NON SYMMETRICAL DATA ANALYSIS: NEW METHODS AND APPLICATIONS

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Most of the well-known and widely used techniques of multidimensional data analysis originated from Canonical Correlation Analysis (CCA, Hotelling 1936), e.g. Discriminant Analysis and Correspondence Analysis. However, the application context of CCA is restricted to symmetrical relationships between two sets of quantitative variables or properly coded qualitative ones so that any *a-priori* information on the different roles played by the observed variables is neglected and trivial results may be reached.

In order to encompass this limit, some techniques have been developed that actually constitute the framework of Non Symmetrical Data Analysis. Classical references are represented by the Principal Component Analysis with Instrumental Variables (PCAIV, Rao 1964) which is clearly set in a multivariate regression-like approach and Redundancy Analysis proposed by van den Wollenberg (1977) as an alternative to CCA.

In a geometrical context, Lauro and D'Ambra (1982, 1984) developed new methods, such as Principal Component Analysis onto a Reference Subspace (PCAR) for quantitative variables and Non Symmetrical Correspondence Analysis (NSCA) for qualitative variables. These methods enriched the interpretation, extended the analysis to the study of more sets of variables and put new insight in NSDA. Since then, particular attention was paid to inferential problems in terms of suitable models (introduced by Lauro and Siciliano 1989, Siciliano et al. 1993 and Esposito 1995), as well as to stability and validation of results (Balbi 1992).

The most recent developments of PCAR extend the treatment to mixed variables (quantitative, ordinal and categorical data) and multiway data. This allows to improve the practice in various fields such as Marketing Research, Repeated Surveys and Quality Control. In fact, some theoretical relationships enable to enrich the interpretation of classical Conjoint Analysis (Lauro et al. 1997b), to graphically compare panel data by means of trajectories (Lauro et al. 1994) and Procrustean rotations (Balbi and Esposito 1997), and to build non parametric multidimensional confidence regions useful for Total Quality Control (Lauro et al. 1996).

In the present paper we intend initially to show the fundamental ideas behind the methodological achievements of Non Symmetrical Data Analysis. We will then focus on some of the mentioned extensions highlighting their application aspects. Finally, we will comment a possible generalisation aiming at dealing with particularly structured data very common in several application fields.

REFERENCES

D'Ambra L., Lauro N. C., 1982, Analisi in componenti principali in rapporto a un sottospazio di riferimento. Rivista di Statistica Applicata, 15, 51-67.

D'Ambra L., Lauro N. C., 1989, Non symmetrical analysis of three-way contingency tables. In: R. Coppi, S. Bolasco (eds.), Multiway Data Analysis, North-Holland, Amsterdam, 301-315.

Esposito V., 1998, Deterministic and Probabilistic Models for Symmetrical and Non Symmetrical Principal Component Analysis. Metron, International Journal of Statistics, LVI, n. 3-4, 139-154.

Esposito V., Balbi S., 2000, Representing Gaps in Sensory Perceptions by a Simultaneous Principal Component Analysis onto a Reference Subspace. Applied Stochastic Models in Business and Industry, John Wiley & Sons, Chichester, (in stampa).

Lauro N. C., D'Ambra L., 1984, L'analyse non symetrique des correspondances. In: E. Diday et al. (eds.), Data Analysis and Informatics, III, North-Holland, Amsterdam.

Lauro N. C., Giordano G., Verde R., 1998, A multidimensional approach to conjoint analysis. Proceedings, Applied Stochastic Models and Data Analysis, John Wiley & Sons, Chichester, 14, 265-274.

Lauro N. C., Scepi G., Balbi S., 1996, Differenti approcci nella costruzione di carte di controllo multivariato. In: Studi in onore di Giampiero Landenna, Giuffré, Milano, 261-291.

Lauro N. C., Siciliano R., 1989, Exploratory methods and modelling for contingency tables analysis: an integrated approach. Statistica applicata, 1, 5-32.

Rao C. R., 1964, The use and interpretation of principal component analysis in applied research. Sankhya, 26, 329- 358.

van den Wollenberg A.L., 1977, Redundancy analysis: an alternative for canonical analysis. Psychometrika, 42, 207-219.