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

ECE 240A
Winter 2010
Shynk
H.O. #3

HOMEWORK #1

Due Friday, January 15, 2010 (5:00 p.m.)

Reading: Lessons 1, 2, and 3

Problems:

1. Problems 2.5, 2.6, and 2.10
2. Problems 3.6 and 3.7
3. Derive the optimal estimator $h(Y)$ that minimizes the mean *absolute* error given by

$$\text{MAE} = E[|X - h(Y)|].$$

   Hint: Use the expression

$$E[|X - a|] = \int_{-\infty}^{a} (a - u) f_X(u) du + \int_{a}^{\infty} (u - a) f_X(u) du.$$

4. Suppose that $Y = X + V$ where X and V are *independent* random variables, V is Gaussian with zero mean and unit variance, and X is Bernoulli: ± 1 with equal probability. Show that the optimal (conditional mean) estimator is

$$\hat{X} = \tanh Y.$$

   Hint: Note that

$$f_X(x) = \frac{1}{2}\delta(x + 1) + \frac{1}{2}\delta(x - 1)$$

   and

$$f_{Y|X}(y|x) = f_V(y - x).$$