

ECS 452: In-Class Exercise #20

Instructions

1. Separate into groups of no more than three persons. **The group cannot be the same as any of your former groups after the midterm.**
2. **Write down all the steps** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.
3. **Do not panic.**

Date: 15/05/2018

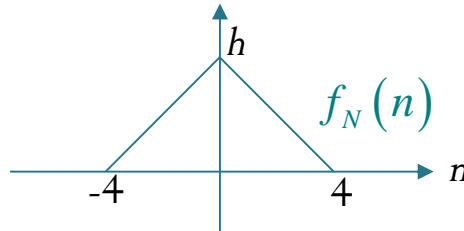
Name

ID (last 3 digits)

Prapun

5 5 5

In a binary antipodal signaling scheme, the message S is randomly selected from the alphabet set $\mathcal{S} = \{-2, 2\}$ with $p_1 = P[S = -2] = 0.6$ and $p_2 = P[S = 2] = 0.4$. The message is corrupted by an independent additive noise N whose pdf is shown below:

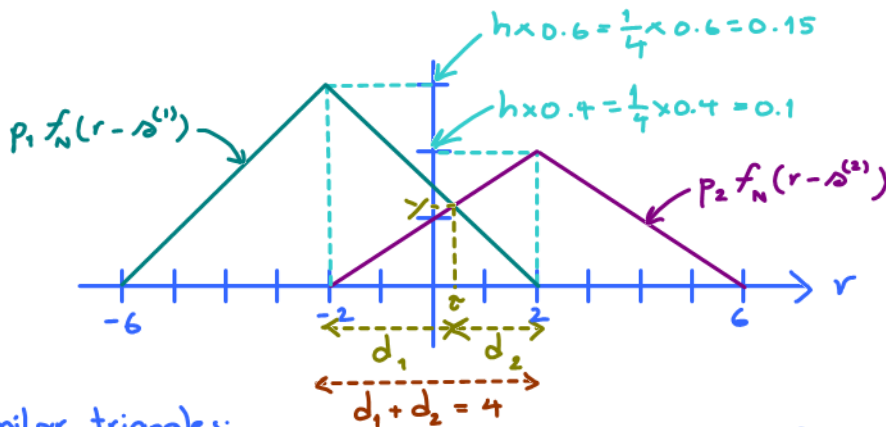


a. What is the value of h ?

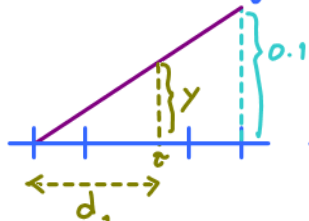
To be a pdf, we need $\int_{-\infty}^{\infty} f_N(n) dn = 1$.

$$\frac{1}{2} \times 8 \times h = 1 \Rightarrow h = \frac{1}{4}$$

b. Suppose the received symbol is $R = r$. Find the MAP detector $\hat{s}_{\text{MAP}}(r)$.



Use similar triangles:



$$\frac{y}{d_1} = \frac{0.1}{4}$$

$$y = \frac{d_1 \times 0.1}{4} = \frac{d_2 \times 0.15}{4}$$

$$d_1 = \frac{3}{2} d_2$$

$$\Rightarrow \frac{3}{2} d_2 + d_2 = 4$$

$$d_2 = 4 \times \frac{2}{5} = \frac{8}{5}$$

$$r = 2 - d_2 = 2 - \frac{8}{5} = \frac{2}{5} = 0.4$$

$$\hat{s}_{\text{MAP}}(r) = \begin{cases} -2, & -6 < r < 0.4, \\ 2, & 0.4 < r < 6, \\ \text{any}, & \text{otherwise} \end{cases}$$

$-6 < r < 0.4$,
 $0.4 < r < 6$,
otherwise

$$= \begin{cases} -2, & r < 0.4, \\ 2, & r \geq 0.4. \end{cases}$$