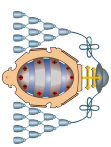




# ROCTEST: R package for flexible ROC curve comparison

DEPARTAMENTO de  
Estatística e Investigación Operativa  
y Didáctica de la Matemática,  
Universidad Oviedo, Spain



Carlos Carleos  
CARLEOS@UNIOVI.ES

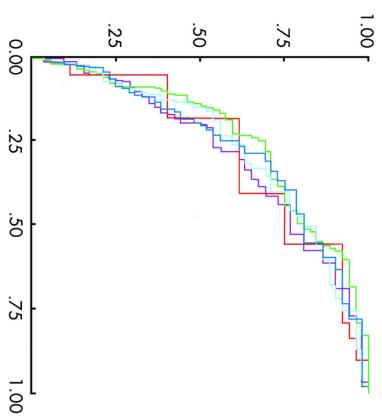
Pablo Martínez-Camblor  
PMC@BLO@HOTMAIL.COM

Norderto Corral  
NORBERT@UNIOVI.ES

## Summary

Receiver operating characteristic curves (ROCs) are a widespread method to represent the error rates of binary classifiers as a discrimination threshold varies. A typical problem in ROC analysis is to test whether several ROCs are significantly different, in order to compare the corresponding classification models. In this context, nonparametric methods are particularly useful, because of usual lack of knowledge on the underlying stochastic behaviour. The authors have recently introduced a novel nonparametric method, based on handling ROCs as cumulative distribution functions, in order to test for equality of several ROCs, both in paired and independent samples. This technique is quite flexible in that it can incorporate a plethora of distance measures, weights, aggregation type (supremum or average), and resampling regime (permutations or bootstrap). Here an R package is presented that implements the new method, besides omnibus versions of other traditional nonparametric ones (AUC, Venkatarman's, etc.). A comparison is done with respect to other ROC-related R packages (ROCR, Biocconductor-ROC) and conversion tools to transfer data between them is provided.

## Algorithms



**Problem:** given  $k$  empirical ROC curves, do they differ significantly?, that is to test  
 $H_0: \text{ROC}_1 = \dots = \text{ROC}_k$   
 $H_1: \text{exist } 1 \leq i, j \leq k, \text{ such that } \text{ROC}_i \neq \text{ROC}_j$

### Approaches:

- Classical
  - AUC
  - Venkatarman's
  - Venkatarman ES, Begg CB. 1996. A distribution-free procedure for comparing receiver operating characteristic curves from a paired experiment. Biometrika.
  - Venkatarman ES. 2000. A permutation test to compare receiver operating characteristic curves. Biometrics.
  - Consider an empirical ROC curve as an ECDF
  - Norbootstrap
  - Martínez-Camblor P, Carleos C, Corral N. 2011. Powerful nonparametric statistics to compare  $k$  independent ROC curves. Journal of Applied Statistics.
  - custom
  - Zhang J, Wu Y. 2006.  $k$ -Sample tests based on the likelihood ratio. Computational Statistics and Data Analysis.
  - Martínez-Camblor P, Carleos C, Corral N. 2011. Powerful nonparametric statistics to compare  $k$  independent ROC curves. Journal of Applied Statistics.
- 1<sup>st</sup> – Choose distance measure:  $L^1, L^2, X^2, G^2, \dots$   
2<sup>nd</sup> – Choose weight: constant,  $\hat{F}, \hat{F} \cdot (1 - \hat{F}), \dots$   
3<sup>rd</sup> – Choose aggregation: supremum, integral.  
4<sup>th</sup> – Paired or independent samples?

## Implementation

Inputs:  
DISEASE – logical  
MEASURE – numeric

APPROXFUN (TIES = "ORDERED")

INTEGRATE

SCHOOLDMATH

ROC.LISTJOIN  
← list of ROC.CURVE.K

