Seminar 5 - Signal detection with multiple samples

DEDP

1. 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 all three interpretations.

2. Consider detecting a signal $s(t) = 3\sin(2\pi f_1 t)$ that can be present (hypothesis H_1) or not (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? Use the geometrical interpretation.

   c. What if the receiver takes an extra third sample at time $t_3 = \frac{0.5}{f_1}$. Will the detection be improved?