LOGISTIC REGRESSSION FOR SPATIAL PAIR-POTENTIAL MODELS

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ABSTRACT

The spatial models considered in this paper are Gibbs processes with pairwise interaction potentials, which provide a rich framework for models where the likelihood of a particular configuration of points depends on attraction or repulsion between neighboring pairs of points. However, standard statistical estimation techniques, such as maximum likelihood estimation, have been extremely difficult or impossible to use because of an awkward normalizing constant in the probability density function.

We develop an estimation method based on an idea of Besag's (1975), who outlined a straightforward estimation procedure that places a fine grid over the realization of a point process and uses a pseudolikelihood method to estimate the parameters of the resulting lattice process.

We show that Besag's pseudolikelihood procedure is equivalent to maximum likelihood estimation of a certain logistic regression model, and we prove convergence of the sequence of the pseudolikelihood (parameter) estimates as the mesh of the grid becomes fine, and consistency as the domain's size increases.

We compare the pseudolikelihood method to a graphical maximum likelihood method with a simulation study. In addition we illustrate the procedure using logistic regression to fit several models to Strauss' (1975) redwood seedling data.