

Random signal analysis I (ECE673)
Solution assignment 8

The due date for this assignment is Wednesday Nov. 15th.

1) A random walk process is a sum process defined as

$$X[n] = \sum_{i=0}^n U[i],$$

where $U[n]$ is an IID random process with $U[n]$ described by the PMF

$$p_U[k] = \begin{cases} 1/2 & k = -1 \\ 1/2 & k = 1 \end{cases}.$$

(i) Generate a few realizations of the process using MATLAB for, e.g., $n = 0, \dots, 99$ (attach at least one with your solution) [Suggestion: recall that the function `sign()` of MATLAB equals ± 1 according to whether its argument is positive or not]. At a first glance, looking at the realization, do you expect the process to be stationary?

(ii) Evaluate the mean sequence $\mu_X[n] = E[X[n]]$ and the covariance sequence $c_X[n, n+k]$. Based on these results, is the process stationary? Is it wide sense stationary (WSS)?

(iii) Now consider the process $Y[n] = U^2[n]$. Is this transformed process IID?

.

2) Consider the random process defined as

$$X[n] = 2U[n] - 4U[n-1],$$

where $U[n]$ is a white noise with zero mean and variance $\sigma^2 = 1$.

(i) Is this process WSS? If so, evaluate, auto-correlation sequence and power spectral density.

(ii) Generate a realization of 1000 samples of $X[n]$ by using MATLAB.