MATHEMATICAL STATISTICS

Place and time: In M105 on Thursday, Jan 4, at 10:30–12:00
Organizers: Pauliina Ilmonen (Aalto University)
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Moment-based parameter estimation in binomial random intersection graph models

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Abstract. Binomial random intersection graphs are parsimonious statistical models of large and sparse networks, with one parameter for the average degree and another for transitivity, the tendency of neighbours of a node to be connected. We will discuss the estimation of these parameters from a single observed instance of the graph, using moment estimators based on observed degrees and frequencies of 2-stars and triangles. The observed data set is assumed to be a subgraph induced by a set of $n_0 \gg n^{2/3}$ nodes sampled from the full set of n nodes. We prove the consistency of the proposed estimators by showing that the relative estimation error is small with high probability. The talk is based on [1].

Joint work with Joona Karjalainen.

[1] J. Karjalainen, L. Leskelä, *Moment-based parameter estimation in binomial random intersection graph models*, arXiv:1704.04278.

Blind source separation based on robust autocovariance matrices

Sara Taskinen *(University of Jyväskylä)*, `sara.taskinen@jyu.fi`

Abstract. Assume a Blind Source Separation (BSS) model, that is, the observed p time series are assumed to be linear combinations of p latent uncorrelated weakly stationary time series. The aim is then to find an estimate for the unmixing matrix which transforms the observed time series back to uncorrelated latent time series. In the classical SOBI (Second Order Blind Identification) method, approximate joint diagonalization of the sample covariance matrix and sample autocovariance matrices with several lags is used to estimate the unmixing matrix. However, it is well known that in the presence of outliers, the sample covariance matrix and sample autocovariance matrices perform poorly and yield to unreliable unmixing matrix estimates. In this talk we thus propose a robust SOBI method which uses so-called M-autocovariance matrices in the estimation. We use finite-simple simulation studies and a real data example to illustrate the performance of our method.

Joint work with J. Miettinen, K. Nordhausen and D.E. Tyler.

On model fitting and estimation of strictly stationary processes

Marko Voutilainen *(Aalto University)*, `marko.voutilainen@aalto.fi`

Abstract. Stationary processes form an important class of stochastic processes that has been extensively studied in the literature. Their applications include modelling and forecasting numerous real life phenomenon such natural disasters,

sales and market movements. One of the most essential families of stationary processes is the ARMA family. One of the reasons for the importance is their approximation property of stationary processes in terms of autocovariance functions.

When modelling existing data with processes of the ARMA family, the first step is to fix the orders of the model. After that, one can estimate the related parameters by using for example the maximum likelihood (ML) or least squares (LS) estimators. The final step is to conduct various diagnostic tests to determine whether the estimated model is sufficient good or not.

We present in [1] a new way of fitting a model to a data that is assumed to be a realization from a stationary process. The approach taken is based on the characterization of stationary processes of [2] yielding an AR(1) representation for arbitrary stationary processes. Although the representation is unique only after parameter H is fixed, we show that in most of the cases only one value of the autocovariance function of the noise is enough to provide us with uniqueness. Note that in ARMA fitting the whole autocovariance function of the noise is assumed. When founding estimation on the AR(1) representation, one does not have to choose between different models and in addition, there is only one parameter left to estimate. Yet another advantage over conventional ARMA estimation is that we obtain closed forms for the estimators, whereas in general, ML and LS estimators do not admit closed form representations. We also show that consistency and asymptotic normality of our estimators follow if the estimators of the autocovariance posses the same properties.

Also applicability in estimation of the ARCH model will be discussed.

Joint work with L. Viitasaari and P. Ilmonen.

[1] Voutilainen, M., Viitasaari, L., Ilmonen, P. (2017), *On model fitting and estimation of strictly stationary processes*, arXiv:1708.07446.

[2] Viitasaari, L. (2016), *Representation of stationary and stationary increment processes via Langevin equation and self-similar processes.*, Statistics & Probability Letters, 115, 45–53.

Context-specific Network Estimation with Application to Interaction Regression Models

Juho A. J. Kontio *(University of Oulu)*, juho.kontio@oulu.fi

Abstract. Despite the vast literature on network inference, the concept of context-specific networks remains indeterminate. One exemplary application would be to identify the quantitative outcome related interactions of covariates in a typical interaction regression model. A truncated Gaussian graphical model (GGM) based approach will be represented to construct such conditioned GGM, based on the underlying parametric interaction model. The proposed truncations of GGM is dependent on the interaction terms contributing to the quantitative outcome variance whose asymptotical properties will be given. The main result is that the conditional dependencies are either preserved or intensified after truncation between the variables depending on their role in that very truncation. Since GGMs are based on conditional independencies, it will be shown that the relevance with respect to the quantitative outcome is asymptotically reflected to truncated network connections. The major impacts and advances on the high dimensional genetic interaction search will be discussed.

Joint work with Professor Mikko J. Sillanpää.