BULL. AUSTRAL. MATH. SOC. 60M30
VOL. 71 (2005) [175–175]

Analysis of spatial point patterns using hierarchical clustering algorithms

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This thesis is a new proposal for analysing spatial point patterns in spatial statistics using the outputs of popular techniques of (classical, non-spatial, multivariate) cluster analysis. The outputs of a chosen hierarchical algorithm, named fusion distances, are applied to investigate important spatial characteristics of a given point pattern.

The fusion distances may be regarded as a missing link between the fields of spatial statistics and multivariate cluster analysis. Up to now, these two fields have remained rather separate because of fundamental differences in approach. It is shown that fusion distances are very good at discriminating different types of spatial point patterns.

A detailed study on the power of the Monte Carlo test under the null hypothesis of Complete Spatial Randomness (the benchmark of spatial statistics) against chosen alternative models is also conducted. For instance, the test (based on the fusion distance) is very powerful for some arbitrary values of the parameters of the alternative.

A new general approach is developed for analysing a given point pattern using several graphical techniques for exploratory data analysis and inference. The new strategy is applied to univariate and multivariate point patterns. A new extension of a popular strategy in spatial statistics, named the analysis of the local configuration, is also developed. This new extension uses the fusion distances, and analyses a localised neighbourhood of a given point of the point pattern.

New spatial summary function and statistics, named the fusion distance function $H(t)$, area statistic A, statistic S, and spatial R_g index, are introduced, and proven to be useful tools for identifying relevant features of spatial point patterns.

In conclusion, the new methodology using the outputs of hierarchical clustering algorithms can be considered as an essential complement to the existing approaches in spatial statistics literature.

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Received 20th September, 2004
Thesis submitted to The University of Western Australia, September 2003. Degree approved, April 2004. Supervisor: Professor Adrian Baddeley.