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Scale effects in multilevel modeling

Russell R. Familiar
University of Wollongong

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Scale Effects in Multilevel Modeling

*A thesis submitted in fulfillment of the
requirements for the award of the degree*

Doctor of Philosophy

from

University of Wollongong

by

Russell R. Familiar B.Sc.Mathematics, MS Applied Statistics.
MSU-IIT

School of Mathematics and Applied Statistics

2008

This thesis is submitted to the University of Wollongong in fulfillment of the requirements for the award of Doctor of Philosophy, in the School of Mathematics and Applied Statistics. I hereby declare that the work described here is my own unless otherwise referenced and has not been submitted for a degree to any other University or Institution.

Russell R. Familiar

May 2008

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Abstract

In many instances data are available as aggregated measurements for a set of areal units that are arbitrarily defined in terms of number and boundaries. Analysis using spatial data is a multi-disciplinary subject attracting the attention of statisticians, geographers, physical and social scientists. The Modifiable Areal Unit Problem (MAUP) is the sensitivity of results of statistical analysis to the definition of areal units for which the data are available. The results vary with the level of aggregation and the configuration of the zoning system. Multilevel models offer an approach to the MAUP. Multilevel modeling is potentially subject to the MAUP, since different estimates of the variance components can be obtained if boundaries are changed or a different scale is used.

This thesis presents results of experiments conducted to look into the scale effects of statistics calculated directly from aggregated data and statistics derived from a simple multilevel under different initial conditions. The analysis of spatial data is usually affected by the complex relationships between variables and the existence of spatial autocorrelation. A reason for multilevel models being subject to the MAUP is that, while the data available may be hierarchical, the population structure may be more complex. Theoretical and empirical investigations to link a simple multilevel model and spatial autocorrelation and the implications for the MAUP are conducted.

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