

S-Joint: a new software for the analysis of spatial data

S-Joint: un software per l'analisi di dati spaziali

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Abstract: In questo lavoro presentiamo un package specializzato nel calcolo di misure di autocorrelazione spaziale in funzione delle informazioni geografiche delle unità spaziali. Il programma offre un gran numero di opzioni nella creazione delle matrici dei pesi in base all'utilizzo di mappe poligonali, mappe a punti e reticoli regolari.

Keywords: Weight Matrix, Vector Maps, Spatial Autocorrelation

1. Introduction

The aim of this work is to develop a new software in space analysis studies in conformity with packages offered by the software industry. In the last couple of years the combination of the GIS geo-referenced data manipulation capabilities and the spatial statistical analysis has allowed the development of additional packages which provided for the GIS lack of spatial statistical function, such as the ArcView S-Plus extension with the integration of Anselin Spacestat package. However, the complexity of the GIS function discourages the use of GIS program for spatial analysis. From the 90s', the high cost of GIS lead to the creation of many spatial analysis packages for the existent mathematical and statistical software such as Bivand's Spdep for R, Sawada's Rookcase tool for Excel, Heba, Malin and Agnan's GEOχP for Matlab. It also brought the creation of "stand alone" applications such as Anselin's Geoda, Rosenberg's Passage and Levine's Crimestat III. Recent revisions and updates of these software provide us with an elevate number of features and functionalities concerning the spatial analysis (spatial autocorrelation indexes, spatial regression, kriging, Ripley's K, Montecarlo simulations). Geoda, for example, is characterized by simple procedures and by a fast learning curve (Anselin et al., 2006). In this software, neighbours are defined by a binary (1-0) row-standardized weight matrix without considering the influence of territorial configuration. The evaluation of the impact of different areas is reported by several well-known authors (Cliff and Ord, 1981, *interalia*). In this context, we propose a new software package (S-Joint) which allows a quite high personalization of the weight matrix based on the territory geographic information.

2. S-Joint software: main features

S-Joint is a MDI (multi-document interface) program realized in C++ language that offers several spatial analysis operations in a simple and intuitive way. The current

version of this program has been planned to run under Microsoft Windows. The graphic interface was built on the QT library (ver. 3.3.2) by Trolltech. Other libraries used were: OpenGL (3D graphic library), LibQGLViewer (QT OpenGL support library), QWT (graphics extension to the Qt GUI application framework), GDAL and OGR (geospatial data abstraction library). S-Joint can open data files, vector maps (point, line and polygonal maps) and raster maps. It is also possible to create regular grids. The vector maps and the grids are shown in three-dimensional windows in order to give greater flexibility in operations such as, for instance, rotations, translations and zooming. Point and polygonal maps, data files and grids can be used to do spatial analysis studies. Moreover the ESRI shapefile (.shp) format, the MapInfo (.mif), the common separated value (.csv), the ARC/INFO coverage (.adf), the USGS SDTS, the dBase (.dbf) have been implemented. In the current development phase, it is also possible to calculate the traditional spatial autocorrelation index (Moran and Geary), to join-count statistics and the local Moran, to show the Moran scatterplot and to calculate new autocorrelation measures based on a “generalized weight system”. S-Joint, in fact, implements the S-DSMA procedure with a local reweighting (La Tona L., Mazza A., Mucciardi M., 2005 and 2006) in order to state the connections between the territorial units according to the geographic information (distance and surface) of the considered areas. It is also possible to choose other systems of weights depending on the map topology (polygonal maps will have different methods of weights creation compared to point maps). Furthermore, each of these systems provides us with a huge number of options which add some more flexibility in the matrix generation. Among the other S-Joint characteristics, we can take into account the layer management, weight matrix importing/exporting to different formats capability, the possibility of selecting/deselecting the vector maps in order to do local analyses. Its complete adaptability to the case of territory subdivision in administrative areas has been verified by applying it to real territorial configurations. Future application developments could be also implemented into formats such as TIGER, GRASS, VRT, Oracle Spatial and other types of spatial databases. Moreover, we are evaluating the chance of including the proportion of the interior boundary of location in the weight matrix.

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