# Looking for alternatives to AUC for comparing crossing ROC curves and its application to a health care data set.

*Franco-Pereira A.M.*[1], *Pardo M.C.*[1]

[1]albfranc@ucm.es, Department of Statistics and OR I. Complutense University of Madrid.

[1]mcapardo@mat.ucm.es, Department of Statistics and OR I. Complutense University of Madrid.

The receiver operating characteristic (ROC) curve is typically used to describe the discriminatory capacity of a biomarker. Clinicians often compare the validity of two biomarkers based on the estimated areas under the respective ROC curves (DeLong et al (1988)). Bandos et al (2005) and Braun and Alonzo (2008) proposed a permutation test and a modified sign test, respectively which had greater power to the conventional non-parametric AUC test when there was moderate correlation between biomarkers, large AUCs and small sample sizes. In some cases, when comparing the areas under the two ROC curves, the two curves might cross and the areas under the two ROC curves may be the same. However, the two curves might still be significantly different over some range of clinical interest and the above procedures do not detect it.

We developed a new procedure for comparing two ROC curves, which is capable of distinguishing ROC curves when they cross but have equal areas. This procedure is based on a summary index defined as the sum of squared errors between the jump of the ROC curve evaluated in two equidistant points and the distance between these two equidistant points.

The new procedure is shown by simulation to have very similar operating characteristics to the standard method based on comparisons of the areas when the curves are parallel, but markedly superior when the curves cross, that is when the curves are different but have similar areas. Therefore, if the primary interest of the clinician is to detect differences in ROC curves at every operating point, even these have similar AUCs, then our method should be used.

To illustrate our procedure, we revisited a well-known dataset used by various statisticians which consists of two pancreatic cancer serum biomarkers (Wieand et al. (1989)).

Keywords: area under ROC curve, biomarker, receiver operating characteristic, non-parametric procedure