Programme and Abstracts

International Workshop in Recent Advances in Time Series Analysis

Department of Mathematics & Statistics
University of Cyprus
Cyprus

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Sponsored by

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SCHEDULE

Saturday, 7th June 2008

18.00–21.00	Registration

Sunday, 8th June 2008

09:30 - 10:30	Plenary Talk (Murray Rosenblatt)
10:30 - 11:00	Coffee Break
11:00 - 12:00	Plenary Talk (Murray Rosenblatt)
12:30 - 16:00	Poster Session 1–Lunch Break
16:00 - 17:30	Inference in Time Series I
17:30 - 18:00	Coffee Break
18:00 - 19:30	Time Series Econometrics
20:30 - 11:00	Welcome Reception

Monday, 9th June 2008

09:00 - 10:30	Inference in Time Series II
10:30 - 11:00	Coffee Break
11:00 - 12:30	Long Memory Time Series
12:30 - 16:00	Poster Session 2–Lunch Break
16:00 - 17:30	Resampling Time Series
17:30 - 18:00	Coffee Break
18:00 - 19:30	Multivariate Time Series

Tuesday, 10th June 2008

09:30 - 10:30	Plenary Talk (Peter Brockwell)
10:30 - 11:00	Coffee Break
11:00 - 12:00	Plenary Talk (Peter Brockwell)
12:30 - 16:00	Poster Session 3–Lunch Break
16:00 - 17:30	Functional Time Series
17:30 - 18:00	Coffee Break
18:00 - 19:30	Financial Time Series

Wednesday, 11th June 2008

09:00 - 10:30	Nonstationary Time Series
10:30 - 11:00	Coffee Break
11:00 - 12:30	Nonparametric Time Series
21.00 - 00.00	Conference Dinner

TALKS

Sunday, 08/06/2008 09:30-10:30 & 11:00-12:00 Plenary talk 1

STRUCTURE OF AND ESTIMATION FOR PROCESSES WITH ALMOST PERIODIC COVARIANCE FUNCTION

Speaker: **Murray Rosenblatt, University of California at San Diego** Chair: E. Paparoditis

Consider the process $\{X_t\}$, $EX_t = 0$, with covariance function $r_{t,\tau} = cov(X_t, X_\tau)$ such that $r_{t+s,\tau+s}$ is an almost periodic function of s for each choice of t, τ. Such processes that are harmonizable in the sense of Loève have spectral mass that is located on a countable set of lines parallel to the diagonal in the two dimensional spectral plane. One can show how to resolve the lines of spectral concentration and estimate spectral densities (if they exist) asymptotically from data $X_t, |t| \leq T$, under a number of assumptions as $T \to \infty$.

Tuesday, 10/06/2009 09:30-10:30 & 11:00-12:00 Plenary talk 2

LÉVY-DRIVEN CARMA PROCESSES AND APPLICATIONS

Speaker: **Peter Brockwell, Colorado State University and Melbourne University** Chair: T. Sapatinas

Gaussian ARMA processes with continuous time parameter, otherwise known as stationary continuous-time Gaussian processes with rational spectral density, have been of interest for many years. (See for example the papers of Doob (1944), Bartlett (1946), Phillips (1959), Durbin (1961), Dzhaparaaridze (1970,1971), Pham-Din-Tuan (1977) and the monograph of Aratò (1982).) In the last twenty years there has been a resurgence of interest in continuous-time processes, partly as a result of the very successful application of stochastic differential equation models to problems in finance, exemplified by the derivation of the Black-Scholes option-pricing formula and its generalizations (Hull and White (1987)). Numerous examples of econometric applications of continuous-time models are contained in the book of Bergstrom (1990). Continuous-time models have also been utilized very successfully for the modelling of irregularly-spaced data (Jones (1981, 1985), Jones and Ackerson (1990)). Like their discrete-time counterparts, continuous-time ARMA processes constitute a very convenient parametric family of stationary processes exhibiting a wide range of autocorrelation functions which can be used to model the empirical autocorrelations observed in financial time series analysis. In financial applications it has been observed that jumps play an important role in the realistic modelling of asset prices and derived series such as volatility. This has led to an upsurge of interest in Lévy processes and their applications to financial modelling. In these talks we discuss second-order Lévy-driven continuous-time ARMA models, their properties and some of their financial applications. Examples are the modelling of stochastic volatility in the class of models introduced by Barndorff-Nielsen and Shephard (2001) and the construction of a class of continuous-time GARCH models which generalize the COGARCH(1,1) process of Klüppelberg, Lindner and Maller (2004) and which exhibit properties analogous to those of the discrete-time GARCH(p.q) process.

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Sunday, 08/06/2008 16:00-17:30 Session 1

INFERENCE IN TIME SERIES I — Chair: Thomas Mikosch

#1: Regression Models with Mixed Sampling Frequencies

Presenter: Elena Andreou,University of Cyprus

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Co-authors: Eric Ghysels and Andros Kourtellos

We study regression models that involve data sampled at different frequencies. We derive the asymptotic properties of the NLS estimators of such regression models and compare them with the LS estimators of a traditional model that involves aggregating or equally weighting data to estimate a model at the same sampling frequency. In addition we provide a new aggregation bias test. We examine the theoretical results and finite sample properties of the NLS estimator for alternative sample sizes and aggregation horizons via an extensive Monte Carlo simulation study We also present an empirical application on economic growth using regression models with mixed sampling frequencies.

#2: Break detection in the covariance structure of multivariate nonlinear time series models

Presenter: Alex Aue,University of California at Davis

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We discuss a general framework for multivariate (non)linear time series which includes as special cases various multivariate GARCH-type models established in the literature. The main goal is to study how the volatility and cross-volatilities evolve over time and to detect breaks in their structure if necessary. We present asymptotic

results for a suitably defined test statistic and evaluate the finite sample behavior in a simulation study and an application to financial data. The talk is based on joint work with S. Hörmann, L. Horváth and M. Reimherr.

#3: **MLE for Alpha-Stable Allpass and Autoregressive Processes**

Presenter: Richard A. Davis,Columbia University

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We consider maximum likelihood estimation for both causal and noncausal autoregressive models and for all-pass models that are driven by non-Gaussian α-stable noise. Allpass models are linear processes which have nonlinear-like behavior. In particular, allpass processes constitute a class of white noise (uncorrelated) processes with interesting dependence features. A nondegenerate limiting distribution is given for for the maximum likelihood estimators of the model parameters, including the parameters of the noise distribution. The estimators for the AR and allpass model parameters are $n^{1/\alpha}$-consistent, while the estimators for the parameters of the stable noise distribution have the traditional $n^{1/2}$ rate of convergence. We study the behavior of the estimators for finite samples via simulation and compare them with rank-based estimation procedures. An example of fitting a noncausal autoregressive model to stock market trading volume data using maximum likelihood is also given. (This is joint work with Beth Andrews and Matt Calder.)

Sunday, 08/06/2008 18:00-19:30 Session 2

Time Series Econometrics — Chair: Helmut Lütkepohl

#1: **Likelihood inference for fractional processes**

Presenter: Søren Johansen,University of Copenhagen

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Cointegration is often studied in the framework of the vector autoregressive model for nonstationary variables. The purpose of this lecture is to present some results on the statistical analysis of a vector autoregressive model for fractional processes. The model is given by the equations

$$\Delta^d X_t = \alpha \Delta^{d-b} L_b \beta' X_t + \sum_{i=1}^{k} \Phi_i \Delta^d L_b^i X_t + \varepsilon_t,\ L_b = 1 - \Delta^b,$$

with solution

$$X_t = \begin{cases} \Delta_+^{-d}(C\varepsilon_t + \Delta^b Y_t) + \mu_t^0, & t = 1, 2, \ldots \\ X_t^0, & t = \ldots, -1, 0 \end{cases},$$

see Reference 1. Thus X_t is fractional of order d and $\beta' X_t$ is fractional of order $d - b$.

In order to develop the necessary tools and learn about such processes we focus on the univariate model

$$\Delta^d X_t = \pi \Delta^d L_d X_t + \sum_{i=1}^{k} \phi_i \Delta^d L_d^i X_t + \varepsilon_t.$$

Likelihood based inference is based on Gaussian i.i.d. errors, but the asymptotic results are valid under i.i.d. errors with a suitable moment condition.

The main idea is to consider the likelihood as a stochastic process in the parameter and show tightness, so that we obtain an stochastic equicontinuity in the parameter. This allows us to show that the normalized likelihood and its derivatives converge in distribution. We apply this to show that there is a neighborhood of the true value on which the likelihood is convex (with probability tending to one). This is applied to discuss the existence, consistency and asymptotic distribution of the (local) likelihood estimator, as well as the asymptotic distribution of the test that $\pi = 0$, the fractional unit root test.

Inference is based on the conditional likelihood and the above representation. It is shown that the initial values do not influence the asymptotic distribution, and that inference mimics the well known inference form the $I(1)$ model, except that the Brownian motion is replaced by the fractional Brownian motion of type II: $B_b(u) = \Phi(b)^{-1} \int_0^u (u-s)^{b-1} dW(s)$, see Reference 2.

References

1. Representation of cointegrated autoregressive processes with application to fractional processes. To appear in *Econometric Theory*

2. Likelihood inference for a model for a fractional unit root. Manuscript in preparation (with Morten Nielsen)

#2: **Testing for the cointegrating rank of a vector autoregressive process with uncertain deterministic trend term**

Presenter: Helmut Lütkepohl,European University Institute

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Co-authors: Matei Demetrescu

When applying Johansen's procedure for determining the cointegrating rank to systems of variables with linear deterministic trends, there are two possible tests to choose from. One test allows for a trend in the cointegration relations and the other one restricts the trend to be orthogonal to the cointegration relations. The first test is known to have reduced power relative to the second one if there is in fact no trend in the cointegration relations, whereas the second one is based on a misspecified model if the linear trend is not orthogonal to the cointegration relations. Hence, the treatment of the linear trend term is crucial for the outcome of the rank determination procedure. We compare two alternative testing strategies which are applicable if there is uncertainty regarding the proper trend specification. In the first one a specific cointegrating rank is rejected if one of the two tests rejects and in the second one the trend term is decided upon by a pretest. The first strategy is shown to be preferable in applied work.

#3: **Modeling Expectations with Noncausal Autoregressions**

Presenter: Pentti Saikkonen,University of Helsinki

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Co-authors: Markku Lanne

This paper is concerned with univariate noncausal autoregressive models and their potential usefulness in economic applications. We argue that noncausal autoregressive models are especially well suited for modeling expectations. Unlike conventional causal autoregressive models, they explicitly show how the considered economic variable is affected by expectations and how expectations are formed. Noncausal autoregressive models can also be used to examine the related issue about backward-looking or forward-looking dynamics of an economic variable. We show in the paper how the parameters of a noncausal autoregressive model can be estimated by the method of maximum likelihood and how related test procedures can be obtained. Because noncausal autoregressive models cannot be distinguished from conventional causal autoregressive models by second order properties or Gaussian likelihood a detailed discussion about their specification is provided. Motivated by economic applications we explicitly use a forward-looking autoregressive polynomial in the formulation of the model. This is different from the practice used in previous statistical literature on noncausal autoregressions and, in addition to its economic motivation, it is also convenient from a statistical point of view. In particular, it facilitates obtaining likelihood based diagnostic tests for the specified orders of the backward-looking and forward-looking autoregressive polynomials. Such test procedures are not only useful in the specification of the model but also in testing economically interesting hypotheses such as whether the considered variable only exhibits forward-looking behavior. As an empirical application, we consider modeling the U.S. inflation dynamics which, according to our results, is purely forward-looking.

Monday, 09/06/2008 09:00-10:30 Session 3

INFERENCE IN TIME SERIES II — Chair: Michael Neumann

#1: **Evaluation for moments of a ratio with application to censored data analysis and to regression estimation for time series**

Presenter: Paul Doukhan,ENSAE
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Co-authors: Gabriel Lang

Many problems involve ratios in probability or in statistical applications. We aim at approximating the moments of such ratios under specific assumptions. Using ideas from Collomb (1977), we propose sharper bounds for the moments of randomly weighted sums which also may appear as a ratio of two random variables. We approximate moments of ratios under specific assumptions by using ideas from Collomb (1977)

$$\widehat{R}_n = \frac{\widehat{N}_n}{\widehat{D}_n}, \qquad \widehat{D}_n = \frac{1}{n}\sum_{i=1}^{n} U_{i,n}, \qquad \widehat{N}_n = \frac{1}{n}\sum_{i=1}^{n} U_{i,n}V_{i,n}.$$

Assume that

$$\|\widehat{D}_n - D\|_q = \mathcal{O}(v_n), \qquad \|\widehat{N}_n - N\|_p = \mathcal{O}(v_n)$$

then we prove that

$$\|\widehat{R}_n - N/D\|_p = \mathcal{O}(v_n) \quad ?$$

From interpolation techniques, we essentially only need here $q > p$, while Collomb was using $q > 2p$. Suitable applications are given in more detail here in the fields of functional estimation, in finance and for censored data analysis. Nadaraya Watson kernel regression estimator is considered and we derive minimax bounds for both its errors and its uniform errors. Several weak dependence dependence situations are considered, namely mixing and causal or noncausal weak dependences.

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#2: **Hybrid Bootstrap for Time Series**

Presenter: Jens-Peter Kreiss,TU Braunschweig
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Co-authors: Carsten Jentsch and Efstathios Paparoditis

The paper reconsiders the autoregressive aided periodogram bootstrap which has been suggested in Kreiss and Paparoditis (2003). The focus lies on a bootstrap procedure which still is frequency as well as time domain based, as described in the above cited paper, but explicitly leads to bootstrap observations in the time domain. The aim is to obtain a resample which mimics not only a part but as much as possible the complete covariance structure of the underlying time series. For some examples the asymptotic validity of the hybrid bootstrap proposal is shown.

#3: **Nonparametric estimation for Lévy processes from low-frequency observations**

Presenter: Michael Neumann,Friedrich-Schiller-Universität Jena
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We suppose that a Lévy process is observed at discrete time points. A rather general construction of minimum-distance estimators is shown to give consistent estimators of the Lévy-Khinchine characteristics as the number of observations tends to infinity, keeping the observation distance fixed. For a specific C^2-criterion this estimator is rate-optimal. A key step in the proof is a uniform control on the deviations of the empirical characteristic function on the whole real line. This talk is based on joint work with Markus Reiss.

Monday, 09/06/2008 11:00-12:30 Session 4

LONG MEMORY TIME SERIES Chair: Peter Robinson

#1: **Fractional Cointegration in a Pure-Jump Transaction-Level Price Model**

Presenter: Clifford M. Hurvich,New York University

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We propose a new transaction-level bivariate log-price model, which yields fractional or standard cointegration. The model provides a link between market microstructure and lower-frequency observations. The two ingredients of our model are a Long Memory Stochastic Duration process for the waiting times $\{\tau_k\}$ between trades (so that the cumulative number of transactions for each of the component assets comprises a fractal point process), and a pair of stationary noise processes ($\{e_k\}$ and $\{\eta_k\}$) which determine the efficient and microstructure components of the jump sizes in the pure-jump log-price process. The efficient component is iid, while the microstructure component has negative memory parameter. Our model includes feedback between the disturbances of the two log-price series at the transaction level, which induces standard or fractional cointegration for any fixed sampling interval. We prove that the cointegrating parameter can be consistently estimated by the ordinary least-squares estimator, and obtain a lower bound on the rate of convergence.

#2: **Regression Model Checking with Long Memory Design & Errors**

Presenter: Hira L. Koul,Michigan State University

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This talk will discuss two testing problems pertaining to regression modeling in the presence of long memory in errors and covariates. One is to fit a parametric model to the regression function in heteroscedastic set up. The second problem is to test a sub-hypothesis in homoscedastic linear regression models. Long memory is modeled via moving averages. For the first problem covariate is 1-dimensional and a test based on a certain marked empirical process will be presented.

For the second problem covariate is p-dimensional and the likelihood ratio type test based on the minimized Whittle quadratic form is analyzed. Asymptotic null distribution of the latter test statistic is shown to be a chi-square distribution. Additionally, the estimators of the slope parameters obtained by minimizing the Whittle dispersion is seen to be $n^{1/2}$-consistent for all values of the long memory parameters of the design and error processes. This talk is based on joint works with Hongwen Guo and Donatas Surgailis.

#3: **Asymptotic properties of the LSE of spatial regression in both weakly and strongly dependent stationary random fields**

Presenter: Yoshihiro Yajima,University of Tokyo

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Co-authors: Yasumasa Matsuda

We consider asymptotic properties of the least squares estimator (LSE) in a linear regression model with spatially correlated errors, which follow a stationary random field. We consider the strong consistency, the asymptotic covariance matrix, the asymptotic efficiency relative to the best linear unbiased estimator (BLUE) and the central limit theorem. The main feature is that we propose a unified way in which we can deal with the error terms in both weakly and strongly dependent random fields.

Monday, 09/06/2008 16:00-17:30 Session 5

RESAMPLING TIME SERIES Chair: Dimitrios Politis

#1: **Bootstrap confidence intervals for the extremal index in a Markovian framework.**

Presenter: Patrice Bertail,MODAL'X, University Paris X and CREST-LS, INSEE

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Co-authors: S. Clémençon and J. Tressou

A key parameter in the extremal behavior analysis of (approximately) stationary sequences $Y = \{Y_n\}_{n\in\mathbb{N}}$ of dependent r.v.'s, when well defined, is the *extremal index* $\theta_Y \in (0,1)$, measuring to which extent extreme values tend to come in "small clusters". Indeed, assuming that Y is ergodic with limiting probability measure μ, it allows to connect the distribution of the sample maximum to its counterpart in the case where the Y_n's would be i.i.d. with common distribution μ:

$$\mathbb{P}(\max_{1\le k\le n} Y_k \le u) \approx \mu(]-\infty,\ u])^{n\theta_Y},\ \text{as}\ u \uparrow \infty. \tag{1}$$

As a continuation of the results established in Bertail and Clémençon (2004), Bernoulli, this paper is devoted to introduce a statistical methodology for estimating and constructing confidence intervals for θ_Y in the case where the sequence of interest is an *instantaneous function* of a time-homogeneous regenerative Markov chain $X = \{X_n\}_{n\in\mathbb{N}}$ with state space $(E, \mathcal{E})$, *i.e.* a sequence of the form $f(X) = \{f(X_n)\}_{n\in\mathbb{N}}$ where $f : E \to \mathbb{R}$ is a measurable function.

Various extremal index estimators have been recently proposed in the statistical literature, which generally rely on *blocking techniques*, where data segments of fixed (deterministic) length are considered in order to account for the dependence structure within the observations. To our knowledge, only the convergence in probability has been obtained for this kind of estimators. We propose here a methodology specifically tailored for regenerative sequences. Roughly speaking, data blocks correspond here to *cycles* (of random length) in between successive regeneration times and our procedure boils down to counting how many times over the observed sample path, within a cycle, solely the first observation exceeds a given high threshold u and then dividing the result by the number of cycles with a first observation above u. First developed in the seminal work of Rootzen (1988), the idea of exploiting X's renewal properties for extremal values analysis has recently been revisited in Bertail, Clemençon and Tressou(2007) from a statistical perspective. We show how this kind of estimators are perfectely taylored to apply the regenerative bootstrap proposed in Bertail and Clémençon (2004). In particular we obtain the strong consistency of our estimator and the asymptotic validity of the regenerative bootstrap, which allows to construct confidence intervals for the extremal index.

#2: **Bootstrapping nonparametric financial time series models**

Presenter: Jürgen Franke ,University of Kaiserslautern

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We have a look at nonparametric autoregressive-ARCH models with exogeneous components and consider estimates for the autoregressive and volatility function based on local smoothing. We prove that various bootstrap techniques work in this setup and illustrate their applicability with checking the leverage effect, i.e. the asymmetry of the volatility function, for high frequency foreign exchange rate data. We then extend the model, the estimates and the bootstrap to quantile autoregressive models which allow for estimating conditional quantile functions and, therefore, the value-at-risk, directly without taking a detour over volatility estimates and without specific assumptions on the law of innovations.

#3: **Resampling in state space models**

Presenter: David Stoffer,University of Pittsburgh

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Resampling the innovations sequence of state space and related models has proved to be a useful tool in many respects. For example, while, under general conditions, the Gaussian (quasi-) MLEs of the parameters of a state space model are asymptotically normal, several researchers have found that samples must be fairly large before asymptotic results are applicable. Moreover, problems occur if any of the parameters are near the boundary of the parameter space. In such situations, the bootstrap applied to the innovation sequence can provide an accurate assessment of the sampling distributions of the parameter estimates. We have also found that a resampling procedure can provide insight into the validity of the model. We will provide some theoretical insight into our procedures that show why resampling works in these situations, and we provide simulations and data examples that demonstrate our claims.

Monday, 09/06/2008 16:00-17:30 Session 6

MULTIVARIATE TIME SERIES Chair: Manfred Deistler

#1: **Generalized linear dynamic factor models-a structure theory**

Presenter: Manfred Deistler,TU Vienna

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Co-authors: B.D.O. Anderson

In this lecture we present a structure theory for generalized linear dynamic factor models (GDFM's). GDMF's are a combination and generalization of linear dynamic factor models with strictly idiosyncratic noise and generalized linear static factor models; they have been proposed and developed in a number of papers by Forni, Lippi, Hallin and Reichlin and Stock and Watson. GDFM's provide a way of overcoming the "curse of dimensionality" plaguing multivariate time series modelling, provided that the single time series are similar. They are used in modelling and forecasting for financial and macroeconomic time series.

We consider a stationary framework; the observations are represented as the sum of two uncorrelated component processes: The so called latent process, which is obtained from a dynamic linear transformation of a low-dimensional factor process and which shows strong dependence of its components, and the noise process, which shows weak dependence of the components. The latent process is assumed to have a singular rational spectral density. For the analysis, the cross-sectional dimension n, i.e. the number of single time series is going to infinity; the decomposition of the observations into these two components is unique only for n tending to infinity. We present a structure theory giving a state space or ARMA realization for the latent process, commencing from the second moments of the observations. The main parts are: Factorization of singular rational spectral densities by "tall" transfer functions, realization of state space and ARMA systems from a finite number of covariances of the latent process and the "averaging out" of the noise effects for n tending to infinity. Based on this structure theory an estimation procedure is proposed.

#2: **Bootstrap Tests for Cointegration in Conditional Error Correction and other Time Series Models**

Presenter: Franz C. Palm,Maastricht University

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Co-authors: Stephan Smeekes and Jean-Pierre Urbain

In this lecture we propose and present a bootstrap version of the Wald test for cointegration in a single-equation conditional vector correction model (ECM). The Wald test for cointegration in ECMs is an attractive test compared to the more popular Engle-Granger residual-based Augmented Dickey-Fuller (ADF) test as it does not suffer from imposing invalid common factor restrictions. The multivariate sieve bootstrap is used to deal with dependence in the series. The introduced bootstrap test will be shown to be asymptotically valid. The theoretical results derived are obtained for a multivariate setting that is sufficiently general to be applied to other types of bootstrap tests in multivariate time series models. The sample small properties of the proposed bootstrap test will be discussed on the basis of some Monte Carlo results and will be compared with several alternative bootstrap tests. The bootstrap test offers significant improvements in terms of size properties over the asymptotic test, while having similar power properties. It performs at least as well as the alternative bootstrap tests in terms of size and power. The sensitivity of the bootstrap test to the allowance for deterministic components is also investigated. Simulation results show that tests with sufficient deterministic components are insensitive to the true value of trends in the model, and retain correct size. The analysis of bootstrap test for other types of hypothesis or for other types of settings for multivariate time series is currently undertaken. New results to be obtained in the months to come will be presented during this lecture as well.

#3: **Multivariate Nonlinear Regression Analysis with stationary Correlated Errors. An application to the study of temperature variations**

Presenter: Tata Subba Rao,University of Manchester

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Co-authors: G. Terdik

In this paper our object is to consider the estimation of multivariate multiple regression models using the frequency domain methods. The emphasis is on possible applications to many practical situations ,Here we mainly restrict our attention to the data analysis of Minimum, Maximum temperatures and ozone concentrations at a specific station (Faraday/Verdansky) in the Antarctic Peninsula. The data is obtained from British Antarctic Surveys website. The theoretical results can be found in recent papers published by the authors.

Tuesday, 10/06/2008 16:00-17:30 Session 7

FUNCTIONAL TIME SERIES — Chair: Rainer von Sachs

#1: **Comparison of scalar and functional methods for time series prediction: a nonparametric approach**

Presenter: Cao, Ricardo,University of Corunia

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We deal with the problem of prediction in time series using nonparametric techniques. An extension of the local linear method to regression with functional explanatory variable is proposed in this work. For comparative reasons, the Nadaraya-Watson and local linear methods for autoregression are considered for scalar time series prediction. The extension of these two methods to an explanatory functional variable setup are also studied in a comparative simulation study. Linear parametric models, for scalar and functional explanatory variables, are also included in the comparison. Joint paper with Germ?n Aneiros and Juan M. Vilar.

#2: **Functional semiparametric partially linear model with autoregressive errors**

Presenter: Serge Guillas,University College London

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In this paper, we introduce a functional semiparametric model, where a real-valued random variable is explained by the sum of a unknown linear combination of the components of a multivariate random variable and an unknown transformation of a functional random variable. The errors can be autocorrelated. We focus here on the parametric estimation of the coefficients in the linear combination. First, we use a nonparametric kernel method to remove the effect of the functional explanatory variable. Then, we use generalized least squares to obtain an estimator of these coefficients. Under some technical assumptions, we prove consistency and asymptotic normality of our estimator. We present Monte Carlo simulations that illustrate these findings. We also explore some ongoing generalizations to the regression of functional time series in the 2-D context of random surfaces, using bivariate splines representations.

#3: **Estimation and prediction with ARHD model**

Presenter: Besnik Pumo,Institut National d'Horticulture

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Co-authors: Jean Marie Marion

We introduce and study the Autoregressive Hilbert valued process with derivatives, denoted ARHD model. The ARHD model is an autoregressive model in which the first order derivative of the random curves appears explicitly. Convergent estimates are obtained through two methods. We apply the model to a real set of data and compare our results with results already proposed in the literature.

Tuesday, 10/06/2008 18:00-19:30 Session 8

FINANCIAL TIME SERIES Chair: Richard Davis

#1: **Extremes of Autoregressive Threshold Processes**

Presenter: Alexander Lindner,Technical University of Braunschweig

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An autoregressive threshold (TAR) model of order q with S regimes is a piecewise AR(q) process, where the current regime depends on the size of the past observations. More precisely, by a TAR(S, q) process with noise $(Z_k)_{k\in\mathbb{N}_0}$ we mean a process $(X_k)_{k\in\mathbb{N}_0}$ which satisfies

$$X_k = \sum_{i=1}^{S}\{\alpha_i + \sum_{j=1}^{q}\beta_{ij}X_{k-j}\}\mathbf{1}_{\{(X_{k-d_1},\ldots,X_{k-d_p})\in J_i\}} + Z_k, \quad k \geq \max\{q, d_p\},$$

where $p, q, S, d_1, \ldots, d_p \in \mathbb{N}$ with $d_1 < \ldots < d_p$, α_i and β_{ij} are real coefficients and $\{J_i : i = 1, \ldots, S\}$ is a partition of $\mathbb{R}^p$ into Borel sets. These models have been introduced by Tong in 1977 and since then found various applications in many areas, such as financial economics, population dynamics or physics, to name just a few. In particular, when used as a model for financial data, it is important to have information about the tail- and extremal behaviour of these models, since a stylised fact of financial data is that they have heavy tails and cluster on high levels.

We shall investigate tail and extremal behavior for different classes of (semi-)heavy tailed i.i.d. noise sequences (Z_k): if Z_1 is in the maximum domain of attraction of the Gumbel distribution and has either an exponentially decreasing tail (i.e. is in $\mathcal{L}(\gamma)$ with $\gamma > 0$) or is subexponential, then the stationary solution of the TAR process is tail equivalent to the noise sequence, and the extremal index is equal to 1, so that extremes do not occur in clusters. If however Z_1 is in the maximum domain of attraction of the Frechét distribution, i.e. has regularly varying tail, then the stationary TAR model has in general only O-regularly varying tail. However, if the partition $\{J_i : i = 1, \ldots, S\}$ is a partition into disjoint intervals, then it is shown that the stationary version of TAR(S, 1) processes with regularly varying noise has also regularly varying tails. The finite dimensional distributions are then multivariate regularly varying, and the extremal behavior is studied via point processes. The extremal index is furthermore determined, which is shown to be strictly less than 1 for a large set of parameter values, and hence this model can exhibit cluster behaviour, matching this stylised feature of financial time series in this case. The talk is based on the joint work: Brachner C., Fasen V. and Lindner A. (2008) Extremes of Autoregressive Threshold Processes. Preprint.

#2: **The extremogram**

Presenter: Thomas Mikosch,University of Copenhagen

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Co-authors: Richard A. Davis, Columbia University

The motivation for this research comes from the problem of choosing between two popular and commonly used families of models, the generalized autoregressive conditional heteroscedastic (GARCH) process and the heavy-tailed stochastic volatility (SV) process, for modeling a particular financial time series. Both the GARCH and SV models possess the *stylized features* exhibited by log-returns of financial assets. Specifically, these time series have heavy-tailed marginal distributions, are dependent but uncorrelated, and display stochastic volatility. The latter property is manifested via the often slow decay of the sample autocorrelation function (ACF) of the absolute values and squares of the time series. Since both GARCH and SV models can be chosen to have virtually identical behavior in the tails of the marginal distribution and in the ACF of the squares of the process, it is difficult for a given time series of returns to decide between the two models on the basis of routine time series diagnostic tools.

The asymptotic behavior of the extremes leads to one clear difference between GARCH and SV processes. It was shown in previous work by the authors that GARCH processes exhibit extremal clustering (i.e., clustering of extremes), while SV processes lack this form of clustering. Associated with most stationary time series is a parameter $\theta \in (0, 1]$, called the extremal index, which is a measure of the clustering of extremes. For GARCH processes $\theta < 1$ (clustering) and for SV processes $\theta = 1$ (no clustering). The parameter θ, which can be interpreted as the reciprocal of the expected cluster size in the limiting compound Poisson process of the weakly converging point processes of exceedances of (X_t), turns out to be a difficult quantity to estimate for theses processes.

We focus on strictly stationary sequences whose finite-dimensional distributions (fidis) have power law tails in some generalized sense. In particular, we will assume that the fidis of the d-dimensional process $(\mathbf{X}_t)$ have regularly varying distributions with a positive tail index α. This means that for any $h \geq 1$ the lagged vector $\mathbf{Y}_h = \mathrm{vec}(\mathbf{X}_1, \ldots, \mathbf{X}_h)$ satisfies the relation

$$\frac{P(x^{-1}\mathbf{Y}_h \in \cdot)}{P(|\mathbf{Y}_h| > x)} \stackrel{v}{\to} \mu_h(\cdot)\,,$$

for some non-null Radon measure μ_h on $\mathbb{R}^{hd}\backslash\{\mathbf{0}\}$ with the property that $\mu_h(tC) = t^{-\alpha}\mu_h(C)$, $t > 0$, for any Borel set $C \subset \mathbb{R}^{hd}\backslash\{\mathbf{0}\}$. We call such a sequence $(\mathbf{X}_t)$ *regularly varying with index* $\alpha > 0$. Various time series models of interest are regularly varying. Those include infinite variance stable processes, ARMA-processes with iid regularly varying noise, GARCH processes with iid noise with infinite support (including normally and student distributed noise), SV models with iid regularly varying noise.

As a starting point for the definition of a measure of extremal dependence in a strictly stationary sequence we consider the (upper) *tail dependence coefficient*. It is defined for a two-dimensional vector (X, Y) with $X \stackrel{d}{=} Y$ as the limit (provided it exists) $\lambda(X, Y) = \lim_{x\to\infty} P(X > x \mid Y > x)$. Of course, $\lambda \in [0, 1]$, and $\lambda = 1$ when X and Y are independent or asymptotically independent. The larger λ, the larger the extremal dependence in the vector (X, Y).

The tail dependence coefficient can also be applied to the pairs (X_0, X_h) of a one-dimensional strictly stationary time series. The collection of values $\lambda(X_0, X_h)$ contains useful information about the serial extremal dependence in the sequence (X_t). If one considers a regularly varying sequence (X_t) with index $\alpha > 0$, the definition of regular variation immediately ensures the existence of the quantities $\lambda(X_0, X_h)$.

Now let $(\mathbf{X}_t)$ be a strictly stationary regularly varying sequence of $\mathbb{R}^d$-valued random vectors. Consider two Borel sets A, B in $\mathbb{R}^d$ such that $C = A \times \mathbb{R}^{d(h-1)} \times B$ is bounded away from zero and $\nu_{h+1}(\partial C) = 0$. If both A and B are bounded away from zero,

$$\begin{aligned} & n\,\mathrm{cov}(I_{\{a_n^{-1}\mathbf{X}_0 \in A\}}\,, I_{\{a_n^{-1}\mathbf{X}_h \in B\}}) \\ = \quad & n\,[P(a_n^{-1}\mathbf{X}_0 \in A\,, a_n^{-1}\mathbf{X}_h \in B) - P(a_n^{-1}\mathbf{X} \in A)\,P(a_n^{-1}\mathbf{X} \in B)] \\ \sim \quad & n\,P(a_n^{-1}\mathbf{X}_0 \in A\,, a_n^{-1}\mathbf{X}_h \in B) \sim \gamma_{AB}(h)\,. \end{aligned}$$

We call the right hand limit *extremogram* and its empirical estimator the *sample extremogram*. We calculate the extremogram for examples (GARCH, SV,. . .) and touch on the asymptotic properties of the sample extremogram.

#3: **The stock markets of Europe: Globalization or European Integration?**

Presenter: Cătălin Stărică,Chalmers University of Technology

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Co-authors: Antonello D'Agostino and Jörg Polzehl

A non-stationary analysis of the evolution of the relationship between various levels of aggregation of returns (sectorial, national, continental and international) of the major European financial markets during the last three decades is performed. The aggregated returns are modeled as independent vectors with a time-changing unconditional covariance structure. The methodological frame is that of non-parametric regression with non-random, equidistant design points, where the regression function is the evolving unconditional covariance matrix. The modeling choice reflects our assumption of the existence of four independent factors (an international, an European, a specific national and a specific sectorial factor) that drive the dynamics of the multivariate vector of aggregated returns.

The time-changing proportions of the variance of sectorial returns explained by the national, the European and the international factors reflect the evolution of the market relations and are used to evaluate the integration process possibly at work inside the European economic space.

We find that in all the financial markets we analyzed, the proportion of the sectorial variance explained by the national factor decreased in the last 10-15 years. We also find that this decrease has been matched by an increase in the proportion explained by the international factor. Differences in the amplitude of this movements can be noticed in different markets. We do not find evidence for an increase in the co-movements of the financial indexes at European level.

Wednesday, 11/06/2008 09:00-10:30 Session 9

NONSTATIONARY TIME SERIES Chair: Rainer Dahlhauss

#1: **On recursive estimation for time varying autoregressive processes**

Presenter: Eric Moulines,Ecole Nationale Supérieure des Télécommunications

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This presentation focuses on recursive estimation of time varying autoregressive processes in a nonparametric setting. The stability of the model is revisited and uniform results are provided when the time-varying autoregressive parameters belong to appropriate smoothness classes. An adequate normalization for the correction term used in the recursive estimation procedure allows for very mild assumptions on the innovations distributions. The rate of convergence of the pointwise estimates is shown to be minimax in β-Lipschitz classes for $0 < \beta \leq 1$. For $1 < \beta \leq 2$, this property no longer holds. This can be seen by using an asymptotic expansion of the estimation error. A bias reduction method is then proposed, inspired by the so-called Romberg method, for recovering the minimax rate.

#2: **Statistical analysis of a spatio-temporal model with location dependent parameters and a test for spatial stationarity**

Presenter: Suhasini Subba Rao,Texas A & M University

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In this paper we define a spatio-temporal model with location dependent parameters to describe temporal variation and spatial nonstationarity. We consider the prediction of observations at unknown locations using known neighbouring observations. Further we propose a local least squares based method to estimate the parameters at unobserved locations. The sampling properties of these estimators are investigated. We also develop a statistical test for spatial stationarity. In order to derive the asymptotic results we show that the spatially nonstationary process can be locally approximated by a spatially stationary process. We illustrate the methods of estimation with some simulations and a real data example.

#3: **Local parametric modeling of nonstationary time series**

Presenter: Vladimir Spokoiny,Weierstrass Institute for Applied Analysis and Stochastics

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This paper offers a new procedure for nonparametric estimation and forecasting of time series with applications to volatility modeling for financial data. The approach is based on the assumption of local homogeneity: for every time point there exists a historical interval of homogeneity, in which the volatility parameter can be well approximated by a constant. The procedure recovers this interval from the data using the local change point (LCP) analysis. Afterwards the estimate of the volatility can be simply obtained by local averaging. The approach carefully addresses the question of choosing the tuning parameters of the procedure using the so called "propagation" condition. The main result claims a new "oracle" inequality in terms of the modeling bias which measures the quality of the local constant approximation. This result yields the optimal rate of estimation for smooth and piecewise constant volatility functions. Then the new procedure is applied to some data sets and a comparison with a standard GARCH model is also provided. The numerical results demonstrate a very reasonable performance of the new method.

Wednesday, 11/06/2008 11:00-12:30 Session 10

NONPARAMETRIC TIME SERIES — Chair: Dag Tjøstheim

#1: **A Feasible Estimator for Generalized Structured Models**

Presenter: Stefan Sperlich,Georg-August Universität Göttingen

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Co-authors: Javier Roca Pardiñas

We introduce feasible estimators for a large class of semi- and nonparametric models, called *generalized structured models*, see Mammen & Nielsen (2003), of the form

$$\Lambda(Y) \quad = \quad G\{Z, \beta, g(X)\} + S\{U, \gamma, s(T)\}\,\epsilon$$

with $E[\epsilon|Z,X,U,T] = 0$, Λ, G and S (up to a finite dimensional parameter) known functions, β and γ our unknown finite dimensional parameter; Y the dependent variable with covariates (Z,X,U,T). Further, $g(\cdot)$, $s(\cdot)$ are unknown nonparametric functions under the separability condition that

$$g(X) = \{g_0, g_1(X_1), \ldots, g_d(X_d)\} \qquad , \qquad s(T) = \{s_0, s_1(T_1), \ldots, s_r(T_r)\}\ .$$

In practice, often $(T,U) \subseteq (X,Z)$, but neither $Z \in R^q$ has an overlap with $X \in R^d$, nor $U \in R^p$ with $T \in R^r$. The particular structure is typically motivated from real data problems. Note that this model includes generalized additive, possibly partial linear, models, generalized varying coefficient models, visual GARCH, CHARN, etc., and can be extended for panel data analysis with fixed or random effects.

We derive a general estimation procedure based on an extended idea of smooth backfitting (compare Nielsen, Sperlich, 2005) and add modifications and practical issues like cross validation and fast implementation. Also asymptotic theory is discussed applying the theoretical framework provided in Mammen & Nielsen (2003). A simulation study shows excellent performance of our method. Furthermore, different real data applications from environmetrics and biometrics demonstrate its usefulness.

References

MAMMEN, E. & NIELSEN, J.P. (2003). Generalised structured models. *Biometrika*, **90**, 551-566.

NIELSEN, J.P. & SPERLICH, S. (2005). Smooth backfitting in practice. *Journal of the Royal Statistical Society, B,* **67**, 43-61.

#2: **Gaussian Local Likelihood and Local Correlation**

Presenter: Dag Tjøstheim,University of Bergen

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Several attempts have been made to construct local dependence measures taking into account the values of the variables involved. For example, for large values of two stochastic variables X and Y the local correlation may be higher than for small values of X and Y. We present a novel approach to this problem by approximating the joint distribution of X and Y by a family of bivariate normal distributions and by using local likelihood to obtain an estimate of local correlation. The asymptotic analysis poses challenges that are quite different from those of traditional nonparametric regression. Illustrations on real and simulated data will be given, and a number of possible extensions will be pointed out.

#3: **Modelling high dimensional daily volatilities based on high-frequency data**

Presenter: Yao, Qiwei,London School of Economics

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It is increasingly popular in financial economics to estimate volatilities of asset returns by the methods based on realized volatility and bipower realized volatility from high-frequency data. However the most available methods are not directly relevant when the number of assets involved is large, due to the lack of accuracy in estimating high dimensional matrices. Therefore it is pertinent to reduce the effective size of volatility matrices in order to produce adequate estimates and forecasts. Furthermore, since high-frequency financial data for different assets are typically not recorded at the same time points, conventional dimension-reduction techniques are not directly applicable. In this paper we propose a new method for modelling volatility matrices based on multivariate non-synchronized high frequency return data. The new methodology consists of three steps: (i) estimate realized co-volatility matrices directly based on high-frequency data, (ii) fit a matrix factor model for daily volatility based on the estimated co-volatility matrices, and (iii) fit a vector autoregressive (VAR) model for the volatility factors. The asymptotic theory for the proposed estimators has been established. We illustrate the new methodology with the high-frequency price data on several hundreds of stocks traded in Shen Zhen and Shanghai Stock Exchanges over a period of 177 days in 2003. Joint work with Yazhen Wang, Pengfei Li and Jian Zou.

Posters

Sunday, 8/06/2008 12:30-16:00 Poster Session 1

1. **Treating missing values in INAR(1) models**
   Jonas Andersson and Dimitris Karlis
2. **On Tests for Local Stationarity and their Application to Speech Waveform Data**
   Prabahan Basu and Patrick J. Wolfe
3. **Costationarity and stationarity tests for locally stationary time series with application to stock index returns**
   A. Cardinali and G.P. Nason
4. **Modelling the evolution in autocorrelated water quality time series**
   A. C. Cebrián, J. Abaurrea, J. Asín and M.A García-Vera
5. **Regularized Autoregressive Frequency Estimation**
   Bei Chen
6. **Detecting breakpoints in piecewise-stationary AR models**
   Haeran Cho and Piotr Fryzlewicz
7. **One step-ahead in bootstrap and exponential smoothing methods**
   Clara Cordeiro and Manuela Neves
8. **Detrending errors of the estimated parameters of a noise superposed on a nonmonotonic trend**
   Maria Crăciun and Călin Vamoş
9. **Long-memory time series in the presence of additive outliers. A robust model estimation**
   Fabio A. Fajardo, Valdério A. Reisen and Francisco Cribari-Neto
10. **Detecting changes in the mean of functional observations**
    Robertas Gabrys
11. **Rank-Based Extensions of the Brock, Dechert, and Scheinkman Test**
    Kilani Ghoudi

Monday, 9/06/2008 12:30-16:00 Poster Session 2

1. **Time Series Analysis with Hidden Markov Models**
   Hajo Holzmann
2. **Unit Root Testing: On the Asymptotic Equivalence of Dickey-Fuller With the Log-Log Slope of a Fitted AR Spectrum**
   Evangelos Ioannidis
3. **Ordinal pattern distributions**
   Karsten Keller and Mathieu Sinn
4. **Large Bootstrapping sequential change-point tests**
   Claudia Kirch

5. **Variable transformation strategies for stochastic volatility models with non-Gaussian latent processes.**
   Tore Selland Kleppe and Hans Julius Skaug
6. **Wavelet regression in random design for long memory processes**
   Rafał Kulik
7. **Test for Unit Root against LSTAR models: Wavelet improvement under GARCH distortion**
   Yushu Li and Ghazi Shukur
8. **Using the Divergence Information Criterion for the Determination of the Order of an Autoregressive Process**
   P. Mantalos K. Mattheou and A. Karagrigoriou
9. **On the Prediction of A Class Of (Wide Sense) Stationary Random Processes**
   Juan M. Medina and Bruno Cernuschi-Frías
10. **Locally Stationary Factor Models**
    Giovanni Motta and Christian M. Hafner and Rainer von Sachs

Tuesday, 10/06/2008 12:30-16:00 Poster Session 3

1. **Phase Estimation for Noisy Oscillators**
   Rainer Dahlhaus, Jan Neddermeyer and Konstantinos Paraschakis
2. **Robust estimation of the Hurst parameter and selection of an onset scaling**
   Juhyun Park
3. **Panorama of Estimation Methods for Mixed-State Conditionally Heteroscedastic Latent Factor Models: A Comparative Study**
   Mohamed Saidane and Christian Lavergne
4. **Wavelet coherence using the locally stationary wavelet model**
   Jean Sanderson and Piotr Fryzlewicz
5. **Estimation of ordinal pattern probabilities in fractional Brownian motion**
   Mathieu Sinn and Karsten Keller
6. **A convolution density estimator for nonlinear time series: Simulations and some preliminary analysis**
   Bård Støve and Dag Tjøstheim
7. **Out-of-Sample Evaluation of Explanatory Models of Financial Return Variability**
   Genaro Sucarrat
8. **A Class of Switching Regimes Autoregressive Driven Processes with Exogenous Components**
   Joseph Tadjuidje Kamgaing, Hernando Ombao and Richard A. Davis
9. **A Model-based Approach for Clustering Time Series of Counts**
   Sarah J. Thomas, Katherine B. Ensor and Bonnie K. Ray
10. **Multivariate Autoregression of Order One with Infinite Variance Innovations**
    Zarepour, M. and Roknossadati, S. M.

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