Random Processes

**Instructions:** Answer all Steps within a LATEX document. You may copy paste these questions into your Latex document – this does not need to be a report format. Insert your MATLAB code at the end of your document using an appropriate LATEX package to display the code. You may get help from others for this project but must write your own code and LATEX write-up. All plots should be well labeled, including legends. Ensemble plots should use the same color for each realization to make the plot more readable.

**Overview:** In this lab you will analyze a random process in MATLAB. In the next lab you will take this process a step further and use the results of your analysis to actually model the random process

**Step 1:** Load the data in L:\Courses\EENG\EENG765\Block 3 - Random Processes\Project. There are 1000 samples of a random process which is 100 elements long (If you plot a single realization it should have length 100, not 1000).

**Step 2:** Create a scatter plot comparing data from the second time step to the last time step. Are these two random variables correlated? Repeat with data from the second and 5th time steps. Are these two random variables correlated? Create 1D histograms of at least 5 data points – could this random process be Gaussian?

**Step 3:** Plot 10 realizations of the random process overlaid with the random process mean (based on all 1000 realizations) and +/- the random process standard deviation (based on all 1000 realizations)

**Step 4:** Plot the correlation and covariance kernals of the random process using their definitions – avoid MATLAB’s *xcorr*

**Step 5:** Comment on the stationarity of the random process. Specify wide-sense or strict-sense stationarity, and list how it does or does not meet each criteria. If the process is not stationary, does it become stationary at steady-state?

**Step 6:** Create a new subset of data which removes the first 50 time samples from the data. Repeat Step 4 and Step 5. If the process is stationary, plot the autocorrelation as a 2D function of time lag.

**Step 7:** Comment on the ergodicity of the random process. Choose a single sample realization and use MATLAB’s *xcorr* function to estimate auto-correlation. Compare the autocorrelation of *xcorr* to your autocorrelation from Step 6. Is the time-sample long enough for an ergodic assumption to apply? Are the results from *xcorr* different for different samples? Why?

**Step 8:** Explain a type of natural phenomenon which could be described by the random process you have analyzed. There is no right answer here, just justify your response.