

Seminar 3

Maximum Likelihood criterion

DEDP

1. Consider the problem of deciding between two constant signals, $s_0(t) = -1$ and $s_1(t) = 4$. The signals are affected by AWGN with distribution $\mathcal{N}(\mu = 0, \sigma^2 = 4)$. The receiver takes one sample, at time $t_0 = 0.75$, and the obtained value is $r = 1.8$.
 - a. Write the expressions of the two conditional distributions of the sample, and sketch them
 - b. What is the decision taken with the Maximum Likelihood criterion?
2. Consider the problem of deciding between two possible signals, $s_0(t) = \cos(2\pi t)$ and $s_1(t) = \sin(2\pi t)$. The signals are affected by AWGN with distribution $\mathcal{N}(\mu = 0, \sigma^2 = 4)$. The receiver takes one sample, at time $t_0 = 0.75$, and the obtained value is $r = 3.5$.
 - a. Write the expressions of the two conditional distributions of the sample, and sketch them
 - b. What is the decision taken with the Maximum Likelihood criterion?
 - c. What is the **best** moment t_0 for sampling, in order to best discriminate between the signals? Justify.
 - d. What is the **worst** moment t_0 for sampling, in order to discriminate between the signals? Justify.
 - e. Repeat a) and b) in case the noise has uniform distribution $\mathcal{U}[-4, 4]$. Is there a problem with the decision?
 - f. What is the maximum variance of a uniform noise, with zero-mean, in order to still be able to take a decision with the ML criterion for $r = 3.5$?
3. A signal can have four possible values: -6, -2, 2, 6. Each value lasts for 1 second. The signal is affected by white noise with normal distribution. The receiver takes 1 sample per second. Using ML criterion, decide what signal has been transmitted, if the received samples are:

4, 6.6, -5.2, 1.1, 0.3, -1.5, 7, -7, 4.4

4. A signal can have two possible values, $s_0 = -3$ or $s_1 = 3$. The signal is affected by gaussian noise with distribution $\mathcal{N}(0, 1)$. The receiver performs ML decision based on a single sample r .
- In hypothesis H_0 , which for what values of r do we get a false alarm?
 - Compute the conditional probability of false alarm, $P(D_1|H_0)$
 - Compute the other three conditional probabilities (correct rejection, miss, correct detection)