Pattern Recognition- Assignment 1

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Bayes Decision Theory

1. Prepare a formula sheet for
   - Notations and symbols for Prior Probability, class-conditional probability density, evidence, posterior probabilty and Bayes formula
   - What do you understand by the likelihood p(x|ωj)?
   - What is P (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 (x1, x2):

	ω1				ω2				ω3			
x1	2.1	1.1	1.4	3.3	4.4	3.4	4.5	4.1	-1.3	-3.2	-3.2	-2.1
x2	-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 μ1, μ2 and μ3.
b. Use numpy.cov() to compute covariance matrix Σ for each class Σ1, Σ2, Σ3.
c. Out of the three cases which case applies for computing discriminant function of Multivariate NDF?
d. Let p(ω1)= 0.4, p(ω2)=0.35, p(ω3)=0.25 .Can you write a python function for computing the discriminant functions defined in part c?
e. Compute and plot discriminant functions g1(X), g2 (X), g3(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.