

Time Series Analysis – Assignment II

1. Answer the following:

X , Y and Z are independent random variables possessing identical distribution of $N(1, 1)$ (Gaussian with zero mean and unit variance).

Define the random variables $V = 2X + Y$ and $W = 3X - 2Z + 5$. Then

- (a) Find the covariance between V and W .
- (b) Find the two parameters that completely specify the random variable $V + W$

2. Answer the following:

Calculate by hand the first 10 values of impulse response of an LTI system described by the constant-coefficient difference equation:

$$y[n] - 4y[n - 1] + 4y[n - 2] = x[n] - x[n - 1]$$

Is the LTI system stable?

3. Answer the following:

(Write a program) Create 500 different realizations (of length 2048) of a zero-mean, unit variance Gaussian random process.

- Compute the sample mean and variance for each realization. Plot the distribution of the resulting estimates. What do you observe?
- Compute the average of the estimates and compare with the true value.
- Repeat the above steps for a **chi-square** distributed process (with 5 degrees of freedom) and comment on the results.

4. Answer the following:

Consider a continuous-time sinusoidal signal $x(t) = \sin(2\pi F_0 t)$. Suppose that $F_0 = 2$ kHz and that this signal is sampled at sampling frequency of $F_s = 50$ kHz to produce $x[n]$. Then

- (a) Plot the signal $x[n]$ (stem plot), $0 \leq n \leq 99$. What is the frequency f_0 of the signal $x[n]$?
- (b) Plot the signal $y[n]$ created by taking the even-numbered samples of $x[n]$. Is this a sinusoidal signal? Why? If so, what is its frequency?