

1st part of question :

Code - ques_4a.m

In order to generate random data with the given PDF distribution , I used the concept of Inverse Transform Sampling. This concept i got from a wikipedia page whose link i am giving below https://en.wikipedia.org/wiki/Inverse_transform_sampling which describes that we should first find the inverse of the CDF of the given distribution which I described as invCDF function in my code. I have used two if conditions inside the function to consider the two cases $x < 0$ and $x > 0$ because in these two regions the invCDF is different and then we should pass the inverse CDF function random values with uniform distribution in the range $[F(a), F(b)]$ if range of x in original CDF function is $[a, b]$. So here for $x < 0$ I plug in random values in range $[0, 0.5]$ and for $x > 0$, I plug in random values in the range $[0.5, 1]$ using rand function.

2nd part of the question :

Code - ques_4b.m

Histogram plot - histogram_4b.png

CDF plot - CDF_4b.png

3rd part of question :

Code - ques_4c.png

As given in problem statement , I considered different $X_1, X_2, X_3, X_4, \dots$ and $Y = (X_1 + X_2 + \dots + X_n)/N$. The different rows of y refer to different X and I have just sorted the random values to be able to take their average as final

The second for loop where randperm is used is done to properly randomize the elements each row of the matrix because randomization is necessary in plotting. So the matrix changes contains the same elements as matrix y but with the elements of each row randomized within itself.

The final matrix contains the final random values with given pdf after taking averages of N random variables with similar pdf.

4th part of question :

Histogram plots - histogram_N_2.png

 histogram_N_4.png

 histogram_N_8.png

 histogram_N_16.png

 histogram_N_32.png

 histogram_N_64.png

The histogram plots can be generated using code - ques_4e.m just by changing the value of N as required ($N=2$ or 4 or 8 or....)

CDF plot - CDF_final.png

Code for generating CDF plot - ques_4d.png

In the final matrix , I am storing data for values of N ranging from 1 to 64 but in the CDF plot , I considered only the values of N as $2, 4, 8, 16, 32$ and 64 .