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Autoregressive spatial spectral estimates

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Abstract

Nonparametric spectral density estimates find many uses in econometrics. For stationary random fields on a regular spatial lattice, we propose an autoregressive nonparametric spectral density estimate that is guaranteed positive even when suitable edge-effect correction is employed and is simple to compute using least squares. Our estimate is based on truncating a true half-plane infinite autoregressive representation, while also allowing the truncation length to diverge in all dimensions to avoid the potential bias due to truncation at a fixed lag-length. Uniform consistency of the proposed estimate is established, and new criteria for order selection are also suggested and studied in practical settings. The asymptotic distribution of the estimate is shown to be zero-mean normal and independent at fixed distinct frequencies, mirroring the behaviour for time series. A small Monte Carlo experiment examines finite sample performance. Technically the key to the results is the covariance structure of stationary random fields defined on regularly spaced lattices. We show the covariance matrix to satisfy a generalization of the Toeplitz property familiar from time series analysis.

JEL classifications: C14, C18, C21
Keywords: Spectral density estimation, HAC estimation, random field, covariance matrix, spatial process, lattice data, central limit theorem.

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