EE5585: HOMEWORK 3
DUE: APR 16, START OF CLASS.

INSTRUCTOR: A. MAZUMDAR

All problems carry equal points

(1) Consider a source X uniformly distributed on the set $\{0, 1, 2, \ldots, 2m\}$, for some integer m. Consider the following distortion metric:

$$d(x, \hat{x}) = \begin{cases} 0, & \text{if } x - \hat{x} \text{ is even} \\ 1, & \text{otherwise .} \end{cases}$$

Find the rate distortion function for this source. Suppose you want to use a 1-bit per symbol scalar quantizer. What would be the best distortion that you would achieve? Compare it to the calculated rate-distortion function.

(2) Design a 3-bit uniform quantizer (by specifying the decision boundaries and reconstruction levels) for a source with the following pdf:

$$f_X(x) = \frac{1}{8} e^{-\frac{|x|}{4}}.$$

What is the mean and variance of the random source variable above? Derive the mean of the output of uniform quantizer you designed for the above problem. What is the mean of the optimum quantizer for this distribution?

(3) Following table shows height-weight data of 12 monkeys:

Height	Weight
18	29.5
28	39.2
36	54.5
25	36.0
17	25.4
31	43.8
21	30.4
35	56.1
24	36.0
22	29.9
18	26.9
32	48.2

Assume reasonable rangea of height/weight in the table. Design a 2-bit vector quantizer for this data. What would be the 1-bit scalar quantizer for each column? Find out error for the given data for both the quantizers (scalar and vector).