Testing for first-order homogeneity in spatial point patterns

C Kraamwinkel, IN Fabris-Rotelli
Department of Statistics, University of Pretoria
christine.kraamwinkel@up.ac.za, inger.fabris-rotelli@up.ac.za

Keywords: Spatial point patterns, First-order homogeneity, Hypothesis testing

In statistics, the term 'spatial' refers to the fact that data contains a geographical reference and possibly attribute values. Tobler's law states that observations closer together are more likely to be similar than observations further apart [3]. The location of points can be seen as outcomes of some process and the description of these location patterns is referred to as a point pattern [2]. In spatial statistics we aim to explore the spatial relationship of these points. In order to fit models to these point patterns, we first need to understand the underlying data structure by considering first- and second-order homogeneity [4]. First-order homogeneity refers to the pattern having a constant intensity at different locations on the map whilst second-order homogeneity investigates whether points are completely spatially random, clustered or regularly distributed by considering interpoint interaction [1]. Contrary to first-order homogeneity, tests and theory surrounding second-order homogeneity are well developed in the literature. Density plots are used to visually and subjectively infer on first-order homogeneity. We propose the use of hypothesis tests, developed for the comparison of K Poisson intensities from independent samples, in the spatial setting as a more rigorous statistical approach to testing for first-order homogeneity. Our application considers the household locations in 78 rural villages in Northern Tanzania as an unmarked point pattern.

References

[1] A. Baddeley, Analysing spatial point patterns in R, Technical Report Version 4.1, CSIRO and University of Western Australia, December 2010.

[2] R. Haining, *Spatial Data Analysis: Theory and Practice*, Cambridge University Press, 2003.

[3] W.R. Tobler, A computer movie simulating urban growth in the Detroit region, *Economic Geography*, **46**:234-201, 1970.

[4] J. Wang, R. Haining and Z. Cao, Sample surveying to estimate the mean of a heterogeneous surface: reducing the error variance through zoning, *International Journal of Geographical Information Science*, **26(4)**:523-543, 2010.