EXERCISE 1: GAUSSIAN DISTRIBUTION

a) Use randn('seed',0)

b) Generate a population of N=5000 fishes with the following characteristics:
   - P(w1)=0.5;   P(w2)=0.5;
   - w1 is normally distributed with mean and standard deviation 20 and 3 respectively
   - w2 is normally distributed with mean and standard deviation 25 and 2 respectively

c) Determine the optimal decision boundary estimating the mean and the standard deviation from the previous data

d) How many data of each class do you had to generate if the prior probabilities are P(w1)=0.7 y P(w2)=0.3? What is the decision boundary in this case?

e) If you consider P(w1)=0.3 y P(w2)=0.7, what is the decision boundary?

f) Is the change symmetrical in the position of the decision boundary in the answers c and d with regard to the answer b?

EXERCISE 2: GAUSSIAN DISTRIBUTION

Knowing that the Gaussian density function is defined as:

$$P(x|w_i) = \frac{1}{\sqrt{2\pi\sigma_i^2}} e^{-\frac{(x-\mu_i)^2}{2\sigma_i^2}}$$

We can calculate the decision boundary matching the posteriori probabilities of both classes: P(X|w1)*P(w1)=P(X|w2)*P(w2), or applying logarithm (e base): log(P(X|w1)) +log(P(w1))=log(P(X|w2))+log(P(w2))

a) Modify the follow code to find the decision boundary taking into account the prediction risk:

```
A=s1*s1As2*s2;
B=2*(m1*s2*s2Am2*s1*s1);
C=2*s1 * s1 * s2 * s2 * (log(Pw1) - log(Pw2) - log(s1) + log(s2)) + s1*s1*m2*m2-s2 * s2 * m1*m1;
x1=(-B+sqrt(B*B-4*A*C))/2/A;
x2=(-B-sqrt(B*B-4*A*C))/2/A;
```

To solve this problem you must analyze where it comes the formula above, and properly make the necessary terms of cost. Remember that:

$$r_j(x) = \sum_{i=1}^{M} L_{ij} \cdot p(x|w_i) \cdot p(w_i)$$

b) If we consider the risk to choose w1 being really w2 like 0.8, and choose w2 being really w1 equal to 2, determine the decision boundary.