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Mini-Workshop: Semiparametric Modelling of Multivariate Economic Time Series With Changing Dynamics

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Abstract. Modelling multivariate time series of possibly high dimension calls for appropriate dimension-reduction, e.g. by some factor modelling, additive modelling, or some simplified parametric structure for the dynamics (i.e. the serial dependence) of the time series. This workshop aimed to bring together experts in this field in order to discuss recent methodology for multivariate time series dynamics which are changing over time: by an abrupt switch between two (or more) different regimes or rather smoothly evolving over time. The emphasis has been on mathematical methods for semiparametric modelling and estimation, where "semiparametric" is to be understood in a rather broad sense: parametric models where the parameters are themselves nonparametric functions (of time), regime-switching nonparametric models with a parametric specification of the transition mechanism, and alike. An ultimate goal of these models to be applied to economic and financial time series is prediction. Another emphasis has been on comparing Bayesian with frequentist approaches, and to cover both theoretical aspects of estimation, such as consistency and efficiency, and computational aspects.

Mathematics Subject Classification (2000): 62M10, 62M20, 62H12, 62P20 - IMU 10.

Introduction by the Organisers

Over the past 20 years statisticians have contributed by developing methodology to address the curse of dimensionality when modelling high-dimensional multivariate economic and financial data such that subsequent estimation remains possible. This ranges from parsimonious parametric models, over additive non-parametric modelling to the quite general factor model approach based e.g. on principal components regression. Common to all of these approaches is the goal to describe the common structure of a panel of several tenths of time series by a "simple" model, either in a low-dimensional parametric space or a low-dimensional space of "common components" which up to some idiosynchratic behaviour specific to each time series dimension describe the co-movement over time of the whole panel. This latter factor approach has found lots of applications, not only in the context of macro-economic or financial data. As soon as the data become serially correlated, the afore-mentioned approaches need to be dynamic: (vector-) autoregressive models, either in the (conditional) mean or in the (conditional) variance structure of the data (leading to so called MGARCH models), either parametric or non-parametric (i.e. non-linear AR-models), dynamic (instead of static) factor models, conditional correlation models, and alike. Treating these dynamic models from the point of view of deriving theoretical properties of the accompanying estimation methods, such as consistency, asymptotic normality, efficiency, and to construct reliable prediction methods (intervals) for the future evolution of these time series, calls for more refined mathematical-statistical skills, and it is primarily towards the community of researchers with expertise in this field that the scope of our workshop is addressed. Based on recent empirical evidence, most of these multivariate time series cannot necessarily be considered to have a homogeneous dynamical structure over time: the impact of political and financial crises, changing monetary policies of central banks, and alike, suggests to refine the afore-mentioned models to allow for inhomogeneity, i.e. changing dynamics. Subsequently, the proposed estimation methods need to be refined, and quite naturally, constructing appropriate predictors becomes more challenging. The goal of this workshop attended by 15 researchers from 10 different countries has been to compare a variety of different approaches to model and treat the kind of inhomogeneity described above. These approaches to inhomogeneous time series modelling could be called "semi-parametric", e.g. via a parametrisation locally in time as a stationary processes. Examples for that are (vector-) autoregressive or MGARCH-type models where the parameters become now non-parametric functions of time. Those can be of low regularity (to include abrupt changes over time) or of higher smoothness over time, in order to model a slow evolution of the dynamics. Another instance of semiparametric modelling arises for a different approach to inhomogeneity: in regime-switching models, the underlying stochastic process is modelled as changing from one regime of stationarity to another via a random mechanism (e.g. an underlying Markov chain), i.e. the existence of latent (unobservable) state variables that control in which regime the mean and the variance-covariance structure (conditional or unconditional) are to be found. Modelling the transition of these (nonparametrically modelled) states by Bayesian or frequentist approaches, e.g. via a parametric matrix of transition probabilities, was one emphasis of our discussions, addressing among others questions of statistical inference and subsequent prediction, but also computational issues such as MCMC (Markov Chain Monte Carlo) or EM-algorithms. Summarizing the workshop gave us the opportunity to enjoy lively discussions on the question how models for high-dimensional time series with changing dynamics can be made on the one hand sufficiently parsimonious (in "parameters" through either latent variables or functional parameters whose number is considerably smaller than the number of modelled time series) but on the other hand sufficiently flexible to capture the inhomogeneity of the time series.