Probability and Random Processes - Assignment 8

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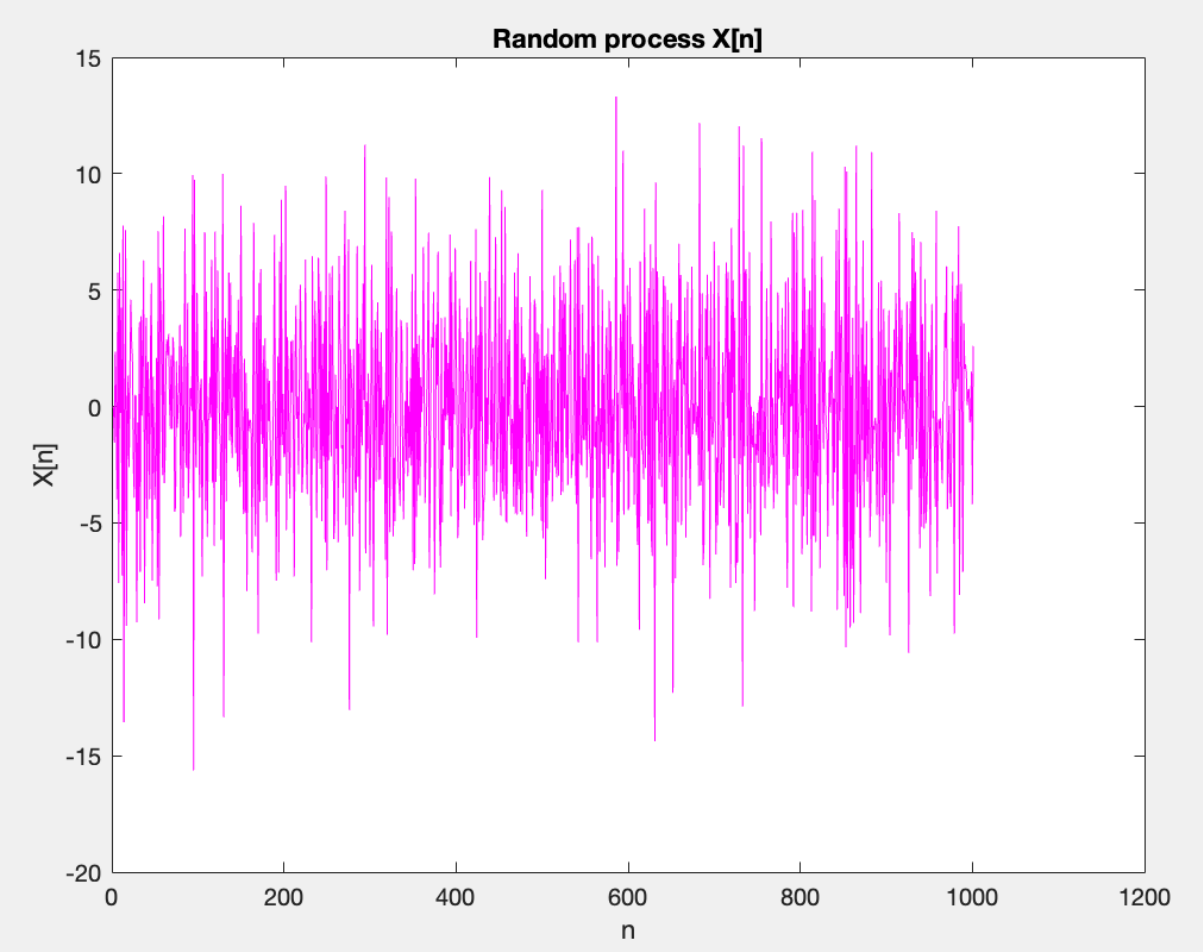
In this assignment, we were asked to write MATLAB simulations for plotting various random processes.

Question - 4

1. In this question, we're asked to generate a random process of the form $X[n] = 2W[n] - 4W[n-1]$

here W[n] → Standard normal random variable



2. This process is not stationary because the pdf of the random variables at each point in the graph is dependent on the previous random variable.
3. No, the process is not WSS because the expectation of the random process is not independent of time.

Question - 5

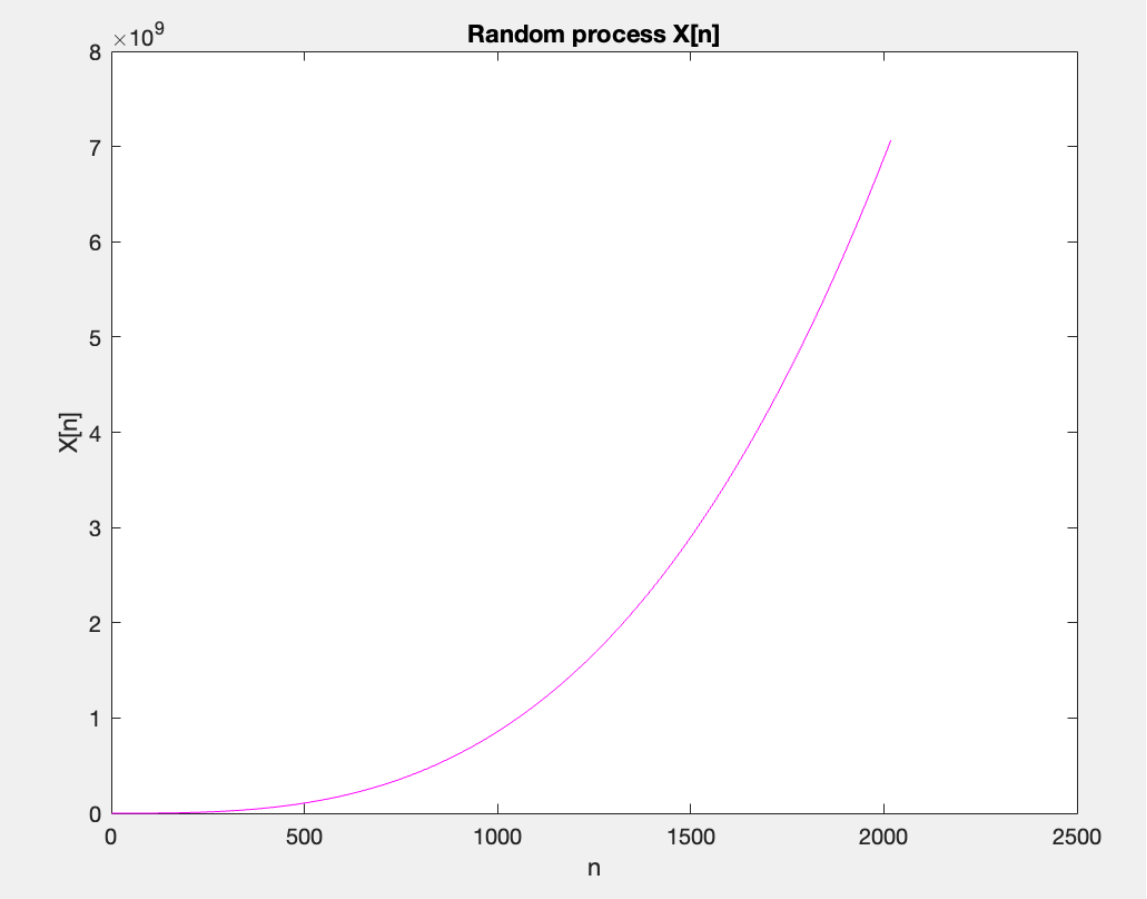
- We were asked to generate a discrete random process of the form

$$X[n] = \sum_{k=0}^{N} A_k n^k$$

where A_k → standard normal random variable

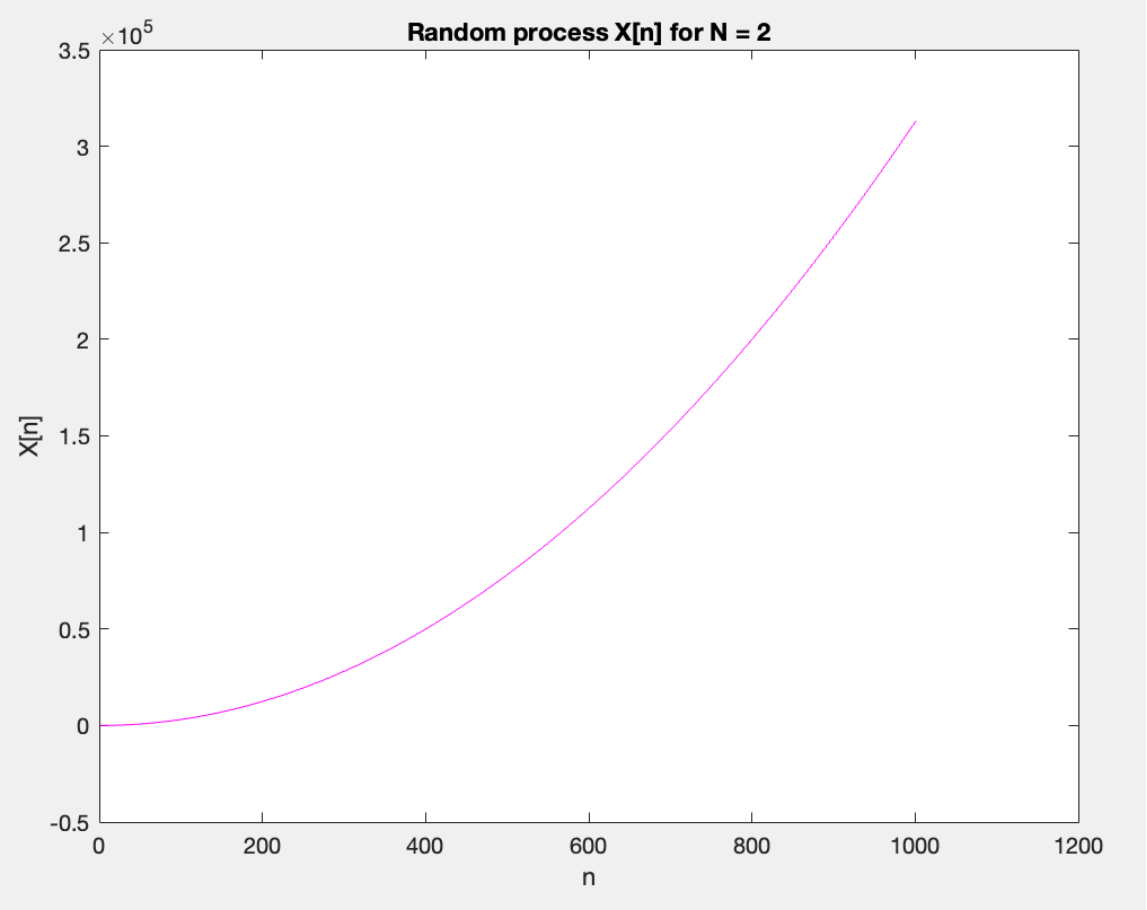
N → constant number

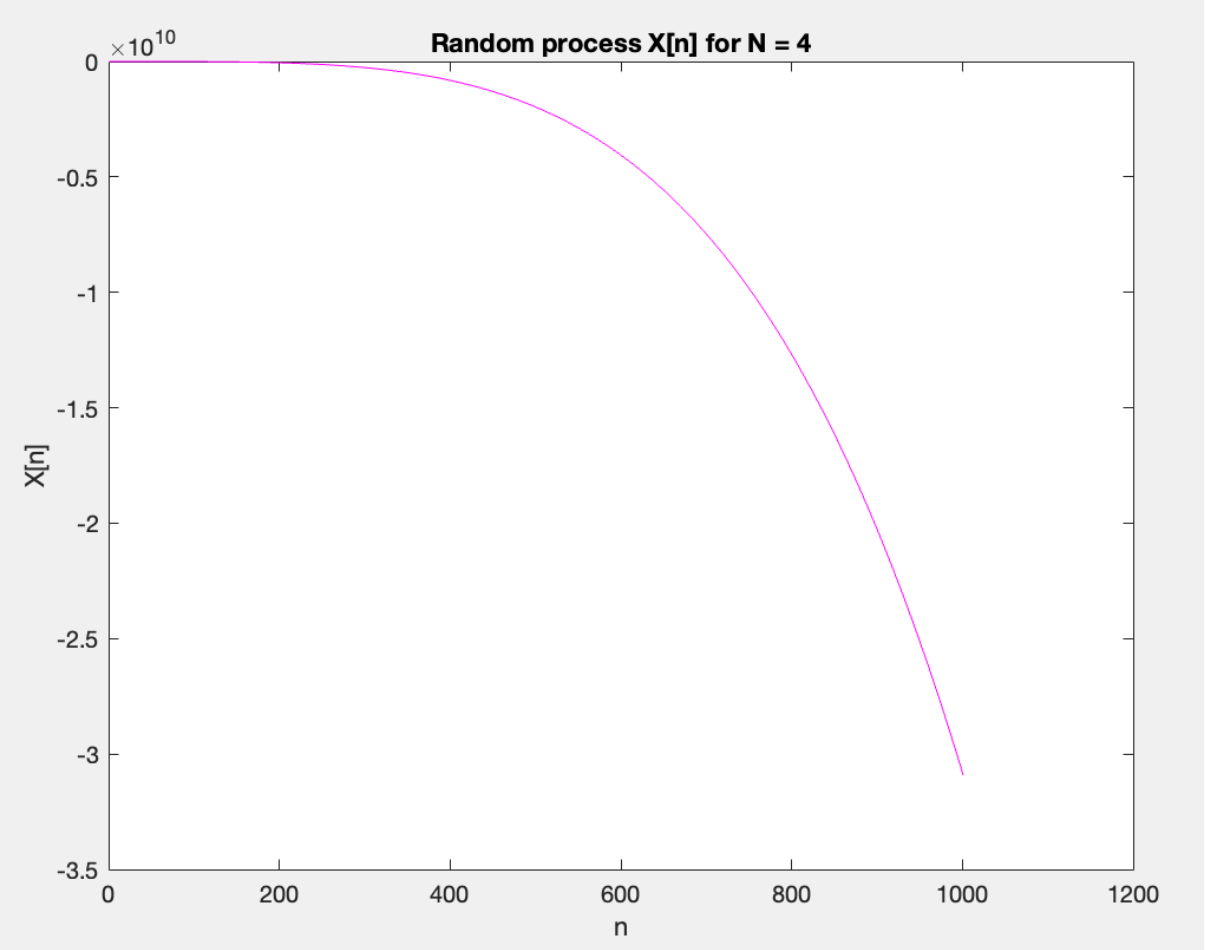
1. A code to generate the random process was written and then plotted for n = 0 to 2017

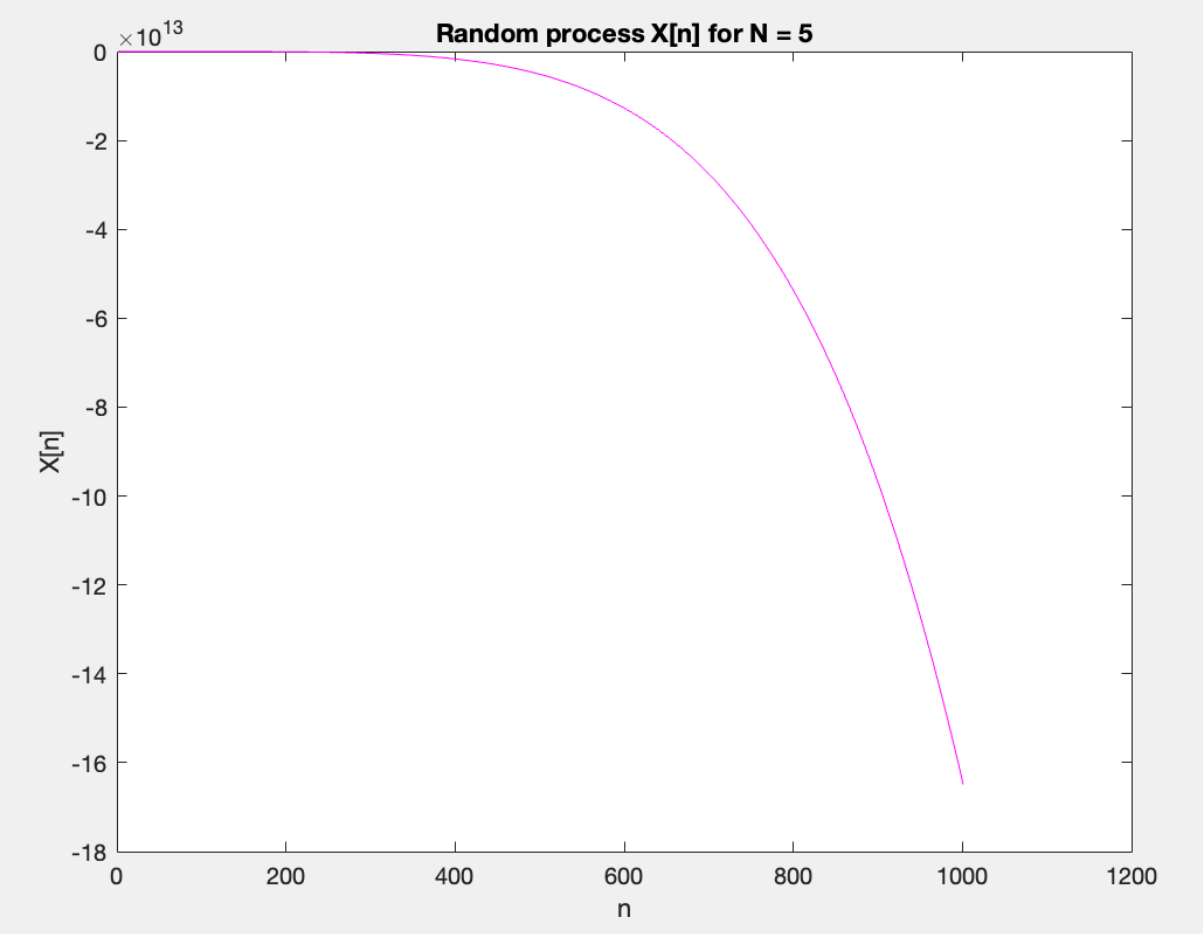


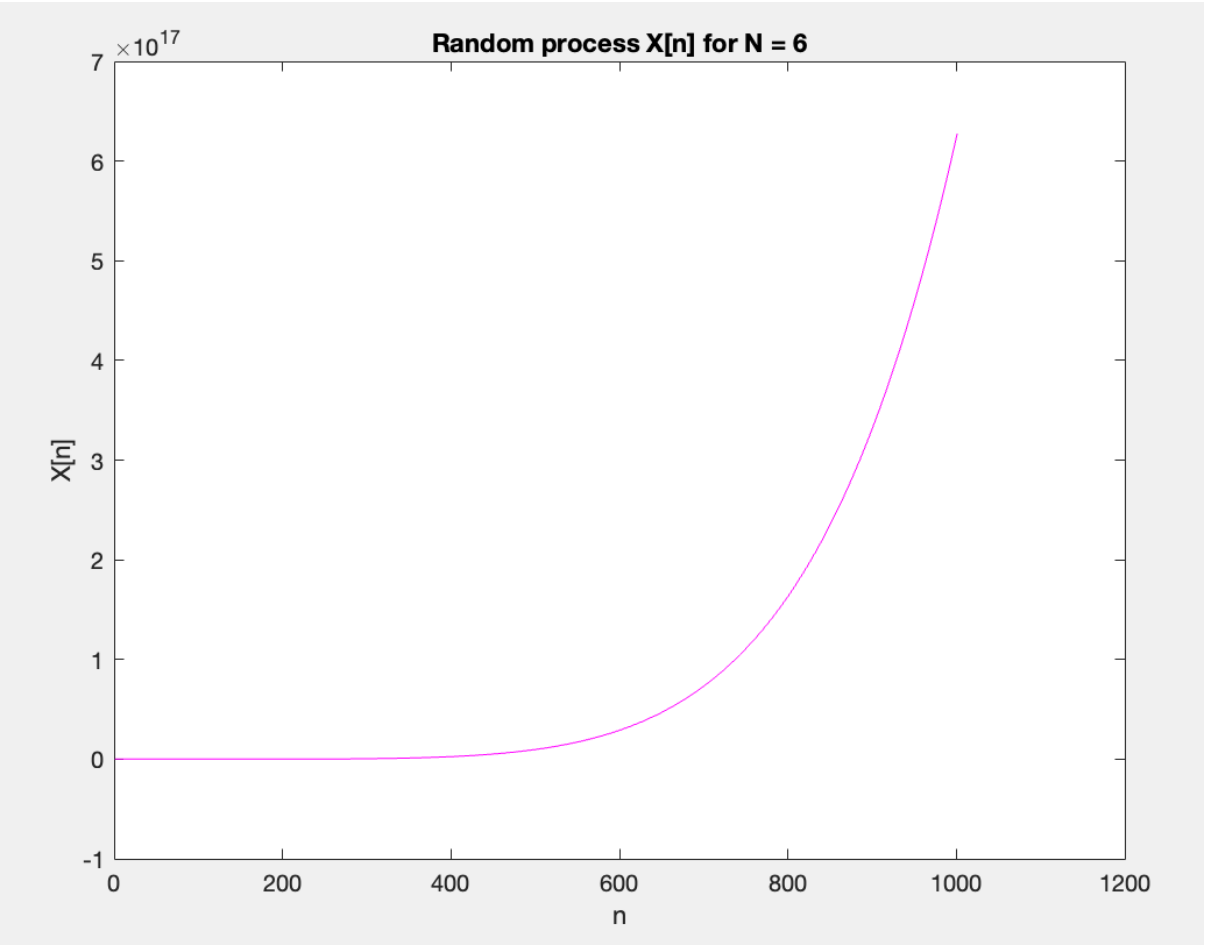
Output plot for the given random process

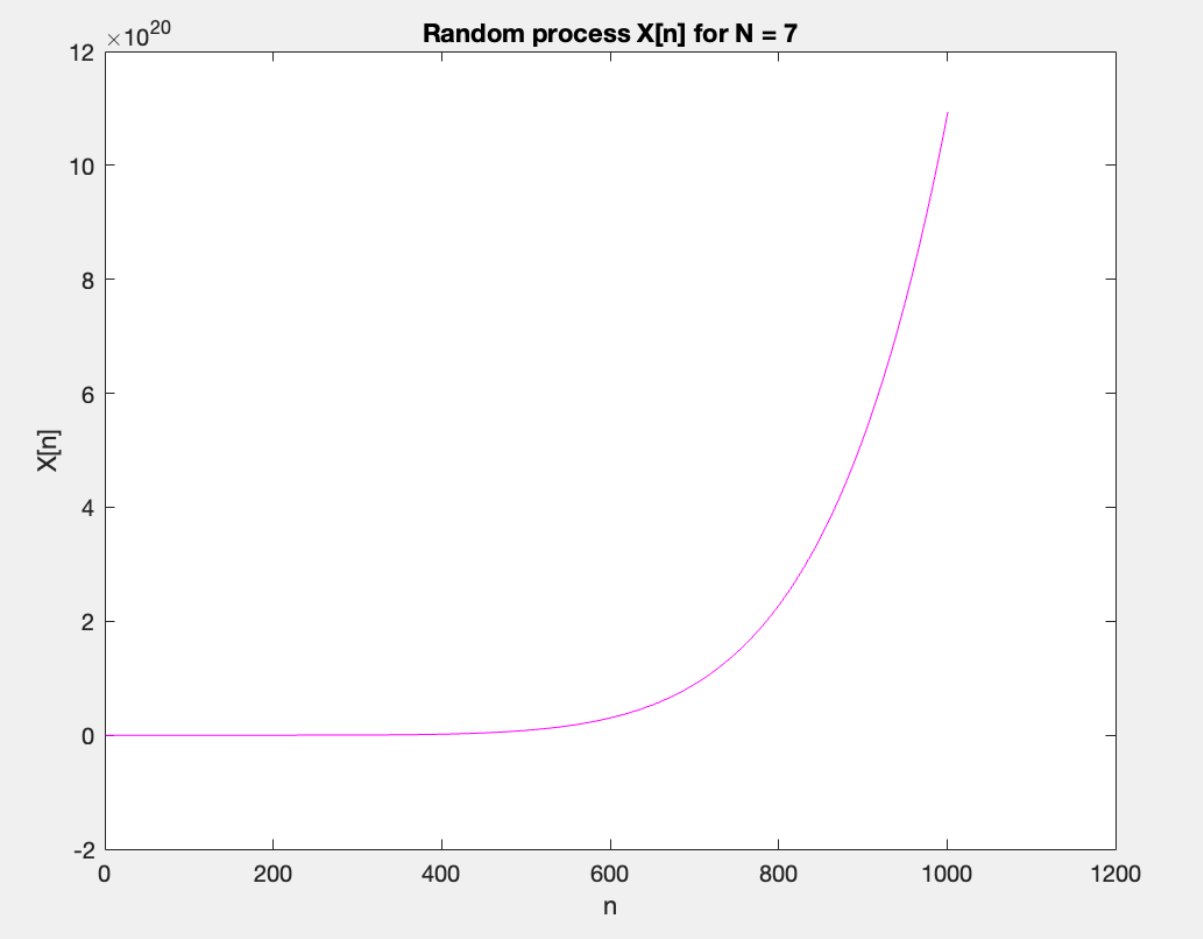
2. We then repeat the same thing for different values of N and plot the outputs. Here, n is from 0 to 1000.


Random process X[n] for N = 2
×10^5
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
X[n]
0
200
400
600
800
1000
1200
n

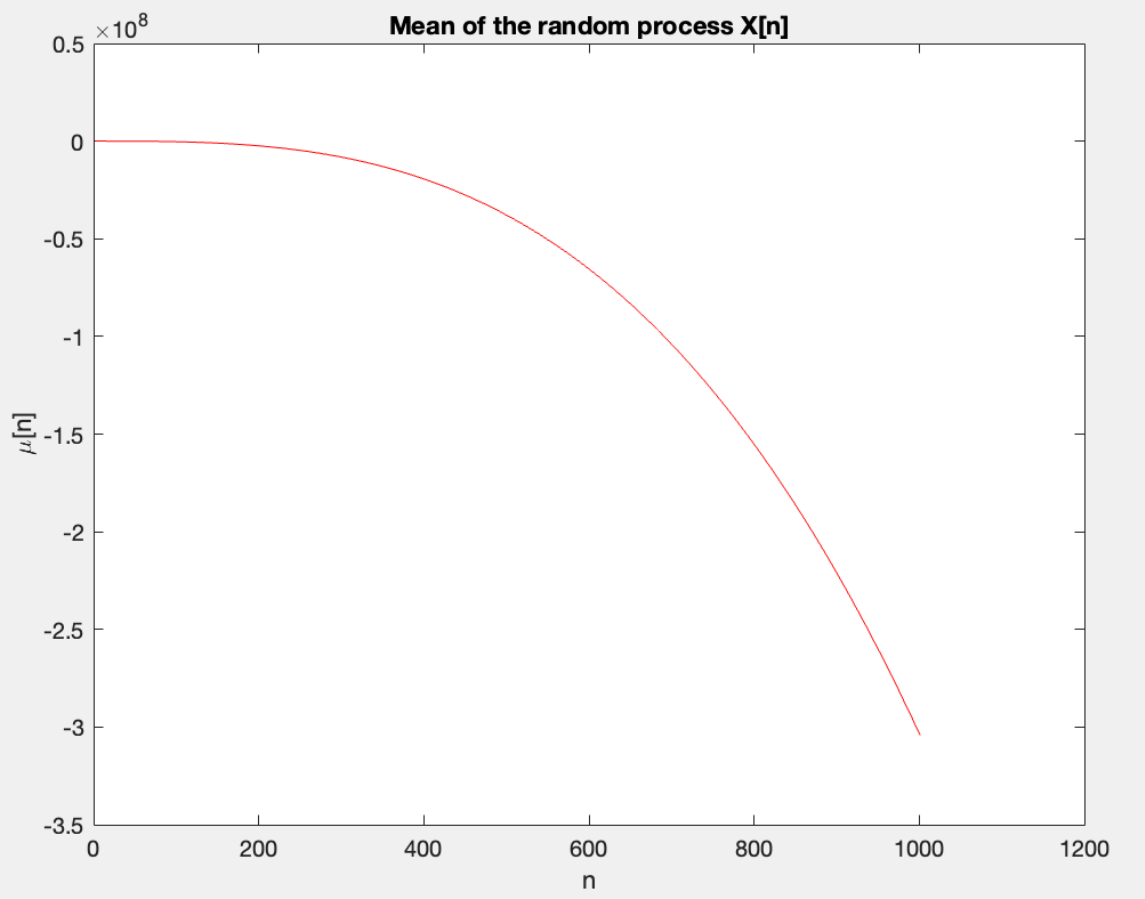

Random process X[n] for N = 4
×10^10
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
X[n]
0
200
400
600
800
1000
1200
n


Random process X[n] for N = 5
×10^13
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
X[n]
0
200
400
600
800
1000
1200
n


Random process X[n] for N = 6
×10^17
7
6
5
4
3
2
1
0
-1
X[n]
0
200
400
600
800
1000
1200
n



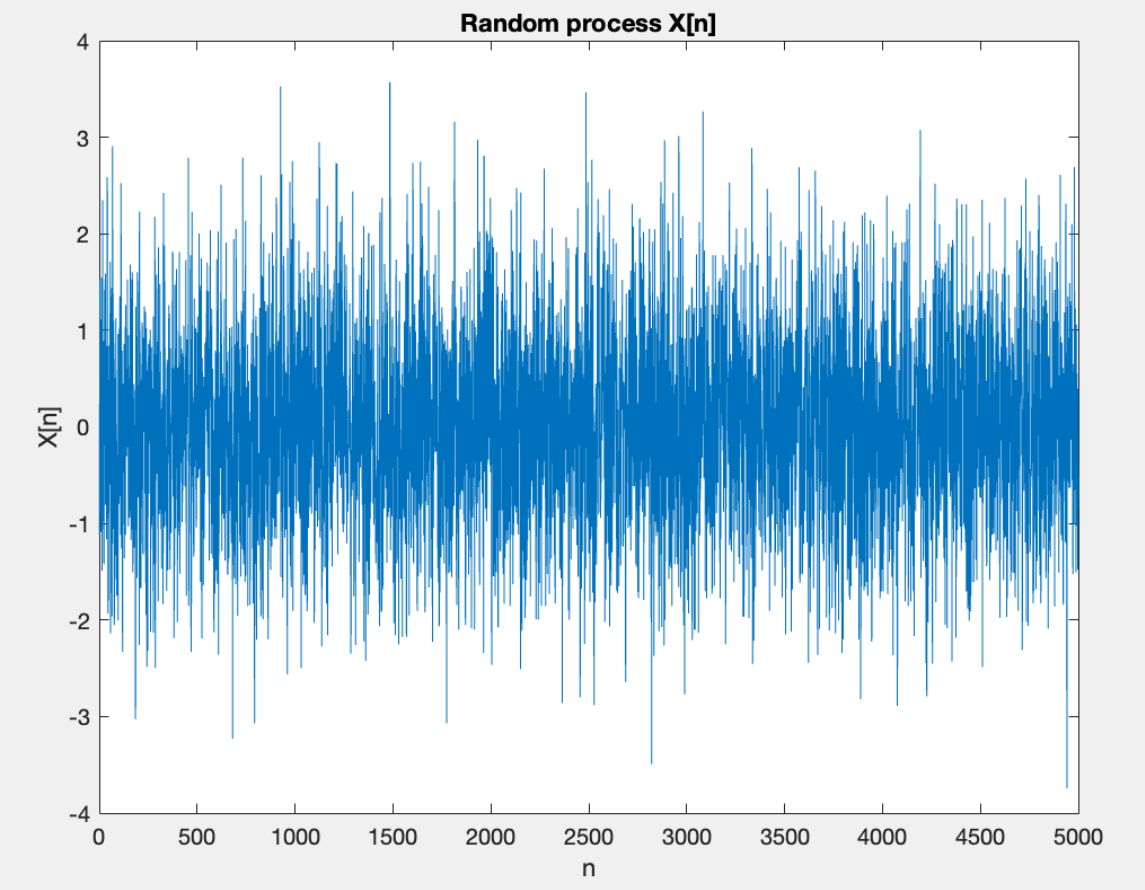
3. The mean function of the generated X[n] is plotted.



5. The mean and autocorrelation functions for different values of N are plotted. Note that since I used independent standard gaussian variables to generate X[n], the autocorrelation of X[n] would always be zero.
6. No, the given random process is not WSS. This is because, the mean function is dependent on time (changes with time), as is evident from the graph. As already established, the autocorrelation function is constant - zero - always. However, since mean changes with time; X[n] is not WSS.

Question - 6

- We were asked to generate a white gaussian random process - a random process in which the random variable at each instant is independent of the variables at every other instant.
- To generate this, I used the *randn* function to generate 5000 independent random gaussian variables.



- The random process will have zero autocorrelation because of the fact that for a white process, any two values are independent of each other. A white noise process has an autocorrelation function of zero, to indicate that the process is completely uncorrelated.