Why

How should we compare two classifiers?

Definitions

Let $a^1, \ldots, a^n$ in A be a dataset of inputs and $b^1, \ldots, b^n$ in B be a dataset of labels. Let $G : A \to B$ be a classifier.

For each $i = 1, \ldots, n$, the classifier associates a prediction $G(a^i)$ with a^i. The prediction $G(a^i)$ is *correct* if $G(a^i) = b^i$ and *incorrect* (*wrong, error*) if $G(a^i) \neq b^i$. The *error rate* is the proportion of the dataset for which the classifier's prediction is an error. In other words, $1/n \, |\{i \mid G(a^i) \neq b^i\}|$.

Given two classifiers, it is natural to prefer the one with the lower error rate. Given that these two are the results of different inductors applied to the same, we can use a separate dataset to *validate* these.

Boolean case

In the case that $B = \{-1, 1\}$, we call the class -1 *negative* and the class $+1$ positive. Similarly, we call an example (a^i, b^i) a *negative example* if $b^i = -1$ and a *positive example* if $b^i = 1$.

We call the result of G on a^i a *true positive* if $b^i = 1$ and $G(a^i) = 1$, a *true negative* if $b^i = -1$ and $G(b^i) = -1$, a *false negative* (or *type II error*, read "type two error") if $b^i = 1$ and $G(a^i) = -1$ and a *false positive* (or *type I error*, read "type one error") if $b^i = -1$ and $G(a^i) = 1$.

The *false positive rate* (*false negative rate*) of a classifier on a dataset is the proportion of dataset elements for which it predicts a *false positive* (*false negative*).

The *true positive rate* (or *sensitivity, recall*) of G on a dataset is the proportion of positive examples which G labels positive. The *precision* (or *positive predictive value*) of G is the proportion of all examples which the classifier labels *positive* whose label is positive. The *true negative rate* (or *specificity, selectivity*) is the proportion of negative examples which G labels negative. The *false alarm rate* is the proportion of negative examples which G *incorrectly* labels positive.

Classifier Errors

Classifiers

Predictors   Factorials

Datasets   Sequences   Natural Products

Lists   Natural Sums

Set Numbers   Direct Products

Finite Sets   Recursion Theorem

Equivalent Sets

Function Inverses   Natural Order   Family Unions and Intersections

Function Composites   Function Images   Peano Axioms   Families

Equivalence Relations   Functions

Relations   Natural Induction

Set Products

Set Powers   Natural Numbers   Generalized Set Dualities

Partitions   Unordered Triples   Successor Sets   Intersection of Empty Set   Set Dualities   Set Unions and Intersections

Ordered Pairs   Set Intersections   Pair Unions   Set Complements

Set Unions   Set Differences   Pair Intersections

Unordered Pairs   Empty Set

Set Specification

Set Inclusion

Standardized Accounts

Accounts

Deductions

Quantified Statements

Logical Statements

Statements

Identities   Sets

Names

Letters   Objects