

EECS 861  
Homework #6

1.  $Z(t) = Xt+Y$

Where X and Y are jointly Gaussian random variables with  $E[X] = \mu_X=0$ ,  $E[Y] = \mu_Y=0$ ,  $\sigma_X=2$ ,  $\sigma_Y=2$ , and  $\rho_{XY}=0.8$ .

- Find  $E[Z(t)]$
- Find  $\text{Var}[Z(t)]$
- What is the pdf of  $Z(t)$ , name of pdf and its parameters?
- Find  $P(Z(1)>8.8)$
- Find autocorrelation function,  $R_{ZZ}(t_1, t_2)$
- Find autocovariance function,  $C_{ZZ}(t_1, t_2)$
- Find the joint pdf of  $Z(0)$  and  $Z(1)$ .

2. Given  $Z(t)$  in problem 1.

- Is  $Z(t)$  strict sense stationary?
- Is  $Z(t)$  wide sense stationary?

3.  $X(t)$  and  $Y(t)$  are SI WSS zero mean random process with  $R_{XX}(\tau)$  and  $R_{YY}(\tau)$ . Find the autocorrelation function of  $Z(t)$ :

- $Z(t) = 2 + 4X(t) + 8Y(t)$
- $Z(t) = X(t)Y(t)$

c. Let  $X(t)$  and  $Y(t)$  be Gaussian SI WSS random processes with zero mean and unit variance, for  $Z(t) = 2X(t) + 3Y(t)$  find  $P(Z(1)<5.9)$ .

4.  $Z(t) = X(t) + 0.5X(t-2)$

Where  $E[X(t)] = \mu_X=0$  and the autocorrelation function of  $X(t)$  is  $R_{XX}(t_1, t_2)$ .

- Find  $E[Z(t)]$
- Find  $R_{ZZ}(t_1, t_2)$ .
- Repeat b. assuming that  $X(t)$  is a wide sense stationary random process.

5. For this problem use the data in this file.

[http://www.ittc.ku.edu/~frost/EECS\\_861/EECS\\_861\\_HW\\_Fall\\_2023/HW-5-Problem-2.xls](http://www.ittc.ku.edu/~frost/EECS_861/EECS_861_HW_Fall_2023/HW-5-Problem-2.xls)

Each Sheet contains data from one discrete time random process,

- Case 1  $X[n]$ ,
- Case 2  $Y[n]$ ,
- Case 3  $Z[n]$ .

Each row is a sample function of that discrete time random process.

a. Consider column  $i$  and  $i+1$  as a pair of random samples (e.g.,  $X[i]$ ,  $X[i+1]$ ); calculate and plot the correlation coefficient between these samples for all  $i$ . That is, column 1 & 2 is random sample one (e.g.,  $X[1]$ ,  $X[2]$ ), column 2 & 3 is random sample 2 (e.g.,  $X[2]$ ,  $X[3]$ ), column 3 & 4 (e.g.,  $X[3]$ ,  $X[4]$ ), is random sample 3.

- Repeat part a) for column  $i$  and  $i+2$  (e.g.,  $X[3]$ ,  $X[5]$ ).
- Repeat part a) for column  $i$  and  $i+3$  (e.g.,  $X[3]$ ,  $X[6]$ ).

- d. Repeat a. - c. for  $Y[n]$  and  $Z[n]$
- e. Comment on the stationary of these random processes.