The University of Chicago

Department of Statistics

Seminar

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"Spectral Methods for Nonstationary Spatial Processes"

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ABSTRACT

Classical geostatistics and Fourier spectral methods are powerful tools to study the spatial structure of stationary processes. However, it is widely recognized that in real applications spatial processes are rarely stationary and isotropic. We present an approach for the spectral analysis of non-stationary spatial processes which is based on the concept of spatial spectra, this means spectral functions which are space dependent. This notion of spatial spectra generalizes the definition of spectra for stationary processes, and under certain conditions, the spatial spectrum at each location can be estimated from a single realization of the spatial process. We propose a nonstationary nonparametric and various parametric approaches to estimate the spectral density of a nonstationary spatial process defined on a continuous space, and we develop new fitting algorithms. We study the asymptotic properties of the proposed estimates via shrinking asymptotics, assuming the distance between neighboring observations tends to zero as the size of the observation region grows without bound.

We also consider the problem of testing a given spatial process for stationarity and isotropy. The approach is based again on the spatial spectral analysis, and the proposed method consists essentially in testing the homogeneity of a set of spatial spectra evaluated at different locations. In addition to testing stationarity and isotropy, the analysis provides also a method for testing whether the observed process fits a uniformly modulated model, and a test for randomness (constancy of spectra).

Applications include modeling and testing for non-stationary of sulfur dioxide concentrations over different geo-political boundaries.
