BOLOGNA-WASEDA TIME SERIES WORKSHOP

October 8 – 9, 2022

Accademia delle Scienze, Via Zamboni, 31, 40126 Bologna

Scientific Committee

Alessandra Luati, Dipartimento di Scienze Statistiche, University of Bologna, Bologna, Italy

Tommaso Proietti, Dipartimento di Economia e Finanza, Università di Roma 'Tor Vergata', Rome, Italy

Masanobu Taniguchi, Department of Mathematical Sciences, Waseda University, Tokyo, Japan

Organizing Committee

Alessandra Luati, Dipartimento di Scienze Statistiche, University of Bologna, Bologna, Italy

Paola Monari, Dipartimento di Scienze Statistiche, University of Bologna, Bologna, Italy

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SATURDAY, OCTOBER 8 – SALA MANFREDI

08:45 – 09:00	Welcome and Opening
SESSION 1	
09:00 – 09:40	**Jean-Michel ZAKOIAN** (ENSAE, Paris), Inference on GARCH-MIDAS models without any small-order moment
09: 40 – 10:20	**Anders RAHBEK** (University of Copenhagen), Lasso-based estimation in ARCH models
10:20 – 11:00	**Esther RUIZ** (University Carlos III, Madrid), Economic activity and CO2 emissions in Spain
11:00– 11:30	**Coffee Break**
SESSION 2	
11:30 – 12:10	**Masanobu TANIGUCHI** (Waseda University), Asymptotic theory for time series analysis
12:10 – 12:50	**Yuichi GOTO** (Kyushu University), Homogeneity tests for one-way models with dependent errors under correlated groups
12:50 – 14:00	**LUNCH**
SESSION 3	
14:00 – 14:40	**Liudas GIRAITIS** (Queen Mary University of London), Robust Inference on Correlation under General Heterogeneity
14:40 – 15:20	**Junichi HIRUKAWA** (Niigata University), Innovation algorithm of fractionally integrated (I(d)) process and applications on the estimation of parameters
15:20 – 16:00	**Christian FRANCQ** (ENSAE, Paris), Optimal estimating function for weak location-scale dynamic models
16:00 – 16:30	**Coffee Break**
SESSION 4	
16:30 – 17:10	**Luca TRAPIN** (University of Bologna), EM algorithm for high-dimensional dynamic matrix factor models
17:10 – 17:50	**Greta GORACCI (**University of Bozen), Robust estimation for threshold autoregressive moving-average

17:50 – 18:30	**Matteo FARNE'** (University of Bologna), An algebraic estimator for large spectral density matrices

CLOSING REMARKS AND DISCUSSION 18:30-18:40

20:00 Conference dinner

SUNDAY, OCTOBER 9 – SALA ULISSE

SESSION 1

09:00 – 09:40	**Kostantinos FOKIANOS** (University of Cyprus), Inference for Non-Stationary Heavy Tailed Time Series
09: 40 – 10:20	**Manfred DEISTLER** (Technische Universität Wien and Wirtschaftsuniversität), High Frequency Linear Time Series Models and Mixed Frequency Data
10:20 – 11:00	**Gabriele FIORENTINI** (University of Florence), PML vs minimum chi-square: the comeback
11:00– 11:30	**Coffee Break**

SESSION 2

11:30 – 12:10	**Marc HALLIN** (Université Libre de Bruxelles), A Class of Rank-Based VARMA Portmanteau Tests: Chitturi-Hosking-Li-McLeod Revisited
12:10 – 12:50	**Matteo BARIGOZZI** (University of Bologna), Quasi Maximum Likelihood Estimation and Inference of Large Approximate Dynamic Factor Models via the EM algorithm
12:50 – 14:00	**LUNCH**

SESSION 3

14:00 – 14:40	**Hiroshi SHIRAISHI** (Keio University), Time Series Quantile Regression by using Random Forests
14:40 – 15:20	**Yan LIU** (Waseda University), Semiparametric empirical likelihood for circular distribution
15:20 – 16:00	**Simone GIANNERINI** (University of Bologna), Testing for threshold effects in presence of volatility and measurement error: the case of Italian strikes

16:00– 16:30	**Coffee Break**

SESSION 4

16:30 – 17:10	**Ilia NEGRI** (University of Bergamo), Z-process method for change point problems in time series
17:10 – 17:50	**Francesca PAPAGNI** (University of Bozen), Efficient nonparametric estimation of generalized autocovariances

CLOSING REMARKS AND DISCUSSION 17:50-18:00

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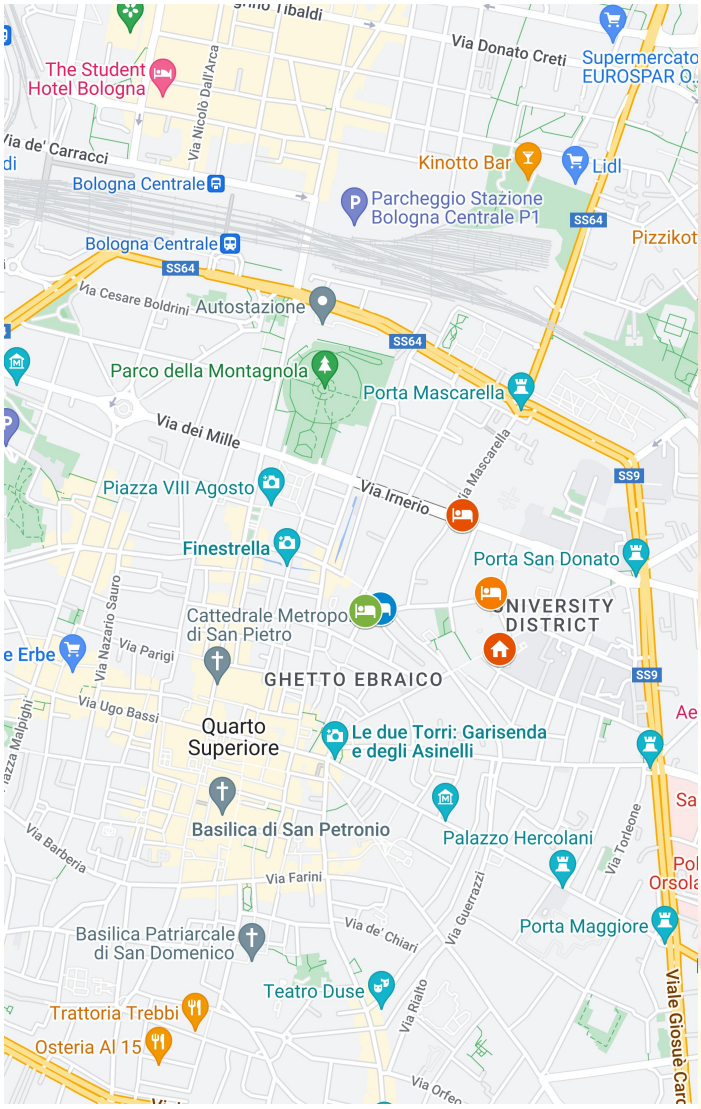
for an interactive updated Google map with venue and places of interest or see below.

Bologna-Waseda

Untitled layer

- Academy of Sciences of the Institute of Bologna
- Almarossa
- Hotel University
- Hotel Accademia
- Residenza Bianconcini

Venue and places of interest related to the workshop



ABSTRACTS

SATURDAY, OCTOBER 8 – SALA MANFREDI

08:45 – 09:00 Welcome and Opening

SESSION 1

09:00 – 09:40 **Jean-Michel ZAKOIAN**

Inference on GARCH-MIDAS models without any small-order moment

GARCH-mixed-data sampling (GARCH-MIDAS) models, the volatility is decomposed into the product of two factors which often received interpretations in terms of "short run" (high frequency) and "long run" (low frequency) components. While two-component volatility models are widely used in applied works, some of their theoretical properties remain unexplored. We show that the strictly stationary solutions of such models do not admit any small-order finite moment, contrary to classical GARCH. It is shown that the strong consistency and the asymptotic normality of the Quasi-Maximum Likelihood estimator hold despite the absence of moments. Tests for the presence of a long-run volatility relying on the asymptotic theory and a bootstrap procedure are proposed. Our results are illustrated via Monte Carlo experiments and real financial data.

Joint with Christian Francq and Baye Matar Kandji

09: 40 – 10:20 **Anders RAHBEK** (University of Copenhagen), Lasso-based estimation in ARCH models

10:20 – 11:00 **Esther RUIZ** (University Carlos III, Madrid), Economic activity and CO2 emissions in Spain

Carbon dioxide (CO2) emissions, largely by-products of energy consumption, account for the largest share of greenhouse gases (GHG). The addition of GHG to the atmosphere disturbs the earth's radiative balance, leading to an increase in the earth's surface temperature and to related effects on climate, sea level rise, ocean acidification and world agriculture, among other effects. The interest in forecasting and designing policies to curbe CO2 emissions globally is gaining interest. In this paper, we look at the relationship between CO2 emissions and economic activity in Spain from 1964 to 2022. We consider a structural-augmented dynamic factor model for the rate of growth of emissions and some preselected economic variables. We show that, once Industrial Production and maritime transportation are considered, the information contained in the macroeconomic data set only has negligible explanatory power for emissions.

Joint with Arranzazu de Juan and Pilar Poncela

11:00– 11:30 **Coffee Break**

SESSION 2

11:30 – 12:10 **Masanobu TANIGUCHI** (Waseda University), Asymptotic theory for time series analysis

This talk consists of the following two parts.
(i) Hellinger Distance Estimation for Non-Regular Spectra. For Gaussian stationary process, we derive the time series Hellinger distance for spectra f and g: T(f, g). Evaluating T(f_θ, f_θ+h) of the form O(h^ α), we elucidate the 1/α-consistent asymptotics of the maximum likelihood estimator of θ for non-regular spectra. For regular spectra, we introduce the minimum Hellinger distance estimator \hat{θ} = arg minθ T(f_θ, gˆn), where gˆn is a nonparametric spectral density estimator. We show that \hat{θ} is asymptotically efficient, and more robust than the Whittle estimator. Small numerical studies will be provided.
(ii)A New Generalized Estimator for AR(1) Model which Improves MLE Uniformly
For the first order autoregressive model, in Ochi (1983), a generalized estimator of the coefficient with two constants c1 and c2 was introduced, which includes Daniels' estimator, least-squares estimator and Durbin's estimator. From Fujikoshi and Ochi (1984), compared with a third-order approximated estimator of maximum likelihood estimator, it was shown that approximated estimator of maximum likelihood estimator is better than Ochi's estimator in the third-order sense if we modify the both estimators to be "third-order asymptotically median unbiased". In this paper, we propose a new estimator when Ochi's c1 and c2 depend on α, i.e., c1 (α) and c2 (α). Then we show that it improves the maximum likelihood estimator uniformly in the sense of the third-order mean square error "without biasadjustments". Because α is unknown, the feasible estimator with c1 (αˆ) and c2 (αˆ) is proposed, and is shown that it is third-order equivalent. Here αˆ is a consistent estimator.

Joint work with Yujie Xue(Waseda University)

12:10 – 12:50 **Yuichi GOTO** (Kyushu University), Homogeneity tests for one-way models with dependent errors under correlated groups

In this talk, we introduce homogeneity tests for one-way models with dependent errors. Existing tests are constructed under the assumption of independence between groups. However, this assumption is quite restrictive and impractical. Hence, we propose a test that allows us to deal with correlated groups.
A proposed test statistic can be used for both fixed effects model and random effects model. First, we show that, under the null hypothesis, the proposed test statistic converges to the chi-square distribution. From this result, an asymptotically size alpha test can be constructed. Then, we prove the consistency of the test, that is, the power of the test converges to 1 under the alternative hypothesis.
Furthermore, we show our test has a non-trivial power under the local alternative hypothesis. In real data analysis, we test whether or not there exist random effects in three industries trading companies, car companies, and telecom companies.

Joint work with K. Arakaki , Y. Liu (Waseda Univ), and M. Taniguchi (Waseda Univ),

12:50 – 14:00 **LUNCH**

SESSION 3

14:00 – 14:40 **Liudas GIRAITIS** (Queen Mary University of London), Robust Inference on Correlation under General Heterogeneity

Considerable evidence in past research shows size distortion in standard tests for zero autocorrelation or cross-correlation when time series are not independent identically distributed random variables, pointing to the need for more robust procedures. Recent tests for serial correlation and cross-correlation in Dalla, Giraitis and Phillips (2021) provide a more robust approach, allowing for heteroskedasticity and dependence in uncorrelated data under restrictions that require a smooth, slowly-evolving deterministic heteroskedasticity process. The present work removes those restrictions and validates the robust testing methodology for a wider class of heteroskedastic time series models and innovations. The updated analysis given here enables more extensive use of the methodology in practical applications. Monte Carlo experiments confirm excellent finite sample performance of the robust test procedures even for extremely complex white noise processes. The empirical examples show that use of robust testing methods can materially reduce spurious evidence of correlations found by standard testing procedures.

Joint with Yufei Li and Peter CB Phillips

14:40 – 15:20 **Junichi HIRUKAWA** (Niigata University), Innovation algorithm of fractionally integrated (I(d)) process and applications on the estimation of parameters

The long memory phenomena frequently occur in the empirical studies of various fields. The fractionally integrated process is the one of the suitable candidate which appropriately represents the long memory property. There are two recursive algorithms for determining the one-step predictors of time series, that is, the Durbin-Levinson algorithm and the innovation algorithm. The Durbin-Levinson algorithm for the fractionally integrated process is well-known and widely used, which naturally derives the Cholesky factorization of the inverse matrix of the covariance matrix of the process. In this talk, we derive the innovation algorithm for the fractionally integrated process. The result is also applied to the derivation of the Cholesky factorization of the covariance matrix of the process in the explicit form. Moreover, the asymptotic theory of Gaussian maximum likelihood estimator (GMLE) is derived in terms of the innovation algorithm.

Joint work with Kou Fujimori Shinshu University

15:20 – 16:00 **Christian FRANCQ** (ENSAE, Paris), Optimal estimating function for weak location-scale dynamic models

Estimating functions provide a very general framework for estimating dynamic models under weak assumptions. We consider a class of time series models
consisting in the parametrization of the first two conditional moments which---by contrast with classical location scale dynamic models---do not impose further constraints on the

conditional distribution/moments. Quasi-Likelihood Estimators (QLE) are obtained by solving estimating equations deduced from those two conditional moments.
Conditions ensuring the existence and asymptotic properties (consistency and asymptotic normality) of such estimators are provided. We pay particular attention to the optimal QLE in Godambe's sense. The particular case of the Quasi-Maximum Likelihood Estimators (QMLE) is considered. A data-driven procedure for optimally choosing the QLE is proposed. Our results are illustrated via Monte Carlo experiments and real financial data.

Joint with Jern-Michel Zakoian

16:00 – 16:30 **Coffee Break**

SESSION 4

16:30 – 17:10 **Luca TRAPIN** (University of Bologna), EM algorithm for high-dimensional dynamic matrix factor models

High-dimensional matrix-variate time series data are becoming increasingly popular in economics and finance. This has stimulated the development of matrix factor models to achieve significant dimension reduction. This paper proposes an approximate dynamic matrix factor model that accounts for the time series nature of the data, and develops an EM algorithm to perform quasi-maximum likelihood estimation of the model parameters. The algorithm is further extended to estimate the dynamic matrix factor model on a dataset with arbitrary pattern of missing data. The finite sample properties of the proposed estimation strategies are assessed through a large simulation study and an application to a financial dataset.

Joint with Matteo Barigozzi

17:10 – 17:50 **Greta GORACCI (**University of Bozen), Robust estimation for threshold autoregressive moving-average

Threshold autoregressive moving average models have gained attention in econometrics, statistics and other fields, due to their ability to describe nonlinear features in the data, such as chaos, asymmetric cycles and irreversibility, using few parameters. However, neither theory nor suitable estimation methods are currently available when the data presents extremely heavy tails or anomalous observations deviating from the assumed model structure. In this paper, we introduce robust parameter estimation for TARMA models by minimizing a M-estimating objective function with bounded derivative, which ensures certain robustness properties of the resulting estimator. Under mild conditions, we show that the robust estimator for the threshold parameter is super-consistent, while those for the autoregressive and moving average parame- ters are strongly consistent and asymptotically normal. The finite sample performance of the new estimator is studied through Monte Carlo simulations and an empirical application on the dynamics of commodity prices is provided.

Joint with Davide Ferrari, Simone Giannerini, Francesco Ravazzolo

17:50 – 18:30 **Matteo FARNE'** (University of Bologna), An algebraic estimator for large spectral density matrices

A new estimator of high-dimensional spectral density matrices is introduced which is called UNshrunk ALgebraic Spectral Estimator (UNALSE), under the assumption of an underlying low rank plus sparse structure, as typically assumed in dynamic factor models. The UNALSE is computed by minimizing a quadratic loss under a nuclear norm plus l1 norm constraint to control the latent rank and the residual sparsity pattern. The loss function requires as input the classical smoothed periodogram estimator and two threshold parameters, the choice of which is thoroughly discussed. We prove the consistency of UNALSE as both the dimension pand the sample size T diverge to infinity, as well as algebraic consistency, i.e., the recovery of latent rank and residual sparsity pattern with probability one. The finite sample properties of UNALSE are studied by means of an extended simulation exercise as well as an empirical analysis of US macroeconomic data.

Joint with Matteo Barigozzi

CLOSING REMARKS AND DISCUSSION 18:30-18:40

20:00 Conference dinner

SUNDAY, OCTOBER 9 – SALA ULISSE

SESSION 1

09:00 – 09:40 **Kostantinos FOKIANOS** (University of Cyprus), Inference for Non-Stationary Heavy Tailed Time Series

We consider the problem of inference for non-stationary time series with heavy-tailed error distribution. Under a time-varying linear process framework we show that there exists a suitable local approximation by a stationary process with heavy-tails. This enable us to introduce a local polynomial based estimator which estimates consistently the time-varying parameter of the model at hand. The work is illustrated by real and simulated data examples.

Joint work with F. Akashi and J. Hirukawa.

09: 40 – 10:20 **Manfred DEISTLER** (Technische Universität Wien and Wirtschaftsuniversität), High Frequency Linear Time Series Models and Mixed Frequency Data

This talk is concerned with the problem of identifiability of the parameters of a high frequency multivariate autoregressive model from mixed frequency time series data. We demonstrate identifiability for generic parameter values using the population second moments of the observations. In addition we display a constructive algorithm for the parameter values and establish the continuity of the mapping attaching the high frequency parameters to these population second moments. These structural results are obtained using two alternative tools viz. extended Yule Walker equations and blocking of the output process. The cases of stock and flow variables, as well as of general linear transformations of high frequency data, are treated. Finally, we briefly discuss how our constructive

identifiability results can be used for parameter estimation based on the sample second moments.

10:20 – 11:00 **Gabriele FIORENTINI** (University of Florence), PML vs minimum chi-square: the comeback

Arellano (1989a) showed that valid equality restrictions on covariance matrices could result in efficiency losses for Gaussian PMLEs in simultaneous equations models. We revisit his two-equation example using finite normal mixtures PMLEs instead, which are also consistent for the mean and variance parameters regardless of the true distributions of the shocks. Because such mixtures provide good approximations to many distributions, we relate the asymptotic variance of our estimators to the semiparametric efficiency bound. Our Monte Carlo results indicate that they systematically dominate MD, and that the version that imposes the valid covariance restriction is more efficient than the unrestricted one.

Joint with Dante Amengual and Enrique Sentana

11:00– 11:30 **Coffee Break**

SESSION 2

11:30 – 12:10 **Marc HALLIN** (Université Libre de Bruxelles), A Class of Rank-Based VARMA Portmanteau Tests: Chitturi-Hosking-Li-McLeod Revisited

The so-called *portmanteau test* is certainly among the most popular and most widely used testing procedures in time series analysis. It is simple, intuitive, apparently well understood, and naturally complements eye inspection of residual correlograms. The classical asymptotic theory for these tests, however, is surprisingly imprecise. Revisiting this theory in the light of Le Cam's asymptotic theory of statistical experiments, we also develop a class of rank-based versions that appears more robust and more powerful than the classical one.

Joint with Hang Liu (University of Science and Technology of China, Hefei)

12:10 – 12:50 **Matteo BARIGOZZI** (University of Bologna), Quasi Maximum Likelihood Estimation and Inference of Large Approximate Dynamic Factor Models via the EM algorithm

This paper studies Quasi Maximum Likelihood estimation of Dynamic Factor Models for large panels of time series. Specifically, we consider the case in which the autocorrelation of the factors is explicitly accounted for, and therefore the model has a state-space form. Estimation of the factors and their loadings is implemented through the Expectation Maximization (EM) algorithm, jointly with the Kalman smoother. We prove that as both the dimension of the panel n and the sample size T diverge to infinity, up to logarithmic terms: (i) the estimated loadings are asymptotically normal if $\sqrt{T}/n \to 0$; (ii) the estimated factors are $\sqrt{n}$-consistent and asymptotically normal if $\sqrt{n}/T \to 0$; (iii) the estimated common component is $\min(\sqrt{n}, \sqrt{T})$-consistent and asymptotically normal regardless of the relative rate of divergence of n and T. Although the model is estimated as if the idiosyncratic terms were cross-sectionally and serially uncorrelated and normally distributed, we show that these mis-specifications do not affect consistency. Moreover, the estimated loadings are asymptotically as efficient as those obtained with the Principal Components estimator, while the estimated factors are more efficient if the idiosyncratic covariance is sparse enough. We then propose robust estimators of the asymptotic covariances, which can be used to conduct inference on the loadings and to compute confidence intervals for the factors and common

components. Finally, we study the performance of our estimators and we compare them with the traditional Principal Components approach through MonteCarlo simulations and analysis of US macroeconomic data.

Joint with Matteo Luciani

12:50 – 14:00 **LUNCH**

SESSION 3

14:00 – 14:40 **Hiroshi SHIRAISHI** (Keio University), Time Series Quantile Regression by using Random Forests

The Quantile Regression introduced by Koenker and Bassett (1978) has been widely used in many fields and extended to be applicable for many stochastic models. Among them, the Quantile Regression Forests (QRF) introduced by Meinshausen (2006) is a procedure to fit observed data to a quantile regression model by using Random Forest. In this study, we consider the QRF in the case that the observed data is a class of time series model.

Joint work with Ryotaro Shibuki (Keio Univ.) and Tomoshige Nakamura (Keio Univ.).

14:40 – 15:20 **Yan LIU** (Waseda University), Semiparametric empirical likelihood for circular distribution

We consider the empirical likelihood of the data coming from the circular distribution. Many circular distributions have probability densities proportional to ones among the ARMA spectra family. However, many parameters of interest do not have explicit forms. We propose a semiparametric empirical likelihood method for statistical inference for circular distributions. The empirical likelihood ratio has a chi-squared limiting distribution. The theoretical results are justified by numerical simulations and real data analysis.

Joint work with Lan Wu (Waseda Univ.) and Masanobu Taniguchi (Waseda Univ.).

15:20 – 16:00 **Simone GIANNERINI** (University of Bologna), Testing for threshold effects in presence of volatility and measurement error: the case of Italian strikes

We address the issue of testing for a threshold ARMA effect in presence of conditional heteroscedasticity. We show that tests that do not account for the presence of volatility fail to achieve the correct size even for moderate sample sizes. We propose a supremum Lagrange Multiplier test statistic where the null hypothesis specifies a linear ARMA-GARCH model against the alternative of a TARMA-GARCH model. We derive the asymptotic theory for the test and use it for the analysis of the macroeconomics series of Italian strikes. We show that the TARMA-GARCH specification is consistent with the relevant macroeconomic theory while capturing the main features of the Italian strikes dynamics, such as asymmetric cycles and regime switching. Moreover, we show that the TARMA specification naturally accounts for the ubiquitous presence of measurement error that affects macroeconomic data.

Joint with F. Angelini, M. Castellani, G. Goracci

16:00– 16:30 **Coffee Break**

SESSION 4

16:30 – 17:10 **Ilia NEGRI** (University of Bergamo), Z-process method for change point problems in time series

Z-process method were introduced as a general unified approach based on partial estimation functions to construct a statistical test in change point problems for ergodic models but also for some models where the Fisher information matrix is random. In this paper, we consider the problem of testing for parameter changes in time series models based on this Z-process method. As examples, we consider the change of the parameter in some linear time series models. Some possibilities for non linear model are also discussed.

17:10 – 17:50 **Francesca PAPAGNI** (University of Bozen), Efficient nonparametric estimation of generalized autocovariances

This paper provides a necessary and sufficient condition for asymptotic efficiency of a nonparametric estimator of the generalised autocovariance function of a stationary random process. The generalised autocovariance function is the inverse Fourier transform of a power transformation of the spectral density and encompasses the traditional and inverse autocovariance functions as particular cases. A nonparametric estimator is based on the inverse discrete Fourier transform of the power transformation of the pooled periodogram. We consider two cases: the fixed bandwidth design and the adaptive bandwidth design. The general result on the asymptotic efficiency, established for linear processes, is then applied to the class of stationary ARMA processes and its implications are discussed.
Finally, we illustrate that for a class of contrast functionals and spectral densities, the minimum contrast estimator of the spectral density satisfies a Yule-Walker system of equations in the generalised autocovariance estimator.

Joint with Alessandra Luati and Tommaso Proietti

CLOSING REMARKS AND DISCUSSION 17:50-18:00