Final workshop of the thematic cycle
of the *Institut des études avancées*
de l'Université de Cergy-Pontoise

on

Nonstationarity and risk management

CIRM, 21–25 January 2013

Scientific organisation
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Contents

1 Aim of the workshop

The aim of this workshop is to conclude a a one year long activities, taken up by various groups of Cergy-Pontoise University, focusing on the broad area of statistical analysis for dependent data. This thematic cycle was the opportunity of fruitful and interdisciplinary exchange during the main events that had been organised, namely

- a regular seminar in Cergy-Pontoise,
- 4 conferences in Cergy-Pontoise and in Paris,
- 4 series of advanced courses given by renowned specialists.

Several workshops and conferences were also organised as satellite events of the present cycle: the "workshop on prediction" organised by Matthieu Cornec and the "thematic days on brain" organised by Eva Locherbach.

Those research activities were mainly concerned with the study of the broad fields of time series, stochastic processes and extremes. Such studies are motivated by the fact that recent technological advances produce scientific data which require sophisticated tools for statistical modeling, associated inference and prediction. In fact, most of the data found in diverse applications are dependent and therefore time series, and more generally stochastic processes, methods are more important than ever for model identification and prediction.

It is customary for time series analysis to model a data generating processes with respect to a one dimensional parameter, i.e. a time index, and under the assumption of stationarity. However, recent real data examples, have shown that both assumptions might not be adequate in practice. For example, the time index can also describe other magnitudes; for instance graph length — for DNA molecules — and Euclidean distance — for geographic information. In addition, non-stationarity is an ubiquitous property for realistic models like the seasonal variability of global warming studies, stock exchange behaviour modulated by the economic cycles, among many others. Moreover, extreme events arising with very low probability occur in various fields ranging from financial and social sciences to climatology, ecology etc. Is of the utmost scientific, economic, and social importance to develop the methods and tools for the study of such rare phenomena, especially under the framework of dependence.

Our goal for this final conference is to open new research tracks and perspective for both young and senior researchers. In doing so, we have organized several talks addressing various points described above and three round-table discussion for exchanging ideas and pointing out new research directions. We are confident that during the workshop days, several new ideas, discussions and collaborations will emerge whose main goals will be the development of research for attacking several such problems.

schedule	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-9:30	Opening	Klueppelberg (60)	Bardet (30)	Douc (60)	Arlot (30)
9:30-10:00	Le Courtois (30)		Szewczak (30)		Neuman (30)
10:00-11:00	Dahlhaus (60)	Touzi (60)	Surgailis	Jakubowski (60)	Roueff (30)
					Christou (15)
					Wendler (15)
Pause					
11:30-12:30 (11:30-12, 12:00-12:15,12:15-12:30)	Berkes (60)	Huyen Pham (60)	Tjostheim (60)	Lang (30)	Kreiss (60)
				Boutahar (15)	
				Soja-Kukieła (15)	
lunch					
14:00-14:15	Xiaoyin Li (15)	Letifi (15)		Kitromilidou (15)	End of the workshop
14:15-14 :30	Clausel (15)	Puplinskaite (15)		Hamonier (30)	
14:30-14 :45	Sabourin (15)	Markeviciute (15)	Naveau (60) Discussion (30)		
14:45-15:10	Anevski (25)	Loisel (25)		Bouchard (25)	
15:10-15:35	Leonenko (25)	Reboul (25)	Mathematics for the planet earth	Pedeli (25)	
Pause					
16:10-16:35	Leipus (25)	Campi (25)		Leucht (25)	
16:35-17:00	Kengne (25)	Stelzer (25)		Philippe (25)	
Pause					
17:30-18:30	Round table : Non-stationarity	Round table : Risk measures and Stochastic processes		Round table : Extremes	
Dinner					
After dinner			Round table : *Understanding probability*		

2 Schedule

- Monday, January 21
  - 9:00-9:30 Opening session (Chair: *P. Doukhan*)

    9:30-10:00 Olivier Le Courtois
    10:00-11:00 Rainer Dahlhaus
    11:00-11:30 Coffee break
    11:30-12:30 Istvan Berkes
  - 12:30-14:00 Lunch

    Evening Session (Chair: *R. Dahlhaus*)

    14:00-14:15 Xiaoyin Li
    14:15-14:30 Marianne Clausel
    14:30-14:45 Anne Sabourin
    14:45-15:10 Dragi Anevski
    15:10-15:35 Nikolai Leonenko
    15-35-16::10 Tea break
    16:10-16:35 Remigijus Leipus
    16:35-17:00 William Kengne
    17:00-17:30 Break
  - 17:30-18:30 Round table: Discussion on **Nonstationarity**
    Chair: Didier Dacunha-Castelle. Discussants: Dragi Anevski, R. Dahlhaus, Jens-Peter Kreiss and Dag Tjøstheim.
- Tuesday, January 22
  - Morning Session (Chair: *J.-L. Prigent*)

    9:00-10:00 Claudia Klüppelberg
    10:00-11:00 Nizar Touzi
    11:00-11:30 Coffee break
    11:30-12:30 Huyen Pham
  - 12:30-14:00 Lunch
  - Evening Session (Chair: *H.-Y. Pham*)

    14:00-14:15 Nourdine Letifi
    14:15-14:30 Donata Puplinskaite
    14:30-14:45 Jurgita Markeviciutev
    14:45-15:10 Stéphane Loisel
    15:10-15.35 Laurence Reboul
    15.35-16:10 Tea break
    16:10-16:35 Luciano Campi
    16:35-17:00 Robert Stelzer
  - 17:00-17:30 Break

- 17:30-18:30 Round table: Discussion on **Risk Measures** and **Stochastic processes**.

- Wednesday, January 23
  - Morning Session (Chair: E. *Rio*)

    9:00-9:30 Jean-Marc Bardet

    9:30-10:00 Zbigniew Szewczak

    10:00-11:00 Donatas Surgailis

    11:00-11:30 Coffee break

    11:30-12:30 Dag Tjostheim
  - 12:30-14:00 Lunch
  - 14:30-16:00 Philippe Naveau: "Statistics and Mathematics for Meteorology" under the framework "Mathematics for Planet Earth" (in French).
  - 21.00-22.00 Round table discussion on "Understanding Probability: 300 years after *Ars Conjectandi* by Jacob Bernoulli.
    Chair: Adam Jakubowski.

- Thursday, January 24
  - Morning Session (Chair: *K. Fokianos*)

    9:00-10:00 Randal Douc

    10:00-11:00 Adam Jakubowski

    11:00-11:30 Coffee break

    11:30-12:00 Gabriel Lang

    12:00-12:15 Mohammed Boutahar

    12:15-12:30 Natalia Soja-Kukiela
  - 12:30-14:00 Lunch
  - Evening Session (Chair: *M. Neumann*)

    14:00-14:15 Stella Kitromilidou

    14:15-14:45 Julien Hamonier

    14:45-15:10 Bruno Bouchard

    15:10-15:35 Xanthi Pedeli

    15:10-16::10 Tea break

    16:10-16:35 Anne Leucht

    16:35-17:00 Anne Philippe

    17:00-17:30 Break
  - 17:30-18:30 Round table: Discussion on **Extremes**.
    Chair: Claudia Klüppelberg. Discussants: Adam Jakubowski, Alexander Lindner and Robert Stelzer.

- Friday, January 25
  - Morning Session (Chair: *D. Tjøstheim*)

9:00-9.30 Sylvain Arlot
9.30-10:00 Michael Neumann
10:00-10:30 François Roueff
10.30-10.45 Vasiliki Christou
10.45-11.00 Martin Wendler
11:00-11:30 Coffee break
11:30-12:30 Jens-Peter Kreiss

– 12:30-14:00 Lunch

3 Abstracts

Dragi ANEVSKI, Lund

Isotonic regression and monotone trend estimation

- D. Anevski and O. Hössjer, "A general asymptotic scheme for inference under order restrictions" Ann. Statist. Volume 34, Number 4 (2006), 1874-1930.
- Zhao, O. and Woodroofe, M., " Estimating a monotone trend." (2012) Statistica. Sinica, 22, 359-378.

Sylvain ARLOT, ENS-Paris

Kernel change-point detection

We tackle the change-point problem with data belonging to a general set. We propose a penalty for choosing the number of change-points in the kernel-based method of Harchaoui and Cappe' (2007). This penalty generalizes the one proposed for one dimensional signals by Lebarbier (2005). We prove it satisfies a non-asymptotic oracle inequality by showing a new concentration result in Hilbert spaces. Experiments on synthetic and real data illustrate the accuracy of our method, showing it can detect changes in the whole distribution of data, even when the mean and variance are constant. Our algorithm can also deal with data of complex nature, such as the GIST descriptors which are commonly used for video temporal segmentation

Jean-Marc BARDET, Paris 1

Moment bounds and central limit theorems for Gaussian subordinated arrays with Donatas Surgailis

A general moment bound for sums of products of Gaussian vector's functions extending the moment bound in Taqqu (1977, Lemma 4.5) is established. A general central limit theorem for triangular arrays of nonlinear functionals of multidimensional non-stationary Gaussian sequences is proved. This theorem extends the previous results of Breuer and Major (1981), Arcones (1994) and others. A Berry-Esseen-type bound in the above-mentioned central limit theorem is derived following Nourdin, Peccati and Podolskij (2011). Two applications of the above results are discussed. The first one refers to the asymptotic behavior of a roughness statistic for continuous-time Gaussian processes and the second one is a central limit theorem satisfied by long memory locally stationary process.

Istvan BERKES, Graz

Change point tests for dependent stable processes

The normed CUSUM functional of i.i.d. sequences converges weakly in the case of finite variances, as well as in the case of stable variables, leading to satisfactory tests for the change of location of such processes. In a rare instance in weak dependence theory, this phenomenon breaks down in the case of mixing random variables. We show that by a suitable trimming of the sample and after a random centering, the normed partial sums of dependent stable processes converge weakly to Brownian bridge, extending the change point theory for such cases. We also construct a ratio test for the same problem. Our results provide the first asymptotic results for trimmed dependent sequences and as simulations show, they have nice power properties even for small and moderate sample sizes.

Joint work with Alina Bazarova and Lajos Horvath

Bruno BOUCHARD, Paris 9

Risk management and stochastic target technics

We shall review some recent advances in the theory of optimal control related to stochastic target problems and focus on their applications to risk management. We shall first discuss pricing and hedging problems under a risk criteria. We will explain how one can directly derive partial differential equations associated to the pricing function by applying a geometric dynamic programming principle to a stochastic target problem with augmented state space. A robust version allowing one to take model uncertainty into account will then be discussed. In the second part, we shall consider optimal portfolio management problems under expected shortfall constraints. We shall show how one can convert this non-standard optimal control problem into a standard state constraint one, and provide an suitable pde characterization.

References :

B. Bouchard and N. M. Dang. Generalized stochastic target problems for pricing and partial hedging under loss constraints - Application in optimal book liquidation, Finance & Stochastics, 2013, 17(1), 31-72.

B. Bouchard, R. Elie and C. Imbert. Optimal Control under Stochastic Target Constraints, SIAM Journal on Control and Optimization, 2010, 48 (5), 3501-3531.

B. Bouchard, R. Elie and N. Touzi. Stochastic target problems with controlled loss, SIAM Journal on Control and Optimization, 2009, 48 (5), 3123-3150.

B. Bouchard and M. Nutz. Weak Dynamic Programming for Generalized State Constraints, to appear in SIAM Journal on Control and Optimization.

B. Bouchard and T. N. Vu. A stochastic target approach for P&L matching problems, Mathematics of Operation Research, 2012, 37(3), 526-558.

Mohamed BOUTAHAR, Marseille

Wald Test for detecting changes in distribution of independent random vectors

In this paper we consider independent observations X_t with a cumulative distribution function (cdf) $F(\theta_t)$ and we perform the Wald test to detect changes in the parameter θ_t. We prove that under the null the test statistic has a non standard limiting distribution. When testing a total change of θ_t, the limiting distribution is free of nuisance parameters and hence can easily be tabulated. However, when testing a partial change in θ_t the limit distribution depends on population parameters and in this case a bootstrap procedure is necessary to perform the Wald test.

Luciano CAMPI, Paris 13

Utility indifference pricing for non-smooth payoffs with application to power derivatives

Vasiliki CHRISTOU, Cyprus

Testing Linearity for Nonlinear Count Time Series Models, with Konstantinos Fokianos

We consider testing linearity against two special classes of nonlinear alternatives for count time series data. The first class contains of models which do not face the problem of nonidentifiability, that is all the parameters of the model are identified under the null hypothesis. For this class of models and under the null hypothesis of linearity, the score test statistic possesses an asymptotic $\mathcal{X}^2$ distribution. The second class of nonlinear models consists of models in which a nonnegative nuisance parameter exists under the alternative hypothesis but not when linearity holds. In this particular case the testing problem is nonstandard and the classical asymptotic theory for the score test does not apply.
We focus on count time series autoregressive models based on either the Poisson or the negative binomial distribution. After parameterizing suitably the negative binomial distribution so that it has the same mean as the Poisson, we employ quasi likelihood inference to get the consistent estimators. Once the estimators are obtained, we calculate the score test statistic and based on parametric bootstrap procedure, we investigate the size and the power of the test by a simulation study.

Marianne CLAUSEL, Paris Dauphine

High order chaotic limits of wavelet scalograms under long–range dependence

Let G be a non–linear function of a Gaussian process $\hat{E}\{X_t\}_{t\in\mathbb{Z}}$ with long–range dependence. The resulting process $\hat{E}\{G(X_t)\}_{t\in\mathbb{Z}}$ is not Gaussian when G is not linear. We Êconsider random wavelet coefficients associated with $\hat{E}\{G(X_t)\}_{t\in\mathbb{Z}}$ and the corresponding wavelet scalogram which Êis the average of squares of wavelet coefficients over locations. We obtain Êthe asymptotic behavior of the scalogram as the number of observations and Êthe analyzing scale tend to infinity. It is known that when G is a Hermite Êpolynomial of any order, then the limit is either the Gaussian or the ÊRosenblatt distribution, that is, the limit can be represented by a multiple ÊWiener-ItŹ integral of order one or two. We show, however, that there are Êlarge classes of functions G which yield a higher order Hermite Êdistribution, that is, the limit can be represented by a a multiple ÊWiener-ItŹ integral of order greater than two. This happens for example if ÊG is a linear combination of a Hermite polynomial of order 1 and a ÊHermite polynomial of order $q > 3$. The limit in this case can be Gaussian but Êit can also be a Hermite distribution of order $q - 1 > 2$. This depends not only Êon the relation between the number of observations and the scale size but Êalso on whether q is larger or smaller than a new critical index q^*. The Êconvergence of the wavelet scalogram is therefore significantly more complex Êthan the usual one.

Claudia KLUPPELBERG, Munich

Statistical modelling and estimation of extreme observations in space and time

Often, in modelling complex systems such as weather events or wind fields, also financial systems, statistical methodology can be applied to reconcile physical or economic phenomena with the data. For an adequate risk analysis, the statistical modelling of extreme events, such as floods, wind gusts, or financial crises, is essential.

Historically, Gaussian random fields play a central role in modelling spatio-temporal data. When it comes to extremes and extremal dependence, Gaussian processes are not appropriate, since observations at two different locations and time points are in Gaussian models independent at high levels. A natural extension from uni- and multivariate extreme value theory is formed by so-called max-stable random fields. We suggest new statistical models for extreme data measured in space and time. We present the basic aspects and challenges of simulation and estimation of max-stable spatio-temporal random fields.

This is joint work with Richard Davis and Christina Steinkohl.

Rainer DAHLHAUS, Heidelberg

Locally Stationary Processes - An Overview

The talk gives an overview on locally stationary processes. After summarizing the basic models and techniques we discuss in more detail the likelihood theory for locally stationary processes and empirical process theory for the theoretical treatment of statistical inference. We also present the notion of stationary derivative processes. We present a Taylor type expansion for locally stationary processes and show how these techniques can be used for investigating the statistical properties of estimators.

Randal DOUC, TELECOM Paris-Sud

Ergodicity of observation-driven time series models and consistency of the maximum likelihood estimator, joint work with P. Doukhan and E. Moulines.

This works deals with a general class of observation-driven time series models with a special focus on time series of counts. We provide conditions under which there exist strict-sense stationary and ergodic versions of such processes. The consistency of the maximum likelihood estimators is then derived for well-specified and misspecified models.

Julien HAMONIER, Valenciennes

Wavelet estimation of the Hurst's functional parameter of linear multifractional stable motion. A joint work with Antoine AYACHE - Université Lille1

The Linear Multifractional Stable Motion (LMSM), denoted by $Y = \{Y(t) : t \in \mathbb{R}\}$, is a Strictly α-Stable ($\mathcal{S}t\alpha\mathcal{S}$) stochastic process which was introduced by Stoev and Taqqu in [1, 2] with a view to model some features of traffic traces on telecommunication networks, typically changes in operating regimes and burstiness (the presence of rare but extremely busy periods of activity). This process is obtained by replacing the constant Hurst parameter of the Linear Fractional Stable Motion by a function $H(\cdot)$. Throughout our talk, we will assume that the function $H(\cdot)$ takes values in $(1/\alpha, 1)$ and satisfies an uniform Hölder condition of order $\rho \geq \max_{x\in[0,1]} H(x)$ over $[0, 1]$.

In the case of LFSM, the statistical problem of estimation of H has already been studied in several articles and strongly consistent estimators (i.e. convergent almost surely), based on the discrete wavelet transform of LFSM, have been proposed; notice that the latter estimators of H do not require that α to be known.

On the other hand, in the LMSM's case, any work of the estimation of $H(t_0)$ (t_0 is an arbitrary and fixed real number) or $\min_{t\in I} H(t)$ (I is a fixed, non-empty,

compact interval), has not yet been undertaken; this is what we propose to do here, thanks to wavelet coefficients of this process.

References

[1] Stoev, S. and Taqqu, M.S., *Stochastic properties of the linear multifractional stable motion*. Advances in applied probability, 36, 4, 1085–1115, 2004.

[2] Stoev, S. and Taqqu, M.S., *Path properties of the linear multifractional stable motion*. Fractals, 13, 2, 157–178, 2005.

Adam JAKUBOWSKI, Torún

Functional convergence of linear processes with heavy tail innovations. Joint work with Raluca Balan (Ottawa) and Sana Louhichi (Grenoble).

A linear process built upon i.i.d. innovations $\{Y_j\}_{j\in\mathbb{Z}}$ is (for us) a sequence $\{X_n\}_{n\in\mathbb{Z}}$ given by

$$X_n = \sum_{j\in\mathbb{Z}} c_{n-j} Y_j,$$

where the numbers $\{c_j\}_{j\in\mathbb{Z}}$ are such that the series defining X_n is convergent.

Linear processes form the simplest class of dependent models which are suitable for computations and exhibit various interesting phenomena such as clustering of big values and long-range dependence.

We are interested in various forms of convergence of partial sum processes

$$S_n(t) = \frac{1}{a_n} \sum_{k=1}^{[nt]} X_k.$$

We shall consider only the case when Y_j's are in the domain of strict attraction of a strictly α-stable and non-degenerate distribution on $\mathbb{R}^1$, $\alpha \in (0,2)$, the numbers c_j are summable:

$$\sum_{j\in\mathbb{Z}} |c_j| < +\infty,$$

and the linear processes are non-trivial, i.e. at least two among c_j's are non-zero.

Since the work by Avram and Taqqu (1992) it is known that in this case the convergence in Skorokhod's J_1-topology cannot hold. Avram and Taqqu (1992)

and Louhichi and Rio (2011) obtained functional convergence in Skorokhod's M_1-topology for the case when *all* $c_j \geq 0$ (what implies that X_n's are associated).

In this talk we show functional convergence of $S_n(t)$ in so-called S-topology, introduced by Jakubowski (1997). We give some implications of this fact.

We discuss also convergence of finite dimensional distributions and obtain a complete characterization. It leads to new – and tractable – sufficient conditions in case $0 < \alpha < 1$.

William KENGNE, Cergy-Pontoise

Testing for structural change in time series of counts.

Stella KITROMILIDOU, Cyprus

Robust Estimation for Count Time Series Log-Linear models. Joint work with Konstantinos Fokianos and Roland Fried

We consider a log-linear Poisson model for count time series without feedback. We study the model under three forms of interventions: an Additive Outlier (AO), a Transient Shift (TS) and a Level Shift (LS). We estimate the parameters using the Maximum Likelihood Estimator (MLE), the Conditionally Unbiased Bounded-Influence estimator (CUBIF), proposed by Künsch et al (1989) and the Mallows Quasi-Likelihood estimator (MQLE), proposed by Cantoni and Ronchetti (2001) and compare all three estimators in terms of their Mean Absolute Error (MSE), bias, Median Absolute Deviation (MAD) and Mean Absolute Error (MAE). Our empirical results show that under a LS or a TS there are no significant differences among the three estimators and the most interesting results are obtained in the presence of AOs.

Gabriel LANG, Agroparistech-INRA Paris

Aggregation of individual genomics sequences for the definition of significantly altered zones by cancer disease.

We model alteration of genomic sequence by a Markovian On/Off model. We show that the normalized sum of independent copies of those models converges to the Ornstein-Uhlenbeck diffusion. We try to approximate the distribution of the longest excursion of this process above a level, in order to test for abnormally long altered zones in the genome of a cohort of cancer patients.

Olivier LE COURTOIS, Lyon 1

Optimal portfolio problem of a pension fund.

We solve the optimal portfolio problem of a pension fund maximizing the expected present value of the remaining wealth at the death time of a representative subscriber. The fund can invest in a risky and a riskless asset. Both contributions and pensions are assumed to be constant, while risky asset returns are modelled by a general Lévy process. Assuming a CRRA utility function, we are able to obtain a quasi-closed-form formula for optimal weights. In order to solve fully a portfolio/pension fund problem with Lévy processes, it is necessary to switch back and forth between the stochastic differential and the standard exponential representations. We develop this procedure, and illustrate it with two dynamics: the Variance Gamma process and a process introduced by AŢt-Sahalia, Cacho-Diaz and Hurd (2009). We compute the optimal portfolio fund allocation in these two sub-settings and in the standard mean-variance framework. We show that when market stylized features (i.e. asymmetry, leptokurtosis and jumps) are suitably taken into account, the optimal portfolio share in the risky asset may be around half that obtained in the Gaussian framework.

Remigijus LEIPUS, Vilnius

Detection of non-constant long memory parameter, joint work with Anne Philippe.

We deal with detection of non-constant long memory parameter in time series. The null hypothesis presumes stationary or nonstationary time series with constant long memory parameter, typically an I(d) series with $d > .5$. The alternative corresponds to an increase in persistence and includes in particular an abrupt or gradual change from I(d_1) to I(d_2), $.5 < d_1 < d_2$. We discuss several test statistics based on the ratio of forward and backward sample variances of the partial sums. The consistency of the tests is proved under a very general setting. We also study the behavior of these test statistics for some models with changing memory parameter. A simulation study shows that our testing procedures have good finite sample properties and turn out to be more powerful than the KPSS-based tests considered in some previous works. The talk is based on the joint work with Frédéric Lavancier and Donatas Surgailis.

Nikolai N. LEONENKO, Cardiff

Limit theorems for weighted non-linear transformations of Gaussian stationary processes with singular spectra

The limit Gaussian distribution of multivariate weighted functionals of non-linear transformations of Gaussian stationary processes, having multiple singular spectra, is derived, under very general conditions on the weight function. This

paper is motivated by its potential applications in non-linear regression, and asymptotic inference on non-linear functionals of Gaussian stationary processes with singular spectra. This is a joint work with A.V. Ivanov, M. D. Ruiz-Medina and I. N. Savich

References

Ivanov, A.V., Leonenko, N.N., Ruiz-Medina, M.D. and Savich I.N. (2013) Limit theorems for weighted non-linear transformations of Gaussian stationary processes with singular spectra, Annals of Probability, in press

Anne LEUCHT, Mannheim

Model-specification tests for GARCH(1,1) processes

There is already an overwhelming amount of model specification tests in the econometric literature. These methods typically rely on the assumption that the information variables as well as the response variables are observable. However, this condition is violated in the case of GARCH models, where unobserved quantities enter the information variable. We establish a consistent model-specification test for GARCH(1,1) models based on an L2-type test statistic. The latter can be approximated by a degenerate V-statistic and its asymptotics are then derived invoking results of Leucht and Neumann (2013). Since the test statistic as well as its limit distribution depend on unknown quantities in a complicated way, critical values cannot be derived directly.We present a bootstrap-based testing procedure that overcomes these difficulties. Moreover, the approach presented in this talk can be carried over to many other test problems.

References

Leucht, A. and Neumann, M. H. (2013). Degenerate U- and V-statistics un- der ergodicity: Asymptotics, bootstrap and applications in statistics. (Forth- coming in Annals of the Institute of Statistical Mathematics).

Xiaoyin LI, Cergy-Pontoise

Aggregation for time series prediction, with Pierre Alquier and Olivier Wintenberger

In this talk, we tackle the problem of learning rates in time series forecasting. In a serie of papers, it is shown that the main tools used in learning theory with iid observations can be extended to the prediction of time series. The main message is that, given a family of predictors and n observations, we are able to build a new predictor that forecasts the series as well as the best predictor in the family, up to a small remainder Δ_n. However, in these papers only the absolute loss and the quadratic loss are considered, and in this last case the rates Δ_n are suboptimal. In this talk, we establish general results under any Lipschitz loss function, with a

rate Δ_n of the order of $\Delta_n \sim 1/\sqrt{n}$. Under stronger assumptions on the loss (including the quadratic loss) and on the time series, the remainder is shown to be actually of order f $\Delta_n \sim 1/n$. Thus, the optimal rate reached for iid variables, see e.g. Tsybakov, and individual sequences, see Cesa-Bianchi et al, is achieved for uniformly mixing processes.

Jurgita MARKEVICIUTE, Vilnius and Lille 1

Functional limit theorems for residuals of nearly nonstationary processes, joint work with Alfredas Račkauskas (Vilnius University) and Charles Suquet (Lille 1 University)

We study some Hölderian functional central limit theorems for the polygonal line partial sum processes built on a first order autoregressive process $y_{n,k} = \phi_n y_{n,k-1} + \epsilon_k$ with ϕ_n converging to 1 and iid centered square integrable innovations. In the case where $\phi_n = \exp \gamma_n/n$ with a negative constant γ, we prove that the limiting process is an integrated Ornstein-Uhlenbeck one. In the case where $\phi_n = 1 - \gamma_n/n$, with γ_n tending to infinity slower than n, the convergence to Brownian motion is established in Hölder space in terms of the rate of γ_n and the integrability of the ϵ_k's.

Keywords: Autoregressive process, Brownian motion, functional central limit theorem, Hölder space, integrated Ornstein-Uhlenbeck process, maximal inequality, partial sums, polygonal line.

Michael NEUMANN, Jena

Dependent wild bootstrap for degenerate U- and V-statistics

Degenerate U- and V-statistics play an important role in the field of hypothesis testing since numerous test statistics can be rewritten as or approximated by such statistics. I present a recent result on the asymptotic behavior of degenerate U- and V-statistics of τ-dependent random variables. As main contribution, I introduce a model-free bootstrap that may be viewed as a modification of the dependent wild bootstrap recently proposed by Xiaofeng Shao (2010, JASA). Consistency is proved under easily verifiable conditions. This talk is based on joint work with Anne Leucht (University of Mannheim).

Donata PULPINSKAITE, Vilnius

Aggregation of triangular array of random-coefficient AR(1) processes

We discuss contemporaneous aggregation of independent copies of a triangular array of random-coefficient AR(1) processes with i.i.d. innovations belonging to the domain of attraction of an infinitely divisible law W. The limiting aggregated process is shown to exist, under general assumptions on W and the mixing distribution, and is represented as a mixed infinitely divisible moving-average $\{\mathcal{X}(t)\}$. Partial sums process of $\{\mathcal{X}(t)\}$ is discussed under the assumption that the mixing density is regularly varying at the "unit root" $x = 1$ with exponent $\beta > 0$. We show that the above mentioned partial sums process may exhibit four different limit behaviors depending on β and the Lévy triplet of W.

This is joint work with D. Surgailis (Vilnius), A. Philippe (Nantes).

Xanthi PEDELI, Cyprus

The Saddlepoint Approximation for the Estimation of Higher-Order INAR(p) Processes, joint work Anthony C. Davison and Konstantinos Fokianos

An INAR(p) process ([4] and [1]) is defined as a sequence of random variables $\{X_t : t \in \mathbb{N}\}$ that satisfy a difference equation of the form $X_t = \sum_{i=1}^{p} \alpha_i \circ X_{t-i} + \epsilon_t$, where $\alpha_i \in [0, 1)$ and ϵ_t is a sequence of uncorrelated non-negative integer-valued random variables. The operator '$\circ$', known as the binomial thinning operator [5], mimics the scalar multiplication used for normal time series models, so as to ensure that only integer values will occur. Traditionally, the method of conditional least squares has been used for the estimation of the INAR(p) model. This is because the more efficient maximum likelihood estimation requires distributional assumptions and, as the order p increases, it can become too cumbersome. As an alternative, we consider a saddlepoint approximation (SPA) [2] to the log-likelihood of the INAR(p) process. As it is shown, the SPA is simple in its application and performs well even in the tails of the distribution [3] and under complicated INAR models. We consider the cases of Poisson and negative binomial innovations and we study the asymptotic properties of the SPA estimators both theoretically and empirically.

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Huyen PHAM, Paris Diderot

A semi-Markov process modeling for market microstructure

Anne SABOURIN, Lyon 1

Bayesian Dirichlet mixture model for multivariate extremes: a re-parametrization joint work with Philippe Naveau

The probabilistic framework of extreme value theory is well-known. The dependence among large events is characterized by an angular measure on the positive quadrant of the unit sphere. The family of these angular measures is non-parametric by nature. Nonetheless, any angular measure may be approached arbitrarily well by a mixture of Dirichlet distributions. The semi-parametric Dirichlet mixture model for angular measures is theoretically valid in arbitrary dimension, but the original parametrization is subject to a moment constraint rendering Bayesian inference very challenging in dimension greater than three. In this paper, a new parametrization is proposed which is unconstrained and allows for a natural prior specification, which posterior consistency is verified. A reversible-jump algorithm is implemented to approximate the posterior and tested up to dimension five. In this non identifiable setting, convergence assessment is performed by integrating the sampled angular densities against Dirichlet test functions.

Natalia SOJA-KUKIELA, Toruń

Managing local dependencies in limit theorems for maxima of weakly dependent random fields

Let us consider a d-dimensional stationary random field $\{X_{\mathbf{K}}\}_{\mathbf{K}\in\mathbb{Z}^d}$. For $\mathbf{N}\in\mathbb{N}^d$ we define $M_{\mathbf{N}} := \max\{X_{\mathbf{K}} : \mathbf{1}\leqslant\mathbf{K}\leqslant\mathbf{N}\}$. The purpose is the study of asymptotic behaviour of probabilities $\mathbb{P}(M_{\mathbf{N}}\leqslant u_{\mathbf{N}})$, as $\mathbf{N}\to\infty$ (coordinatewise) and $(u_{\mathbf{N}})\subset\mathbb{R}$.

O'Brien [2] considered the case $d=1$. Under suitable mixing conditions, he has proven the existence of *phantom distribution function*, i.e. a distribution function G such that

$$\sup_{x\in\mathbb{R}}\left|\mathbb{P}(M_N\leqslant x)-G(x)^N\right|\to 0,$$

as $N\to\infty$. Moreover, he has shown how to construct a sequence (R_N) such that $R_N=o(N)$ and

$$\sup_{x\in\mathbb{R}}\left|\mathbb{P}(M_N\leqslant x)-\mathbb{P}(X_0\leqslant x)^{N\mathbb{P}(M_{R_N}\leqslant x|X_0>x)}\right|\to 0,$$

as $N\to\infty$. Thus, if the *extremal index* θ exists, one may calculate it as the following limit

$$\theta=\lim_{N\to\infty}\mathbb{P}(M_{R_N}\leqslant v_N|X_0>v_N)$$

for some sequence $(v_N)\subset\mathbb{R}$.

We develop an analogous theory for the case $d \geqslant 2$. Using the notion of phantom distribution function and the Bonferroni-like inequality taken from [1] we obtain a new formula that allows us to compute the extremal index of random fields.

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Robert STELZER, Ulm

Estimating Multivariate CARMA Processes and Continuous Time State Space Models

Multivariate Lévy-driven continuous time autoregressive moving average processes are the continuous time analogues of the well-known ARMA processes. Formally, they are defined as stationary solutions to (possibly high order) linear differential equations driven by a Lévy process. In this talk we will first discuss briefly the proper definition and the equivalence to general order continuous-time state space models.

Finally, in the main part of the talk we will establish that under natural assumptions a quasi-maximum likelihood approach can be used to estimate the autoregressive and moving average parameters of a multivariate CARMA process based on discrete time equidistant observations. We will illustrate the estimation scheme by a simulation study and a data example.

Donatas SURGAILIS, Vilnius

Aggregation of autoregressive random fields and anisotropic long memory, joint work with F. Lavancier (Nantes), R. Leipus (Vilnius) and D. Puplinskait

We introduce the notion of anisotropic long memory for random fields on $\mathbb{Z}^2$ whose partial sums on incommensurate rectangles with sides growing at different rates $O(n)$ and $O(n^{H_1/H_2}), H_1 \neq H_2$ tend to an operator scaling random field on $\mathbb{R}^2$ with two scaling indices H_1, H_2. The random fields with such behavior are obtained by aggregation of independent copies of a random-coefficient nearest-neighbor autoregressive random fields on $\mathbb{Z}^2$ whose (random) spectral radius has a regularly varying probability density near the 'unit root' $A = 1$. The proofs are based on the study of the scaling limits of the corresponding lattice Green functions.

Zbigniew SZEWCZAK, Torún

Some almost sure limit theorems for dependent random variables

Let $\{X_k\}_{k\in\mathcal{Z}}$, $\mathcal{Z}=\{\ldots,-1,0,1,2,\ldots\}$, be a random sequence defined on a probability space $(\Omega,\mathcal{F},P)$ taking values on the real line $\mathcal{R}$ and $S_n=\sum_{k=1}^n X_k$. $\{X_k\}$ is said to satisfy almost sure (distributional) limit theorem if there exist sequences $\{a_n\}$, $\{b_n\}$, $b_n\to\infty$, such that

$$\frac{1}{\ln n}\sum_{\nu=1}^{n}\frac{1}{\nu}I_{[b_\nu^{-1}S_\nu-a_\nu\in A]}\overset{\text{a.s.}}{\to}\mu(A),\quad \mu(\partial A)=0.$$

If μ is the measure concentrated at 1 we say that $\{X_k\}$ is almost sure relatively stable (AS RS).

$\{X_k\}$ is said to satisfy almost sure local limit theorem (AS LLT) if there exist sequences $\{a_n\}$, $\{b_n\}$, $b_n\to\infty$, such that for some density g

$$\frac{1}{\ln n}\sum_{\nu=1}^{n}\frac{b_\nu}{\nu}I_{[S_\nu\in\kappa_\nu+I]}\overset{\text{a.s.}}{\to}g(\kappa)|I|\ \text{ as }\ \frac{\kappa_\nu-a_\nu}{b_\nu}\to\kappa,$$

where $I\subset R$ is some bounded interval.

Almost sure results for dependent random variables related to relative stability and local limit theorem will be discussed.

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Dag TJOSTHEIM, Bergen

Nonstationary and nonlinear time series models

There is a well-developed theory for time series models that are linear and nonstationary and for models that are nonlinear and stationary. In this talk I will look at time series models that are both nonlinear and

nonstationary. Both parametric and nonparametric modeling will be considered. The concept of a null recurrent Markov chain is a central tool. The connection to nonlinear cointegration will be pointed out, and several examples and applications will be mentioned.

Nizar TOUZI, Ecole Polytechnique

Optimal Transportation and Robust Hedging of Derivatives

The problem of robust hedging consists in finding the minimal initial capital needed in order to hedge some derivative security under all possible models satisfying the no-arbitrage condition and calibrated to some given marginals of the underlying asset price process. The dual formulation of this problem turns out to correspond to a new branch in the of the Monge-Kantorovitch theory of optimal transportation. The continuous-time formulation also provides an interesting connection with the Skorohod embedding problem. Our approach allows to recover the Azema-Yor solution and to extend it to the multimarginals case, a questions left open in the previous probabilistic literature. Finally, we prove a version of the Brenier theorem in our martingale transportation problem which provides an explicit extension of the so-called Frechet-Hoeffding coupling, and describes a worst case financial market for a class of derivative securities.

Martin WENDLER, Bochum

Robust Change Point Detection under Dependence Based on U Quantiles

U-quanitiles are a generalization of sample quantiles and have applications in robust statics. For example, the Hodges-Lehmann estimator of location is the median of pairwise means and can resist up to 29% outliers. We will present a functional central limit theorem for U-quantiles of short range dependent random variables. Furthermore, we will establish the consistency of the nonoverlapping block bootstrap for U-quantiles. With the help of these results, we will establish a test for change points for dependent and heavy tailed data.

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