Spatial Statistics When Locations Are Uncertain

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Abstract

Spatial statistics quantify spatial pattern and identify local and global departures from null spatial models. As part of Exploratory Spatial Data Analysis they play a critical role in the evaluation of spatial pattern, and in the formulation of hypotheses to explain spatial pattern. While all spatial data have imprecise locations, the magnitude of this imprecision can vary dramatically from one measuring instrument to another and from one study to another. When does location uncertainty impede our ability to quantify spatial pattern? This paper describes credibility-based spatial randomization tests that propagate location uncertainty through proximity metrics and into spatial statistics. Credibility is a flexible new approach to spatial randomization tests, but is not a panacea. It applies to spatial statistics that incorporate measures of geographic proximity (*e.g.* spatial adjacency, weight, nearest neighbor relationship, distance *etc*.). It uses Monte Carlo sampling to generate the null distribution, and not distribution theory, as classical statistics do. It is a technique for testing hypotheses regarding spatial pattern, and is best described as a method for Exploratory Spatial Data Analysis. It is meant to complement, not replace, traditional spatial statistics that use P-values and alpha levels. In conjunction with these techniques it forms a quantitative basis for evaluating the likely impact of location uncertainty on one's ability to make statistical decisions with spatial data.