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CIE 327

In this project, It is required to create a GUI-based tool that allows a user to: 1) Enter the values of random variable values and results in the statistics of such variable. 2) Enter any stochastic process and results in the ensemble and the time statistics of such process.

The GUI should do the following: 1)

Section 1: Random Variables

• Allow the user enter a random variable in the form of its sample space. An example .m file of the sample space is attached.

So in this task we made a button that accept the location of the data file that contain the parameter of the random variable

• Display the mean, the variance and the third moment of the random variable

The mean of the first random variable and the third moment of the random variable (the file given)

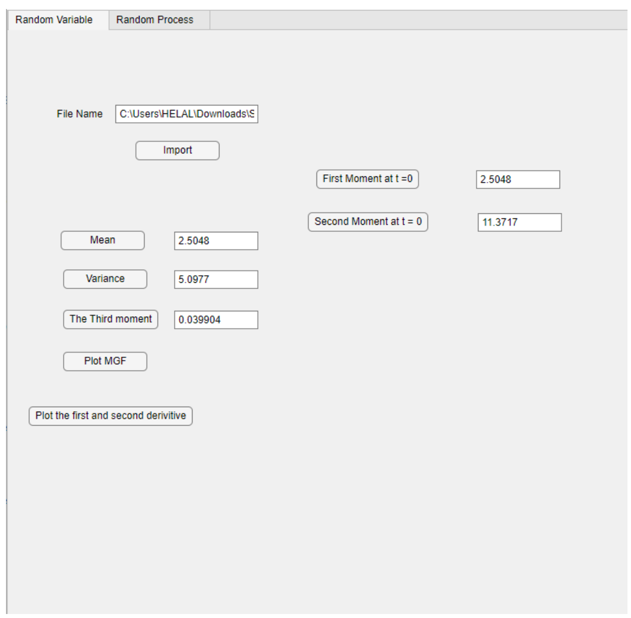


Figure 1mean-variance-thirdmoment

• Plot the MGF M(t) vs 0 < t < 2

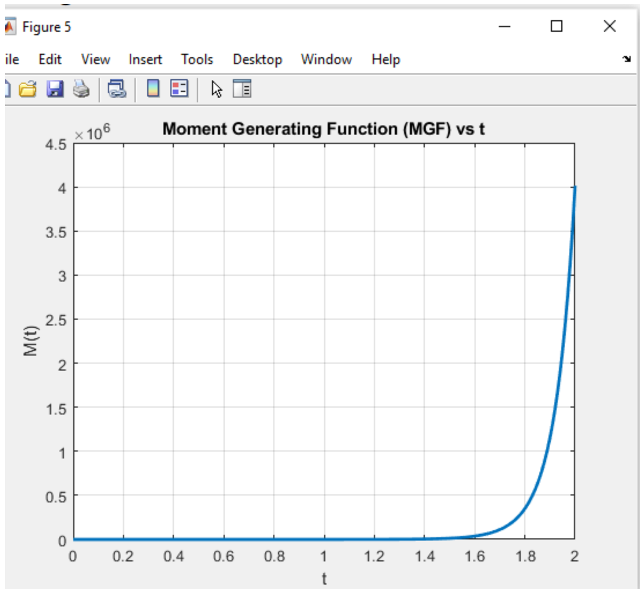
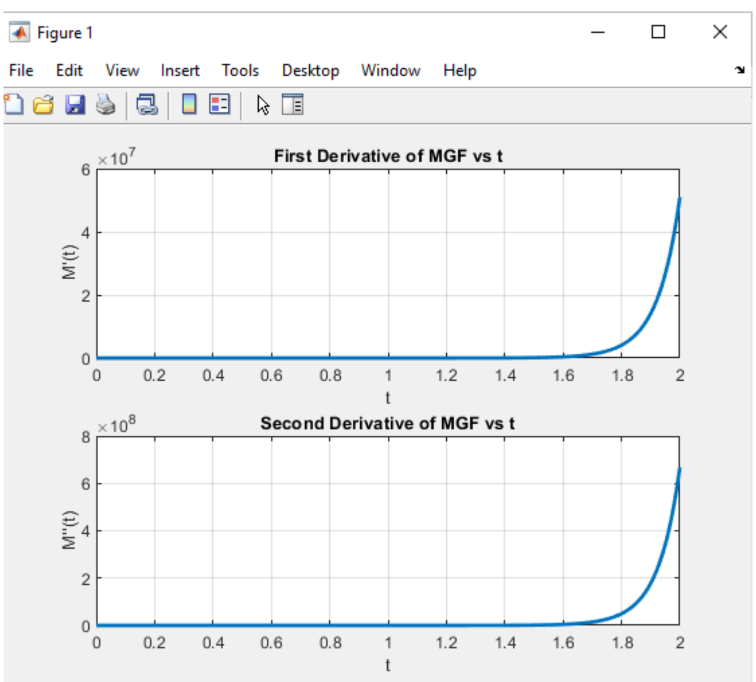
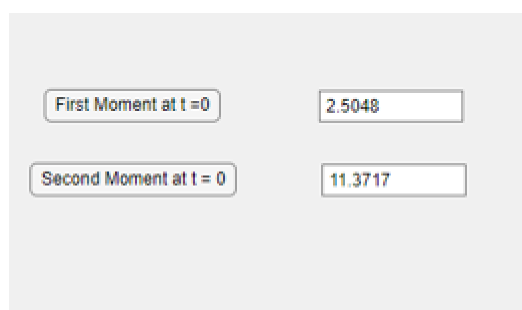


Figure 2MGF Plot

Plotting the first and the second derivatives of M(t), and calculate their values at t = 0





X is a RV, where $X \sim U(-3, 5)$

It is a uniform distribution so the mean should be

$$x = \frac{a+b}{2} = \frac{5+(-3)}{2} = 1$$

the mean of the data file approximately is 1 (~ .9987)

Also the first moment and the second moment is approximately the mean and the variance

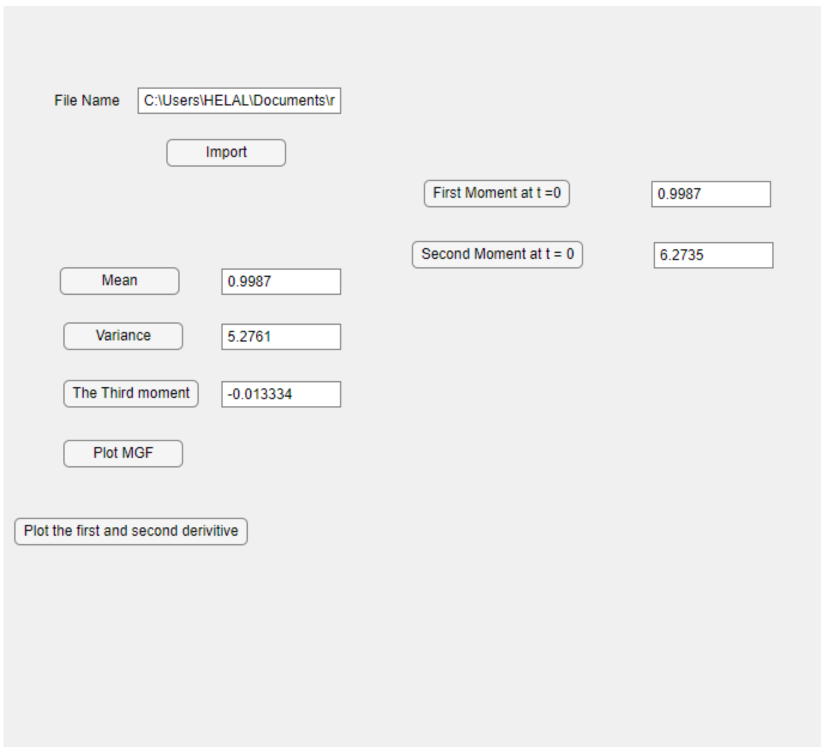


Figure 3Mean-Vairance-Third Moment

Plot MGF

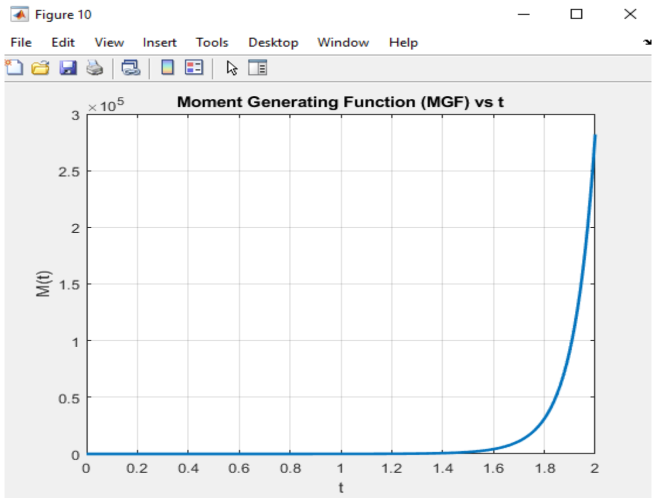


Figure 4MGF Plot

Plotting the first and the second derivatives of M(t)

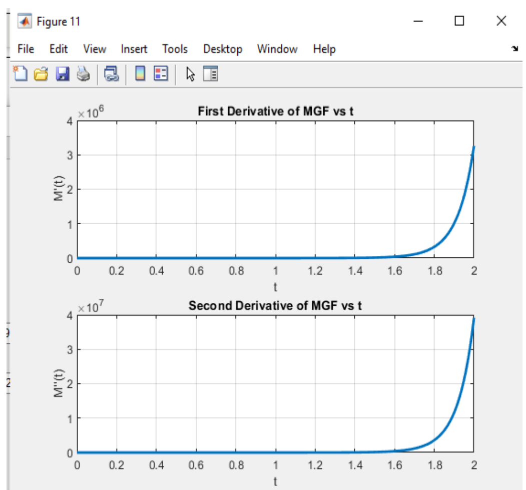


Figure 5First and second derivitve

3) Y is a RV, where Y ~ N (−8, 4).

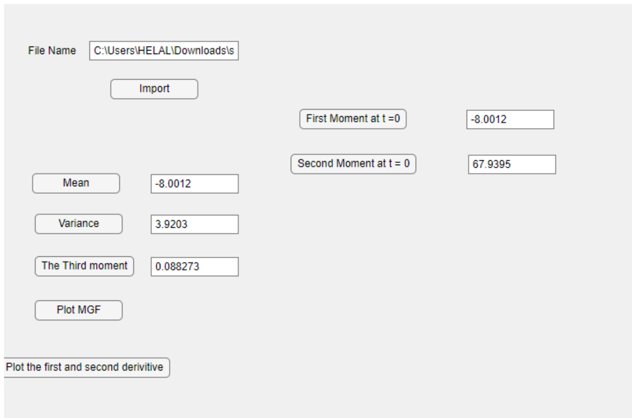


Figure 7Mean- Variance -3-moment

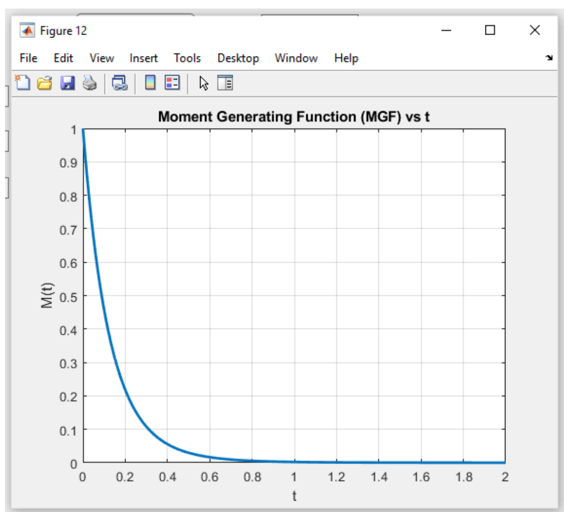


Figure 6 MGF

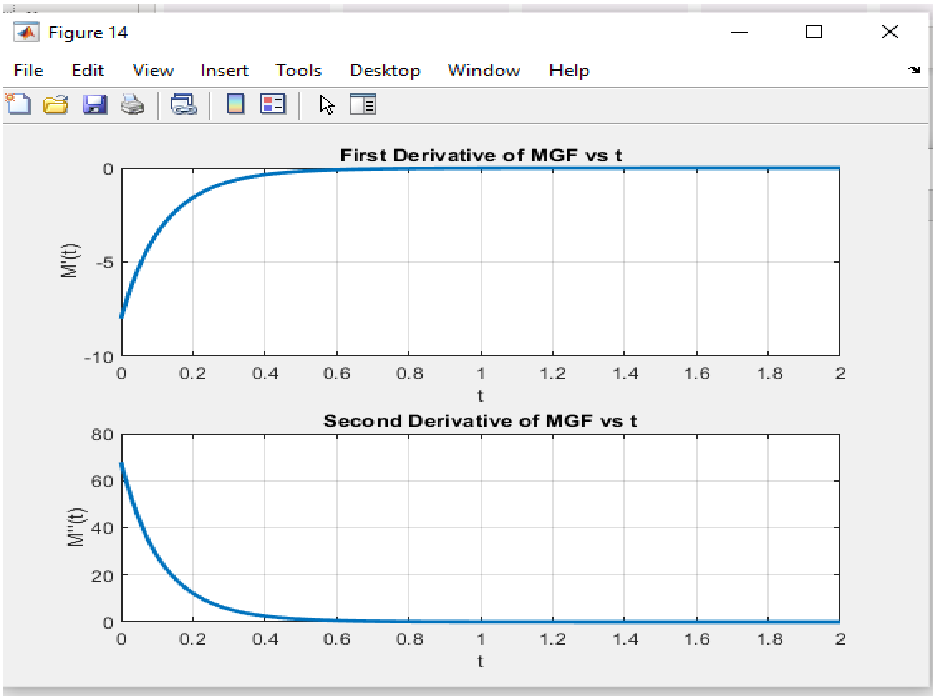


Figure 8 first and second derivitive

Section 2: Random Processes

Allowing the user enter a random process in the form of the ensemble, and all the sample functions, each defined by two vectors; time and amplitude. Note that the time vector can be common to all the sample functions

1- Plot M sample functions of the ensemble of the process, where M is entered by the user – Calculate and plot the ensemble mean of the process

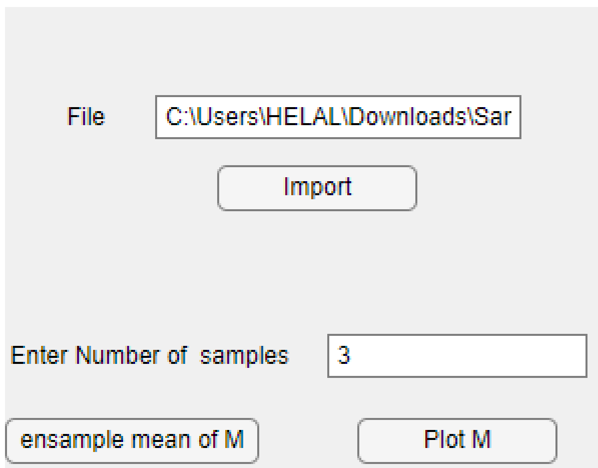


Figure 10 M enterd by the user

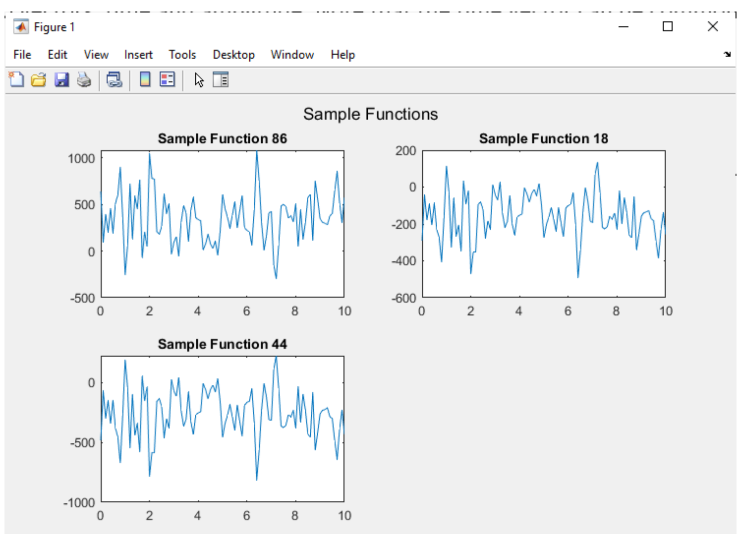


Figure 9 3 random sample function

Calculating and plotting the ensemble mean of the process

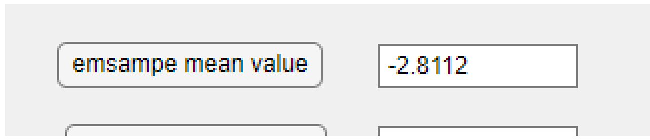


Figure 11 ensample mean

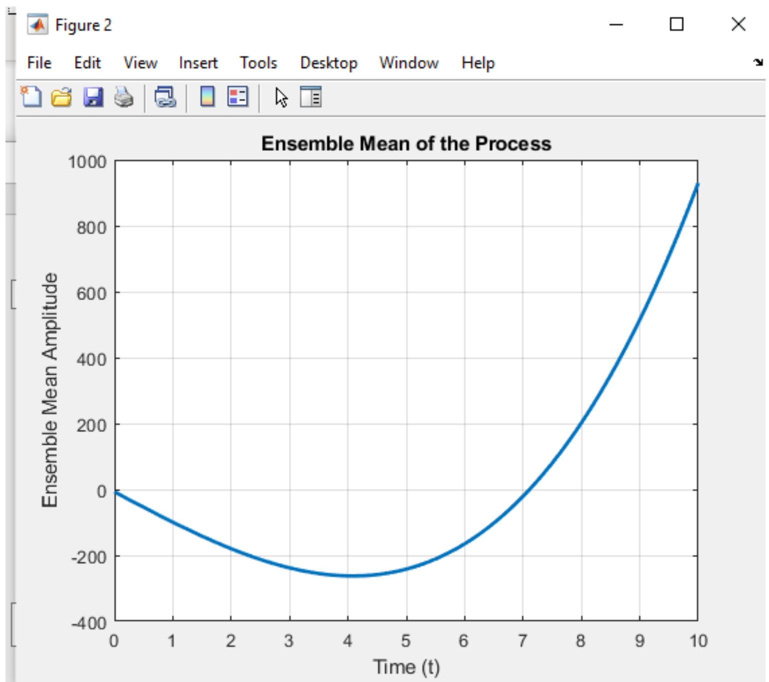
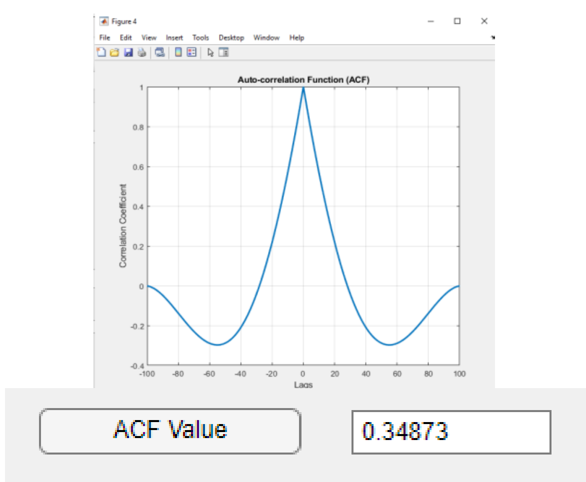
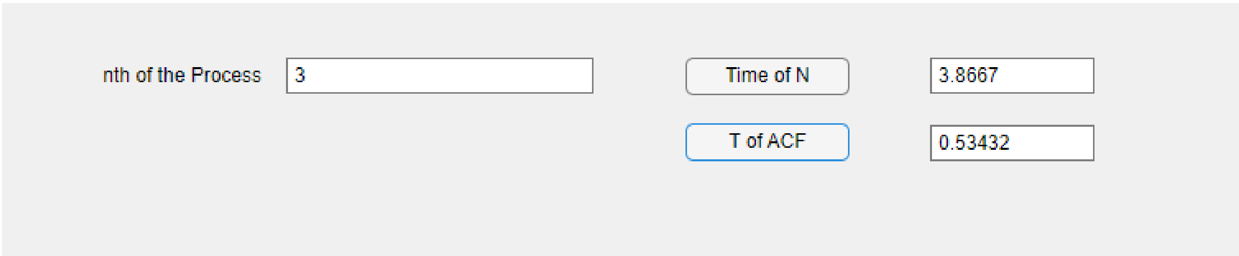


Figure 12 ensample mean plot

Calculating and plotting the statistical auto-correlation function



Calculating the time mean of the n-th sample function of the process, where n is entered by the user



Calculate and plot the power spectral density of the process

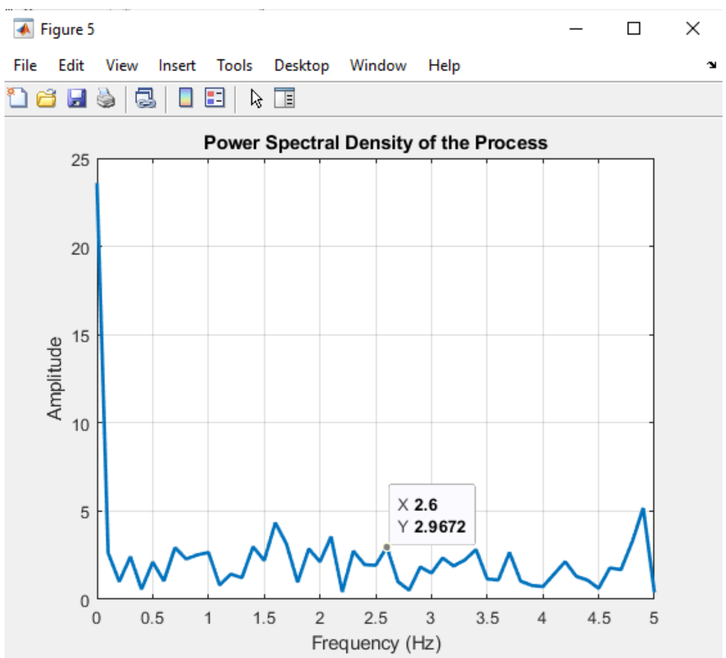


Figure 14 PSD

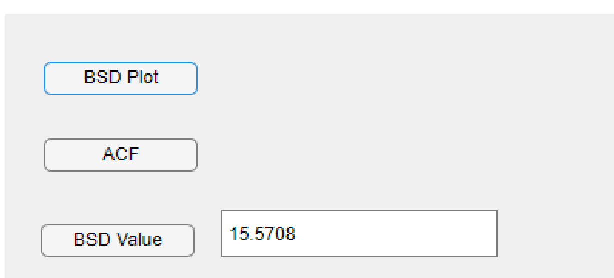


Figure 13 PSD VALUE

Calculating the total average power of the process

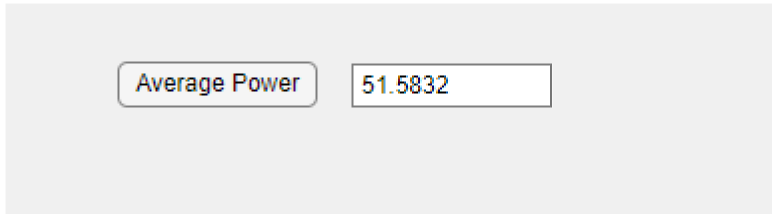


Figure 15 total average power

Z(t) is a RP, where Z(t) = cos(4πt + θ), where $0 \le t \le 2$, $\theta \sim U(0, \pi)$.

The mean of the uniform distribution should be

$$x = \frac{a+b}{2} = \frac{0+\pi}{2} = \sim 1.57$$

when we test the datafile that satisfy the equation we get ~ 1.57

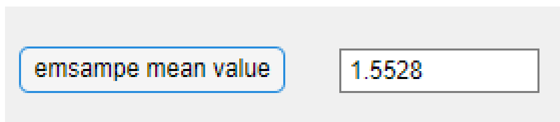


Figure 16 ensample value

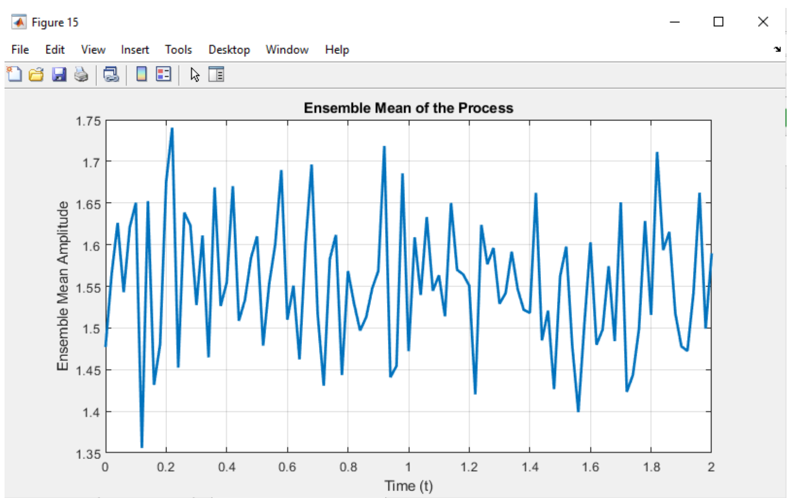


Figure 17ensample plot

Calculating and plotting the statistical auto-correlation function

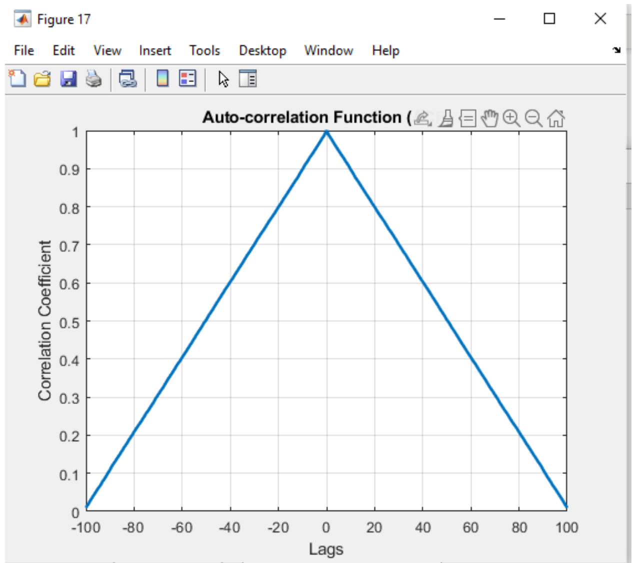


Figure 18 ACF

Calculating the time mean of the n th sample function of the process, where n is entered by the user

Calculating the time auto-correlation function of the n th sample function of the process, where n is entered by the user

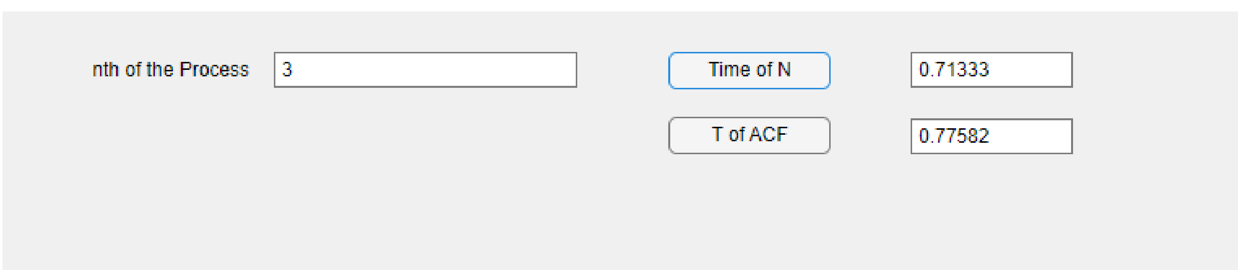
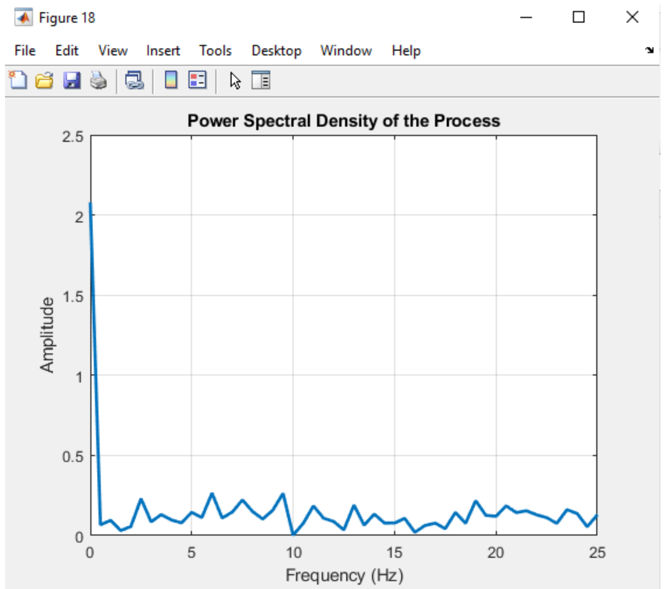


Figure 19 Time of N and ACF

Calculating and plotting the power spectral density of the process



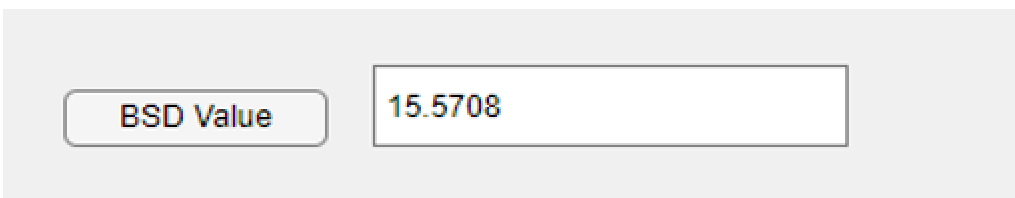


Figure 20 BSD VALUE

Calculating the total average power of the process

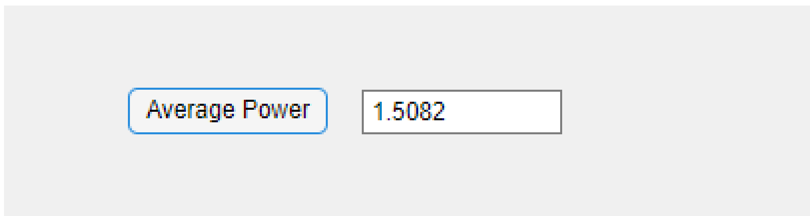
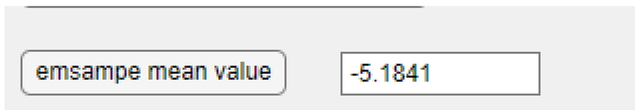


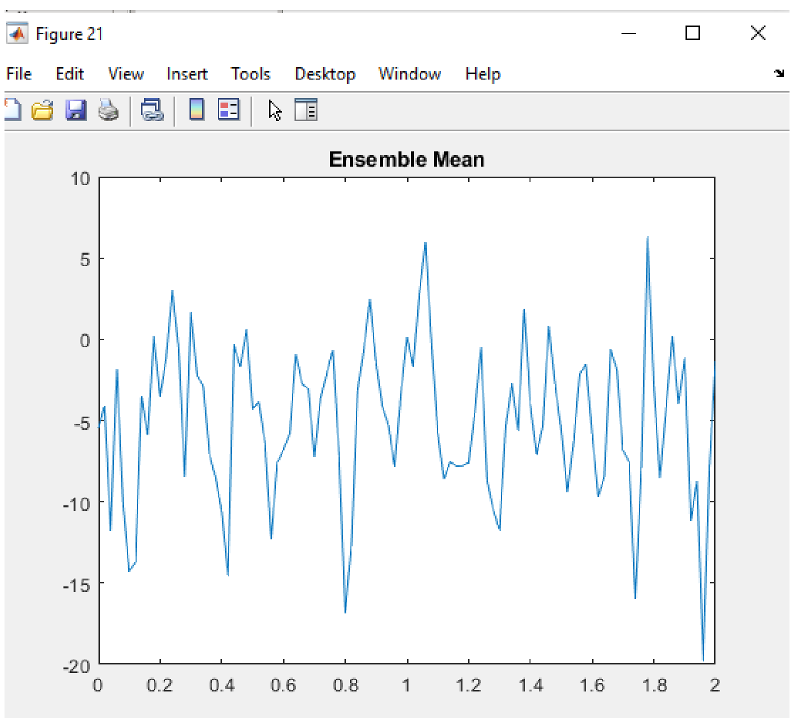
Figure 21 Total Averge Power

W(t) is a RP, where W(t) = A cos(4πt), where $0 \le t \le 2$, $A \sim N(-5, 5)$.

The mean of Gaussian distribution should be -5

An that we get in the datafile of the random process





Calculating and plotting the statistical auto-correlation function

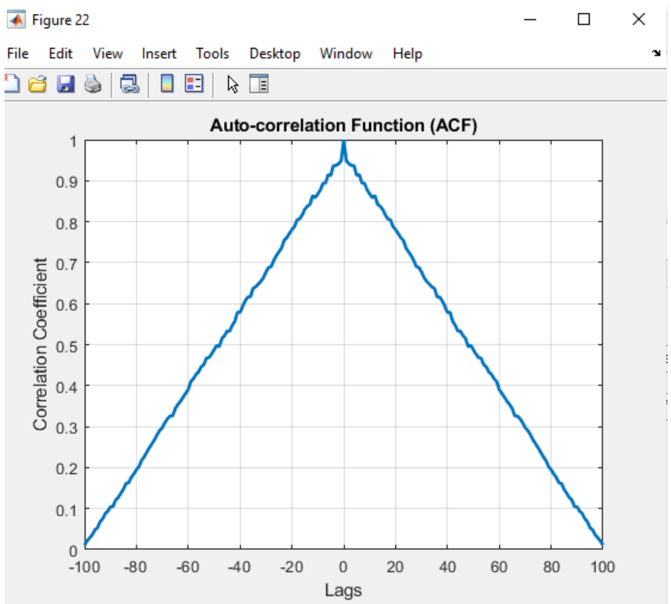


Figure 22 ACF

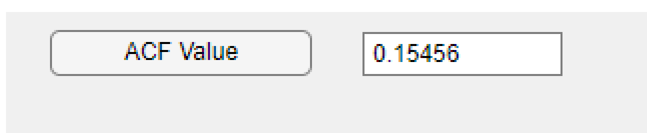
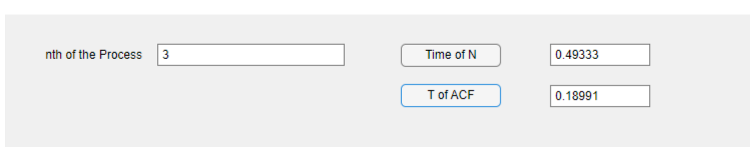


Figure 23 ACF value

Calculate the time mean of the n th sample function of the process, where n is entered by the user



Calculate and plot the power spectral density of the process

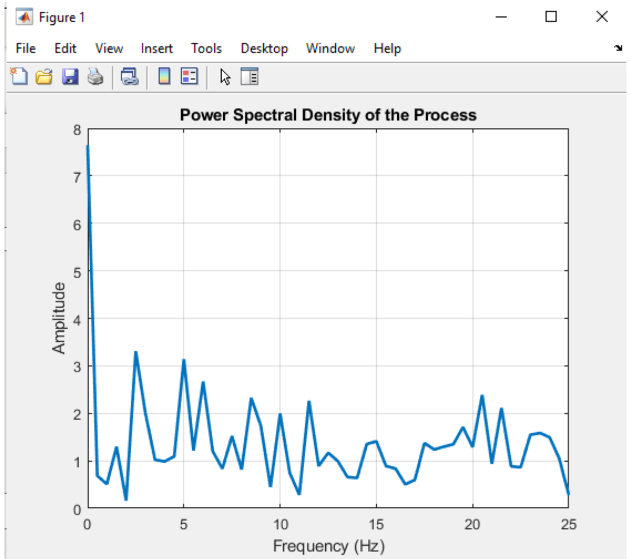


Figure 24 PSD

Calculate the total average power of the process

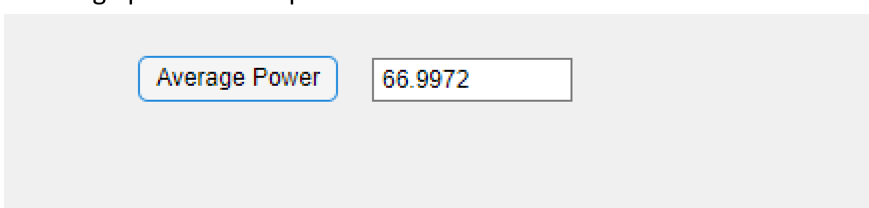
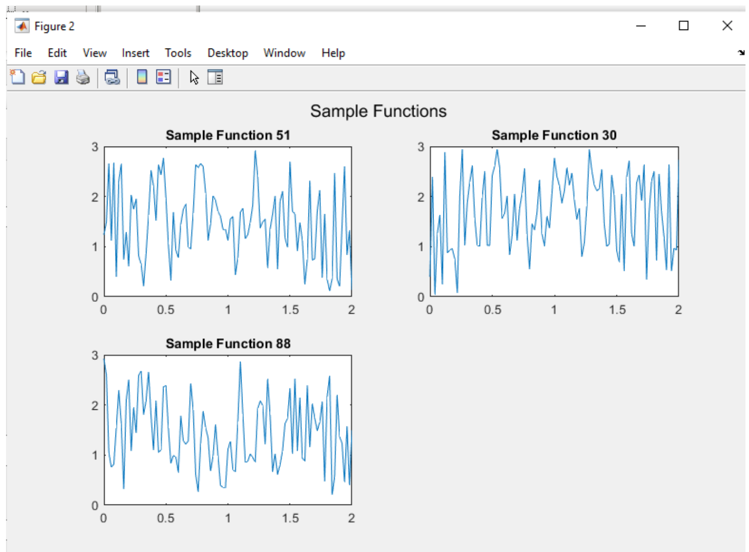
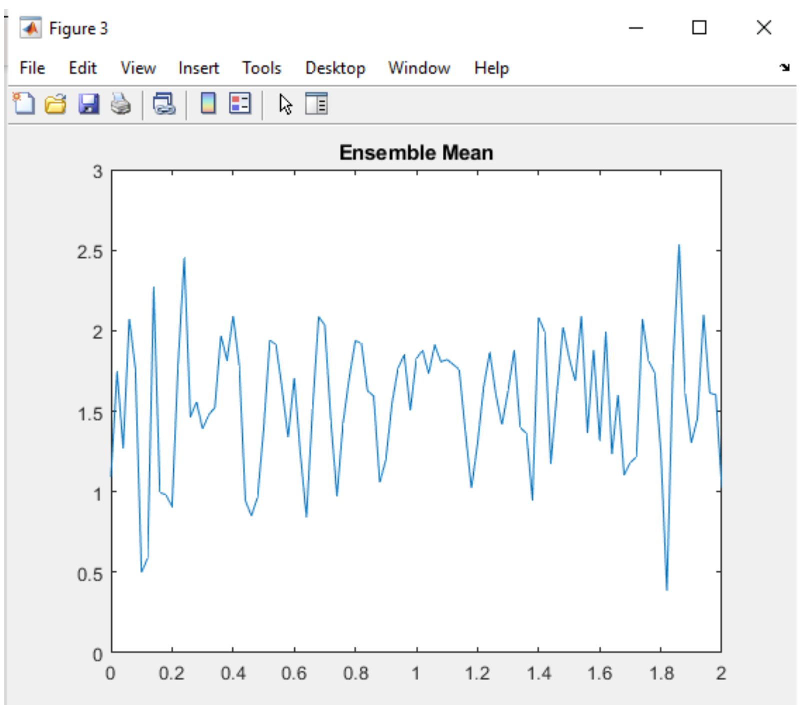


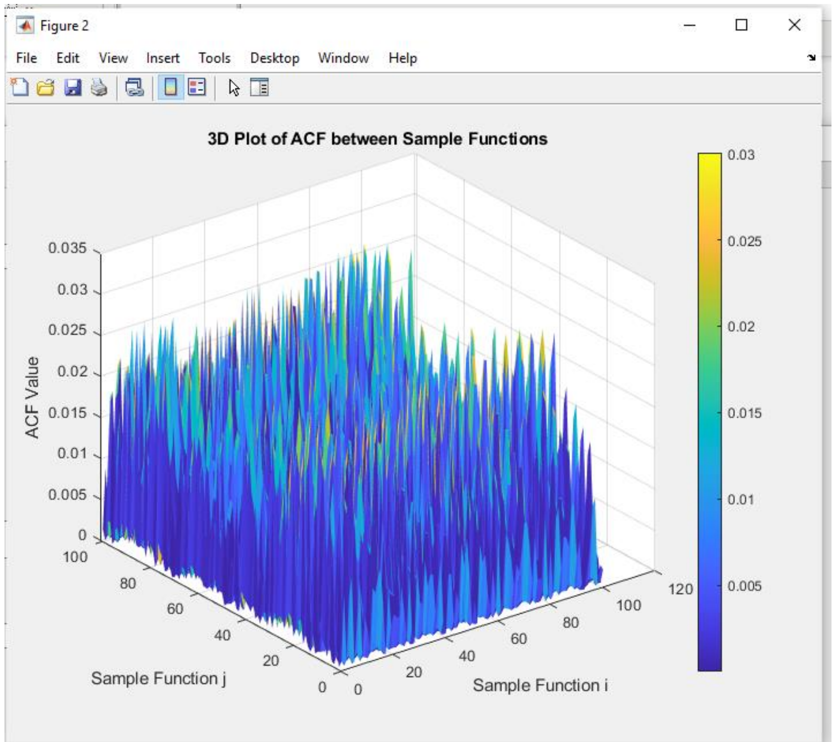
Figure 25 Averge Power

A plot of 3 random sample functions of the process, each plotted in a different subplot and plot of the ensemble mean, and comment on the resulting plot.
Z(t) is a RP, where Z(t) = cos(4πt + θ), where 0 ≤ t ≤ 2, θ ~ U(0, π).



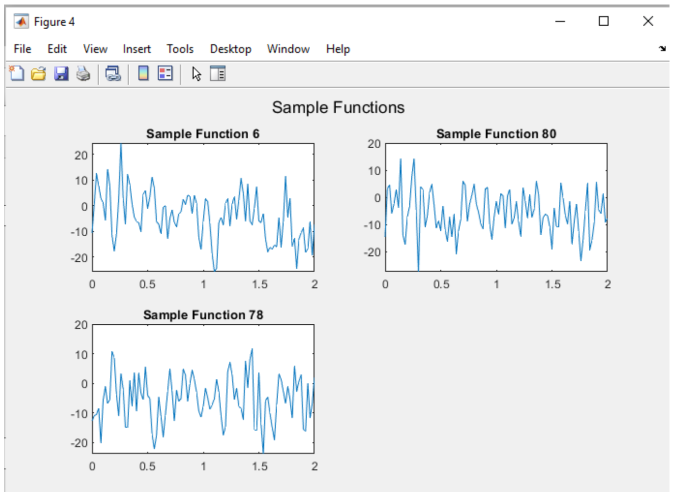


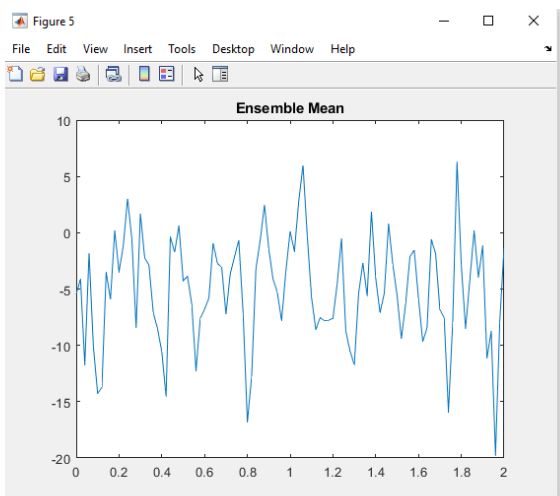
A 3D plot of the ACF between i th sample and the j th sample for every i and j. Hint: This is a 3D plot, where the horizontal axes are i and j, and the vertical axis in the value of the ACF



The plot show a bit wide in the Auto-Correlation Function values between i-th and j-th samples

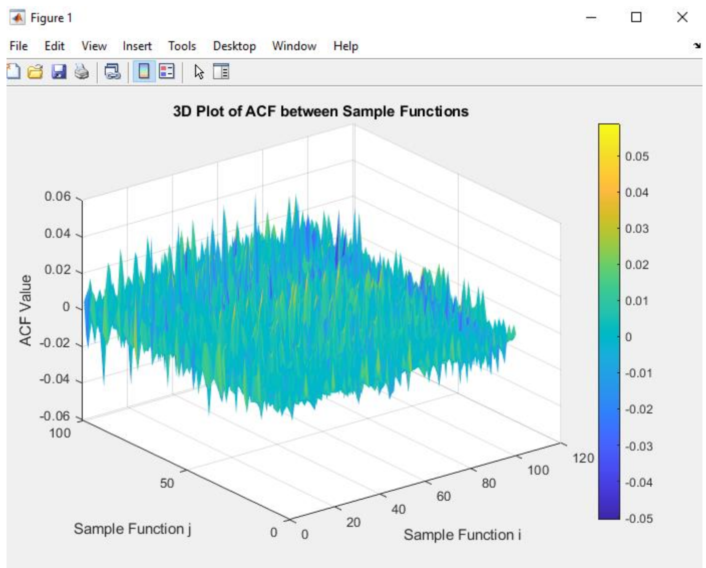
W(t) is a RP, where W(t) = A cos(4πt), where $0 \le t \le 2$, A ~ N (−5, 5)





the resulting plot is the ensample of the three plots

A plot of 3 random sample functions of the process, each plotted in a different subplot and plot of the ensemble mean, and comment on the resulting plot.



The plot shows a bit trend in the Auto-Correlation Function values between i-th and j-th samples

The Given file

A plot of 3 random sample functions of the process

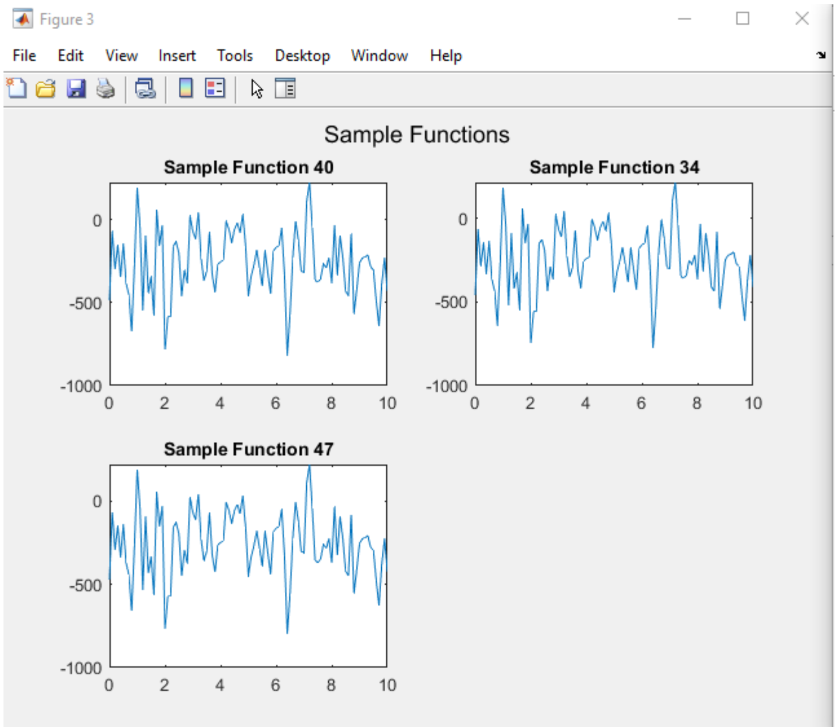


Figure 27 A plot of 3 random sample functions of the process

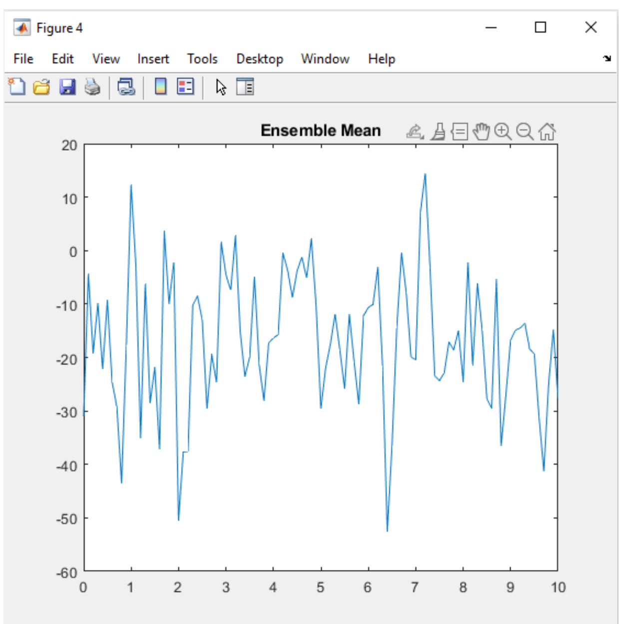


Figure 26 ensample mean

The given file

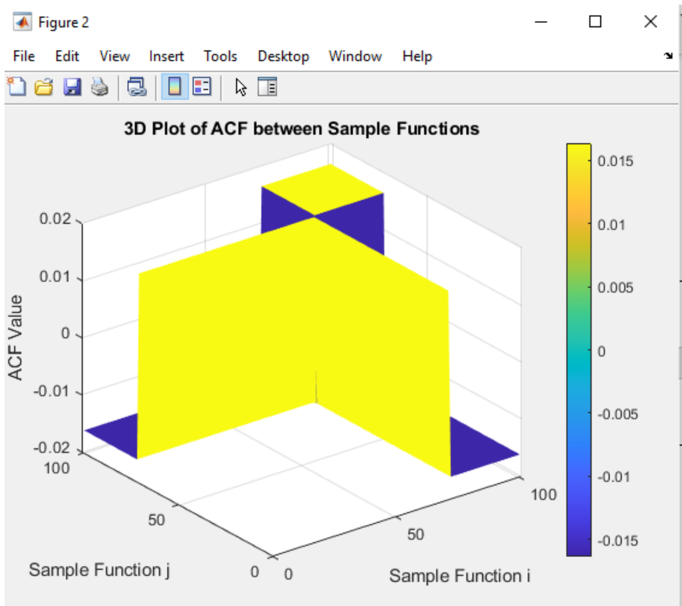


Figure 28 ACF

Symmetrical patterns in the ACF plot indicates a balanced correlation between i-th and j-th samples, The value of the time average and the time ACF of a random sample function.

The file given

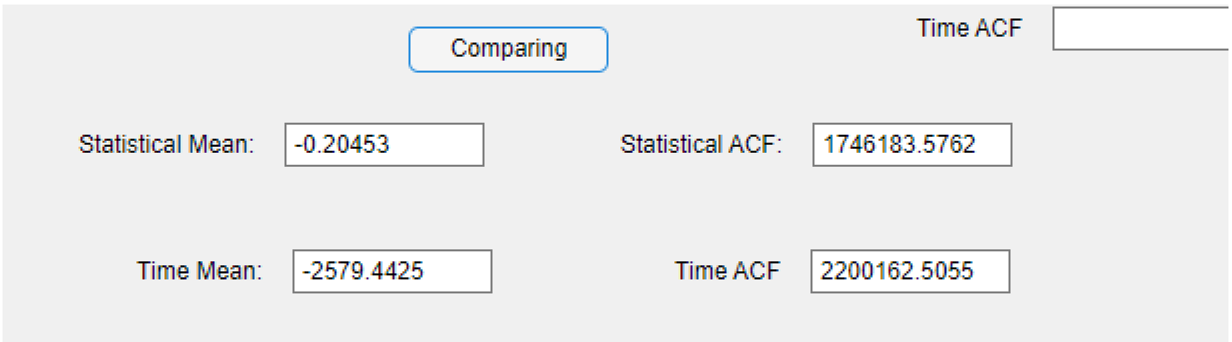


Figure 29 Comparing for ergodic function

The relation between the statistical mean and the time mean, for the test process
the difference between statical mean and time mean is so difference so it is not wide sense stationary and there for it is not ergodic they must be the same in the ergodic

there a relation between the statistical ACF and the time ACF, for the test process? Comment
the difference between statical ACF and time mean is different but comparing to the big number it may be wide sense stationary and therefor ergodic there for it is ergodic they must be the same in the ergodic

) Z(t) is a RP, where $Z(t) = \cos(4\pi t + \theta)$, where $0 \le t \le 2$, $\theta \sim U(0, \pi)$.

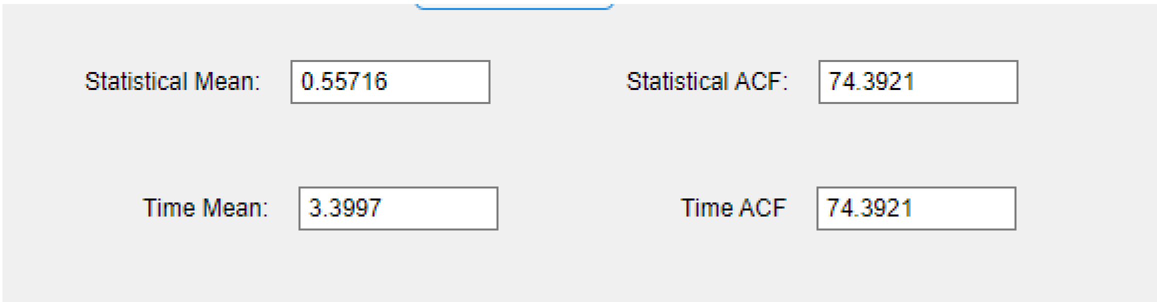


Figure 30 Comparing for ergodic function

The relation between the statistical mean and the time mean, for the test process
the difference between statical mean and time mean is so difference so it is not wide sense stationary and there for it is not ergodic they must be the same in the ergodic

The relation between the statistical ACF and the time ACF, for the test process
statical ACF and time mean is the same so it is WSS and therefor it is ergodic

W(t) is a RP, where W(t) = A cos(4πt), where $0 \leq t \leq 2$, $A \sim N(-5, 5)$

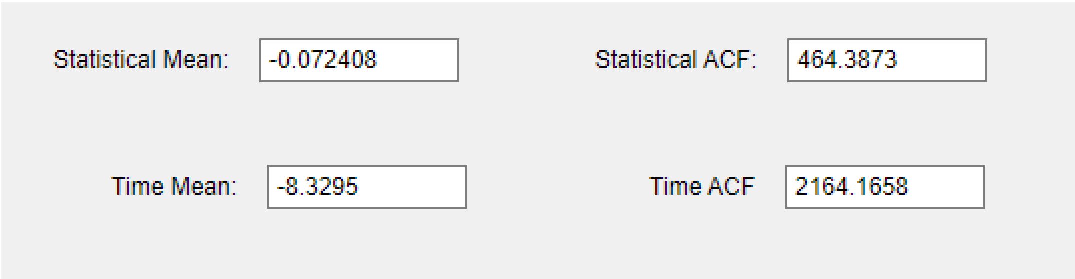


Figure 30 Comparing for ergodic function

there is no relation between the statistical mean and the time mean so it is not ergodic
there is no relation between the statistical ACF and the time ACF so it is not ergodic