Sponsored by the Society for Computational Economics.

The workshop aims at bringing together researchers and practitioners to discuss recent developments in computational methods for decision making and design. The workshop will cover computational methods and tools for decision and control in economics, finance, management and engineering. This is intended to include areas such as data mining, management science/operations research, econometrics, statistics, computer science, numerical methods, engineering decision and design problems such as control systems, process systems, power systems and energy production.

Papers are solicited that deal significantly with computational aspects of such topics as: linear and nonlinear systems, econometrics, statistics, stochastic control, automatic differentiation, nonlinear model solution methods, mathematical programming algorithms, variational inequality and other algorithms for computing equilibria, algorithmic models of decision making including genetic algorithms, auction modeling, neural networks, artificial intelligence, computability and complexity theory, parallel and supercomputing, qualitative reasoning and models including qualitative simulation.

Publication:

- Peer review papers will be considered for publication in a special issue of the journal Computational Management Science. Submissions and information: Berc Rustem (br@doc.ic.ac.uk).
- Papers containing a strong computational statistics component will be considered for publication in the journal Computational Statistics & Data Analysis. Standard peer review procedure will be applied. Submissions and information: Erricos John Kontogiorghes (journal.csda@unine.ch).

Co-Chairs:
E.J. Kontogiorghes (CH), A. Nagurney (USA), P. Pardalos (USA) and B. Rustem (UK).

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Local organizing committee:
E.J. Kontogiorghes, C. Gatu, P. Yanev, M. Fyrillas (Univ. of Neuchâtel); S. Panis (Cyprus Telecommunications Authority); P. Masouras (Cyprus Computer Society).

Important dates:
- Submission of 1-page abstracts: 19 February 2003
- Notification of acceptance: 25 February 2003
- Workshop: 28-30 March 2003
- Submission of full papers: 30 May 2003
- Notification of acceptance: 30 August 2003
- Final papers: 30 November 2003
Scientific Programme

International Workshop on
Computational Management Science, Economics, Finance and Engineering

Scientific Programme

Friday 28th March 2003

- 8:45 - 9:00 Opening
- 9:00 - 10:00 Keynote Talk (N. Christofides)
- 10:00 - 10:30 Coffee Break
- 10:30 - 12:30 Sessions 1, 2
- 12:30 - 14:00 Break
- 14:00 - 16:00 Sessions 3, 4
- 16:00 - 16:30 Coffee Break
- 16:30 - 18:30 Sessions 5, 6
- 19:00 - 20:00 Reception

Saturday 29th March 2003

- 9:00 - 10:00 Tutorials 1, 2
- 10:00 - 10:30 Coffee Break
- 10:30 - 12:30 Sessions 7, 8
- 12:30 - 14:00 Break
- 14:00 - 16:00 Sessions 9, 10
- 16:00 - 16:30 Coffee Break
- 16:30 - 18:30 Sessions 11, 12
- 20:30 - 23:30 Workshop Dinner

Sunday 30th March 2003

- 8:30 - 10:30 Sessions 13, 14
- 10:30 - 11:00 Coffee Break
- 11:00 - 12:30 Sessions 15, 16
- 12:30 - 13:15 Keynote Talk (C. Charalambous)

Notes:
- The Opening and Keynote Talks will take place in ARIS lecture room.
- Sessions with odd and even numbers will take place in ARIS and APHRODITE lecture rooms, respectively.
- The Coffee Breaks will take place at the far end of the lobby area.
- The Reception will take place at the pool area.
- The Workshop Dinner will take place in the Ambrosia Restaurant.
Keynote Talks

Friday, 28th March 2003, 9:00 Room: ARIS Chair: B. Rustem
Mathematical methods in risk management.
N. Christofides

Sunday, 30th March 2003, 12:30 Room: ARIS Chair: E. Xekalaki
Research activities on computational management science, Univ. of Cyprus.
C. Charalambous

Tutorials

Saturday, 29th March 2002, 9:00 Room: ARIS Chair: I. Maros
Expected value optimisation and minimax for robust decisions.
B. Rustem

Saturday, 29th March 2002, 9:00 Room: APHRODITE Chair: D.S.G. Pollock
DYNARE: a simulation platform for non-linear rational expectation models.
M. Juillard

Session 1: Optimization methods

Friday, 10:30-12:30 Room: ARIS Chair: J. Gondzio
Preconditioning indefinite systems in interior point methods for optimization.
J. Gondzio
On improving the von Neumann algorithm for linear programming.
J. Goncalves, J. Gondzio and R. Storer
Parallel price coordination for investing strategy optimization.
E. Niewiadomska-Szynkiewicz
Application of the cutting plane method in distributed nonlinear optimization with the direct decomposition.
A. Karbowski

Session 2: Time series

Friday, 10:30-12:30 Room: APHRODITE Chair: A. Luati
General local search methods in time series.
R. Baragona
Some further results on time series of counts.
K. Fokianos
Testing nonlinear dynamics in real world time series.
D. Kugiumtzis
Fixed and random innovative outliers in sets of time series.
V. Karioti and C. Caroni
Scientific Programme

Session 3: **Optimization problems**

Friday, 14:00-16:00  
Room: ARIS  
Chair: A. Migdalas

**A new view of phase-1 in the dual simplex method.**  
I. Maros

**A bilevel programming approach to the location routing problem.**  
A. Migdalas and Y. Marinakis

**Data models and decision models for asset and liability management under uncertainty.**  
G. Birbilis, T. Kyriakis and G. Mitra

**Quadratic interior-point methods in statistical disclosure control.**  
J. Castro

Session 4: **Filters**

Friday, 14:00-16:00  
Room: APHRODITE  
Chair: D.S.G. Pollock

**A robust linear filter for non stationary time series mean prediction.**  
A. Luati and E. B. Dagum

**New algorithms for dating the business cycle.**  
T. Proietti

**Kolmogorov-Wiener filters for finite time series.**  
C. Schleicher

**Improved frequency selective filters.**  
D.S.G. Pollock

Session 5: **Computational economics - 1**

Friday, 16:30-18:30  
Room: ARIS  
Chair: M. Juillard

**What is the contribution of a k order approximation.**  
M. Juillard

**Discrete wavelet analysis in dyadic and non-dyadic intervals.**  
D.S.G. Pollock and I. Lo Cascio

**Is your asymptosis terminal.**  
R. O’Brien

**Using Bayesian networks for estimating the risk of default in credit scoring.**  
M. Egmont-Petersen, B. Baesens and A. Feelders

Session 6: **Robust & bootstrap applications**

Friday, 16:30-18:30  
Room: APHRODITE  
Chair: A. Marazzi

**Robust GMM analysis of models for the short rate process.**  
E. Ronchetti, R. Dell’Aquila and F. Trojani

**Robust statistical procedures for asymmetric distributions and applications to the analysis of hospital costs.**
A. Marazzi
Estimation in hazard regression models under monotone departures from proportionality.

A. Bhattacharjee
A multivariate analysis and visualization system for analysing patent data and producing technological and scientific indicators.

K. Perdikuri, P. Markellou, S. Sirmakessis, A. Tsakalidis, G. Mavritsakis and K. Markellos

Session 7: Finance

Saturday, 10:30-12:30 Room: ARIS Chair: S. Siokos

A comparison of different equity risk models.
S. Siokos and M. Benjamin

Asset allocation for asset managers: the MIG2000+ model.
D. Mignacca, M. Marchesi and E. Rossignani

Treasury auctions: the spanish format.
F. Alvarez and C. Mazon

Optimal limit order strategies.
F. G. Padilla, G. Iori and Z. Mihail

Session 8: Computational econometrics

Saturday, 10:30-12:30 Room: APHRODITE Chair: V. Hajivassiliou

Parallel computation in econometrics: a simplified approach.
J. Doornik, D. Hendry and N. Shephard

Efficient strategies for computing the subset VAR models.
C. Gatu, P. Foschi and E. J. Kontogiorghes

Selecting, estimating and evaluating non-linear models.
P. McSharry

Implementing econometric estimators on parallel computers.
V. Hajivassiliou

Session 9: Portfolio optimization

Saturday, 14:00-16:00 Room: ARIS Chair: M. Gilli

Great expectations and broken promises: risk constraints and assumed distributions in portfolio optimization.
D. Maringer

A multivariate FGD technique to improve VaR computation in equity markets.
G. Barone-Adesi and F. Audrino

Decomposition of multistage stochastic quadratic problems in financial engineering.
P. Parpas and B. Rustem

New numerical approaches to portfolio optimization.
M. Gilli and E. Kellezi
Session 10: **Neural networks & applications**

Saturday, 14:00-16:00  
Room: APHRODITE  
Chair: M. Polycarpou

**Artificial neural networks in medical imaging systems.**  
C. Pattichis, C. Christodoulou, E. Kyriakou and M. Pattichis

**Topology selection for feed-forward neural network models.**  
M. La Rocca and C. Perna

**Isolating sources of variation in multivariate distributions using neural networks.**  
C. Draganova, A. Lanitis and C. Christodoulou

**The incorporation of background knowledge in the data mining process and data mining algorithms.**  
E. Caron and H. Daniels

Session 11: **Least squares and applications**

Saturday, 16:30-18:30  
Room: ARIS  
Chair: B. Mirkin

**Towards comprehensive clustering of mixed scale data with K-Means.**  
B. Mirkin

**An adaptive algorithm for least squares piecewise monotonic data fitting.**  
I. Demetriou

**Least squares data imputation within nearest neighbour framework.**  
I. Wasito

**Conjugate gradient methods for estimating sparse simultaneous equations models.**  
P. Foschi and E. J. Kontoghiorghes

Session 12: **Computational economics - 2**

Saturday, 16:30-18:30  
Room: APHRODITE  
Chair: J. Doornik

**Applications of Toeplitz matrices in econometrics.**  
J. Doornik

**Non-linear stochastic price adjustment of securities.**  
S. Onyango and M. Ingleby

**Computational methods for the analysis of the dynamics of prices for storable commodities.**  
C. Cafiero

**Two sides of the same coin.**  
P. Mantalos

Session 13: **Financial modelling**

Sunday, 8:30-10:30  
Room: ARIS  
Chair: H. Vladimirou

**Reversible investment decisions with stochastic switching costs.**  
S. Martzoukos, N. Pospori and L. Trigeorgis
Evaluating volatility forecasts in option pricing in the context of a simulated options market.
   E. Xekalaki and S. Degiannakis

Option pricing with artificial neural networks and implied parameters.
   S. Martzoukos, P. Andreou and C. Charalambous

Models for managing risk in international investment portfolios.
   H. Vladimirou, N. Topaloglou and S. Zenios

Session 14: **Computational statistics**

Sunday, 8:30-10:30 Room: APHRODITE Chair: C. Koukouvinos

Statistical criteria for evaluating fractional factorial designs that arise from Hadamard matrices.
   C. Koukouvinos, C. Charalambides and H. Evangelaras

A comparison between Groebner bases approach and hidden projection properties in factorial designs.
   H. Evangelaras and C. Koukouvinos

Optimal Cross-Over Designs
   S. Kounias and M. Chalikias

Forecasting a stock market index using a combination of linear models and neural networks.
   H. Tsangari and P. Andreou

Session 15: **Computationally intelligent systems**

Sunday, 11:00-12:30 Room: ARIS Chair: A. Andreou

Using computational intelligent tools for analyzing and predicting financial and defence economics time-series data.
   A. Andreou

Review of computational intelligence techniques in decision-making in financial, economic and political dynamical systems.
   C. Neocleous and C. Schizas

Evolutionary fuzzy cognitive maps as a technique for modeling political crisis situations and decision-making.
   N. Mateou, A. Andreou and G. Zombanakis

Session 16: **Statistics & engineering**

Sunday, 11:00-12:30 Room: APHRODITE Chair: C. D. Charalambous

UMTS Vs CDMA2000 for a satellite environment.
   I. Krikidis, J. L. Danger and L. Naviner

3D ultrasound texture segmentation, using Bayesian networks classifier, based on Markov Chain Monte Carlo method.
   N. Archip and R. Rohling

Probabilistic representations of the Burgers’ model of turbulence.
   C. D. Charalambous
MATHEMATICAL METHODS IN RISK MANAGEMENT

Nicos Christofides
Centre for Quantitative Finance, Imperial College, London, UK
n.Christofides@imperial.ac.uk
RESEARCH ACTIVITIES ON COMPUTATIONAL MANAGEMENT SCIENCE, UNIV. OF CYPRUS.

C. Charalambous
Dept. of Public & Business Administration, University of Cyprus
bachris@ucy.ac.cy
EXPECTED VALUE OPTIMISATION AND MINIMAX FOR ROBUST DECISIONS

Berc Rustem
Dept of Computing, Imperial College, London, UK
E-mail: br@doc.ic.ac.uk

Keywords: worst-case design, minimax, expected values

Abstract

We discuss strategies and algorithms for minimax (worst-case robust) decisions and expected value optimisation for nonlinear models. We compare the results from both strategies.

Minimax yields a guaranteed basic worst-case optimal strategy which will improve if the worst-case does not materialise. As such, it provides a basic insurance cover. Expected value optimisation, on the other hand, corresponds to the best mean-optimal decision. We argue that wise decision making requires the justification of policies based on expected value optimisation in view of the worst-case scenario. Conversely, the cost of assured performance provided by robust worst-case decision making needs to be evaluated relative to optimal expected values.
DYNARE: A SIMULATION PLATFORM FOR NON-LINEAR RATIONAL EXPECTATION MODELS

Michel Juillard
CEPREMAP, University Paris 8, Paris, France
michel.juillard@cepremap.cnrs.fr

**Keywords:** DSGE modelling, rational expectations, simulation

**Abstract**

DYNARE is a simulation platform running over MATLAB or SCILAB. It is aimed at analyzing, solving and simulating linear and nonlinear rational expectation models.

In this tutorial, we will learn how to write a model file to use DYNARE. Then, through examples from growth theory, macroeconomics and monetary policy, we will illustrate deterministic simulations, dynamic analysis, linear approximations and quadratic approximations of stochastic dynamic general equilibrium models.

DYNARE is available at http://www.cepremap.cnrs.fr/dynare
PRECONDITIONING INDEFINITE SYSTEMS IN INTERIOR POINT METHODS FOR OPTIMIZATION

Jacek Gondzio
School of Mathematics, University of Edinburgh, Edinburgh, Scotland
E-mail: J.Gondzio@ed.ac.uk

Keywords: Iterative Methods, Preconditioners, Interior Point Methods

Abstract

In this talk we concentrate on the advantages of iterative solution techniques applied to the regularized KKT system in interior point methods. A number of methods have been implemented including conjugate gradients, BiCGSTAB, GMRES and QMR. Since the presence of the interior point scaling matrix causes unavoidable ill-conditioning of linear systems, iterative methods fail to provide sufficient accuracy unless appropriately preconditioned. In this talk we propose a number of indefinite preconditioners. Our concern is to find a significantly sparser factorization than that of the KKT system and still capture most of the numerical properties of this system. We illustrate our approach by applying it to a number of public domain large quadratic problems. From the numerical results we conclude that the solution times for such problems on a modern PC are measured in minutes when direct methods are used and drop to seconds when iterative methods with appropriate preconditioners are used. This is a joint work with Luca Bergamaschi and Giovanni Zilli from the University of Padova.
ON IMPROVING THE VON NEUMANN ALGORITHM FOR LINEAR PROGRAMMING

Joao Goncalves  
*Lehigh University, Bethlehem, PA 18015, USA*  
*E-mail: jog7@lehigh.edu*

Jacek Gondzio  
*The University of Edinburgh, Edinburgh, UK*

Robert Storer  
*Lehigh University, Bethlehem, PA, USA*

**Keywords:** Linear Programming, von Neumann algorithm

**Abstract**

In this talk, we discuss the von Neumann algorithm for linear programming. In particular, we analyze the convergence of the algorithm and provide some insights about the reasons for its slow convergence. We then present new algorithmic ideas that aim at accelerating the convergence of the von Neumann algorithm. We also show how to reduce any linear programming problem to the "standard" form of the von Neumann algorithm. Finally, we present numerical results on linear programming problems from the netlib library that show the improvements obtained by the algorithms proposed over the von Neumann algorithm.
PARALLEL PRICE COORDINATION FOR INVESTING STRATEGY OPTIMIZATION

Ewa Niewiadowska-Szynkiewicz
Research and Academic Computer Network (NASK), Warsaw, Poland
E-mail: e-n-s@ia.pw.edu.pl

Keywords: hierarchical optimization, parallel computing, optimal portfolio selection

Abstract

Simulation results of application of the parallel hierarchical optimization method - the Price Method for investing strategy optimization are presented. The hierarchical methods are devoted to large scale systems optimization, where the size of the problem is high and the calculation process may be partitioned into several units. Subsystems may be connected directly, through interactions or indirectly through physical constrains (for example resources) or common goals. It is natural to model such a complex system as a set of calculation processes, which can be handled by distributed machines or processors.

The considered case study is portfolio selection. The task is to generate the optimal investing policy for stocks that could be bought or sell at stock exchange. The budget of the investor is fixed. His goal is to maximize the return and minimize the risk, which results two criteria - expected value and variance of profit (as defined by Markowitz). To apply the Price Method to solve the considered problem some modifications had to be done. All stocks in the considered stock exchange were divided into several groups (N), each consisting of several elements (M). In this way the optimization problem was decomposed into N local problems and one coordinator problem. The objective of the coordinator was to guarantee the fulfillment of the global constraint for the fixed capital. Simulations were performed for Warsaw Stock Exchange, in the period 1995-2002. Historical data were partitioned into two groups. The first was used as a source of data for optimization algorithm. The second group was used to test a quality of obtained investing policies. Experiments were performed for two models of risk (standard - Markowitz and modified) and different variants of the optimization problem decomposition. Various preferences of the investor were taken into account. The portfolio optimization was repeated for current data, taking into account provisions of stocks selling and buying. The calculations were carried out on the network of computers using MPI interface. The efficiency of parallel synchronous version of the Price Method was tested.
APPLICATION OF THE CUTTING PLANE METHOD IN DISTRIBUTED NONLINEAR OPTIMIZATION WITH THE DIRECT DECOMPOSITION

Andrzej Karbowski
NASK (Research and Academic Computer Network), Warsaw, Poland
E-mail: A.Karbowski@ia.pw.edu.pl

Keywords: Nonlinear programming, hierarchical optimization, decomposition, the direct method, cutting plane method

Abstract

The direct method of hierarchical optimization, where at the higher level the coordination vector is calculated and at the lower level, treating this vector as a parameter, all local problems are independently solved, has one serious drawback. Namely, it is very difficult to calculate the set of feasible values of coordinating variables, that is such values for which local problems have solutions. This set is not given explicitly, the formulas to estimate it are very complicated. To the author’s knowledge, until now there were no attempts to apply other methods of constrained optimization than the penalty method with extended decision space. It seems promising to apply instead Kelley’s cutting plane method. The main idea of the proposed approach lies in performing for every query point (that is the current value of coordinating variables) verification of the feasibility from the point of view of the mixed constraints, independently for all local problems, and - in the case of a failure - adding the corresponding linear constraints to the coordination problem. The author proved, that this approach leads to the solution of the original problem. The computational experience confirmed its effectiveness.
GENERAL LOCAL SEARCH METHODS IN TIME SERIES

Roberto Baragona

Dipartimento di Sociologia e Comunicazione, Università’ di Roma "La Sapienza", Roma, Italy
E-mail: roberto.baragona@uniroma1.it

Keywords: evolutionary operators, combinatorial optimization, nonlinear time series models, subset autoregressive moving average models, outliers, cluster of time series

Abstract

In time series often arise problems that involve large discrete solution spaces. It may happen that either searching such spaces cannot be accomplished by exhaustive enumeration or satisfactory methods do not exist which are able to yield the optimal solution for problems of moderate and large size. For instance, some nonlinear model parameter estimation, subset autoregression (possibly including moving average terms), outlier identification, clustering time series are all tasks that require the right combination of several parameters to be discovered. General local search methods, also called meta heuristics, or general heuristics, proved to be able to offer useful procedures that may solve such combinatorial-like problems approximately (even exactly, in some circumstances) and in reasonable computing time. We consider the three most popular general local search methods, that is simulated annealing, tabu search and genetic algorithms. Their increasingly wide application in several fields, including many "classical" problem (graph coloring, vehicle routing and salesman traveling, for instance), prompted the use of such methods in statistics and, in particular, in time series analysis. Examples of procedures will be discussed, and some comparisons between meta heuristics and different well established techniques will be presented. Then, suggestions for future developments will be briefly outlined which include, for instance, filter design and wavelet filtering, outlier detection in vector time series, threshold autoregressive moving average models.
SOME FURTHER RESULTS ON TIME SERIES OF COUNTS

Konstantinos Fokianos
University of Cyprus, Department of Mathematics and Statistics, Lefkosia, Cyprus
E-mail: fokianos@ucy.ac.cy

Keywords: partial likelihood, log–linear model, estimation

Abstract

Regression models for time series of counts have been developed over the last years within the framework of generalized linear models methodology to take into account serial dependence that occurs so frequently in applications. Estimation, testing and prediction can be routinely carried out using standard conditional/partial likelihood methods under certain regularity conditions. The aim of this communication is to report some further results on this still evolving applied area by discussing an autoregressive moving average model for time series of counts. Several simulations enrich the theoretical results.
TESTING NONLINEAR DYNAMICS IN REAL WORLD TIME SERIES

Dimitris Kugiumtzis

Department of Mathematical, Physical and Computational Sciences, Polytechnic School, Aristotle University of Thessaloniki, Greece
E-mail: dkugiu@gen.auth.gr

Keywords: Time series analysis, surrogate data test, nonlinear dynamics

Abstract

The investigation of nonlinear dynamics in time series has gained much attention in the last years, also due to the advance of chaos theory and its applications. The surrogate data test for nonlinearity is considered the most rigorous statistical test for this purpose. The most general null hypothesis for this test is that the examined time series is generated by a Gaussian (linear) process undergoing a possibly nonlinear static transform. To test the null hypothesis an estimate from a nonlinear method applied to the original data is compared to the respective estimates from a set of surrogate time series representing the null hypothesis. We discuss the test in particular with respect to the algorithms proposed for the generation of surrogate data and we assess the performance of the algorithms and the test on a number of real world time series. In particular, we apply the test on volatility data from monthly exchange rate USD/GBP and on time series from an experiment on plastic deformation of polycrystal alloys.
FIXED AND RANDOM INNOVATIVE OUTLIERS IN SETS OF TIME SERIES

Vassiliki Karioti  
National Technical University of Athens, Patras, Greece  
E-mail: vaskar@otenet.gr

Chrys Caroni  
National Technical University of Athens, Patras, Greece

Keywords: time series model, IO, AR(p) model, fixed, random

Abstract

The problem of detecting outliers in time series has been examined quite often, in the standard setting of a single long series of observations. However, many practical problems give rise instead to a set of several or many short series. In the present paper, we examine the problem of detecting outlying observations in sets of time series. Our interest lies in the case of an outlier that affects every series at the same time point. We construct models for the innovative outlier, which affects not only the observation at that time but also subsequent observations. The model for each time series is assumed to be AR(p). In one class of model, the outliers are represented as a random effect and we obtain likelihood ratio tests. In a second class of model, we take the size of the outliers to be the same in each series and in this case, a standard regression framework can be used, with various assumptions about the correlations between the noise terms in different series (heteroscedastic uncorrelated, unrestricted and equicorrelated). The performance of these tests is investigated in detail for the AR(1) case, since the length of sets of time series is often relatively short, in which case only simple models can be fitted. Simulation studies show that approximate critical values obtained from the distribution work well for heteroscedastic independent series and for the case of equal correlations between each pair of series.
A NEW VIEW OF PHASE-1 IN THE DUAL SIMPLEX METHOD

Istvan Maros
Department of Computing, Imperial College, London, UK
E-mail: i.maros@doc.ic.ac.uk

Keywords: Linear Programming, Simplex Method, Duality, Computational Techniques

Abstract

The success of the dual simplex method relies on the availability of a dual basic feasible solution. If it is not available a dual phase-1 procedure must be used to create one. Real world linear programming problems include all types of variables and constraints. This necessitates a version of the dual phase-1 that can handle all types of variables efficiently. We present a very capable dual algorithm which is based on the piecewise linear nature of the phase-1 dual objective function. In each iteration it maximizes a piecewise linear function of dual infeasibilities in order to make the largest possible step towards dual feasibility with a selected outgoing variable. The algorithm can be viewed as a generalization of traditional phase-1 procedures. It is based on the multiple use of the expensively computed pivot row. By small amount of extra work per iteration, the progress it can make is equivalent to many iterations of the traditional method. While this is its most important feature, it possesses some additional favorable properties, namely, it can be efficient in coping with degeneracy and numerical difficulties. Some computational experience is also reported which shows the potentials of the method on real world problems.
A BILEVEL PROGRAMMING APPROACH TO THE LOCATION ROUTING PROBLEM

Athanasios Migdalas
Technical University of Crete. Department of Production Engineering and Management. Decision Support System Laboratory

Yannis Marinakis
Technical University of Crete, Department of Production Engineering and Management, Decision Support System Laboratory, University Cambus, Chania, Crete, Greece
E-mail: marinakis@ergasya.tuc.gr

Keywords: Location Routing Problem, Logistics, Vehicle Routing Problem, Local Search, Meta-Heuristics, Bilevel Programming

Abstract

In the last few years, the need of an integrated logistic system has become a primary objective of every manager in a company. Managers recognize that there is a strong relation between the location of facilities, the allocation of suppliers and customers to the facilities and in the design of routes around the facilities. In the Location Routing Problem (LRP) the optimal number, the capacity and the location of facilities is determined and, also, the optimal set of vehicle routes from each facility is sought. In this paper, a new formulation for the Location Routing Problem is proposed and a new algorithm for the solution of the problem is presented. An application of the approach to a wood industry in Greece is also discussed.
DATA MODELS AND DECISION MODELS FOR ASSET AND LIABILITY MANAGEMENT UNDER UNCERTAINTY

George Birbilis
CARISMA, Department of Mathematical Sciences, Brunel University, Uxbridge, UB8 3PH, UK

Triphonas Kyriakis
Analytics, Research House, Perivale, UK
E-mail: info@analytics-solutions.com

Gautam Mitra
CARISMA, Department of Mathematical Sciences, Brunel University, Uxbridge, UB8 3PH, UK

Keywords: Asset and Liability Management, stochastic programming, Value at Risk (VaR), Conditional Value at Risk (CVaR), On-line Analytical Processing (OLAP)

Abstract

Much recent work in the domain of Asset and Liability Management (ALM) has documented the successful use of stochastic programming models in the underlying investment decision process. We analyse the salient aspects of such a decision support framework and show how their practical implementation is based on the integration of alternative modelling components, namely, data models, decision models, and descriptive evaluation models. We discuss the issue of optimal financial planning under uncertainty in which randomness is first captured by a scenario generation system that makes use of econometric models and then embedded within a stochastic programming model for ALM. The coupling of the scenario generation system and the ALM model provides a robust platform for computing optimum hedged decision. We extend this well-established framework to further include simulation models for evaluating the underlying hedged decisions and subsequently underpin the efficacy of the optimisation solution. This descriptive approach of simulation also enables us to compute ?metrics? such as Value at Risk (VaR) and Conditional Value at Risk (CVaR) for these financial planning ?risk decisions?. Finally, we demonstrate how the modern information systems technologies such as On-line Analytical Processing (OLAP) can be used for exploring the data instances of the analytical models and their results.
QUADRATIC INTERIOR-POINT METHODS IN STATISTICAL DISCLOSURE CONTROL

Jordi Castro
Dept. of Statistics and Operations Research, Universitat Politècnica de Catalunya, Barcelona, Spain
E-mail: jcastro@eio.upc.es

Keywords: Interior-point methods, Quadratic programming, Large-scale programming, Statistical disclosure control, Perturbation methods, Tabular data

Abstract

National Statistical Institutes (NSI) routinely release tabular data with any dimension and structure. Each cell of the tables is made up of the information of several individual records. However NSIs must guarantee that no individual information can be derived from the released tables. One widely used type of methods to reduce the disclosure risk is based on the perturbation of the cell values. We consider a new perturbation method which, given a table (or set of tables) to be protected, finds the closest one that satisfies some properties.

This approach means solving a quadratic optimization problem with a much larger number of variables than constraints. Real instances can provide problems with millions of variables. We show than interior-point methods are an effective choice for that problems, and, also, than specialized algorithms that exploit the problem structure can be faster than state-of-the art general solvers. Some preliminary results are presented for problems of up to 1000000 variables.
A ROBUST LINEAR FILTER FOR NON STATIONARY TIME SERIES MEAN PREDICTION

Alessandra Luati  
University of Bologna, Department of Statistics, Bologna, Italy  
E-mail: luati@stat.unibo.it

Estela Bee Dagum  
University of Bologna, Department of Statistics

Keywords: Symmetric weight system; false turning points; gain function; 13-term Henderson filter

Abstract

Dagum (1996) developed a non linear non parametric estimator shown to have excellent properties concerning the prediction of non stationary mean (trend-cycle) of time series characterized by several points of maxima and minima. Relative to the widely applied classical 13-term Henderson filter, this estimator reduces significantly the number of false turning points (unwanted ripples), without increasing the time lag to detect true turning points. In this study, we develop a linear approximation for the symmetric part of the Dagum estimator to obtain a robust filter that is not data dependent. The statistical properties of the new filter are studied by means of spectral analysis.
NEW ALGORITHMS FOR DATING THE BUSINESS CYCLE

Tommaso Proietti  
Dipartimento di Scienze Statistiche, Università di Udine, Udine, Italy  
E-mail: proietti@dss.uniud.it

Keywords: Signal extraction; Low and Band-pass filters; Markov Chains; Simulation smoothing; Structural time series models; Kalman filter and smoother

Abstract

The paper presents a set of new algorithms for dating the business cycle turning points, both in the classical and in the deviation from trend perspectives. As for the former, following the sequence of steps in the celebrated Bry and Boschan (1971) routine, candidate points are detected on the smoothed series extracted by Butterworth or Rational Square Wave filters, by means of an dating algorithm based on an inhomogeneous Markov chain that ensures alternation of phases (recessions and expansions) and enforces minimum duration ties concerning the phases and a full cycle. The cut-off frequency of the low pass filters is determined by the full cycle minimum duration. The corresponding signals are deeply related to the kind of trends that are often entertained in economics. Final turning points are identified on the original series by a constrained search around the preliminary points. The methods proposed take into account the developments in the filtering literature, are clearer to understand and to implement, typically requiring less iterations than the Bry and Boschan routine. Dating the deviation cycle poses similar problems, but it requires band pass filters or cyclical models; moreover, the proposed dating algorithm takes into consideration the constraint that peaks and troughs can only occur when the cycle is positive and negative, respectively.
KOLMOGOROV-WIENER FILTERS FOR FINITE TIME SERIES

Christoph Schleicher
University of British Columbia, Vancouver, Canada
E-mail: christoph@iam.ubc.ca

Keywords: business cycles, mechanical filters, spectral analysis, bootstrap

Abstract

This paper describes a framework of how linear filters can be optimally implemented for finite time series. It is shown that whenever parts of the range of the impulse response function of the ideal filter fall outside the sample, the truncated finite sample filter needs to be adjusted according to the time series properties of the filtered signal. The finite sample filters under consideration have the property that they minimize the mean squared error compared to some ideal hypothetical filter, that is, they are optimal in the sense of Kolmogorov and Wiener. In the frequency domain accuracy of the finite sample transfer function is weighed according to the spectral density of the filtered signal. It is shown in examples that three commonly used filters, the bandpass filter, the Hodrick-Prescott filter and the digital Butterworth filter need to be adjusted when applied to finite samples of serially correlated or integrated data. An empirical example indicates that the proposed optimal filters improve the end-of-sample performance of standard filters when applied to US GDP data.
IMPROVED FREQUENCY SELECTIVE FILTERS

Stephen Pollock
Dept. of Economics, Queen Mary College, University of London, Mile End Road, London, UK
E-mail: stephen-pollock@sigmapi.u-net.com

Keywords: Signal extraction, Linear filtering, Filter design, Trend estimation, Frequency-domain analysis

Abstract

An account is given of some techniques for designing recursive frequency-selective filters which can be applied to data sequences of limited duration which may be nonstationary. The designs are based on the Wiener–Kolmogorov theory of signal extraction which employs a statistical model of the processes generating the data. The statistical model may be regarded as an heuristic device which is designed with a view to ensuring that the resulting signal-extraction filters have certain preconceived properties.
WHAT IS THE CONTRIBUTION OF A K ORDER APPROXIMATION

Michel Juillard
CEPREMAP, University Paris 8, Paris, France

Keywords: perturbation method, dynamic stochastic general equilibrium models

Abstract

We know now that second order approximation of DSGE models gives us an approximation of the level effect on decision of future volatility, a precaution effect.

Increasing the order of the approximation, in most cases, refines the approximation of this level effect, but also modifies the elasticities of the decision rules. This paper proposes to study these effects in a series of small DSGE models currently used in economics (growth models, asset-pricing models, two-country models).

Doing so, several methodological questions relative to the use of perturbation methods will be addressed: around which point to compute the Taylor expansion? using the approximated decision rules to simulate the entire models or only the expectations? simulating with full or truncated polynoms?
DISCRETE WAVELET ANALYSIS IN DYADIC AND NON-DYADIC INTERVALS

Stephen Pollock
Dept. of Economics, Queen Mary College, University of London, Mile End Road, London, UK.
E-mail: stephen-pollock@sigmapi.u-net.com

Iolanda Lo Cascio
Dept. of Economics, Queen Mary College, University of London, Mile End Road, London, UK.

Keywords: Fourier Analysis, Wavelets, Algorithms

Abstract

This paper reveals the structure of a discrete wavelet analysis both for dyadic and non-dyadic frequency intervals in a manner that facilitates computation. Procedures written in Pascal are provided at the end of the paper, which calculate the wavelet coefficients and which use wavelet functions to synthesise frequency-specific components of a time series.

By using a mixed-radix wavelet packet analysis, one should be able to analyse time-varying structures that are found within arbitrary frequency bands, including structures that reside in a series of harmonically related frequency bands.
IS YOUR ASYMPTOSIS TERMINAL

Raymond O'Brien
Dept. Economics, University of Southampton, Southampton, UK
E-mail: rjo@soton.ac.uk

Keywords: Monte Carlo, asymptotic percentile estimation

Abstract

To estimate percentiles of some non-standard asymptotic distributions, it is necessary to approximate a Brownian motion by a random walk, with say T steps. For this purpose, Monte Carlo simulations of N replications have been extensively employed in econometrics, for example by Johansen and Juselius, Oxford Bulletin 1990, and Osterwald-Lenum, Oxford Bulletin 1992. An alternative is presented by MacKinnon, Haug and Michaelis, Journal of Applied Econometrics, 1999. We estimate the percentiles of the Johansen rank test in the presence of intercept shifts. In this process, examples are offered to suggest that while the relationship between N and accuracy is straightforward (certainly ex post), that between T and accuracy is highly model and parameter dependent, and a pre-set T value should almost never be used. Instead the MacKinnon et al. suggestion, that asymptotes be estimated, is recommended, to ensure that one’s search for a ‘large’ sample has been completed.
USING BAYESIAN NETWORKS FOR ESTIMATING THE RISK OF DEFAULT IN CREDIT SCORING

Michael Egmont-Petersen  
*Institute of Computer And Information Sciences, Utrecht University, Utrecht, Netherlands*  
*E-mail: michael@cs.uu.nl*

Bart Baesens  
*Dept. Appl. Econ., Katholieke Univ Leuven*

Ad Feelders  
*Institute of Computer And Information Sciences, Utrecht University*

**Keywords:** Bayesian networks; Metropolis-hastings algorithm; Statistical classifier; Feature selection; Data mining; Credit scoring; Regularization

**Abstract**

Banks and other financial institutions screen applicants for consumer loans. If the probability of default is estimated to be high, the loan is not granted. Our goal is to estimate the probability that the consumer will fail to pay back the loan, solely based on information available before the bank grants the loan to the consumer. We approach the problem with a probability model, which tries to predict whether a consumer will default in the future. Real-life complete data have been obtained from two Belgian financial concerns. The two datasets consist of 24 and 29 variables that have been obtained from more than 5000 applicants that were granted a loan. We use a Bayesian network for estimating the probability that a consumer fails to meet his obligations. We have developed an approach for learning the structure of the Bayesian network, based on the Metropolis-Hastings algorithm. The algorithm results in Bayesian networks with good prognostic capabilities. Comparison with other Machine-learning algorithms (the Naive Bayes classifier and the tree augmented naive bayes classifier) on independent validation sets indicate that the learned networks yield better or at least a similar performance as conventional algorithms.
ROBUST GMM ANALYSIS OF MODELS FOR THE SHORT RATE PROCESS

Elvezio Ronchetti  
*Department of Econometrics, University of Geneva, Geneva, Switzerland*  
*E-mail: Elvezio.Ronchetti@metri.unige.ch*

Rosario Dell’Aquila  
*Quantitative Invest. Research, Zurcher Kantonalbank, Zurich, Switzerland*

Fabio Trojani  
*Institute of Finance, University of Southern Switzerland, Lugano, Switzerland*

**Keywords:** GMM estimators and tests; One-factor models of interest rates; Robust model selection

**Abstract**

We discuss how robust and nonparametric techniques can be used in the statistical analysis of financial models. As an illustration we re-examine the empirical evidence concerning a well-known class of one-factor models for the short rate process.

Standard classical model selection procedures are highly unstable in this application. On the other hand, robust procedures deal with deviations from the assumptions on the model and are still reliable and reasonably efficient in a neighborhood of the model. A robust analysis reveals that all classical models are clearly misspecified. In the parametric set up only the Cox-Ingersoll-Ross model is not rejected, but its performance is not satisfactory when it is applied to extended periods of time.

Finally we present a nonparametric alternative to the estimation of the drift and the volatility in these models.
Keywords: Robust estimates, Robust regression, bootstrap tests, asymmetric models, high breakdown point

Abstract

Positive random variables with asymmetric distributions arise in many econometric applications (e.g., analysis of income and expenditures). Often the population mean (e.g., a mean expenditure in a budgeting problem) is the parameter of interest and depends upon a number of covariates. Unfortunately, the data may contain outliers and the mean is a difficult parameter to estimate and test well in this case.

For example, the mean costs of medically homogeneous groups of patients (with the same diagnosis and treatments) are used for hospital budgeting and it is common to compare cost means of similar groups among different hospitals or over different periods of time. It is easy to give examples where a few atypical stays drastically change the (group-conditional) mean estimates and where common tests of means (e.g. the t-test and its variants) lead to a different decision when these outliers are removed from the data set.

In order to tackle these problems, we recently developed procedures for:

- (a) Defining and estimating a robust mean of an asymmetric distribution;
- (b) Defining and estimating a robust mean of an asymmetric response that depends upon a number of covariates;
- (c) Testing the equality of two or more robust means.

We use popular parametric asymmetric models such as the Lognormal, Gamma, Weibull, and Pareto distributions. The estimators are based on three steps: in a first step, an initial high breakdown point but inefficient estimate (e.g., a S-estimate) of the model parameters is computed; in a second step, observations that are unlikely under the estimated model are rejected; in a third step, the maximum likelihood estimate is computed with the retained observations. The final estimate maintains the breakdown point of the initial estimate (which can be as high as 50%); yet, it can be made as efficient as desired. The sample distribution of these estimators can be approximated using asymptotic results, but finite sample inference – e.g., confidence intervals and tests – is usually obtained with the help of the bootstrap.
ESTIMATION IN HAZARD REGRESSION MODELS UNDER MONOTONE DEPARTURES FROM PROPORTIONALITY

Arnab Bhattacharjee
Research Associate, Department of Applied Economics, University of Cambridge, Cambridge, UK
E-mail: a.bhattacharjee@econ.cam.ac.uk

Keywords: Ordered (monotone) alternatives; Time-varying covariate effects; Biased bootstrap

Abstract

Though the Cox proportional hazards model is widely used for semiparametric analysis of duration data, it is well acknowledged that the proportionality assumption underlying this model is strong. In the two-sample setup, it is of interest to test proportionality against ordered/monotone alternatives, where the ratio of hazard (or cumulative hazard) functions increases or decreases in duration. Recently, a natural extension of such monotone ordering to the case of continuous covariates has been discussed (where the ratio of hazard functions conditional on two different values of the covariate increases/decreases in duration), and tests for the proportional hazards model against such alternatives developed. Such monotone departures are common in applications, and provide useful additional information about the nature of covariate dependence in the case of continuous covariates. In this paper, we describe methods for estimating duration data regression models when such monotone departures are known to hold. In particular, it is shown how histogram sieve estimators can be smoothed and order restricted estimation performed using biased bootstrap techniques. The methods are illustrated with applications from economic duration data and biomedicine.
A MULTIVARIATE ANALYSIS AND VISUALIZATION SYSTEM FOR ANALYSING PATENT DATA AND PRODUCING TECHNOLOGICAL AND SCIENTIFIC INDICATORS

Katerina Perdikuri
Computer Engineering & Informatics Department, University of Patras, Greece
E-mail: perdikur@ceid.upatras.gr

P. Markellou, S. Sirmakessis, A. Tsakalidis, G. Mavritsakis and K. Markellos
Research Academic Computer Technology Institute

Keywords: Patent data, Scientific Indicators, Multivariate analysis, correspondence analysis, cluster analysis, graphics

Abstract

Measurement and assessment of technological innovation is a very specific scientific subject. Nowadays the increasing interest of more and more R&D planners, business analysts, patents analysts, national and international patent offices, economic organizations, national statistical offices and industrial bodies with high scientific and technological activity in discovering and exploiting information related to technological activities and innovation, "hidden" in Patent Databases, makes a necessity the use of particular systems specialized in this domain. In this paper we present a multivariate analysis and visualization system for analysing patent data and producing technological and scientific indicators. More specifically, our system uses existing Patent Databases (input), supports multidimensional analysis and produces new indicators (output). These indicators express information concerning the scientific and technological progress. Multivariate analysis methods available in the system include textual analysis techniques and multivariate methods like Correspondence analysis, Cluster Analysis and Bootstrap Analysis. Visualization techniques include a variety of 2D and 3D charts and graphs, as well as, a tool for producing ready-made reports. Comparing our system with other commercial software packages specialized in the analysis of patent data we propose the combination of non-trivial techniques from the field of Text Mining and Statistical Analysis.
A COMPARISON OF DIFFERENT EQUITY RISK MODELS.

Stavros Siokos  
Citigroup, London, UK  
E-mail: stavros.siokos@citigroup.com

Michael Benjamin  
Citigroup, London, UK

Abstract

In most fund management companies fund managers are not enough involved in the risk management process. Quite often fund management companies have a separate group examining the risk and return of the portfolio. But portfolio managers are risk and return managers. The major problem is that risk management is only practised as risk measurement. This session will examine the following:

- Different risk models used and the computational issues that they enclose
- Incorporating risk based measures into the performance measurement of the portfolio management teams
- Is there a time horizon problem in how we measure and receive risk?
- What risk numbers really mean and how should be interpreted
- Why risk management is more than just avoiding the big disaster, it is about delivering quality risk-adjusted performance
- Making the total portfolio construction process more risk-return efficient on average and over time
- Producing consistent and positive information ratios
- What should portfolio optimisation be based on?
- Maximising stock-specific risk o Minimising factor bias risk in terms of relative performance and risks compared to appropriate equity benchmark
- Reverse optimisation as a tool of portfolio construction and risk analysis
- Cluster Analysis
- How macroeconomic and fundamental characteristics effect risk management
- Computational issues and limitations of these models.
ASSET ALLOCATION FOR ASSET MANAGERS: THE MIG2000+ MODEL

Domenico Mignacca  
SanPaolo IMI AM SGR, Milan, Italy  
E-mail: domenico.mignacca@sanpaolowm.com

Manlio Marchesi  
SanPaolo IMI AM SGR, Milan, Italy

Emiliano Rossignani  
SanPaolo IMI AM SGR, Milan, Italy

Keywords: Black and Litterman Approach, Tracking Error Volatility (TeV), Active Market Exposure (AMEX), Benchmark

Abstract

We present an application of the Black-Litterman philosophy to the asset allocation problem where currency represents a separate asset class from bond and equity. In an asset allocation process for an asset manager the natural comparison of the “optimal” portfolio is the benchmark. Thus the most important constraint to define is the active risk of the “optimal” portfolio vs. benchmark (Tracking Error Volatility) and not the portfolio absolute risk (volatility). We start from the benchmark equilibrium returns (“reverse engineering”), then we show: (a) how to add “qualitative/quantitative” views (our scenario) to equilibrium returns to obtain the expected returns for the optimisation and (b) how to test the likelihood of the scenario. This scenario analysis is fundamental to achieve a good degree of confidence on the output of the optimisation. Next we analyse the optimisation problem with some “new” types of constraints: (i) risk concentration constraints, (ii) AMEX constraints (Active Market Exposure), (iii) currency overlay. The results are validated using a risk management framework. The last part is an overview of the “indirect” optimisation, where we apply our approach on mutual funds or similar financial assets that are not necessarily mapped one-to-one to the asset classes used in the optimisation algorithm.
TREASURY AUCTIONS: THE SPANISH FORMAT

Francisco Alvarez  
*Universidad Complutense Madrid, Dto. Economia Cuantitativa, Fac. CC. Economicas, UCM, Madrid, Spain*  
E-mail: fralvare@ccee.ucm.es

Cristina Mazon  
*Universidad Complutense Madrid*

**Keywords:** Auction theory, Bayesian-Nash equilibria, simulations

**Abstract**

The Treasury auctions are multi-unit auctions in which the bidders may submit (and actually do) multiple quantity-price pairs. Additionally, the value of the good is common to all bidders, unknown at the time of the auction, and bidders are eventually asymmetrically informed and risk averse. The strategical behavior of the bidders within this scenario comes to be so complex that one of the classical questions in auction theory -which auction format maximizes the expected seller’s revenue- remains elusive, even within very simple models.

In this paper we use a simultaneous game of incomplete information which includes the mentioned characteristics of the Treasury auctions and we develop an algorithm to compute numerically all (if any) of the symmetric Bayesian-Nash equilibria. We compute the seller’s revenue under SBNE for three different auction formats: discriminatory, uniform and Spanish. Most of the Treasuries around the world use the first of those formats, some few use the second, and Spain is -to our knowledge- the only country in using an hybrid format.

Our simulation results show parameter values for which each of the previous formats outperforms the others in terms of the expected seller’s revenue. Additionally, we get new insights on why do bidders submit multiple quantity-price pairs.
Most modern financial markets operate continuously. The mismatch between buyers and sellers is solved via an order-based market with two basic kinds of orders. Impatience traders submit market orders, which are a request to buy or sell a given number of shares immediately at the best available price for the transaction. More patient traders submit limit orders, which also state a limit price for the transaction. Limit orders often fail to result in an immediate transaction, and are stored in a queue called the limit order book. Buy limit orders are called bids and sell limit orders are called offers or asks. The different between the best offer to buy and to sell is called ask-bid spread. Due to its practical importance, it is needed to understand the benefits obtained from using limit orders.

We present a model to analyze the optimal limit orders. In this model, the investor decides the limit order execution price $K$, given the expire time $T$. Limit orders are executed if the price of the underlying reaches the (execution) price of the limit order. In case the limit time $T$ is exceeded without execution, we assume the investor buys/sells at the market price at time $T$. A strategy consists of a given of the pair $(K, T)$. We define the value of the strategy as the expected return from the operation (buy or sell).

In this paper, we analyze the value of the limit order for different strategies and for different models of the price of the underlying. In particular, we are interested in finding the optimal value of the strategy. To model the price of the underlying, we use a log-normal process and a mean reverting one, that it is useful to model commodity markets. We study first a simplified case in which we neglect the ask-bid spread and then we show the effect of taking it into account.

In the log normal case, we obtain an analytical solution for the problem. We find that depending on the discounting rate, the value process is a sub-martingale, super-martingale or martingale. If the value is a super-martingale, the optimal strategy is obtained by choosing a limit order execution price equal to the actual value, while for the sub-martingale case it is optimal to execute at the expire time. For the martingale case, all strategies have the same value.

In the mean reversion case, we formulate the problem as a partial differential equation using the Feynman-Kac formula. The optimal strategy is calculated by numerical integration. We find that, given the initial value and expire time, there is a unique optimal value of the execution price. This optimal value depends on the parameter chosen to model the price of the underlying. An interesting crossover appears in the expire time. We find that fast mean reverting markets are more profitable than slow ones for small expire times, while the situation is the opposite for long expire times.
PARALLEL COMPUTATION IN ECONOMETRICS: A SIMPLIFIED APPROACH

Jurgen Doornik
Nuffield College, University of Oxford, Oxford, UK
E-mail: jurgen.doornik@nuffield.ox.ac.uk

David Hendry
Nuffield College, University of Oxford

Neil Shephard
Nuffield College, University of Oxford

Keywords: Code optimization; Econometrics; High-performance computing; Matrix-programming language; Monte Carlo; MPI; Ox; Parallel computing; Random number generation

Abstract

Parallel computation has a long history in econometric computing, but is not at all widespread. We believe that a major impediment is the labour cost of coding for parallel architectures. Moreover, programs for specific hardware often become obsolete quite quickly. Our approach is to take a popular matrix programming language (Ox), and implement a message-passing interface using MPI. Next, object-oriented programming allows us to hide the specific parallelization code, so that a program does not need to be rewritten when it is ported from the desktop to a distributed network of computers. Our focus is on so-called embarrassingly parallel computations, and we address the issue of parallel random number generation.
EFFICIENT STRATEGIES FOR COMPUTING THE SUBSET VAR MODELS

Cristian Gatu  
*Institut d’Informatique, Universite de Neuchatel, Neuchatel, Switzerland*  
*E-mail: cristian.gatu@unine.ch*

Paolo Foschi  
*University of Bologna, Bologna, Italy*

Erricos John Kontoghiorghes  
*Institut d’Informatique, Universite de Neuchatel, Neuchatel, Switzerland*

**Keywords:** VAR model; SUR model; Subset regression; Least squares; QR decomposition

**Abstract**

Model selection procedures used in unrestricted Vector Autoregressive (VAR) models for choosing a subset of the most statistically-significant variables are proposed. The selection criteria such as Akaike Information Criterion (AIC), Hannan-Quinn (HQ) and Schwarz Criterion (SC) and are based on the residual sum of squares. When prior restrictions are not available, subset procedures can be used to detect, or confirm, possible zero constraints. The VAR model with zero coefficient restrictions is formulated as a Seemingly Unrelated Regression (SUR) model. Furthermore, the SUR model is transformed into one of smaller size, where the exogenous matrices comprise columns of a triangular matrix. The proposed algorithms exploit the common columns of the exogenous matrices and Kronecker structure of the variance-covariance of the disturbances. The main computational tool of the selection procedures is the generalized QR factorization and its modification.
SELECTING, ESTIMATING AND EVALUATING NON-LINEAR MODELS

Patrick McSharry
Mathematical Institute, Department of Engineering, University of Oxford, UK
E-mail: mcsharry@maths.ox.ac.uk

Keywords: Forecasting, non-linear, probabilistic, model inadequacy, parameter estimation

Abstract

In real-world systems, non-linearity is the rule rather than the exception. Nevertheless, the confidence (as well as the simplifications) offered by traditional linear models makes this well-tested collection of tools an attractive option when investigating observed time series data. A number of new techniques originally developed for the construction, estimation and evaluation of nonlinear models can be employed within the context of linear models. This allows insight into issues of model inadequacy and the role of observational uncertainty. Indeed, it is these techniques that justify the introduction of non-linear models.

A collection of techniques for estimating parameters, testing consistency between the model and observations, identifying model inadequacy and evaluating (monte carlo based) probabilistic forecasts is presented. Accounting for uncertainty by generating multi-model multi-initial condition forecasts, shows whether non-linear models provide significantly more valuable out-of-sample forecasts. This is implemented in a way that the modelling strategy can correctly reduce towards the optimal (linear) least squares predictor when appropriate. This approach is illustrated using both synthetic data and observed time series.
IMPLEMENTING ECONOMETRIC ESTIMATORS ON PARALLEL COMPUTERS

Vassilis Hajivassiliou
London School of Economics, London, UK
E-mail: vassilis@econ.lse.ac.uk

Keywords: parallelization, econometric estimators, simulation-based inference, distributed architecture

Abstract

Recently developed parametric simulation estimation methods for static and dynamic LDV econometric models have two general features. First, they are defined as the solution of nonlinear optimization problems of suitable criterion functions. Second, the criterion functions are approximated by certain Monte-Carlo simulators. Both features exhibit the potential of significant computational benefits by parallelization, because the necessary calculations can be organized in essentially an independent pattern.

In this paper, I first discuss the parallelization benefits in solving econometric optimization estimators not involving simulation. In this case the parallelized calculations involve the contributions to the criterion function in the i.i.d. observations, as in typical econometric applications using cross-sectional and longitudinal data sets with several thousands of i.i.d. observations.

I then study the effects of parallelization on leading simulation-based estimation methods. The results suggest strongly that using parallelization the more sophisticated methods lose some of their advantages relative to more crude ones.

Finally, the paper examines the solution of a full econometric simulation estimator where parallel calculations are used both for the simulation of each contribution to the criterion function, as well as in the overall iterative optimization of the simulated criterion function. This practice seems to open up the study of more realistic econometric models, currently computationally intractable on single-processor computers.
GREAT EXPECTATIONS AND BROKEN PROMISES: RISK CONSTRAINTS AND ASSUMED DISTRIBUTIONS IN PORTFOLIO OPTIMIZATION

Dietmar Maringer

University of Erfurt, Faculty of Economics, Law and Social Sciences, Erfurt, Germany
E-mail: Dietmar.Maringer@uni-erfurt.de

Keywords: Value at Risk, Expected Loss, distribution of returns, heuristic optimization, risk constraints, portfolio optimization

Abstract

Both literature and theory often claim that under Value at Risk and Expected Tail Loss, the use of empirical rather than normal distributions were favourable – if only the computational load was manageable. As already shown in Gilli/Kellezi (2001), the computationally demanding optimization model associated with empirical distributions can be approached with heuristic search methods. Maringer/Winker (2003) apply a modified version of Memetic Algorithms, a population based heuristic that combines local and global search aspects, to the optimization problem and find that this method finds stable and reliable results. This paper builds on Maringer/Winker (2003), yet with the focus on the properties of the resulting portfolios. Performing a computational study based on empirical data for S&P100 stock returns, the results indicate that — as expected and already discussed in the literature — the use empirical distributions rather than relying on the assumption of normally distributed returns makes the optimization problem much more demanding. However, the efforts might not be worth the trouble: Though portfolios optimized under empirical distributions promise a higher (in sample) utility than their ‘normal’ counterparts, they have a significantly higher chance of violating the risk constraints when out of sample tests are performed.
A MULTIVARIATE FGD TECHNIQUE TO IMPROVE VaR COMPUTATION IN EQUITY MARKETS

Giovanni Barone-Adesi
University of Southern Switzerland, Institute of Finance, Lugano, Switzerland
E-mail: giovanni.barone@lu.unisi.ch

Francesco Audrino
University of Southern Switzerland

Keywords: Multivariate volatility estimation, Filtered Historical Simulation, VaR

Abstract

We present a multivariate, non-parametric technique for constructing reliable daily VaR predictions for individual assets belonging to a common equity market segment, which takes also into account the possible dependence structure between the assets and is still computationally feasible in large dimensions. The procedure is based on functional gradient descent (FGD) estimation for the volatility matrix (Audrino and Bühlmann, 2003) in connection with asset historical simulation and can also be seen as a multivariate extension of the filtered historical simulation method proposed by Barone-Adesi et al. (1999). Our FGD algorithm is very general and can be further adapted to other multivariate problems dealing with (volatility) function estimation. We concentrate our empirical investigations on the Swiss pharmaceutical and the US biotechnological equity market and we collect, using statistical and economical backtests, strong empirical evidence of the better predictive potential of our multivariate strategy over other univariate techniques, with a resulting significant improvement in the measurement of risk.
DECOMPOSITION OF MULTISTAGE STOCHASTIC QUADRATIC PROBLEMS IN FINANCIAL ENGINEERING

Panos Parpas
Department of Computing, Imperial College of Science, Technology and Medicine, London, UK
E-mail: pp500@doc.ic.ac.uk

Berc Rustem
Department of Computing, Imperial College of Science, Technology and Medicine

Keywords: Stochastic programming, Large-Scale Optimization, Quadratic Programming, Mean-Variance Optimization

Abstract

We consider decomposition approaches for the solution of multistage stochastic programs that appear in financial applications. In particular, we discuss the performance of two algorithms which we test on the mean-variance portfolio optimization problem. The first algorithm is based on a regularized version of Benders decomposition, we discuss its extension to the quadratic case. The second algorithm is an augmented Lagrangian method. Our results indicate that the algorithm based on Benders decomposition is more efficient, this is in line with similar studies performed in the linear setting.
NEW NUMERICAL APPROACHES TO PORTFOLIO OPTIMIZATION

Manfred Gilli
Department of Econometrics, University of Geneva, Genève, Switzerland
E-mail: Manfred.Gilli@metri.unige.ch

Evis Kellezi
International Center FAME

Abstract

The new institutional settings on equity requirements imposed by the Basle accord have urged an increasing interest in new approaches to risk management. The well known mean-variance approach to risk measurement cannot cope with these new requirements. Unfortunately, the methods used for analyzing and optimizing portfolios in the mean-variance framework do not carry over easily to other risk concepts like shortfall probability, expected shortfall etc. Also constraints on the holding size of assets, trading volume, number of assets in a portfolio etc. result in further complications for standard optimization tools. To solve these complex optimization tasks we propose the use of an optimization heuristic.
ARTIFICIAL NEURAL NETWORKS IN MEDICAL IMAGING SYSTEMS

Constantinos Pattichis  
*Department of Computer Science, University of Cyprus, Nicosia, Cyprus*  
E-mail: pattichi@ucy.ac.cy

Christodoulos Christodoulou  
*Department of Computer Science, University of Cyprus, Nicosia, Cyprus*

Efthyvoulos Kyriakou  
*Department of Computer Science, University of Cyprus, Nicosia, Cyprus*

Marios Pattichis  
*Department of Electrical and Computer Engineering, University of New Mexico, Albuquerque, NM 87131-1356, USA*

**Keywords:** neural networks, medical imaging, classification, atherosclerotic carotid plaques

**Abstract**

Recent technological advances in medicine facilitated the development of sophisticated equipment enabling the better delivery of health care services. In parallel, artificial neural networks emerged as promising tools for the application and implementation of intelligent systems. The aim of this paper is to provide a snapshot of selected applications of neural network systems in medical imaging. The paper will highlight neural network applications in the analysis of nuclei of immunocytochemically stained histopathological sections, and in ultrasound imaging for the characterization and classification of atherosclerotic carotid plaques. Concluding, it is hoped that the application of neural network systems in medicine will provide the framework for the development of emerging medical systems, enabling the better delivery of health care.
TOPOLOGY SELECTION FOR FEED-FORWARD NEURAL NETWORK MODELS

Michele La Rocca  
Dept. Economics and Statistics, University of Salerno, Salerno, Italy  
E-mail: larocca@unisa.it

Cira Perna  
Dept. Economics and Statistics, University of Salerno, Salerno, Italy

Keywords: Feed-forward Neural Networks, Subsampling, Model selection

Abstract

In this paper, we focus on the determination of the hidden layer size and we propose and discuss a method which uses information criteria based on measures of the predictive ability of the selected model. To obtain a complete strategy for the choice of the network topology, this approach will be combined with a variable selection test extended to stationary and mixing data. This strategy strictly follows the usual one generally employed when selecting a model in the classical regression framework and it improves its interpretability through an understanding of the effect of the independent variables on the prediction of the model.

The proposed procedure involves analytical derivations which, even if possible in principle, are very complex to derive and to deal with. Therefore, alternatively we propose a resampling scheme based on subsampling to obtain the p-value of the test and the variability of the information criteria. This technique is valid for both the case of iid data and the case of stationary mixing data. Applications to simulated and real data will illustrate the proposed strategy.
ISOLATING SOURCES OF VARIATION IN MULTIVARIATE DISTRIBUTIONS USING NEURAL NETWORKS

Chrisina Draganova  
Dept. of Computing, Communication technology and Mathematics, London Metropolitan University, London, UK  
E-mail: c.draganova@londonmet.ac.uk

Andreas Lanitis  
Department of Computer Science and Engineering, Cyprus College, P.O. Box 22006, Nicosia, Cyprus

Chris Christodoulou  
School of Computer Science and Information Systems, Birkbeck College, University of London, Malet Street, London WC1E 7HX, UK

Keywords: neural networks

Abstract

In many problems involving the analysis of multivariate data distributions it is desirable to isolate specific sources of variation within the distributions, where the sources of variation in question represent a quantity of interest related to the specific problem domain. We investigate the use of Neural Network based methods in order to define the relationship between the parametric multidimensional representation of the samples in a training set and the corresponding values of the source of variation we wish to isolate. Once the optimum Neural Network architecture and parameters are established, it is possible to generate typical samples of the distribution that display to a predefined extend the isolated quantity of interest. In effect Neural Networks learn a complex mapping function that can be used for mapping different values of a quantity of interest to typical synthetic samples of the distribution.

We have applied our method to the problem of reconstructing face images displaying certain facial attributes. In this context, we use PCA based coding techniques in order to represent face images as coordinate vectors in a low dimensional space. Based on this representation we train Neural Networks that learn the relationship between certain facial attributes and the coded face images in the training set. We then use the resulting Neural Networks to reconstruct face images displaying faces with specific attributes. Both the visual and quantitative results of our experiment demonstrate the potential of our approach.
THE INCORPORATION OF BACKGROUND KNOWLEDGE IN THE
DATA MINING PROCESS AND DATA MINING ALGORITHMS

Emiel Caron
ERIM, Erasmus University Rotterdam, Rotterdam, The Netherlands
E-mail: ecaron@fbk.eur.nl

Hennie Daniels
ERIM: Erasmus University Rotterdam, Center: Tilburg University (The Netherlands)

Keywords: Background knowledge, Data mining, Knowledge discovery in databases, Monotonicity, Neural networks

Abstract

Use of background knowledge (domain knowledge, prior knowledge) in the process of identifying general patterns within a database leads to patterns that are more useful and significant, and it could also improve the efficiency of data mining algorithms for business decision making. In this paper we want to give an overview of the implementation of background knowledge in the data mining process and the incorporation of background knowledge in data mining algorithms. We explicitly consider the implementation of a special form of a background knowledge that is typical in economic decision problems like credit loan approval or risk analysis, namely the monotone relationship between the independent and dependent decision variables. This monotonicity constraint is guaranteed by using a class of neural networks that is monotone by construction. Finally, we discuss a framework for combining background knowledge in the form of knowledge of experts in the field, encoded in some accessible way, and monotone neural networks. This framework is applicable to a wide variety of risk management problems. It is illustrated in a case study on fraud detection in insurance. The results of the case study clearly show that the combination of background knowledge with monotonic neural networks leads to significant performance improvements.
TOWARDS COMPREHENSIVE CLUSTERING OF MIXED SCALE DATA WITH K-MEANS

Boris Mirkin
School of Computer Science, Birkbeck College, University of London, London, UK
E-mail: mirkin@dcs.bbk.ac.uk

Keywords: comprehensive clustering, K-means, mixed scales, bribery

Abstract

To be a proper data mining tool, clustering should be comprehensive, that is, tackle not only the stage of partitioning of a well presented data set, but also such less formalised issues as data developing and pre-processing, interpretation of the results and drawing conclusions. We propose to extend K-Means, a most popular clustering method, with tools for (a) mixed scale data pre-processing, (b) setting initial centroids and their number, and (c) interpretation of clustering results. The extensions are based on a bilinear model being fitted with the least squares criterion. To tackle the issues above, we propose (a) to scale and rescale features by using feature ranges and weighting coefficients involving numbers of categories, (b) to use a one-by-one cluster extraction method parallel to the Principal Component Analysis, and (c) to utilize cluster-specific feature contribution weights and conjunctive interval descriptions. Thus modified version of K-means is applied to the issue of synoptic analysis of a set of newspaper articles on bribery cases.
AN ADAPTIVE ALGORITHM FOR LEAST SQUARES PIECEWISE MONOTONIC DATA FITTING

Ioannes Demetriou
Department of Economics, University of Athens, Athens, Greece
E-mail: demetri@econ.uoa.gr

Keywords: data smoothing, divided difference, piecewise monotonicity, trend statistic

Abstract

If measurements of a univariate function include large uncorrelated errors, then a method Demetriou & Powell makes the least sum of squares change to the data so that the first divided differences of the smoothed data change sign at most k times, thus obtaining a fit that is composed of at most k+1 monotonic sections. Although, the optimization problem may have about $O(n^k)$ local minima, n being the number of data, the fit is calculated in only $O(kn^2)$ operations. The disadvantage of the D&P method is that a suitable value of k should be prescribed by the user. We have developed an algorithm that with a little additional work accords with human judgement for an adequate value for k in more than 93% of the experiments we have conducted. The algorithm includes a test that attempts to distinguish between genuine trends and data errors. Specifically, if there are trends, then the monotonic sections of the D&P fit increase by one, otherwise the current fit seems to meet the trends and the algorithm terminates. A computer program has been written in order to implement the algorithm, while the actual calculation seems to be more efficient than the complexity indicates in theory.
LEAST SQUARES DATA IMPUTATION WITHIN NEAREST NEIGHBOUR FRAMEWORK

Ito Wasito
School of Computer Science and Information Systems, Birkbeck College, University of London, London, UK
E-mail: ito@dcs.bbk.ac.uk

Keywords: Least Squares, SVD, Nearest Neighbour, Data Imputation

Abstract

The subject of imputation of missing data entries has attracted considerable efforts in such areas as editing of survey data or maintenance of medical documentation. We consider two least-squares imputation algorithms: (a) ILS, which interpolates missing values by using only the non-missing entries for an SVD-type approximation and (b) IMLS, which recurrently applies SVD to the data completed initially with ad-hoc values (zero, in our case). Then we extend both methods within the nearest neighbour framework. We experiment with a number of algorithms on various data models and missing patterns. The results show that nearest neighbour versions of the least squares imputation are the best among a number of imputation methods that include such previously proposed techniques as: (a) the nearest neighbour mean imputation, (b) global least-squares approximation and imputation algorithms and (c) Gaussian EM based data imputation programs. The only exception is the case when two 'incomplete' databases have been merged into a database so that there are a number of features that are present in either one or the other of the original databases only: ILS and IMLS are the best in this case.
CONJUGATE GRADIENT METHODS FOR ESTIMATING SPARSE SIMULTANEOUS EQUATIONS MODELS

Paolo Foschi
Univ. of Bologna, Dept. of Mathematics, Bologna, Italy
E-mail: paolo.foschi@unine.ch

Erricos J. Kontoghiorghes
Univ. of Neuchatel, Neuchatel, Switzerland

Keywords: Least Squares, Conjugate Gradient method, Simultaneous Equations Models, 3SLS

Abstract

The estimation of the Simultaneous Equations Model (SEM) is considered for the case of large and sparse regressor matrices. For this class of SEMs, standard estimation techniques destroy the sparsity of the matrices and thus cannot be directly used. The three stage least squares (3SLS) estimator derives from the solution of a constrained least squares model which can be reformulated as a sparse augmented system. The performance of different Conjugate Gradient methods when used to solve that linear system is investigated and compared.
APPLICATIONS OF TOEPLITZ MATRICES IN ECONOMETRICS

Jurgen Doornik
Nuffield College, University of Oxford, Oxford, UK
E-mail: jurgen.doornik@nuffield.ox.ac.uk

Keywords: ARFIMA; Estimation; Filtering; Forecasting; Stochastic Volatility; Simulation; Time Series; Toeplitz matrix

Abstract

In earlier work (Doornik and Ooms, 2003), it was shown how maximum likelihood estimation of ARFIMA models could be achieved efficiently using an adjusted version of Durbin’s algorithm for solving the Yule-Walker equations. The resulting procedure has much wider applicability, which is explored in the current paper. While it is often not the most efficient procedure available, it is very convenient. It therefore deserves to be in the econometricians toolbox.
NON-LINEAR STOCHASTIC PRICE ADJUSTMENT OF SECURITIES

Silas Onyango  
*University of Huddersfield, UK*  
E-mail: s.n.onyango@hud.ac.uk

Michael Ingleby  
*University of Huddersfield, UK*

**Keywords:** Supply/Demand functions, Excess Demand, Walrasian price adjustment, Logistic equations, Ito calculus, Logistic Brownian motions

**Abstract**

We introduce a class of Ito processes that model adjustment of asset price of a traded security to changes in supply and demand. It is based on supply function and demand function and the Walrasian price adjustment model. The key dynamical assumption is that fractional price increase is proportional to market excess demand. If the supply and demand functions are linearised about market equilibrium price $P^*$, the dynamical equation for price adjustment turns out to be a logistic form of Brownian motion. If the volatility is zero, then the equation is the simple deterministic logistic differential equation. We use Itô calculus to convert the logistic Brownian motion to get a dynamical stochastic differential equation for the asset price. Finally we analyse the equation, explore some issues associated with fitting it to market historical price data and estimate volatility.
Keywords: commodity storage, non-linear rational expectation models, pseudo maximum likelihood

Abstract

Estimating a model that implements the rational expectation solution to the competitive storage model requires the computation of a numeric solution which is approximated over a finite grid of points, as introduced in a seminal paper by Deaton and Laroque (1995).

This paper explores the robustness of the Pseudo Maximum Likelihood Estimator of Deaton and Laroque (1995) to alternative specifications of the grid over which to approximate the solution function. By using the same price samples that have been previously analyzed in the literature, it shows that the estimates are highly unstable when the grid is too widely spaced, thus raising doubts on their reliability.

New estimates are presented which correspond to various grid specifications, to assess the sensitivity of the estimator to three crucial parameters of the grid: the lower value, the upper value and the number of grid points. Moreover, alternative specifications of the storage cost function are presented that allow for a better fit of the data sets.
Keywords: Bootstrap, Granger-Causality, VAR system, Wald test

Abstract

We study the properties of the bootstrap test for restrictions in two versions a) by bootstrapping under the null hypothesis, restricted, and b) by bootstrapping under the alternative hypothesis, unrestricted. We show the equivalence of these two methods and by Monte Carlo methods, we illustrate the small sample properties of the Wald test for testing Granger-Causality in a stable stationary VAR system. Our analysis regarding the size of the test reveals that, as we expected, both bootstrap tests have actual sizes that lie close to the nominal size. Regarding the power of the test, we find that by using the Size-Power Curves on a correct size-adjusted basis the Wald and bootstrap tests share the same power.
REVERSIBLE INVESTMENT DECISIONS WITH STOCHASTIC SWITCHING COSTS

**Spiros Martzoukos**  
*Dept. of Public & Business Administration, University of Cyprus, Nicosia, Cyprus*  
*E-mail: baspiros@ucy.ac.cy*

**Nayia Pospori**  
*University of Cyprus*

**Lenos Trigeorgis**  
*University of Cyprus*

**Keywords:** Investments under uncertainty, hysteresis, economic depreciation, switching costs, option pricing

**Abstract**

We study dynamic investment strategy in a network of sequential and partially reversible decisions in the presence of hysteresis-inducing switching costs. We allow time intensive (time-to-build) decisions, and operating constraints (e.g., exhaustible resources). More importantly, we allow for switching costs and recovery (abandonment) values that are themselves path (utilization) dependent, and thus stochastic. This framework enables the study of optimal investment (technology) choice, optimal scale (production capacity), optimal sequence of expansion, contraction and mothballing (temporary shutdown) strategies, etc. including economic depreciation – a mostly ignored factor in real option analysis – as an element that affects valuation and decision making. We provide illustrative examples with learning-by-doing in sequential investments, and search for dominant technologies when introducing a new product/technology in shipping. It is seen that economic depreciation can be a very significant factor in valuation, with striking effects especially for the most important for decision-makers range of at- or near out-of-the-money investment options. Our other results are intuitive but sometimes non-conventional, e.g., in the presence of flexibility, an increase in uncertainty often can lead to investing earlier instead of waiting. Similar results are often observed with a decrease in the asset payout yield. In addition to previous literature we demonstrate that such non-conventional results may decrease or vanish in the presence of factors like operating constraints that limit flexibility.
EVALUATING VOLATILITY FORECASTS IN OPTION PRICING IN THE CONTEXT OF A SIMULATED OPTIONS MARKET

Evdokia Xekalaki  
*Department of Statistics, Athens University of Economics and Business, Greece*

Stavros Degiannakis  
*Department of Statistics, Athens University of Economics and Business, Greece*

**Keywords:** ARCH models, Forecast Volatility, Model selection, Predictability, Correlated Gamma Ratio Distribution, Prediction Error Criterion, Option Pricing

**Abstract**

Degiannakis and Xekalaki (1999) have considered a comparative evaluation of the forecasting ability of two Autoregressive Conditional Heteroscedastic (ARCH) models using a selection algorithm based on a standardized prediction error criterion (PEC). According to the PEC model selection algorithm, the models with the lowest sum of squared standardized one-step-ahead prediction errors are the most appropriate to exploit future volatility. In this paper, adopting Engle et al.’s (1993) approach, we consider evaluating the PEC model selection algorithm on the basis of the cumulative profits of the participants in a simulated options market in pricing one-day index straddle options based on the variance forecasts. In particular, an options market consisting of 104 traders is simulated. Each participant applies his/her own variance forecast algorithm to price a straddle on Standard and Poor’s 500 (S&P500) index for the next day. It turns out that traders who base their selection on the PEC model selection algorithm achieve the highest profits. Thus, the PEC model selection method appears to be a useful tool in guiding one’s choice of the appropriate model for estimating future volatility in pricing derivatives.
OPTION PRICING WITH ARTIFICIAL NEURAL NETWORKS AND IMPLIED PARAMETERS

Spiros Martzoukos  
Dept. of Public & Business Administration, University of Cyprus, Nicosia, Cyprus  
E-mail: baspiros@ucy.ac.cy

Panagiotis Andreou  
University of Cyprus

Chris Charalambous  
University of Cyprus

Keywords: Option pricing, index options, neural networks, discontinuities

Abstract

In this paper, using daily data for the S&P 500 European call options and the underlying, we compare the predictive ability of the Black-Scholes Formula (BS) and Artificial Neural Networks (ANNs) to price call options. Both historical and implied volatility measures were included in this study. We incorporate into our analysis many volatility forecasts and we also introduce a maturity-adjusted volatility that eventually helps ANNs to improve their pricing accuracy. The practically standard backpropagation training algorithm in financial applications with ANNs was replaced with a modified Levenberg-Marquardt optimisation algorithm. Using the best models in each sub-period tested, our results are significant and differ from previous literature (i.e. Hutchison et al., 1994, etc). Concerning the pricing performance of each method our results show that: hybrid artificial neural network model that also incorporates a unique maturity adjusted implied volatility per contract, systematically outperforms the BS even if BS utilizes an implied volatility forecast. The BS method is also extended to the case of jump-diffusion with (implied) parameters derived from data.
MODELS FOR MANAGING RISK IN INTERNATIONAL INVESTMENT PORTFOLIOS

Hercules Vladimirou  
HERMES European Center of Excellence on Computational Finance & Economics, University of Cyprus  
E-mail: hercules@ucy.ac.cy

Nikolas Topaloglou  
HERMES European Center of Excellence on Computational Finance & Economics, University of Cyprus

Stavros Zenios  
HERMES European Center of Excellence on Computational Finance & Economics, University of Cyprus

Abstract

We develop an integrated modeling framework for addressing risk management problems in international investment portfolios. The portfolios are composed of assets (stock and bond indices) denominated in multiple currencies and are exposed to market risk and currency exchange risk. The first component of the modeling framework is a scenario generation procedure that depicts jointly the uncertainty in asset returns and currency exchange in terms of a discrete distribution. The scenarios are generated so that specific statistical properties of the random variables, namely the first four marginal moments and the correlations, match the values determined from historical market data. The scenarios are used as inputs in stochastic programming models that determine jointly the asset selections and the appropriate level of hedging in each market. The portfolio management models are based on the conditional value-at-risk (CVaR) risk measure. Alternative hedging strategies are examined using currency futures as well as derivatives (options on indices and quantos). The introduction of derivative securities in the portfolio management model requires the development of methods for arbitrage-free pricing of the derivatives in a setting consistent with the postulated scenarios for asset returns and exchange rates. We investigate empirically the performance of the models on international portfolios of stock and bond indices using historical market data. Through backtesting experiments we establish that (1) the introduction of derivatives in the portfolio is effective in controlling risk, and (2) holistic strategies that jointly hedge market and currency risk (through the use of quantos) yield the most effective risk management tactic.
STATISTICAL CRITERIA FOR EVALUATING FRACTIONAL FACTORIAL DESIGNS THAT ARISE FROM HADAMARD MATRICES

Christos Koukouvinos
Department of Mathematics, National Technical University of Athens, Athens, Greece
E-mail: ckoukouv@math.ntua.gr

Charalambos Charalambides
Department of Mathematics, University of Athens, Athens 15784, Greece

Haralambos Evangelaras
Department of Mathematics, National Technical University of Athens, Zografou 15773, Athens, Greece

Keywords: Screening designs, Hadamard matrices, inequivalent projections, fractional factorial designs, generalized resolution, confounding frequency vector, generalized wordlength pattern, generalized optimal moment, distinct runs, D-efficiency, variance inflation factor

Abstract

Usually a large number of factors (q) has to be examined in an experimental situation. It is often anticipated that only few (k) or these factors will be important. In most circumstances, it is not known which of the q factors will have a substantial influence on the response, that is, it is not known which k columns of the experimental design will be of further interest. Hadamard matrices have traditionally been used for such screening purposes.

After the identification of the active factors, the columns of the design that correspond to these factors are selected to form a new design that is called a projection. Since the choice of the k columns varies with the outcome of the analysis, it is desired to study the statistical properties of all possible projections of the experimental design into k columns under certain criteria.

In this paper we present several well-known criteria that can be used to rank and compare fractional factorial designs especially when the identification of active two factor interactions is of primary interest. In particular, a complete evaluation of the combinatorially inequivalent projections of Hadamard matrices of order n=24 into k=4 factors is also presented.
A COMPARISON BETWEEN GROEBNER BASES APPROACH AND HIDDEN PROJECTION PROPERTIES IN FACTORIAL DESIGNS

Haralambos Evangelaras  
Department of Mathematics, National Technical University of Athens, Zografou 15773, Athens, Greece

Christos Koukouvinos 
Department of Mathematics, National Technical University of Athens, Athens, Greece  
E-mail: ckoukouv@math.ntua.gr

Keywords: Plackett and Burman designs, inequivalent projections, Groebner bases, leading terms, divisibility condition, estimable effects, hidden projection, D-efficiency, $D_s$-efficiency

Abstract

Screening designs are useful for situations where a large number of factors ($q$) is examined but only few ($k$) of these are expected to be important. Plackett and Burman designs have traditionally been used for this purpose. Since these designs are only main effects plans and since the number of runs are greater than the number of active factors (main effects), there are plenty degrees of freedom unused for identifying and estimating interactions of factors.

Computational Algebraic Geometry can be used to solve identifiability problems in design of experiments in Statistics. The key idea is to view the design as a solution set of a system of non-linear polynomial equations. Then, the theory of Groebner bases allows one to identify the whole set of estimable effects (main or interactions) of the factors of the design.

On the other hand, the hidden projection property approach, as introduced by Wang and Wu (1995), that deals with the same identification problem, gives us a measure of how efficient our identification of active effects is.

In this paper we discuss the advantages and disadvantages of both methods in certain two level (fractional) factorial designs that arise from Plackett and Burman designs.
OPTIMAL CROSS-OVER DESIGNS

**Stratis Kounias**  
*Department of Mathematics, University of Athens*  
*skounias@math.uoa.gr*

**Miltiades Chalikias**  
*Department of Mathematics, University of Athens*

**Keywords:** Design, algorithm, optimal, carry-over effects

**Abstract**

In Cross-Over designs, there are $p$ periods and in every period one of $q$ treatments is applied to every experimental unit. We are interested in estimating treatment and carry-over effects. We examine the cases where the $p$ observations on every experimental unit are: a) Independent, b) Have an unknown covariance structure.

For $n$ experimental units, for two treatments we give the uniformly optimal designs for estimating treatment effects and also we give D-optimal, A-optimal and E-optimal designs for estimating carry-over effects for treatment and carry-over effects.

For $p$ periods and $q$ treatments, algorithms are utilized to find the optimal designs for treatment and/or carry-over effects.
FORECASTING A STOCK MARKET INDEX USING A COMBINATION OF LINEAR MODELS AND NEURAL NETWORKS

Haritini Tsangari  
University of Cyprus, Nicosia, Cyprus  
E-mail: haritini@ucy.ac.cy

Panayiotis Andreou  
University of Cyprus

Keywords: Stock Market Index, Linear models, Multiple regression, Neural Networks, Forward selection, Backward selection, Pruning, Forecasting, Options

Abstract

Our objective is to create a system to predict a stock market index using a number of related variables, with a combination of linear and non-linear models. First, the structure of the response is modelled using time series techniques and then the most related inputs are identified, using multiple regression. However, since multiple linear regression only indicates which variables are linearly related with the response variable, we extend this parsimonious model to capture any residual non-linear dependencies, using Neural Networks. An iterative procedure analogous to forward selection identifies any variables which give incremental value if added in the model, using criteria such as complexity-adjusted payoff measures or RMSE. Validation with a backward selection is also considered. The S&P500 Composite Index is our example of response. Possible inputs include Open, High, Low, Closing Price and Volume of the response, Related Local and Foreign Markets variables (such as S&P100, Nasdaq and Dow Jones, VIX Volatility, Nikkei 225 and FTSE 100), economic variables (interest or exchange rates) and Technical indicators. The resulting system is used for forecasting of price and directional movement, and different criteria are used for evaluation of forecasting performance and implementation of options to boost profits.
USING COMPUTATIONAL INTELLIGENT TOOLS FOR ANALYZING AND PREDICTING FINANCIAL AND DEFENCE ECONOMICS TIME-SERIES DATA

Andreas Andreou
University of Cyprus, Department of Computer Science, Nicosia, Cyprus
E-mail: aandreou@ucy.ac.cy

Keywords: artificial neural networks, genetic algorithms, exchange-rates, devaluation, arms-race

Abstract

The present paper is involved with the analysis and forecasting of financial and defence economics data series using various computational intelligent tools, such as neural networks, genetic algorithms and hybrid systems. Three case studies are used to demonstrate how one can employ these tools in an attempt to reach to high prediction accuracy. The first targets at predicting the Greek foreign exchange-rates market, the second focuses on analyzing and predicting devaluation events based on the Greek drachma, while the third deals with issues from the Defence Economics field such as the military debt and expenditure of Greece. The focus of these case studies is the proper use of computational intelligent methods to model complex, real-world systems in an efficient and reliable manner.
REVIEW OF COMPUTATIONAL INTELLIGENCE TECHNIQUES IN DECISION-MAKING IN FINANCIAL, ECONOMIC AND POLITICAL DYNAMICAL SYSTEMS

Constantinos Neocleous  
Higher Technical Institute, Department of Mechanical and Marine Engineering, Nicosia, Cyprus  
E-mail: costas@ucy.ac.cy

Christos Schizas  
Department of Computer Science, University of Cyprus, Nicosia, Cyprus

Keywords: neural networks, fuzzy systems, evolutionary systems, artificial life

Abstract

A review of the basic mechanics of the workings of the neural networks, fuzzy systems, evolutionary systems, artificial life and combinations/variants of these will be presented. The techniques will be classified and comparatively evaluated. The important parameters that control an effective application will be identified, critically evaluated and exemplified. Special emphasis will be given to learning strategies as applied to these techniques. Specific attention will be given to neural networks as supreme paradigms of the application of learning as error reduction optimization procedure. The effective application of these tools in diverse applications in the general fields of finance-economics (time-series predictions, optimization, general decision-making), and in complex dynamical systems (political, sociological, financial) will be explained. The incorporation and applicability of the techniques in well-established general purpose simulation packages such as SIMULINK will be explained and emphasized as an important powerful approach to incorporating knowledge in a learning system that can handle complex dynamical problems. Examples of the applicability of the above systems in the finance-economics-politics will be presented.
EVOLUTIONARY FUZZY COGNITIVE MAPS AS A TECHNIQUE FOR MODELING POLITICAL CRISIS SITUATIONS AND DECISION-MAKING

Nicos Mateou  
Department of Computer Science, University of Cyprus, Nicosia, Cyprus  
E-mail: nic.mateou@cytanet.com.cy

Andreas Andreou  
Department of Computer Science, University of Cyprus, Nicosia, Cyprus

George Zombanakis  
Bank of Greece, Research Dept., Athens 10250, Greece

Keywords: fuzzy cognitive maps, genetic algorithms, decision-making, political crisis

Abstract
This paper examines the use of Fuzzy Cognitive Maps (FCMs) as a technique for modeling political and crisis situations and supporting the decision-making process. FCMs use notions borrowed from artificial intelligence and neural networks to combine concepts and causal relationships, aiming at creating dynamic models that describe a given political setting. The Cyprus issue is modeled via FCMs, employing domain experts to identify the various concepts involved and the relationships among them. This paper proposes an extension of Certainty Neuron Fuzzy Cognitive Maps (CNFCMs) used in crisis management and decision-making, aiming at increasing their reliability. The objective of the Genetically Evolved Certainty Neuron Fuzzy Cognitive Map (GECNFCM) is to overcome the main weakness of CNFCMs, which lies with the recalculation of the weights corresponding to each concept every time a new strategy is adopted. This paper aims at solving these problems by combining CNFCMs with Genetic Algorithms (GAs) thus creating a hybrid model. Simulations were performed by asking the model to reach a desirable activation level for a certain concept. The case-study scenarios were the following: An environment of intensity on the island, the degree of acceptance of a possible solution by the two sides involved in the settlement of the Cyprus issue and the consequences in case a solution of the Cyprus problem is achieved.
UMTS VS CDMA2000 FOR A SATELLITE ENVIRONMENT

Ioannis Krikidis
Ecole Nationale Supérieure des Télécommunications, Paris, France
E-mail: krikidis@enst.fr

Jean Luck Danger
Ecole Nationale Supérieure des Télécommunications, Paris, France

Lirida Naviner
Ecole Nationale Supérieure des Télécommunications, Paris, France

Keywords: UMTS, CDMA2000, satellite communications, Rice channel

Abstract

The satellite component is seen as an indispensable part of a 3G terrestrial communication system in order to maintain a high QoS and a global coverage. In order to have a terminal, which can support the terrestrial and satellite components with the minimum complexity, the two biggest telecommunication markets of the world, the European and the American, propose a 3G-satellite radio interface that is an extension of theirs terrestrial interfaces. Thus, the American proposition is an extension of the standard CDMA2000 and the European one, of the standard UMTS. In this paper, we compare the forward link performance of the two standards for a satellite environment. The comparison become a little trickier when the standards occupy different bandwidths. In order to make an ‘apples-to-apples’ comparison, we analyse the two standards for two modes, which occupy identical bandwidths. Thus, our study focus on the mode CDMA2000 3X (MC-CDMA) and mode UMTS-FDD (DS-CDMA).
3D ULTRASOUND TEXTURE SEGMENTATION, USING BAYESIAN NETWORKS CLASSIFIER, BASED ON MARKOV CHAIN MONTE CARLO METHOD

Neculai Archip
Dept. of Electrical and Computer Engineering, University of British Columbia, Vancouver, Canada
E-mail: neculai.archip@ece.ubc.ca

Robert Rohling
Dept. of Electrical and Computer Engineering, University of British Columbia, Canada

Keywords: image segmentation, texture analysis, Markov Chain Monte Carlo, Bayesian Network

Abstract

Texture segmentation is one of the early steps towards identifying surfaces and objects on images. A new technique for texture classification based on Bayesian networks is introduced. The maximum likelihood is estimated using a Markov Chain Monte Carlo algorithm. Thought, it is known that the convergence is guaranteed under some weak conditions, main problems are related to its speed. Computational improvements are investigated. The target application is fast segmentation of 3D ultrasound images. This is a critical step for the intraoperative use of this imagery modality in neurosurgery applications.
PROBABILISTIC REPRESENTATIONS OF THE BURGERS’ MODEL OF TURBULENCE

Charalambos D. Charalambous
University of Ottawa, McGill University, Ottawa, Canada
E-mail: chadcha@site.uottawa.ca

Keywords: Navier-Stokes, Burgers, Wiener Process, Stochastic Control, Large Deviations, Viscosity Solutions, Free Energy, Relative Entropy, Action Functionals

Abstract

The statistical characteristics of the Burgers’ model of turbulence are investigated, including the limiting case when the kinematic viscosity tends to zero. The analysis consists of a hierarchy of partial differential equations, whose solutions along with initial conditions, are described through probabilistic representations using Wiener Processes, Free Energy, Relative Entropy and Stochastic Optimization. The viscous free Burgers’ equation subject to pressure term, is obtained in the limit, as the kinematic viscosity, which represents the Brownian noise intensity tends to zero, using two different methods. The first method is based on viscosity solutions of nonlinear partial differential equations, and the second is based on the Laplace-Varadhan Lemma of Large Deviations Theory. Finally, in keeping with the spirit of a pilot study, the results are applied to the Burgers equation to develop insight into the general methodology.
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<tbody>
<tr>
<td>Francisco Alvarez</td>
<td>Univ. Complutense Madrid</td>
<td>Spain</td>
<td><a href="mailto:fralvare@ceee.ucm.es">fralvare@ceee.ucm.es</a></td>
</tr>
<tr>
<td>Andreas Andreou</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
<td><a href="mailto:aandreou@ucy.ac.cy">aandreou@ucy.ac.cy</a></td>
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<td>Neculai Archip</td>
<td>Univ. of British Columbia</td>
<td>Canada</td>
<td><a href="mailto:neculai.archip@ece.ubc.ca">neculai.archip@ece.ubc.ca</a></td>
</tr>
<tr>
<td>Roberto Baragona</td>
<td>Univ. di Roma “La Sapienza”</td>
<td>Italy</td>
<td><a href="mailto:roberto.baragona@uniroma1.it">roberto.baragona@uniroma1.it</a></td>
</tr>
<tr>
<td>Giovanni Barone-Adesi</td>
<td>Univ. of Southern Switzerland</td>
<td>Switzerland</td>
<td><a href="mailto:giovanni.barone@lu.unisi.ch">giovanni.barone@lu.unisi.ch</a></td>
</tr>
<tr>
<td>Arnab Bhattacharjee</td>
<td>Univ. of Cambridge</td>
<td>UK</td>
<td><a href="mailto:a.bhattacharjee@econ.cam.ac.uk">a.bhattacharjee@econ.cam.ac.uk</a></td>
</tr>
<tr>
<td>Carlo Cafero</td>
<td>Univ. of Naples Federico II</td>
<td>Italy</td>
<td><a href="mailto:cafero@unina.it">cafero@unina.it</a></td>
</tr>
<tr>
<td>Emiel Caron</td>
<td>Erasmus Univ. Rotterdam</td>
<td>Netherlands</td>
<td><a href="mailto:ecaron@fbk.eur.nl">ecaron@fbk.eur.nl</a></td>
</tr>
<tr>
<td>Jordi Castro</td>
<td>Univ. Politecnica de Catalunya</td>
<td>Spain</td>
<td><a href="mailto:jcastro@eio.upc.es">jcastro@eio.upc.es</a></td>
</tr>
<tr>
<td>Charalambos D. Charalambous</td>
<td>Univ. of Ottawa</td>
<td>Canada</td>
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</tr>
<tr>
<td>Chris Charalambous</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
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<tr>
<td>Nicos Christofides</td>
<td>Imperial College London</td>
<td>UK</td>
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</tr>
<tr>
<td>Christophe Deissenberg</td>
<td>Univ. de la Mediterranee</td>
<td>France</td>
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<tr>
<td>Ioannes Demetriou</td>
<td>Univ. of Athens</td>
<td>Greece</td>
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</tr>
<tr>
<td>Jurgen Doornik</td>
<td>Univ. of Oxford</td>
<td>UK</td>
<td></td>
</tr>
<tr>
<td>Chrisina Draganova</td>
<td>Metropolitan Univ. London</td>
<td>UK</td>
<td><a href="mailto:c.draganova@londonmet.ac.uk">c.draganova@londonmet.ac.uk</a></td>
</tr>
<tr>
<td>Michael Egmont-Petersen</td>
<td>Utrecht Univ.</td>
<td>Netherlands</td>
<td></td>
</tr>
<tr>
<td>Haralambos Evangelaras</td>
<td>Nat. Tech. Univ.</td>
<td>Greece</td>
<td></td>
</tr>
<tr>
<td>Konstantinos Fokianos</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
<td><a href="mailto:fokianos@ucy.ac.cy">fokianos@ucy.ac.cy</a></td>
</tr>
<tr>
<td>Paolo Foschi</td>
<td>Univ. of Bologna</td>
<td>Italy</td>
<td><a href="mailto:paolo.foschi@unico.it">paolo.foschi@unico.it</a></td>
</tr>
<tr>
<td>Marios Fyrillas</td>
<td>Univ. of Neuchatel</td>
<td>Switzerland</td>
<td><a href="mailto:marios.fyrillas@unico.it">marios.fyrillas@unico.it</a></td>
</tr>
<tr>
<td>Cristian Gatu</td>
<td>Univ. of Neuchatel</td>
<td>Switzerland</td>
<td><a href="mailto:cristian.gatu@unico.it">cristian.gatu@unico.it</a></td>
</tr>
<tr>
<td>Manfred Gilli</td>
<td>Univ. of Geneva</td>
<td>Switzerland</td>
<td><a href="mailto:Manfred.Gilli@metri.unige.ch">Manfred.Gilli@metri.unige.ch</a></td>
</tr>
<tr>
<td>Joao Goncalves</td>
<td>Lehigh Univ.</td>
<td>USA</td>
<td><a href="mailto:jog7@lehigh.edu">jog7@lehigh.edu</a></td>
</tr>
<tr>
<td>Jacek Gondzio</td>
<td>Univ. of Edinburgh</td>
<td>Scotland</td>
<td></td>
</tr>
<tr>
<td>Vassilis Hajivassiliou</td>
<td>London School of Economics</td>
<td>UK</td>
<td><a href="mailto:vassilis@econ.lse.ac.uk">vassilis@econ.lse.ac.uk</a></td>
</tr>
<tr>
<td>Michel Juillard</td>
<td>Univ. of Paris 8</td>
<td>France</td>
<td><a href="mailto:michel.juillard@cepremap.cnrs.fr">michel.juillard@cepremap.cnrs.fr</a></td>
</tr>
<tr>
<td>Andrzej Karbowski</td>
<td>NASK Warsaw</td>
<td>Poland</td>
<td><a href="mailto:A.Karbowski@ia.pw.edu.pl">A.Karbowski@ia.pw.edu.pl</a></td>
</tr>
<tr>
<td>Vassiliki Karioti</td>
<td>National Technical Univ. of Athens</td>
<td>Greece</td>
<td><a href="mailto:vaskarioti@otenet.gr">vaskarioti@otenet.gr</a></td>
</tr>
<tr>
<td>Erricos J. Kontogiorganis</td>
<td>Univ. of Athens</td>
<td>Switzerland</td>
<td><a href="mailto:erricos.kontogiorganis@unico.it">erricos.kontogiorganis@unico.it</a></td>
</tr>
<tr>
<td>Christos Koukouvinos</td>
<td>Nat. Tech. Univ. of Athens</td>
<td>Greece</td>
<td><a href="mailto:ckkoukou@math.nua.gr">ckkoukou@math.nua.gr</a></td>
</tr>
<tr>
<td>Stratis Kounias</td>
<td>Univ. of Athens</td>
<td>Greece</td>
<td><a href="mailto:skounias@math.unamu.gr">skounias@math.unamu.gr</a></td>
</tr>
<tr>
<td>Ioannis Krikidis</td>
<td>Ecole Nat. Sup. des Telecom.</td>
<td>France</td>
<td><a href="mailto:krikidis@enstr.f">krikidis@enstr.f</a></td>
</tr>
<tr>
<td>Dimitris Kugiumtzis</td>
<td>Univ. of Thessaloniki</td>
<td>Greece</td>
<td><a href="mailto:dkugiumtzis@university.gr">dkugiumtzis@university.gr</a></td>
</tr>
<tr>
<td>Michele La Rocca</td>
<td>Univ. of Salerno</td>
<td>Italy</td>
<td><a href="mailto:larocca@unisa.it">larocca@unisa.it</a></td>
</tr>
<tr>
<td>Alessandra Luati</td>
<td>Univ. of Bologna</td>
<td>Italy</td>
<td><a href="mailto:luati@unibo.it">luati@unibo.it</a></td>
</tr>
<tr>
<td>Panagiotis Mantalos</td>
<td>Blekinge Inst. of Tech.</td>
<td>Sweden</td>
<td><a href="mailto:Panagiotis.Mantalos@bth.se">Panagiotis.Mantalos@bth.se</a></td>
</tr>
<tr>
<td>Alfio Marazzi</td>
<td>Univ. de Lausanne</td>
<td>Italy</td>
<td><a href="mailto:alfio.marazzi@unicl.ch">alfio.marazzi@unicl.ch</a></td>
</tr>
<tr>
<td>Manlio Marchesi</td>
<td>Sanpaoi IMI SGR</td>
<td>Germany</td>
<td><a href="mailto:manlio.marchesi@sanganow.com">manlio.marchesi@sanganow.com</a></td>
</tr>
<tr>
<td>Dietmar Maringer</td>
<td>Univ. of Erfurt</td>
<td>UK</td>
<td><a href="mailto:Dietmar.Maringer@uni-erfurt.de">Dietmar.Maringer@uni-erfurt.de</a></td>
</tr>
<tr>
<td>Istvan Maros</td>
<td>Imperial College London</td>
<td>UK</td>
<td><a href="mailto:i.maro@doc.ic.ac.uk">i.maro@doc.ic.ac.uk</a></td>
</tr>
<tr>
<td>Spiros Martzoukos</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
<td><a href="mailto:baspio@ucy.ac.cy">baspio@ucy.ac.cy</a></td>
</tr>
<tr>
<td>Nicos Mateou</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
<td><a href="mailto:nic.mateou@cytanet.com.cy">nic.mateou@cytanet.com.cy</a></td>
</tr>
<tr>
<td>Giorgos Mavritsakis</td>
<td>Univ. of Patras</td>
<td>Greece</td>
<td><a href="mailto:mayritsas@ceid.upatras.gr">mayritsas@ceid.upatras.gr</a></td>
</tr>
<tr>
<td>Patrick McSharry</td>
<td>Univ. of Oxford</td>
<td>UK</td>
<td><a href="mailto:mcherry@maths.oa.ac.uk">mcherry@maths.oa.ac.uk</a></td>
</tr>
<tr>
<td>Athanasios Migdalas</td>
<td>Tech. Univ. of Crete</td>
<td>Greece</td>
<td><a href="mailto:migdalas@ergysa.tuc.gr">migdalas@ergysa.tuc.gr</a></td>
</tr>
<tr>
<td>Domenico Mignacca</td>
<td>Sanpaoi IMI AM SGR</td>
<td>Italy</td>
<td><a href="mailto:domenico.mignacca@sanganow.com">domenico.mignacca@sanganow.com</a></td>
</tr>
<tr>
<td>Boris Mirkin</td>
<td>Birkbeck College</td>
<td>UK</td>
<td><a href="mailto:mirkin@dcn.bbk.ac.uk">mirkin@dcn.bbk.ac.uk</a></td>
</tr>
<tr>
<td>Constantinos Neocleous</td>
<td>Higher Technical Institute</td>
<td>Cyprus</td>
<td><a href="mailto:costas@ucy.ac.cy">costas@ucy.ac.cy</a></td>
</tr>
<tr>
<td>Ewa Niewiadomska-Szynkiewicz</td>
<td>NASK Warsaw</td>
<td>Poland</td>
<td><a href="mailto:e-n-s@ia.pw.edu.pl">e-n-s@ia.pw.edu.pl</a></td>
</tr>
<tr>
<td>Raymond O’Brien</td>
<td>Univ. of Southampton</td>
<td>UK</td>
<td><a href="mailto:rjo@soton.ac.uk">rjo@soton.ac.uk</a></td>
</tr>
<tr>
<td>Silas Onyango</td>
<td>Univ. of Huddersfield</td>
<td>UK</td>
<td><a href="mailto:s.onyango@hud.ac.uk">s.onyango@hud.ac.uk</a></td>
</tr>
<tr>
<td>Francisco G. Padilla</td>
<td>King’s College of London</td>
<td>UK</td>
<td><a href="mailto:padilla@kath.kcl.ac.uk">padilla@kath.kcl.ac.uk</a></td>
</tr>
<tr>
<td>Panos Parpas</td>
<td>Imperial College of Science</td>
<td>UK</td>
<td><a href="mailto:pp500@doc.ic.ac.uk">pp500@doc.ic.ac.uk</a></td>
</tr>
<tr>
<td>Constantinos Pattichis</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
<td><a href="mailto:pattichis@ucy.ac.cy">pattichis@ucy.ac.cy</a></td>
</tr>
<tr>
<td>Name</td>
<td>Affiliation</td>
<td>Country</td>
<td>Email</td>
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<tr>
<td>Ludo Peeters</td>
<td>Univ. Campus</td>
<td>Belgium</td>
<td><a href="mailto:ludo.peeters@luc.ac.be">ludo.peeters@luc.ac.be</a></td>
</tr>
<tr>
<td>Stephen Pollock</td>
<td>Queen Mary College</td>
<td>UK</td>
<td><a href="mailto:stephen.pollock@sigmapi.u-net.com">stephen.pollock@sigmapi.u-net.com</a></td>
</tr>
<tr>
<td>Marios Polycarpou</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
<td><a href="mailto:mpolycar@ucy.ac.cy">mpolycar@ucy.ac.cy</a></td>
</tr>
<tr>
<td>Tommaso Proietti</td>
<td>Universit'a di Udine</td>
<td>Italy</td>
<td><a href="mailto:proietti@dss.uniud.it">proietti@dss.uniud.it</a></td>
</tr>
<tr>
<td>Elvezio Ronchetti</td>
<td>Univ. of Geneva</td>
<td>Switzerland</td>
<td><a href="mailto:Elvezio.Ronchetti@metri.unige.ch">Elvezio.Ronchetti@metri.unige.ch</a></td>
</tr>
<tr>
<td>Berc Rustem</td>
<td>Imperial College London</td>
<td>UK</td>
<td><a href="mailto:br@doc.ic.ac.uk">br@doc.ic.ac.uk</a></td>
</tr>
<tr>
<td>Christoph Schleicher</td>
<td>Univ. of British Columbia</td>
<td>Canada</td>
<td><a href="mailto:christoph@iam.ubc.ca">christoph@iam.ubc.ca</a></td>
</tr>
<tr>
<td>Stavros Siokos</td>
<td>Citigroup London</td>
<td>UK</td>
<td><a href="mailto:stavros.siokos@citigroup.com">stavros.siokos@citigroup.com</a></td>
</tr>
<tr>
<td>Haritini Tsangari</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
<td><a href="mailto:haritini@ucy.ac.cy">haritini@ucy.ac.cy</a></td>
</tr>
<tr>
<td>Hercules Vladimirou</td>
<td>Univ. of Cyprus</td>
<td>Cyprus</td>
<td><a href="mailto:hercules@ucy.ac.cy">hercules@ucy.ac.cy</a></td>
</tr>
<tr>
<td>Evdokia Xekalaki</td>
<td>Athens Univ. of Business</td>
<td>Greece</td>
<td><a href="mailto:exek@aueb.gr">exek@aueb.gr</a></td>
</tr>
<tr>
<td>Ito Wasito</td>
<td>Birkbeck College</td>
<td>UK</td>
<td><a href="mailto:ito@dc.bbk.ac.uk">ito@dc.bbk.ac.uk</a></td>
</tr>
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