**Digital Signal Processing Fundamentals [5ESC0]**

**Lab3**

**‘Answer form’**

***Assignment 18 to 26***

**Group number:**

**Names with ID:**

**Date:**

**Assignment 18: Mean and variance**

1. Expression for the mean and variance:



**Figure 4: u[n] for different N**

1. Statement about the mean and variance of a random variable which consists of the normalized sum of N IID random variables:

**Assignment 19: Mathematical expressions for variance and correlation coefficients**

1. Expression and plot of variance:



**Figure 1: Plot of variance as a function of N**

1. Expression and plot of normalized cross correlation coefficient:



**Figure 2: Plot of normalized cross correlation coefficient as a function of N**

**Assignment 20: Scatter plots and empirically evaluate correlation coefficient**



**Figure 3: Scatter plot of ordered pairs of samples**

1. Comparison of numerical estimates and theoretical results:
2. Explain how the scatter plots are related to the normalized cross correlation coefficient:

**Assignment 21: Correlation function and power spectral density (PSD) function**

1. Expression for theoretical correlation:
2. Derivations for theoretical PSD (two different ways):

**Assignment 22: Scatter plots**



**Figure 5: Scatter plots**

What can you deduce about the random process y[n] from these scatter plots?

**Assignment 23: Empirical correlation and PSD function**



**Figure 6: Theoretical and estimated autocorrelation values**

1. For what value of lag l do the theoretical and estimated autocorrelation reach their maximum values?
2. Procedure for obtaining the PSD from the estimated values of the autocorrelation:



**Figure 7: Theoretical and estimated PSD**

1. Give a short reasoning of possible differences between the theoretical and estimated values of the PSD:

**Assignment 24: Expression for cross-correlation**

1. Short derivation for rxy[l]:
2. Procedure for estimating :

**Assignment 25: Test cross-correlation function**



**Figure 8: cross-correlation test plot**

1. Which value of l produces the largest cross-correlation? Why?
2. Is the cross-correlation function an even function? Why or why not?

**Assignment 26: Estimate delay for radar data**



**Figure 9: transmitted and received signal**



**Figure 10: auto- and cross-correlation**

1. Delay for :

Bonus questions:

1. How would you reduce the influence of the noise w[n]?
2. How would you handle non-integer values for τ?