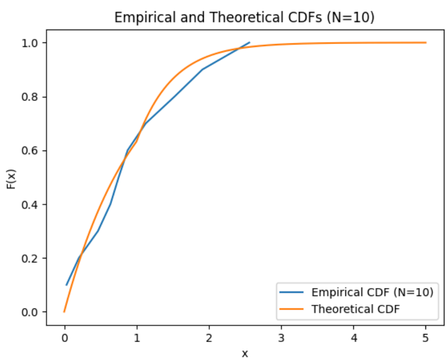
N=100000: mean=0.2498, var=0.0375

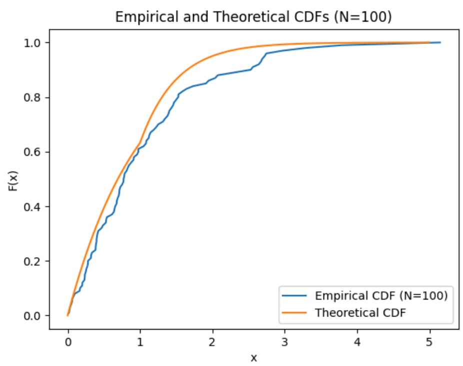
Observations:

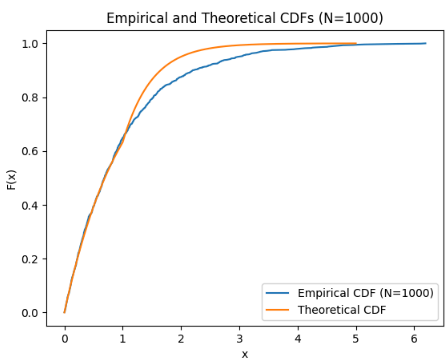
The plots show that the empirical CDFs converge to the theoretical CDF as the sample size increases. The mean and variance of the generated samples are also calculated and printed for each sample size

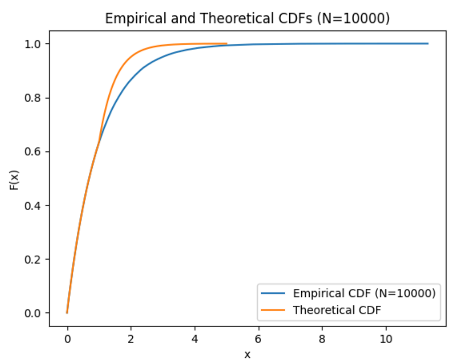
QUESTION-2:

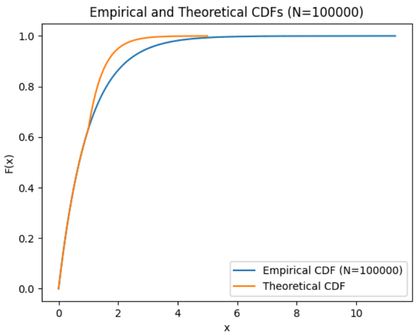
- **E (X) = ∫x f (x)** =∫ [0,1] (xe^-x)dx+∫ [1,∞] (2xe^(-2x+1))dx =0.816
- **Var(X) =E(X^2)-[E(X)]^2** = 1.083-0.816^2 = 0.4153











N=100: mean=1.0445, var=0.8359

N=1000: mean=0.9751, var=0.9485

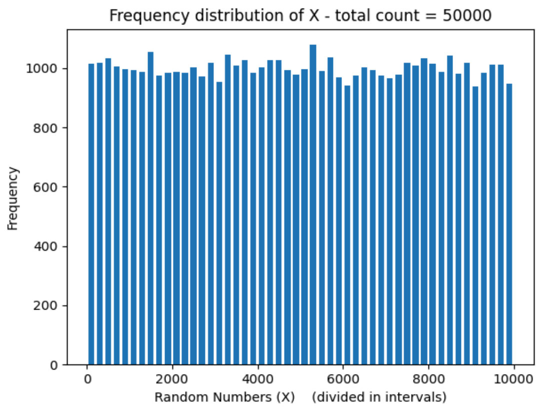
N=10000: mean=0.9995, var=0.9991

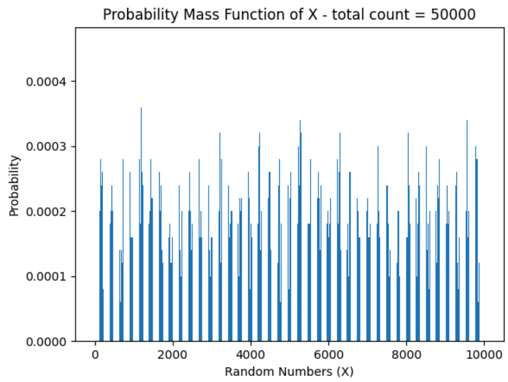
N=100000: mean=1.0001, var=1.0023

QUESTION-3

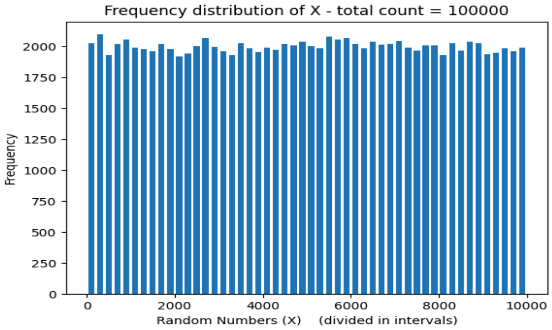
While generating the plot for frequency distribution, I have binned the complete set of random numbers for a size of 50, i.e, each interval on x axis is of size = 50 *(for better clarity and insights)*.

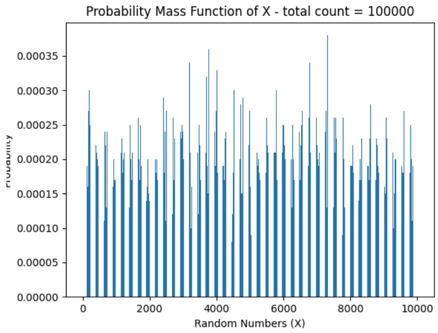
·**Plot when total number of random numbers generated = 50000**



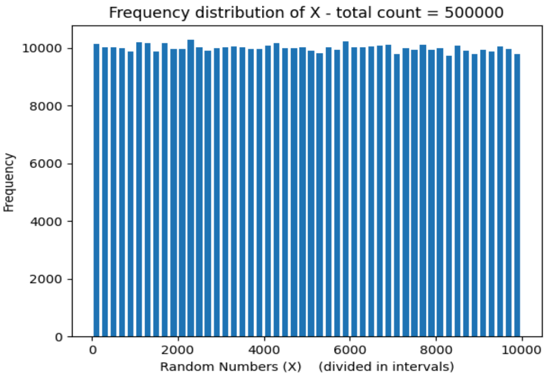


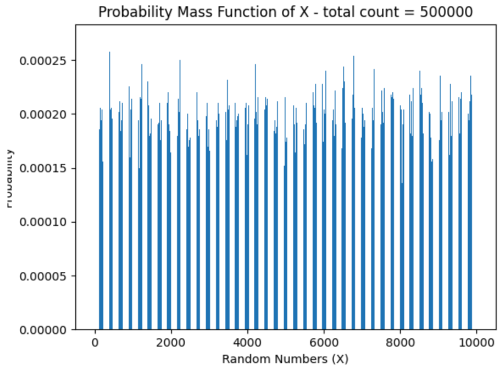
·**Plot when total number of random numbers generated = 100000**



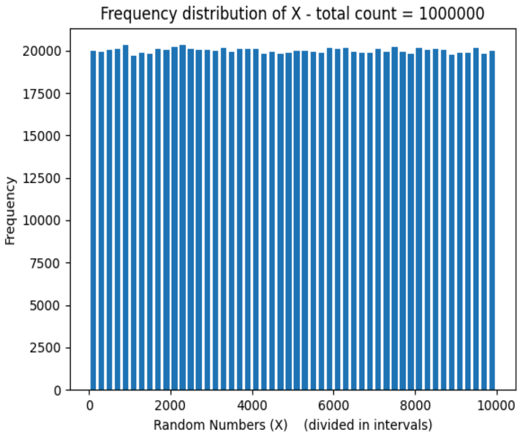


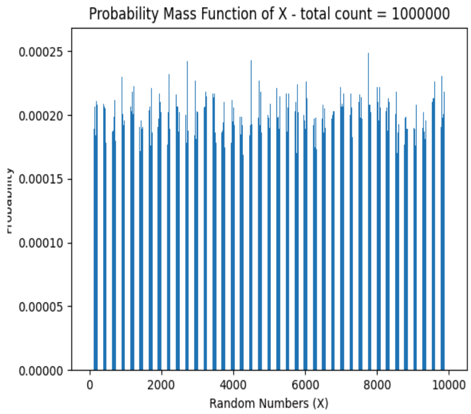
· **<u>Plot when total number of random numbers generated = 500000</u>**



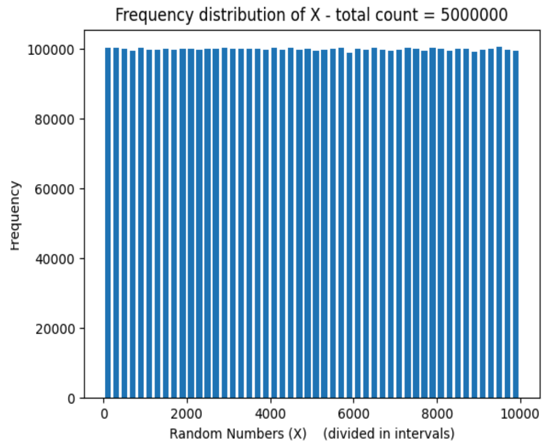


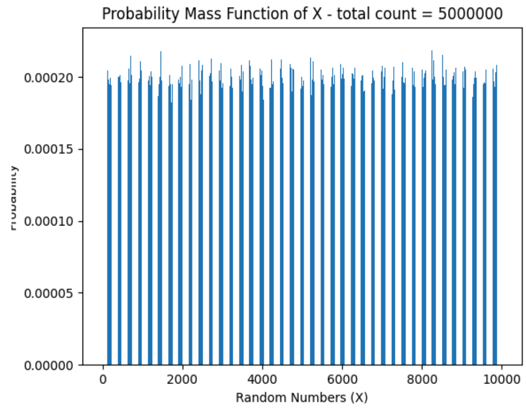
· **<u>Plot when total number of random numbers generated = 1000000</u>**





· **<u>Plot when total number of random numbers generated = 5000000</u>**





- **Observations:**
  1. It is evident from the different plots that as the count of generated random numbers increases, the probability distribution of the generated number converges to the uniform distribution on {1, 3, 5, …, 999}. This is clearly shown by the plots since the height of each bar in both cases is almost uniform when total no of random numbers generated reaches 5000000.
  2. Also, the probability of each random number converges to 1/5000 as the number of random numbers generated increases. This also supports the fact that the random numbers generated are uniformly distributed.