Bayesian Spatial-Temporal Modeling of Ecological Zero-Inflated Count Data

Dipak K. Dey
University of Connecticut
(joint with Xia Wang, Ming-Hui Chen, Rita C. Kuo)

Abstract: A Bayesian hierarchical model is developed for count data with spatial and temporal correlations as well as excessive zeros, uneven sampling intensities, and inference on missing spots. Our contribution is to develop a model on zero-inflated count data that provides flexibility in modeling spatial patterns in a dynamic manner and also improves the computational efficiency via dimension reduction. The proposed methodology is of particular importance for studying species presence and abundance in the field of ecological sciences. The proposed model is employed in the analysis of the survey data by the Northeast Fisheries Sciences Center (NEFSC) for estimation and prediction of the Atlantic cod in the Gulf of Maine - Georges Bank region. Model comparisons based on the deviance information criterion and the log predictive score show the improvement by the proposed spatial-temporal model.

Key words and phrases: Bayesian hierarchical modeling, deviance information criterion, log predictive score, spatial dynamic modeling, zero-inflated Poisson.

On Generating A Flexible Class Of Non-Stationary Spatial Models Using Gaussian Predictive Processes

Sujit K. Sahu

University of Southampton

Abstract: This article proposes a flexible class of non-stationary spatial models by using recently developed Gaussian predictive processes. So far these processes are only used as approximate dimension reduction models for analysing large spatial data sets. The contribution of the current article lies in proposing these models even for small sizes and studying the nature of non-stationarity implied by these predictive processes under various scenarios of selection of the knot locations where the predictive process is to be anchored for both small and large data sets. Results obtained here show that different random and non-random choices of knot-locations lead to new flexible forms of non-stationary covariance functions not yet studied in the literature. These new covariance functions give rise to new flexible and accurate Bayesian predictive models but do not complicate the fitting and analysis methods unlike other non-stationary models. The proposed methods are illustrated using two practical data sets on modelling air pollution exposure in London and the other on modelling a well-known data set on scallop abundance in the Atlantic Ocean near the City of New York.

Likelihood Based Inference for Spatial Models with Censored Response

Víctor Hugo Lachos Dávila
IMECC-UNICAMP
(Joint with Larissa Avila Matos (IMECC-UNICAMP) and Marcos Prates (DEX-UFMG))

Spatial environmental data sometimes include below detection limit observations (i.e., censored values reported as less than a level of detection). Historically, the most common practice for analysis of such data has been to replace the censored observations with some function of the level of detection (LOD), like LOD/2. We propose an exact estimation procedure to obtain the maximum likelihood estimates of the fixed-effects and variance components, using a stochastic approximation of the EM (SAEM) algorithm. This approach permits estimation of the parameters of a spatial linear model when censoring is present in an easy and fast way. As a by-product, predictions of unobservable values of the response variable are possible. Our methods are illustrated using data from a dioxin contaminated site in Missouri. We also use simulation to investigate the small sample properties of predictions and parameter estimates and the robustness of the SAEM algorithm.

Keywords: Censored data, Geostatistical data, SAEM Algorithm, Limit of Detention (LOD)