Recent Advances in Spatial Statistics

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YING MACNAB, University of British Columbia
Bayesian Hierarchical Spatial Mixture for Modeling Sparse Data on a Discontinuous and Modestly Large Irregular Lattice

A class of Bayesian hierarchical Bernoulli-Binomial spatial mixture zero-inflated Binomial models is developed for modeling noisy and mostly low small area crude rates. Three spatial prior formulations, the intrinsic conditional autoregressive or iCAR, the BYM, and the modified BYM models, were explored for their performance on modelling sparse data on a modestly large (N in the thousands) and discontinuous irregular lattice. The methods are illustrated via an in-depth Bayesian analysis of postcode-level response rates from a recent recruitment for a physical exercise intervention in Sheffield, UK. With increasing availability of spatial data referenced at fine spatial scales, the sparse-data situation and the Bayesian models and methods discussed herein should have considerable relevance to disease mapping and spatial regression.

RHONDA ROSYCHUK, University of Alberta
A Spatial Scan Statistic for Compound Poisson Data, Using Negative Binomial Distribution and Accounting for Population Stratification

Much effort has been devoted to the development of spatial data analysis methods, including the detection of spatial clusters of cases and events in the biological sciences and epidemiology. Recently, research has examined detecting clusters of correlated count data associated with health conditions of individuals. Such a method allows researchers to examine spatial relationships of disease-related events rather than just incident or prevalent cases. We introduce a spatial scan test that identifies clusters of (correlated) events. We base the test on a special compound Poisson model (representation of a negative binomial distribution) that realizes advantages in computation over the general compound Poisson model. We illustrate our method on emergency department visits data, adjusted by key population characteristics such as age.

MAHMOUD TORABI, University of Manitoba
Spatial Generalized Linear Mixed Models with Multivariate CAR Models for Areal Data

Disease mapping studies have been widely performed with considering only one disease in the estimated models. Simultaneous modeling of different diseases can also be a valuable tool both from the epidemiological and also from the statistical point of view. In particular, when we have several measurements recorded at each spatial location, we need to consider multivariate models in order to handle the dependence among the multivariate components as well as the spatial dependence between locations. We use an approach, which yields to maximum likelihood estimation, to conduct frequentist analysis of spatial generalized linear mixed models with multivariate conditional autoregressive (CAR) models for areal data. The proposed approach is evaluated through a simulation study and also by a real dataset.