The Johns Hopkins University

JHU ENGINEERING FOR PROFESSIONALS PROGRAM

NEURAL NETWORKS

Problem Set #7

7.1 The sensitivity of a detector can be expressed in terms of the set of numbers: true positives, false positives, true negatives and false negatives. Derive a similar expression for the positive predictive value (PPV) and the negative predictive value (NPV). Recall that the positive predictive value is the probability of an entity being associated with or having a characteristic given that it produced a positive test result.

Ans: $\text{PPV} = \underline{\Pr\{C \mid D\}} = \dfrac{\Pr\{C \cap D\}}{\Pr\{D\}} = \dfrac{\text{TP}}{\text{TP} + \text{FP}}$,

$\text{NPV} = \underline{\Pr\{\bar{C} \mid \bar{D}\}} = \dfrac{\Pr\{\bar{C} \cap \bar{D}\}}{\Pr\{\bar{D}\}} = \dfrac{\text{TN}}{\text{TN} + \text{FN}}$

7.2 A neural network is used to classify patients based on a large number of patient histories and blood chemistries. Each patient's blood is tested for a series of bio-markers which then serves as inputs to a neural network to determine whether they have a particular disease based on the output of the neural network. Below is the confusion table indicating the test results from a large number of patients along with their respective disease states.

Test/Characteristic	Primary Aldosteronism	No aldosteronism
Positive	20	100
Negative	250	300

Calculate the sensitivity, specificity, the PPV and the NPV. Comment on whether this is a good test or not and whether it has any utility.

Ans: $\text{Sen.} = \dfrac{\text{TP}}{\text{TP+FN}} = \dfrac{20}{20+250} = 0.074, \text{Spec.} = \dfrac{\text{TN}}{\text{TN+FP}} = \dfrac{300}{300+100} = 0.75$

$\text{PPV} = \dfrac{\text{TP}}{\text{TP} + \text{FP}} = \dfrac{20}{20+100} = 0.1666..., \quad \text{NPV} = \dfrac{\text{TN}}{\text{TN} + \text{FN}} = \dfrac{300}{300+250} = 0.5454...$

The test is a very weak test as it detects less than 10% of cases and its PPV is 1/6 … very low for a credible test. It's NPV is similarly weak and only provides about even odds as to whether a negative test result could signal the absence of aldosteronism.