VISROC 2.0: Updated Software for the Visualization of the significance of Receiver Operating Characteristics based on confidence ellipses

Stavros-Richard G. Christopoulos[a,b,*], George I. Tsagiannis[c], Konstantina A. Papadopoulou[a], Nicholas V. Sarlis[b,d]

[a] *Faculty of Engineering, Environment, and Computing, Coventry University, Coventry, UK*

[b] *Solid Earth Physics Institute, Physics Department, National and Kapodistrian University of Athens, Panepistimiopolis, Zografos 157 84, Athens, Greece*

[c] *UFR SSA (Social Sciences and Administration), Paris Nanterre University, 92001 Nanterre, France*

[d] *Section of Condensed Matter Physics, Physics Department, National and Kapodistrian University of Athens, Panepistimiopolis, Zografos 157 84, Athens, Greece*

Abstract

The Receiver Operating Characteristics (ROC) method is used to evaluate the diagnostic accuracy of binary quantitative tests in a broad spectrum of disciplines, including medicine, physics of complex systems, geophysics, meteorology, etc. The estimation of the significance of the examined prediction method is of high importance and it's usually approximated by Monte Carlo calculations. To simplify this problem, a *FORTRAN* code called VISROC was submitted to the CPC Program Library in 2014. VISROC evaluates the significance of binary diagnostic and prognostic tools for a family of k-ellipses which are based on confidence ellipses and cover the whole ROC space. Since that time, the code has been significantly improved and several new capabilities have been added. Most importantly, a Graphical User Interface (GUI) has been implemented, which can be invoked using either the *R* shiny web application or the *Python* application available for Windows, Mac, and Linux operating systems, both of which are described here.

Keywords: Receiver Operating Characteristics (ROC), complex systems,

*Corresponding author.

E-mail address: ac0966@coventry.ac.uk

systems obeying power laws, significance level, p-value

NEW VERSION PROGRAM SUMMARY

Program Title: VISROC 2.0
CPC Library link to program files: (to be added by Technical Editor)
Developer's repository link: (if available)
Code Ocean capsule: (to be added by Technical Editor)
Licensing provisions(please choose one): none
Programming language: *R* and *Python*
Supplementary material:
Journal reference of previous version: N.V. Sarlis, S.-R. G. Christopoulos, Comput. Phys. Commun 185 (2014) 1172.
Does the new version supersede the previous version?: Yes
Reasons for the new version: Overcome previous version's limitations and implement GUI
Summary of revisions: *R* and *Python* applications, GUI, Ability to input files containing ROC data
Nature of problem(approx. 50-250 words): The Receiver Operating Characteristics (ROC)[1] is a method used to evaluate the diagnostic ability of binary tests and prediction methods in a broad spectrum of disciplines. Apart from the sensitivity (or True Positive rate, TPr) and specificity (which is complementary to False Positive rate, FPr, i.e., specificity=1-FPr) measures, the estimation of the statistical significance of the examined method is of high importance. VISROC evaluates the significance of binary diagnostic and prognostic tools for a family of k-ellipses which are based on confidence ellipses and cover the whole ROC space.
Solution method(approx. 50-250 words): Using the statistics of random binary predictions for a given value of the predictor threshold ϵ_t, one can construct the corresponding confidence ellipses. The envelope of these confidence ellipses is estimated by varying ϵ_t in the interval $[0, 1]$ and one obtains a new family of ellipses, called k-ellipses[2]. They cover the whole ROC space and lead to a well defined Area Under the Curve (AUC). Mason and Graham[3] have shown that AUC follows the Mann-Whitney U-statistics[4] which can be used[5] to estimate the statistical significance of each k-ellipse. As the transformation is invertible, any point on the ROC plane corresponds to a unique value of k, hence it belongs to a unique k-ellipse that allows the estimation of the probability (p-value) to obtain this point by chance. The present GUI applications provide the p-value on the ROC plane as well as the k-ellipses corresponding to the (p=)10%, 5% and 1% significance levels using as input the number of the positive (P) and negative (Q) cases to be predicted.

References

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