

Pattern Recognition- Assignment 1

Bayes Decision Theory

1. Prepare a formula sheet for

- Notations and symbols for Prior Probability, class-conditional probability density, evidence, posterior probability and Bayes formula
- What do you understand by the likelihood $p(x|\omega_j)$?
- What is $P(\text{error}|x)$?
- What is the formula for Bayes' decision rule for minimizing the probability of error?
- What is conditional risk and how it is defined in notations?
- What is the formula for Bayes min risk?
- How do you write Bayes risk rule for two-category classification problems over continuous feature vector?
- Derive formula for minimum error rate classifier.
- What is the formula for univariate NDF and Multivariate NDF?
- Write discriminant functions for Multivariate NDF for all three cases.

2. Given this data, where each feature vector X has 2 feature components (x_1, x_2):

	ω_1				ω_2				ω_3			
x_1	2.1	1.1	1.4	3.3	4.4	3.4	4.5	4.1	-1.3	-3.2	-3.2	-2.1
x_2	-2.5	-3.1	-2.1	-1.8	6.5	5.8	7.2	5.65	-2.3	-4.5	-4.5	-3.3

- a. Compute Mean vector μ over all samples, and class means μ_1, μ_2 and μ_3 .
- b. Use `numpy.cov()` to compute covariance matrix Σ for each class $\Sigma_1, \Sigma_2, \Sigma_3$.
- c. Out of the three cases which case applies for computing discriminant function of Multivariate NDF?
- d. Let $p(\omega_1)=0.4, p(\omega_2)=0.35, p(\omega_3)=0.25$. Can you write a python function for computing the discriminant functions defined in part c?
- e. Compute and plot discriminant functions $g_1(X), g_2(X), g_3(X)$ and the sample points in 2 dimensions.

Some Helpful points:

1. How to compute covariance matrix.
Read the following link on how to compute covariance matrix:
<https://www.cuemath.com/algebra/covariance-matrix/>
2. python scripts for computing the same
<https://www.geeksforgeeks.org/python-numpy-cov-function/>
3. Search for python functions to compute inverse and determinants of matrix.