Spatial and Spatio-Temporal Nonlinear Processes

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In this talk a new spatial model is presented that incorporates heteroscedastic variances depending on neighboring locations. The proposed process is regarded as the spatial equivalent of the temporal autoregressive conditional heteroscedastic (ARCH) model. It is shown as well how the introduced spatial ARCH model can be used in spatiotemporal settings. The process turns out to be strictly and weakly stationary under some conditions on the noise process and the weight matrix. Although it possesses several properties of a temporal ARCH process some important features are no longer fulfilled. The conditional variance of the process depends on all locations and only for an oriented process it is a function of the locations lying closer to the center. Moreover, the squared process is not a spatial autoregressive process. In order to estimate the parameters of the spatial process the maximum-likelihood approach is applied. For a certain type of weight matrices it is proved that the estimators are asymptotic normally distributed. Via Monte Carlo simulations, the performance of the estimator for various spatial weighting matrices and for a finite sample size is analyzed. Moreover, the well-known spatial autoregressive model is combined with the spatial ARCH model assuming heteroscedastic errors. Eventually, the proposed autoregressive process is illustrated using an empirical example. Specifically, the lung cancer mortality in 3108 U.S. counties is modeled and the introduced model is compared with two benchmark approaches.