1. Let $x[n], n = 0, 1, ..., N - 1$ be $N$ samples of a zero mean wide sense stationary process.

   (a) Provide an expression for the Periodogram estimate of the power spectrum.  
   
   (b) Assuming the process to be a white Gaussian process with variance $\sigma^2$, calculate 
   the mean and variance of the Periodogram estimate of the power spectrum.  
   
   (c) Comment on the Periodogram as an estimator of the power spectrum.

2. Consider the real autoregressive process $x[n]$ of order 4, described by the difference equation

   $$x[n] = 1.5x[n - 1] - 1.25x[n - 2] + .5x[n - 3] - .25x[n - 4] + w[n],$$

   where $w[n]$ is a real white Gaussian noise process of zero mean and variance 1.

   (a) Find the power spectrum of $x[n]$.  
   
   (b) Find the best linear predictor of $x[n]$ given $x[n - 1], x[n - 2], ..., x[n - 10]$ and the 
   associated mean squared prediction error. Explain your answer.  
   
   (c) Assuming a forward linear predictor of order 3, find the optimal predictor coefficients 
   and the associated mean squared prediction error. (show all your 
   computations)  
   
   (d) State the problem of backward linear prediction. Find the best backward predictor 
   of order 3 and the associated mean squared prediction error.