



Pairwise and Other Post-hoc Tests of Spatial Clustering Based on NNCTs

Elvan Ceyhan

Department of Mathematics

Koç University, Istanbul, Turkey – elceyhan@ku.edu.tr

Patterns of spatial clustering (such as segregation and association) among multiple classes have important consequences in various fields, e.g., in ecology, and can be explored by tests based on nearest neighbor contingency tables (NNCTs). A NNCT is constructed using the types and frequencies of the nearest neighbor (NN) pairs. We consider the pairwise (or cell-specific) and overall segregation tests based on NNCTs in literature and introduce new ones and determine their asymptotic behavior. We show that, asymptotically, pairwise tests have normal distribution, while overall tests have chi-square distributions. Generalized inverse of the rank-deficient covariance matrix may be unstable and this may confound some of the overall tests. To overcome this problem, rank-based corrections are proposed for the overall tests to stabilize their behavior. An extensive Monte Carlo simulation study is performed to (i) compare the finite sample performance of the tests in terms of empirical size and power based on the asymptotic and Monte Carlo critical values, (ii) determine the tests that have the best size and power performance and (iii) determine the tests that are robust to differences in relative abundances (of the classes). In addition to the pairwise tests, one(-class)-versus-rest type of tests are also used as post-hoc tests after a significant overall test. The concepts of total, strong, and partial segregation/association are also introduced to differentiate different levels of these patterns. The new tests are compared with the existing NNCT-tests in literature with simulations and the methods are illustrated on an ecological data set.

Keywords: Association; asymptotic distribution; completely mapped data; complete spatial randomness; overall tests; random labeling; segregation