

Modelling Mixed Multivariate Time Series: A graphical models approach

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Abstract

Graphical models are ubiquitous for summarizing conditional relations in multivariate data. In many applications involving multivariate time series, it is of interest to learn an interaction graph that treats each individual time series as nodes of the graph, with the presence of an edge between two nodes signifying conditional dependence given the others. Typically, the partial covariance is used as a measure of conditional dependence. However, in many applications, the outcomes may not be Gaussian and/or could be a mixture of different outcomes. In this talk, we propose a broad class of time series models for multivariate mixed-type time series, that includes the classical VAR model as a special case. For each node in the time series we model its conditional distribution with a distribution from the exponential family. We call this construction a conditionally exponential stationary graphical model CESTGM. This modelling approach has several potential advantages. The first is that due to the versatility of the exponential class, it allows one to stitch together several different variable "types". The second is that the univariate conditional specification allows for simple estimation procedures using standard GLM tools. Finally, the conditional specification is specifically designed to succinctly encode process-wide conditional independence in its parameters. We derive conditions that ensure the model leads to a well defined strictly stationary time series and show that the model is geometrically beta-mixing. We propose an approximate Gibbs sampler for simulating sample paths from CESTGM. Finally, we conclude the talk with some numerical experiments and real data examples.