On Consistency and Sparsity for Large-Scale Curve Time Series with Application to Autoregressions

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Abstract: Modelling a large collection of curve time series arises in a broad spectral of real applications. Under such a scenario, not only the number of functional variables, p, is large relative to the number of temporally dependent curve observations, n, but each curve itself is an infinite-dimensional object, posing a challenging task. In this talk, a standard three-step procedure is proposed to address such large-scale problems. To provide theoretical guarantees for the three-step procedure, we focus on multivariate stationary processes and propose a novel functional stability measure based on their spectral properties. Such stability measure facilitates the development of some useful concentration bounds on sample covariance matrix functions, which serve as a fundamental tool for further consistency analysis, in particular, for deriving rates of convergence on the regularized estimates in large p, small n settings. As functional principal component analysis (FPCA) is one of the key dimension reduction techniques in the first step, we also investigate the consistency properties of the relevant estimated terms under a FPCA framework. To illustrate with an important application, we consider vector functional autoregressive models and develop a regularization approach to estimate autoregressive coefficient functions under the sparsity constraint. Using our derived convergence results, we investigate the theoretical properties of the regularized estimate under high-dimensional scaling. Finally, the finite-sample performance of the proposed method is examined through both simulations and a public financial dataset.