Department of Electrical & Computer Engineering
University of California, Santa Barbara

ECE 245
Spring 2011
Shynk
H.O. #4

HOMEWORK #2

Due Friday, April 15, 2011 (5:00 p.m.)

Reading: Chapters 2 (2.8–2.10) and 4 (4.1–4.7)

Problems:

1. Chapter 2: Problem 3
2. Chapter 2: Problem 5
3. Chapter 2: Problem 6
4. Chapter 2: Problem 10
5. Chapter 2: Problem 11
6. Suppose that the signal $x(n)$ has the following autocorrelation function:

$$\phi_{xx}(m) = \sigma_x^2 a^{|m|}, \quad m = 0, 1, \ldots$$

where σ_x^2 and a are fixed parameters.

(a) Derive the optimal $N = 1$ and $N = 2$ coefficient filters for predicting $x(n)$ based on N previous samples.

(b) Does the result for $N = 2$ violate your intuition? What property of the process causes this result? What would you expect the result to be for $N = 3$?

(c) Suppose instead that $x(n)$ has the power spectral density function

$$\Phi_{xx}(z) = \frac{\sigma_x^2}{A(z)\ A(z^{-1})}$$

where

$$A(z) = 1 - \sum_{k=1}^{N} a_k z^{-k}$$

and the parameters $\{a_k\}$ are fixed. Find the optimal N-length filter for predicting $x(n)$ from past samples.