Asymmetric Space–Time Covariance Functions via Hierarchical Mixtures

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ABSTRACT

This work is focused on constructing stationary space-time covariance functions through a hierarchical mixture approach that can serve as building blocks for capturing complex dependency structures. This hierarchical mixture approach provides a unified modelling framework that not only constructs a new class of asymmetric space-time covariance functions with closed-form expression, but also provides corresponding space-time process representations, which further unify constructions for many existing space-time covariance models. This hierarchical mixture framework decomposes the complexity of model specification at different levels of hierarchy, for which parsimonious covariance models can be specified with simple mixing measures to yield flexible properties and closed-form derivation. A characterization theorem is also provided for the hierarchical mixture approach on how the mixing measures determines the statistical properties of space-time covariance functions. A general class of asymmetric space-time covariance functions is also given that can allow arbitrary and possibly different degrees of smoothness in space and in time and flexible long-range dependence. Several of the new models are illustrated with simulation studies and a real dataset.

Keywords: Asymmetry; Hierarchical mixture; Smoothness; Long-range dependence; Space-time process

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Graphical Modeling of Multivariate Inhomogeneous Spatial Point Processes

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ABSTRACT

In this presentation, we propose a new graphical model for a multivariate spatial point process, where the intensity functions vary over space. The key idea is to utilize the coherence and partial coherence of the intensity-reweighted version of the original process. We introduce estimators for coherence and partial coherence and illustrate our results through a real data analysis of multivariate tropical forest tree data.

Keywords: Coherence; inhomogeneous; partial coherence; periodogram; point processes

Fast Variable Selection in Semiparametric Spatial Zero-inflated Models: Application to Extreme Climate Events

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ABSTRACT

Extreme climate events, such as heavy rainfall, are typically recorded as spatial count data with an overabundance of zeros due to their rarity. Modeling such zero-inflated spatial counts requires flexible approaches that simultaneously account for spatial dependence and excess zeros. In this talk, we present a semiparametric spatial zero-inflated modeling framework tailored to the analysis of extreme climate events. The proposed method introduces a novel, distribution-free, and computationally efficient variable selection criterion, inspired by the structure of Lasso regression, to identify key covariates without reliance on a fully specified likelihood. We demonstrate its performance through comprehensive simulations. An application to Taiwan's 2016 daily extreme rainfall data highlights the method's practical utility for environmental studies.

Keywords: Computational efficiency; Extreme events; Lasso regression; Model selection; Spatial count data