Seminar 4
Decision criteria
DEDP

1. A vehicle airbag system detects a crash by evaluating a sensor which provides two values: $s_0(t) = 0$ (no crash) or $s_1(t) = 5$ (crashing).

   The signal is affected by gaussian noise $\mathcal{N}\left(\mu = 0, \sigma^2 = 1\right)$.

   The costs of the scenarios are: $C_{00} = 0$, $C_{01} = 100$, $C_{10} = 10$, $C_{11} = -100$.

   The probabilities of the two hypotheses are $P(H_0) = 2/3$, $P(H_1) = 1/3$.

   a. Find the decision regions R_0 and R_1, with each criterion: ML, MPE, MR
   b. Find the decision taken based on a sample $r = 3.1$, with each criterion: ML, MPE, MR
   c. Find the probability of miss, if the threshold T has value $T = 3$
   d. What if the noise is uniform $U[-3, 3]$?

2. Repeat exercise above, but the noise is uniform $U[-3, 3]$.

   Also consider the fourth criterion: Neyman-Pearson criterion with false-alarm probability $P_{fa} = 0.01$

3. 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 $C_{00} = 0$, $C_{10} = 10$, $C_{01} = 20$, $C_{11} = 5$?
   d. How large should $P(H_0)$ be, in order for the decision according to MPE criterion to be D_0?