Seminar 6 - ML / MPE criteria

DEDP

1. Consider detection between two signals: $s_0(t) = -2, \forall t$ and $s_1(t) = 3\sin(2\pi\frac{1}{4}t)$ The signal is affected by gaussian noise $\mathcal{N}(\mu = 0, \sigma^2 = 2)$. The receiver takes a single sample at time $t_0 = 1$, and it has the value $r(t_0) = 2.4$. The probabilities of the two hypotheses are $P(H_0) = \frac{1}{4}$ and $P(H_1) = \frac{3}{4}$.
   a. Sketch the two conditional distributions
   b. What decision is taken according to ML criterion and to the MPE criterion?
   c. Find the decision regions for both criteria
   d. Compute the probabilities of correct rejection, false alarm, miss and correct detection for ML and MPE criteria
   e. Re-compute the probabilities in case the sampling time changes to $t_0 = 1.1$
   f. What are the possible values of $P(H_0)$ that make the false alarm probability smaller than 1%, for each criterion?
   g. If we could change the value of $s_0(t) = A$, what is the maximum value of A such that the probability of false alarm is smaller than 0.1%?

2. Consider the decision between two constant signals: $s_0(t) = -5$ and $s_1(t) = 5$. The signals are affected by gaussian noise $\mathcal{N}(0, \sigma^2 = 3)$ The receiver takes one sample r.
   a. Find the decision regions R_0 and R_1 according to the MPE criterion
   b. What are the probabilities of false alarm and of miss?
   c. Repeat a) and b) considering that $s_1(t)$ is affected by uniform noise $\mathcal{U}[-4, 4]$