Project 3

A stochastic signal $x(n)$ can be modelled by an autoregressive (AR) process as

$$\sum_{i=0}^{P} a_i x(n-i) = \nu(n), \qquad a_0 = 1$$

where P defines the model order and $\nu(n)$ is a zero mean white noise (say Gaussian distributed) with variance σ_v^2. First derive power spectral density function (PSDF) of the process $x(n)$ in terms of a_is and σ_v^2.

Now generate a sequence $x(n)$ as follows.

$$x(n) = \sum_{i=1}^{L} b_i \cos(\omega_i n) + \nu'(n),$$

here $\nu'(n)$ is a system noise with variance $\sigma_{v'}^2$(assume white). Select the frequencies ω_i appropriately (like quite close/apart), b_i and $\sigma_{v'}^2$. Now estimate the parameters a_i of the AR process. Plot the PSDF and verify whether you can locate the spectral components at ω_i and their relative weights.

Repeat the above experiments for following cases:

1. For different data size N in $\{x(n)\}_{k=0}^{N-1}$.
2. For different values of P.
3. For different values of $\sigma_{v'}^2$.
4. For different values of $\{L, \omega_i, b_i\}$. Try all combinations.