

# Seminar 8 - Criteria / Multiple samples

## DEDP

1. A signal can have two values, 0 (hypothesis  $H_0$ ) or 6 (hypothesis  $H_1$ ). The signal is affected by AWGN  $\mathcal{N}(0, \sigma^2 = 1)$ . The receiver takes 5 samples with values  $\{1.1, 4.4, 3.7, 4.1, 3.8\}$ .
  - a. What is decision according to Maximum Likelihood criterion?
  - b. What is decision according to Minimum Probability of Error criterion, assuming  $P(H_0) = 2/3$  and  $P(H_1) = 1/3$ ?
  - c. What is the decision according to Minimum Risk Criterion, assuming  $P(H_0) = 2/3$  and  $P(H_1) = 1/3$ , and  $C_{00} = 0$ ,  $C_{10} = 10$ ,  $C_{01} = 20$ ,  $C_{11} = 5$ ?

**Only a) Done:**

2. Consider detecting a signal  $s_1(t) = 3 \sin(2\pi f_1 t)$  that can be present (hypothesis  $H_1$ ) or not ( $s_0(t) = 0$ , hypothesis  $H_0$ ). The signal is affected by AWGN  $\mathcal{N}(0, \sigma^2 = 1)$ . The receiver takes 2 samples.
  - a. What are the best sample times  $t_1$  and  $t_2$  to maximize detection performance?
  - b. The receiver takes 2 samples with values  $\{1.1, 4.4\}$ , at sample times  $t_1 = \frac{0.125}{f_1}$  and  $t_2 = \frac{0.625}{f_1}$ . What is decision according to Maximum Likelihood criterion?
  - c. What if we take the decision with Minimum Probability of Error criterion, assuming  $P(H_0) = 2/3$  and  $P(H_1) = 1/3$ ?
  - d. What is the decision according to Minimum Risk Criterion, assuming  $P(H_0) = 2/3$  and  $P(H_1) = 1/3$ , and  $C_{00} = 0$ ,  $C_{10} = 10$ ,  $C_{01} = 20$ ,  $C_{11} = 5$ ?
  - e. What if the receiver takes an extra third sample at time  $t_3 = \frac{0.5}{f_1}$ . Will the detection be improved?

**Not done (yet):**

3. A signal can have two values,  $-4$  (hypothesis  $H_0$ ) or  $5$  (hypothesis  $H_1$ ). The signal is affected by AWGN  $\mathcal{N}(0, \sigma^2 = 1)$ . The receiver takes 3 samples with values  $\{1.1, 4.4, 2.2\}$ .
  - a. What is decision according to Maximum Likelihood criterion? Use both interpretations.