**ECE 3522: Stochastic Processes in Signals and Systems**

# Computer Assignment (CA) No. 6: Mean and Variance Revisited

I should have assigned this earlier. I want to reinforce the concept we discussed in the last problem on the first exam. Use MATLAB’s random number generator and generate uniformly distributed random numbers on the range [0,1]. We all agree that the mean, *μ*, should be 0.5, and the variance, σ2, should be ??? (can you derive this?).

The tasks to be accomplished are:

1. Generate N random numbers, denoted by the signal x[n]. Estimate the mean () and variance () using N data points. Compute the error of these estimates as:

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Plot  and  for N=[1, 106]. Use a log base 10 scale for the horizontal axis (n – the number of points) and a linear scale for the error. Explain this plot.

1. Estimate the pdf of x[n] using a bin size of 0.01 (100 bins for the range [0,1]). Plot the mean-squared error between the measured distribution and the actual distribution using:



where *B* is the number of bins, p(x) is the “true” distribution (a uniform distribution in this case), and  is the estimate of the distribution. Obviously, for N < B, some of the bins will be empty. Does that remind you of the exam problem?

Estimate the pdf for N = [1, 106], and plot MSE[N] using the same linear/log scale as above. Explain your findings. Plot the pdfs for N = 101, 103, and 106 and compare/contrast them.

The theory we learn in this class is a great thing... but there is a catch. We rarely know the parameters of these distributions or the functional forms of the distributions. We have to estimate these from the data and hope that our estimates are sufficiently accurate. Methods to estimate these parameters and smooth these estimates, which today is known as the field of machine learning, will be discussed later in the course and are still a very active area of research in statistics.