The 18th International Symposium on Forecasting

Edinburgh, Scotland
June 10 – 13, 1998

NAPIER UNIVERSITY
EDINBURGH

ISF 98

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ACKNOWLEDGEMENTS

The ISF 98 Organising Committee would like to thank the following people for their help and support:

Anne Bell
Neil Bowie
Lynn Corrigan
Carol Edgar
Lindsey Wright
Staff at the EICC

The ISF 98 local organisers would also like to thank the following who provided invaluable assistance and advice:

Scott Armstrong
Derek Bunn
Robert Fildes
Ken Holden
Andrew Hughes-Hallet
George Wright

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NAPIER UNIVERSITY
EDINBURGH

21 May 998

FROM THE PRINCIPAL AND VICE-CHANCELLOR
PROFESSOR JOHN MAVOR FEng, FRSE

DIRECT LINE: (0131) 455 4600/4601
e-mail: j.mavor@napier.ac.uk

OUR REF YOUR REF

Dear Delegate.

I am delighted to welcome you to this prestigious conference in the beautiful City of Edinburgh and would like to thank you for being here to share what I am sure will be a most delightful and stimulating few days.

Napier University is proud to be involved. We take our name from the great Scottish mathematician and polymath, John Napier,whose former home now forms part of one of the university campuses. It is a name we are proud to live up to in a university which, although only six years old, has an excellent reputation across a wide field of disciplines: Science, Engineering, Arts and Social Sciences, Napier Business School and Health Studies. We have excellent links thoughout Britain with industry and commerce .

We are so lucky to be located in Edinburgh with its centuries of history, tradition and culture. The city is a paradise for students, residents and visitors. I hope you will take the opportunity to explore during breaks in the conference. I am sure you will find it rewarding.

All that remains for to say is to welcome you all once more and thank you for coming. Have a marvellous conference!

Yours sincerely

John Mavor

·EDINBVRGH·
THE CITY OF EDINBURGH COUNCIL

The Right Honourable
Eric Milligan J.P.
Lord Provost

Dear Delegate

As Lord Provost of Edinburgh, I am delighted to welcome you to the City for the 18th International Symposium on Forecasting being hosted at the magnificent Edinburgh International Conference Centre by Napier University and the International Institute of Forecasters.

I would like, in particular, to welcome those of you who are visiting Edinburgh for the first time. I know that you will have a very busy time attending the Symposium, but I do hope that in the course of your visit you will be able to enjoy something of Edinburgh and its many attractions.

Edinburgh is a beautiful, dynamic, prosperous European city, benefiting from a unique architectural heritage and a magnificent natural setting. It is host to many thousands of visitors who come here throughout the year to enjoy numerous cultural and sporting events such as "Edinburgh's Hogmanay" and the Edinburgh International Festival.

Edinburgh is also the home of Government, law, the churches and banking in Scotland and enjoys a reputation for academic and scientific excellence and for offering a superb quality of life to those who live and work here. With a Scottish Parliament being established in the city for the first time in three hundred years, Edinburgh will enter the Millennium as a more complete capital city.

I do hope that you will enjoy having your Symposium in Edinburgh. I hope that it will be a successful one and I hope that you will come back to Edinburgh again on many future occasions whether it be for leisure or business.

Yours sincerely

ERIC MILLIGAN
Lord Provost

ISF 98

18th International Symposium on Forecasting

Edinburgh: June 10-13, 1998

In collaboration with the
International Institute of Forecasters and Napier University

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Ceud Mile F'ailte

Welcome to ISF98

On behalf of the organising committee, I should like to welcome you to the 18th International Symposium on Forecasting. This event is continuing the long tradition of promoting excellence in forecasting. There are representatives from thirty-five countries presenting their work, all of which is at the forefront of the principles, methodology and practice of forecasting.

When the organising team collated and presented me with the conference programme, I was left with no doubt that this would be a beneficial and stimulating event. Both research and practice of forecasting will advance after this symposium but still leave us with plenty of room to make further progress in Washington next year. The success of the Symposium should be attributed to our keynote and feature speakers, exhibitors and, sponsors, but most of all it is the delegates who are presenting their new work which will prove of immense importance to the future of forecasting.

I hope that you enjoy your stay in Edinburgh, Scotland's capital city. It is a city rich in history, which I hope that you will get a chance to appreciate through the many museums and galleries. You can also appreciate Edinburgh through its many fine restaurants and pubs. I feel sure that if you consulted the Oracle at Delphi you would be told that Edinburgh, "the Athens of the North", is the place to be in June 1998. Do try to see some of the rest of Scotland; trips to Stirling and the Trossachs, Glasgow and the Isle of Skye are recommended.

I and the rest of the team sincerely hope that you have a memorable time in Edinburgh, increase your knowledge of forecasting, reacquaint yourself with old friends and make many new ones.

Finally I would like to thank all those who made this event possible, and especially the delegates.

Yours sincerely

Dr Robert Raeside
Symposium Chair

Sages their solemn e'en may steek
And raise a philosophic reek,
And physically causes seek,
In clime and season;
But tell me whisky's name in Greek,
I'll tell the reason.

The Author's Earnest Cry
by Robert Burns (1759-1796)

Accommodation and Social Programme: J Robertson, Clansman Monarch, 1 Hill Street, Edinburgh
Tel: 00 44 131 226 5222 Fax: 00 44 131 226 5333

ISF 98 LOCAL ORGANISING COMMITTEE

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GENERAL INFORMATION

Registration

Registration will begin at 5pm at Napier University, Craighouse Campus, Craighouse Road, Edinburgh. A welcoming informal buffet will be available from 7pm. If you are using an ISF 98 conference hotel, a coach will collect you from your hotel.

Please check bus times at the registration desk of your hotel.

Registration at the Edinburgh International Conference Centre, 10 Melville Crescent, Edinburgh will take place in the Strathblane Hall, which is at the main entrance, between the following times:

- 8am and 3.30pm on Thursday 11th June
- 8.30am and 3.30 on Friday 12th June
- 8.30am until 10.30am on Saturday 13th June.

The Welcome Address will be at 9am on Thursday 11th June in the Pentland Auditorium followed by the first Plenary Session, which begins at 9.15am in the Pentland Auditorium.

Information Desk/Message Centre

An information desk will be open for the duration of the conference and will be staffed at all times. This is also situated in the Strathblane Hall. A notice board will be at this desk, please check regularly for any messages, updates or programme changes.

Paper Requests

If delegates wish to receive copies of session papers please make the request to the first named author of the paper. All delegates, their address and email numbers are listed in your List of Delegates.

Accommodation and Social Desk

This desk will be open from 9am until 12 noon on Thursday 11th and Friday 12th. A member of Clansman Monarch staff will be present to take any bookings or enquiries and to meet/book guests for tours.

Badges

Your name badge serves as a pass for all programme sessions, lunch and refreshment breaks. Delegates are requested to wear their personal badges at all times during the conference. For easy identification, the badge background colours are as follows:

- **Delegates - white**
- **Conference Staff - red**
  Exhibitors – grey

All enquiries should be addressed to the conference staff with red badges.

Business Services

Photocopying, word-processing, fax and internet facilities will be available in the Business Centre which is situated at the side of the Strathblane Hall. There will be a charge for use of all these facilities, which will be at the delegates' own expense. A list of charges will be available from the Information Desk.

Refreshment Breaks

Lunch and all refreshment breaks will be served in the Cromdale Hall.

Exhibition

The exhibition will be open throughout the conference and will be held in the Cromdale Hall where all refreshments will take place.

Additional copies of the programme

Additional copies of the programme book may be purchased from the Information Desk for £20. Please make cheques payable to "Napier University". After the Conference additional copies of the book may be purchased for £20 from

Carol Edgar
Conference Office
Napier University
Craiglockhart Campus
EDINBURGH EH14 1DJ
Email: c.edgar@napier.ac

Conference Social Events

Wednesday 10th - Welcome Reception from 7pm at Napier University, Craighouse Campus, Edinburgh

Friday 12th - Conference Dinner and Ceilidh from 7.30pm at the Assembly Rooms, George Street, Edinburgh

Official ISF 98 Hotels

Apex Hotel
Maitland Hotel
Thistle Court Hotel
Forte Post House Hotel

Tours

Clansman Monarch will operate their desk from 9am to 12 noon on Thursday 11th and Friday 12th June. A member of the company's staff will be present to take any bookings or enquiries.

Additional Information

Church Services
There are many denominations to choose from, please ask at the Information Desk for details.

Banking Facilities
Please ask at the Information Desk for details.

General Enquiries
If you have any queries or problems, please ask any member of staff wearing a red badge, who will do their best to help you.

Important Information

Police	112	(Emergencies Only)
Ambulance	5	(Emergencies Only)

Nearest Police Station: West End Police Station – Tel: 229 2323
Nearest Hospital: Royal Infirmary (Accident & Emergency Dept.) Tel: 536 4000

Exhibitors at ISF '98

Peg Young: Chair: ISF '99 - Immigration and Naturalisation Service,Washington D.C., 20536, USA

Sandra Grijzenhout, Elsevier Science, Elsevier Science Exhibitions Department, Molenwerf 1, 1014 AG Amsterdam The Netherlands

Martin Vicars, Wiley Publishers, Baffins Lane, Chichester, Sussex PO19 UD, UK

ouisa Nutt, Blackwell Publishers, 108 Cowley Road, Oxford, OX4 JF, UK

Fred Ingram and Suzanne Hemsel, Delphus Inc., 103 Washington Street. Morristown, NJ 07960, USA.

David Reilly, Automatic Forecasting Systems, Inc., PO Box 563, Harboro, PA 19040, USA.

SAS Institute, Tara House, 46 Bath Street, Glasgow UK

James Picksley, Mercia Software Ltd., Holt Court North, Henage Sreet West, Aston Science Park, Birmingham B7 4AX, UK

Philip Watson, International Rubber Study Group, 8th Floor, York House, London, UK

Helen McKnight, PR & Marketing Dept (Craiglockhart), Napier niversity Edinburgh.

Timberlake Consultants, 47 Hartfield rescent, West Wickham, Kent BR4 9DW JK

Eric Stellwagen, Business Forecast Systems Inc, 68 Leonard Street, Belmont, MA 02178, USA

COMMITTEE MEETINGS

EDITORS AND ASSOCIATE EDITORS

Tuesday, 9th June 1998
9.00 a.m. - 5.00 p.m.
Study Room,
Merchiston Campus,
Napier University.

IIF STRATEGY MEETING

Tuesday, 9th June 1998
2.00 p.m. - 5.00 p.m.
The Board Room,
Merchiston Campus,
Napier University.

DIRECTORS

Wednesday, 10th June 1998
9.00 a.m. - 3.00 p.m.
Study Room,
Merchiston Campus,
Napier University.

Joint Meeting of

ORGANISING COMMITTEE, DIRECTORS, and EDITORS & ASSOCIATE EDITORS

Wednesday, 10th June 1998
4.00 p.m. - 6.30 p.m.
Club Room,
Craighouse Campus,
Napier University.

PAST PRESIDENTS OF THE IIF

Estelle Dagum University of Bologna. ITALY	1988-1989
Robert Winkler Duke University, Durham, .S.A.	1989-1990
Everette S. Gardener, Jr. University of Houston, S.A.	1990-1992
Stuart Bretschneider Syracuse University .S.A.	1992-1994
Hans Levenbach Delphus Inc., .S.A.	1994-1996
Mich: Lawrence, University of New South Wales, AUSTRALIA	1996-

PREVIOUS ISF CONFERENCE VENUES

Year	Place
1981	Quebec City, Canada
1982	Istanbul, Turkey
1983	Philadelphia, U.S.A.
1984	London, UK
1985	Montreal, Canada
1986	Paris, France
1987	Boston, U.S.A.
1988	Amsterdam, Holland
1989	Vancouver, Canada
1990	Delphi, Greece
1991	New York, U.S.A.
1992	Wellington, New Zealan
1993	Pittsburgh, U.S.A.
1994	Stockholm, Sweden
1995	Toronto, Canada
1996	Istanbul, Turkey
1997	Bridgetown, Barbados
1998	Edinburgh, Scotland

HISTORY OF INTERNATIONAL INSTITUTE OF FORECASTERS

The International Institute of Forecasters (IIF) is a non-profit organisation founded in 1981 with support from INSEAD, the Manchester Business School, IMEDE, Laval University, and the Wharton School. Its objectives are to simulate the generation, distribution and use of knowledge on forecasting.

	Research	Develop and unify forecasting as a multi-disciplinary field of research drawing on management, behavioural, social, engineering, and other sciences.
•	**Practice**	Contribute to the professional development of analysts, managers, and policy makers with responsibilities for making and using forecasts in business and government.
•	**Theory & Practice**	Bridge the gap between theory and practice, with practice helping to set the research agenda and research providing useful results.
•	**International Scope**	Bring decision makers, forecasters and researchers from all nations together to improve the quality and usefulness of forecasting.

The IIF has held seventeen International Symposia on Forecasting in cities around the world beginning with Quebec City in 1981 and most recently in Bridgetown, Barbados. The next symposium will be in Washington DC, U.S.A. It publishes a quarterly newsletter jointly with the International Association of Business Forecasting (IABF). Items include short articles by practitioners and researchers, news about the IIF and the IABF, brief software reviews, announcements, and upcoming events.

For further information, contact:
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U.S.A.

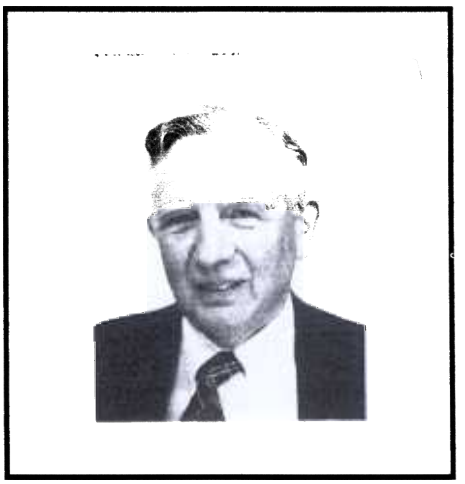
e-mail: allen@resecon.umass.edu

KEYNOTE ADDRESSES

Chair: George Wright

The Use of Scenarios in Forecasting: Setting the Context

Professor Kees van der Heijden
Department of Management Science
University of Strathclyde, Scotland



Forecasting requires a 'problem definition' context; the decision what to forecast cannot be derived from the activity itself. The scenario technique is one, increasingly popular, way of setting this context. The address discusses the subject from the perspective of two different worldviews on the subject of the futurity of organisational actions. The situation facing the forecaster is highly complex, it cannot be understood in all its details and both perspectives have something to offer.

The first looks at a problematic situation as something to be clarified through rationalistic reasoning based on empirical observation. The scenario technique can be interpreted as a way to turn intuitive knowledge of a problematic situation into clear and unambiguous research questions which can be explored by systemic analysis in general and forecasting in particular. This can only be done by making a distinction between the predictable and the indeterminate elements in a situation, which gives rise to a characterisation of the future in terms of multiple scenarios, from which the technique derives its name. The scenario planner alternates intuitive exploration of the situation with rational analysis and forecasting in an iterative way until it is felt that the two are in comfortable juxtaposition, at which point a satisfactory description of the future has been derived, in terms of both its pre-determined and indeterminate elements.

An alternative processual perspective is based on the assumption that organisations construct (part of) their reality socially in an ongoing conversation. Forecasting in isolation will develop views of the future in terms of variables that are already included in the shared mental model, and leave out those variables that fall outside what is already being seen. Important trend breaks may be caused by developments outside the existing 'thinking box' of the organisation. The scenario technique can help organisations to explore this unknown territory through allowing the internal strategic conversation to be linked to other relevant conversations taking place elsewhere, in this way bringing variables within the horizon of the organisation which would otherwise escape attention.

A discussion of the scenario technique and forecasting from these two perspectives on the organisational decision making process clarifies the possible roles each approach can play in preparing organisations to deal with the future.

Professor van der Heijden has been Professor of Strategic Management at the Department of Management Science of Strathclyde University, Glasgow since 1991. Before joining the Strathclyde faculty he was in charge of Royal Dutch/Shell's scenario planning activity, as head of the Group's Business Environment Division. His responsibilities included monitoring and analysis of the business environment, consulting with top management on strategic implications and general development of the process of scenario planning in which the Group has taken a world-wide leading role. Prior to this Professor van der Heijden was head of Royal Dutch/ Shell's internal strategy consultancy group, assisting management teams world-wide in strategy development and implementation. He has consulted widely in the areas of scenario planning and strategy and his main research interests are in scenario planning, strategy development, institutional strategic management processes and institutional learning. Since 1995 he has been a visiting Professor at Nijenrode University, Holland. He is also the co-founder of the Global Business Network.

Chair: Robert Raeside

Prediction of Global and Local Climate Change Using A Dynamic Climate Model

Professor Ulrich Cubasch
Head of the Model Application Group at the "Deutsches Klimarechenzentrum"(DKRZ), Hamburg, Germany

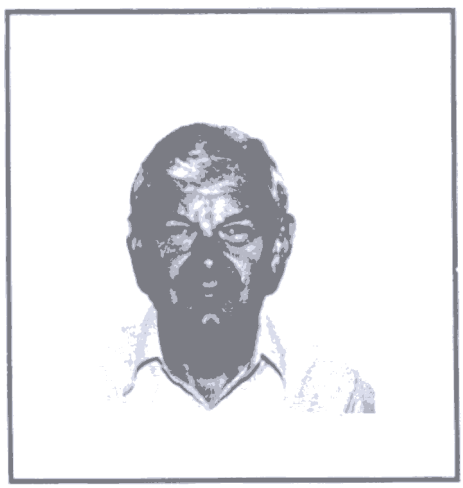
A number of numerical experiments have been performed with a globally coupled ocean-atmosphere model simulating the present-day climate and its internal variability, the future climate influenced by the anthropogenic emissions of greenhouse gases and sulfate aerosols, as well as the variations introduced by the variability of solar intensity. The climate models are able to realistically represent the present-day climate. The global climate will warm by about 0.35 K per decade as a consequence of the projected increase (IPCC scenario A "business as usual") of the anthropogenic greenhouse gases. If one takes the effect of the sulfate aerosols into consideration too, the global temperature rise is reduced to 0.25 K per decade. An analysis of the pattern of the observed temperature rise with the method of optimal finger- printing indicates a probability that the temperature rise observed during the last three decades has been caused by natural variability of less than 5%. The pattern of the observed warming agrees best with the model simulation in which the effect of the greenhouse gases and the sulfate aerosols has been taken into consideration. The warming which has been simulated as a consequence of the increased solar intensity during the last 100 years is not sufficient to explain the observed global warming. Statistical and/or dynamical methods have been developed to estimate the local climate change from the coarse grid climate change simulations performed with the global model.

Professor Cubasch's main areas of work include the development of quasi-operational models of the climate system, climate variability and climate change studies with numerical models. From 1987 to 1991 he was the Senior Scientist at the Max-Planck-Institut fur Meteorologie,Hamburg, Germany and prior to that worked as a Scientist/Numerical Analyst at the "European Centre for Medium Range Weather Forecast" in Reading, England. He is currently a member of the WMO/GCOS AOPC (Atmospheric Observation Panel for Climate) as lead investigator and is a contributing author to the IPCC reports 1990, 1992,1995 "Scientific assessment of Climate Change"

Chair: Robert Fildes

Credit and Behavioural Scoring to Forecast Financial Risk

Professor Lyn Thomas
Department of Business Studies
University of Edinburgh, Scotland



Finance has provided a very successful application area for forecasting in the last two decades. Perhaps the most successful if least publicised, has been the use of forecasting tools to determine which new applicants for consumer credit are likely to default. This is known as Credit Scoring and the approaches which try to forecast the subsequent repayment and ordering behaviour of existing applicants is known as Behavioural Scoring. This KeyNote address will review the techniques currently employed in this field - regression, logistic regression, mathematical programming, Markov chain and classification trees - and those techniques which are being developed - neural nets, genetic algorithms, nearest 'neighbour' approaches. The address will also discuss the implementation and monitoring of these systems and the impact of legislation and data protection on their development. The address will also highlight some of the current developments such as profit and customer scoring and the incorporation of economic forecasts into credit scoring systems.

Professor Thomas is Professor of Management Science at the University of Edinburgh and has been engaged in credit scoring research for nearly twenty years. Educated as a mathematician at the University of Oxford, he has held academic posts at the Universities of Swansea and Manchester and the Naval Postgraduate School, Monterey. Professor Thomas is the author of over one hundred books and papers on credit scoring, sequential decision-making and game theory applications. He is a past President of the Operational Research Society, a Fellow of the Royal Society of Edinburgh and an active member of the Credit Research Centre at Edinburgh.

Chair: Andrew Hughes-Hallet

Recent Developments in Time Series Forecasting

Professor Ruey S. Tsay
Graduate School of Business
University of Chicago

Improvement of prediction accuracy using data observed at different frequencies in, for example, forecasting U.S. quarterly unemployment rates. A comparison of linear and non-linear predictions - the conditions under which non-linear models useful.Forecasting comparisons between econometric models developed for high frequency data: these introduce new challenges and new research opportunities for forecasters.

Professor Tsay is Professor of Econometrics and Statistics at the Graduate School of Business,University of Chicago, an elected Fellow of the American Statistical Association, the Institute of Mathematical Statistics and the Royal Statistical Society. Professor Tsay has served as co-editor of the Journal of Business and Economic Statistics, 1995-1997 and was elected Chair of the Business and Economics Section of the American Statistical Association in 1995. His research interests include linear and non-linear time series analysis, econometric and multivariate modeling, Baysian inference and analysis of high-frequency data. He has published extensively in major econometric and statistical Journals and his recent work includes forecasting Taiwan macreconomic variables and U.S. unemployment rates.

PANEL DISCUSSIONS and FEATURE SESSIONS

PANEL DISCUSSIONS & FEATURE SESSIONS

Thursday 11th June

11:00-13:00 **PENTLAND**

Panel Discussion:
Scenario Forecasting:
Professors Kees van der Heijden, Scott Armstrong and George Wright.

14:00-15:30 **PENTLAND**

Feature Speakers:
Technology Forecasting
Professor Harold Linstone, University of Oregon, USA.

Foresight and Beyond.
Ian Mills, Director (PREST), University of Manchester, Manchester, UK. –

Chair: Robert Raeside

16:00-18:00 **PENTLAND**

Panel Discussion:
Technology Forecasting
Ian Mills, Alan Porter and Theodore Modis.

Chair: Professor Harold Linstone.

17:00-18:00 **SIDLAW**

Panel Discussion:
Neural Networks for Time-Series Forecasting
William Remus and Marcus O'Connor

Chair: Chris Chatfield

16:00 - 18:00 **CARRICK 1**

Panel Discussion:
Regional Forecasting Accuracy and Methodology in a Changing World

(1) The Accuracy of State-Level Forecasts Over Time and by State

Timothy D Hogan, Director, Center for Business Research, Arizona State University, AZ, USA.

(2) Regional Forecasting Approaches Incorporating Input-Output Economic Impact Models: Some Applications and Results.

Roy L. Pearson, Director Bureau of Business Research, College of William & Mary, Virginia, USA and R.Keith Schwer, Director, Centre for Business and Economic Research, University of Nevada, Las Vegas, USA.

(3) Integration of Forecasting Models in Planning for Sustainable Development in the Bi-national Lower Rio Grande/Rio Bravo River Basin

Jared E. Hazleton, Director, Center for Business and Economic Analysis, Texas A&M University, College Station, TX 77843-4217,USA.

Chair: Roy Pearson

14:00-15:30 **SIDLAW**

Special Session on Forecasting over Space and Time

(1) Forecasting Geographic Data:
Michael Leonard, SAS Institute, USA.

(2) Demographics: a Picture of Criminality:
Andrew Yates and Mike Rees, University of Westminster, Kent, England

(3) Forecasting for Public Service Facility Location Decisions
Professor Will Gorr, John Gant, Michael Johnson, Stephen Roehrig and Piyusha Singh.
H.John Heinz III School of Public Policy, Carnegie-Mellon University, Pittsburgh USA.

Friday 12th June

1:00- 1:00 **M3 Panel Discussion** **SIDLAW**

Michele Hibon and Spyros Makridakis INSEAD, Boulevard de Constance, 77305 Fontainebleau, France.

Chair: Keith Ord, The Pennsylvania State University, Department of Management Science and Information Systems, University Park, PA 16802, USA.

Discussants: Benito Flores, Business Analysis Department, Lowry Mays College of Business Administration, Texas A&M University, College station, TX 77843-4217, USA.

Monica Adya Department of Information Systems, University of Maryland, Baltimore County, Baltimore, MD 21250, USA.

Sandy Balkin, Pennsylvania State University, Department of MS&IS, 303 Beam BAB, University Park PA 16802-1913, USA.

3:30-4:30 **Feature Speaker** **SIDLAW**

Multivariate Long Memory Modelling of Temperature Data and Tree Rings with Implications for Economic Policy
Richard T Baillie
Michigan State University

Chair: Derek Bunn

Saturday 13th June

11:00-1:00 **SIDLAW**

Panel Discussion:
Integrating Social, Technological and Economic Change in Forecasting.

Chair: Timothy Mack,
Co-Editor, Futures Research Quarterly, AAI Research, 929 Westminster Street, NW, Washington, DC 20001, USA.

Panelists: Kenneth Hunter, President, Collaborative Futures International

Sharon Newma and Rima Shaffer, John Hopkins University

Sessions by Time and Location

Session Contents

Details of Sessions (Abstracts)

Session Chair:
Professor Lars-Erik Oller, National Institute of Economic Research and Stockholm School of Economics, Stockholm, Sweden.

Methodologies of Integrating Annual National Account and Indicators

Gema de Cabo Serrano, Departamento de Fundamentos del An E1lisis Econ F3mico II (Econom EDa Cuantitativa), Facultad de Ciencias EconF3micas y Empresariales Universidad Complutense de Madrid, Campus de Somosaguas, 28223, Spain.

In this paper a way of integrating Annual National Account (ANA) data with indicators is investigated, in order to improve forecasting of ANA series. As a first possibility, currently available methodologies to estimate Quarterly National Account (QNA) series are studied, because they integrate ANA series and indicators. The idea is to use QNA series for forecasting the corresponding ANA series. However, it is observed that the techniques applied for building QNA series are based on assumptions insufficiently justified and they are often used automatically. For this reason, it is concluded that these methodologies are not useful tools for connecting annual data and indicators. Hence, a methodology is proposed for taking advantage of the information of indicators in forecasting ANA series, with which we intend to overcome the drawbacks of the methodologies for building QNA series. This new methodology is not an alternative for building quarterly series, but an alternative integration approach based on explicit analyses of relationships between ANA data and indicators, and in which the different phases of analyses and treatment of annual series and indicators are connected.

2. Issues in Macroeconomic Forecasting

Prof. Dr. Herman Stekler, George Washington University, Washington DC 20052, U.S.A.
Prof. Robert Fildes, Lancaster University, Lancaster LA1 4YX, U.K.

Macroeconomic forecasts are used extensively in industry and government. This presentation first reviews different approaches to evaluating macroforecasts. The historical accuracy of US and UK forecasts are examined in the light of these different criteria. Issues discussed include the comparative accuracy of macroeconometric models compared to their time series alternatives, whether the forecasting record has improved over time, the rationality of macroeconomic forecasts and how a forecasting service should be chosen. The role of judgment in producing the forecasts is also considered where the evidence unequivocally favors such interventions. Finally the use of macroeconomic forecasts and their effectiveness is discusses. The conclusion drawn is that researchers have given too little attention to the issue of improving the forecasting accuracy record. Areas where improvements would be particularly valuable are highlighted.

3. Determinants of Consumer Sentiment

Detelina Ivanova and **Kajal Lahiri**, Department of Economics, University at Albany – SUNY, 1400 Washington Avenue, Albany NY 12222, USA

The Index of Consumer Sentiment (ICS) is known to have significant power to forecast aggregate consumption and business cycles. The inflation and unemployment rates have been found to be the prime factors affecting ICS. However, a large proportion of the variation in ICS over time remains unexplained. Responses from five different questions in the Survey of Consumer Attitudes and Behaviour (SCAB) on personal finances, expectations of general business conditions in short and medium runs, and timing of durable purchases are used to construct ICS. We study the determinants of each of the components of ICS using pooled cross-section time-series SCAB data from 1978:1 to 1993:12 in an Ordered Logit framework. Data on more than 100 variables including consumers' perceptions and expectations about personal finances, government approval, aggregate unemployment, inflation, interest rates and uncertainty as well as personal characteristics (e.g. income, education, age, gender, employment status, household size etc.) and actual macroeconomic conditions have been utilised to investigate the relative importance of these factors.

We found that variations in the components of ICS can largely be explained by perceptions/ expectations variables, with personal idiosyncratic factors also contributing to the explanatory power for components referring to the personal questions. We also found support for the hypothesis that ICS is a reflection of consumers' expectations about the economy derived from their own experiences. Our results show that the most important common factors affecting the five components of ICS are consumers' approval of the economic policy of the government and their expectations of aggregate unemployment family income over the 1-year horizon. Once these factors have been taken into account, expectations of inflation and interest rates do not contribute significantly to the explanatory power of the model, neither do past values of unemployment, inflation, Treasury bill rate, stock market return or change in aggregate personal income. In terms of the percent of correct predictions per quarter and other diagnostic tests, the estimated models exhibited remarkable stability over alternative stages of the business cycles

4. Thailand and Mexico: Expectations Cast their Shadow before Crisis

Professor Rae Weston, Macquarie Graduate School of Management, N.S.W. 2109, Australia.

This paper explores the question of forecasting economic crises using forecast and expected estimates of economic data for the two cases of Mexico and Thailand. Sources used to provide information for intending and actual foreign investors in the two countries are examined for the periods around the crisis period as well as for more stable times. An overshooting hypothesis is established using the two Mexican economic crises and is tested for the Thailand situation. A control group of other countries is used to verify that the overshooting phenomenon is characteristic of pre-crisis situations only. The association of overseas investment with the pre-crisis situations is also explored. The results strongly suggest that there is information embedded in the forecast and expectation data that could lead to the construction of a suitable warning indicator of a coming economic crisis. Some suggestions are made for the construction of an index of economic fragility which could improve forecasting of economic crisis.

Session Chair:
Professor Ken Holden, Liverpool Business School, 98, Mount Pleasant, Liverpool L3 5UZ, UK

1. Econometric Forecasting: knowing better what we (still) don't know

Professor P. Geoffrey Allen, University of Massachusetts, Amherst, MA 01003, U.S.A.
Professor Robert A. Fildes, University of Lancaster, Lancaster LA 1 4YX, UK.

Recommendations for econometric forecasters are based more on theory than on empirical analysis. We review some of the accepted practices and principles of econometric forecasting using such empirical evidence as is available. Some examples of issues follow. Should VAR (or single equation) models be initially specified with variables in differences when tests show unit roots are present? Does an error correction model forecast better than an equation in levels when tests support parameter restrictions? Can some within-sample mis-specification test results (on normality, heteroskedasticity, autocorrelation, parameter constancy) be ignored in the search for the best forecasting model? Evidence on the first two issues, sometimes limited, says no. On the last, we do not at present know, nor do we appear to be conducting research that would find out. The paper concludes with some key research questions where the answers, if they had been available, would have helped in setting down the principles of practical econometric forecasting.

2. Stability Failures in Time-Series Macro-economic Modelling

Paul Ormerod, 35 The Avenue, Kew, Richmond, Surrey, TW9 2AL, U.K.

Problems involving lack of stability of equations are widespread in time-series macro-modelling. Wickens (1995), for example, argues that 'although the consumption function is the most studied of equations, the different specifications are legion and little or nothing has been resolved.' Hendry (1997, for example) has tried to develop a theory of intercept adjustments to cope with this serious problem.

This paper argues that instability over time is an inherent feature of such equations. The consequences of the existence of even a mild degree of non-linearity are examined, viewing sets of differential equations as a vector field and illustrating the consequences of external shocks in the vector field.

The high dimensional nature of the issue is illustrated by applying techniques of phase space attractor reconstruction to macro-data series.

3. Forecasting Non-stationary Economic Time Series

David F. Hendry, Nuffield College, Oxford, England.
Michael P. Clements, Economics Department, Warwick University, Coventry, U.K.

We outline a framework for research into economic forecasting, which subsumes the 'conventional' approach to economic forecasting. We consider forecasting in an evolving economy subject to structural breaks, using mis-specified, data-based models. This lets us delineate the implications for 'causal' modelling, and enunciate a taxonomy of forecast errors. We explore the causes of forecast failure, and show forecast-period shifts in deterministic factors are the dominant source of systematic failure, interacting with model mis-specification, collinearity, and inconsistent estimation. Various solutions are considered for avoiding systematic forecasting errors, including intercept corrections, differencing, and co-breaking. Their properties emphasise the distinction between equilibrium correction (cointegration) and error correction (offsetting past errors).

Session Chair:
Roy Batchelor, City University Business School, London

1. Modelling and Forecasting a Financial Account

Raquel del Rio Paramio, Facultad de Ciencias Economicas y Empresariales, Universidad Complutense de Madrid, 28003, Somosaguas, Madrid

This paper reports on the study of variables from the financial account of the balance of payments of an economy, with the aim of forecasting Time series corresponding to these. Such variables present special characteristics that make them difficult to model and are different from the characteristics of variables from the current account. In this paper a method is developed to model and forecast this type of variable. Models are obtained, which are useful in forecasting and monitoring operations as well as in establishing an essential starting point for analyses of relationships with interest rates and profits rates in general, not only national but foreign as well. The results of these relationships are very interesting in their implications for Economic Theory. Illustrations are taken from the author's study of the Spanish case with monthly data.

2. International Asset Pricing with Time Varying Risk: Evidence from Emerging Markets

Gökçe Soydemir, Department of Economics and Finance, College of Business Administration, University of Texas - Pan American, Edinburg, TX 78539, USA.

In this paper, a conditional version of the international CAPM is estimated and tested using weekly data of emerging and developed stock markets around the globe. The risk premias, betas and correlations are allowed to vary through time. The results show that the static CAPM does not price market risk whereas a time varying CAPM does. There is a slight increase in the estimated cross country correlations and a decline in the price of world risk over the latter part of the sample. The findings are consistent with the view that increasing integration of Latin American markets with the world has reduced investors' ability to improve their reward to risk ratio by diversifying into these emerging markets.

3. Exchange Rate Forecasting on Integrated Financial Markets

Folke Axel Rauscher, Daimler-Benz Research & Technology North America Inc., Palo Alto, CA 94304, U.S.A.

The globalisation of the world economy and the rapid advance of information technology have increased the integration of international financial markets. Because of these theoretically supported market interdependencies, forecasting models focusing only on one isolated market independently waste the information which is incorporated in the interrelations between different financial magnitudes.

By estimating different, however related, tasks simultaneously the underlying interdependencies between them can be exploited. The innovative Multi-Task Learning approach presented in this paper is an inductive transfer method which uses additional information in form of knowledge-based domain-specific hints about related tasks as an inductive bias to guide the learning or estimation process towards better solutions of the main problem.

The paper presents a combination of the multivariate Johansen cointegration procedure with its evolving vector error correction models and the proposed Multi-Task Learning methodology for exchange rate forecasting. The forecasting performance is evaluated out-of-sample in and in-depth empirical investigation.

4. Forecasting T-bill Yields: Accuracy versus Profitability?

Roy Batchelor, City University Business School, London

Many studies show that short term interest rates approximate a random walk. In theory there should therefore be (asymptotic) positive correlations between measures of forecast accuracy and the profits from natural trading rules based on these forecasts. However, empirical studies show no correlation between accuracy and profitability.

This paper uses a large panel of 13500 forecasts of US T-bill yields to re-examine the relationship between RMSE accuracy and trading profitability. In our panel, the expected positive correlation appears. The paradoxical results of previous studies are shown to reflect finite-sample bias, exacerbated by the inclusion of the no-change random walk forecast, which is typically very accurate, but not very profitable.

5. Data for Forecasting International Financial Crises

Lois Stekler, Federal Reserve Board, USA

In the aftermath of the Mexican crisis, the IMF undertook a major initiative to encourage countries to provide more accurate and timely economic and financial data. The hope was that, by providing investors with an early warning of developing problems, market discipline would force governments to make timely adjustments to policy before the problems reached crisis proportions. As recent developments in Asia have made obvious, this initiative was not adequate to the task. This paper explores the holes that have become apparent in the coverage of the IMF's data dissemination standards and the broader question of the role improved data availability is likely to play in avoiding future international financial crises.

Session Chair:
Dr. Robert Raeside, Napier University, Edinburgh

1. A Simulation Study on Predictive Residuals Sum of Squares

Sidika Basçi, Asad Zaman, Department of Economics, Bilkent University, Ankara, Turkey.

Predictive Residuals Sum of Squares (PRESS) is a newly suggested criterion for the estimation of lag order of an Autoregressive (AR) process. Simulation results show that PRESS does not penalize high orders of lag as much as other widely used criteria. In this paper we present some modified versions of PRESS to overcome this problem and report their performance among themselves and also with the other widely used criteria in a Monte Carlo study. While doing this, since we use different distributions to generate the model, we can also see the robustness of the criteria. We consider the probability of estimating the true lag order and mean squared forecasting error while comparing the criteria. Depending on the simulation results we can say that all of the modified versions are an improvement over the original PRESS. Although they have a tendency to underestimate the lag order their mean squared forecasting errors are lower relative to other widely used criteria. This indicates that being parsimonious while selecting the model is better in terms of forecasting.

2. Measuring Intervention Effects on Multiple Time Series Subjected to Linear Restrictions: A Banking Example.

Victor M. Guerrero, Daniel Pena and **Pilar Poncela**

We consider the problem of estimating the effects of an intervention on a time series vector subjected to a linear constraint. Minimum variance linear and unbiased estimators are provided for two different formulations of the problem: (i) When a multivariate intervention analysis is carried out and an adjustment is just needed to fulfill the restriction. (ii) When a univariate intervention analysis was performed on the aggregate series obtained from the linear constraint, previous to the multivariate analysis, and the results of both analyses are required to be made compatible with each other. A banking example that gave rise to this work illustrates our solutions.

3. Evaluation of a Non-parametric Approach to Forecasting Foreign Exchange Rates

Stephen Wang & Nigel Meade, Management School, Imperial College London.

A non-parametric approach to modelling possible non- linearities is the nearest neighbour method. The talk will include definition of the current state of the time series; definition of the distance between current and past states; identification of the n nearest neighbours and computation of the forecast. The evidence from the literature for the success of this type of approach is very mixed. The tentative conclusion presented here is that the approach holds some promise for intra-day data. The evidence presented will be based on daily, hourly and half hourly data.

4. The Automatic Selection of a Suitable Exponential Smoothing Method

Richard Lawton, Mathematical Sciences Department,University of the West of England, Bristol BS16 1QY

This paper addresses the efficacy of various proposed methods of automatic selection of exponential smoothing methods. The methods examined include the Gardner-McKenzie method (based on the degree of differencing of a series which results in the lowest variance), the use of the Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC). The paper restricts itself to the choice between the three non-seasonal methods, simple exponential smoothing, damped Holt's method and Holt's method.

Many studies in the past have applied the selection methods to real data, for which it is not known which method is best. This paper looks at simulated data series where the generation process is known and for which one of the methods is known to be optimal. This enables the success of the selection methods to be assessed. This yields clear advice as to how best to automatically select which exponential smoothing method to use.

5. The Theta Model

V. Assimakopoulos and K. Nikolopoulos, National Technical University of Athens, Greece

One of the major difficulties in the forecasting process is the identification of the hidden pattern of a time series. The theta model consists of a nonlinear nonparametric estimator (called as Theta estimator) and an expert system that combines a variety of methods in the smoothed data so as to produce the final forecasts. This method is based in a linear transformation which gradually smoothes the initial curve, while maintaining the trend and mean value of the original data (Theta transformation). Practical tools have been realized so as to identify the parameters of the method in order to produce a minimum mean square estimation and a satisfactory forecast. The "Theta model" has taken part in the M3-Competion. The results and a first presentation of the method has been made in the Decision Sciences Conference this year in San Diego.

Session Chair:
Anne B. Koehler, Department of Decision Sciences and Information Systems, Miami University. Oxford, OH 45056, USA.

Modelling and Forecasting Car Ownership and Use: The British Experience

Peter Romilly, Economics Division, School of Social and Health Sciences, University of Abertay Dundee, 158 Marketgait House, Dundee DD1 1NJ, Scotland.
Haiyan Soing, Department of Management Studies, University of Surrey, Guildford GU2 5XH. Surrey, England.
Xiaming Liu, Strategic Management Group, Aston Business School, Aston University, Birmingham B4 7EP, England.

This paper extends the methodology and results of a forthcoming publication (Romilly, Song and Liu, 1998). It deals with the modelling and forecasting of both car ownership and use in Britain, following the recent publication of a fourth set of road traffic forecasts by the UK Department of the Environment, Transport and the Regions. Using a number of estimation techniques, cointegrating relationships are found between per capita car ownership (and car use) and real per capita personal disposable income, real motoring costs and real bus fares. The corresponding error correction models are derived. The forecasts from these cointegrating relationships are compared with the forecasts produced by the Department, and with those from a number of alternative forecasting models. The results suggest that the model developed by the authors is still a good predictor of car ownership and use in Britain.

Long-term Forecasting of Aggregate Passenger Demand at UK Airports with Structural Models

Howard Grubb, The University of Reading, Department of Applied Statistics, Reading RG6 6FN. U.K.
Alexina Mason, Civil Aviation Authority, Economic Regulation Group,

We consider the problem of forecasting the monthly air passenger demand, aggregated at all UK airports. This is required for planning purposes, a task for which the Civil Aviation Authority (CAA) has responsibility. Planning decisions are often relatively long-term (of the order of ten years), so a reliable historical dataset is required, together with industry-specific knowledge, to make robust forecasting decisions. Although disaggregate forecasts, at each airport, are the most useful in detailed capacity planning, an aggregate forecast, for all airports and passenger types together, is valuable to constrain allocation models, which might otherwise be inconsistent.

The CAA collects data on air transport, including a long historical dataset of monthly total passenger numbers, back to 1972, with older observations also available after a brief gap, during which there was only quarterly reporting. The series exhibits strong, regular growth, with some evidence of a recent slowing in growth and pronounced, multiplicative seasonality.

This behaviour leads us to consider structural models for these data. We examine their forecasting performance and compare this with other models and current industry long-term forecasts to explore the range of uncertainty in this type of forecasting application.

3. Forecasting Weekly Movie Attendance

Philip Hans Franses, Rotterdam Institute for Business Economic Studies, Erasmus University Rotterdam, NL-3000 DR Rotterdam, The Netherlands. (with Jedid Jah Jonker)

Typical features of nation-wide weekly movie attendance are an exponential decay and often a temporary increase in attendance after a few weeks. This sudden increase may be due to delayed distribution in certain parts of the country or to advertising/WOM effects. We propose a simple parsimonious model which can account for these two features. We estimate its parameters for observed attendance in The Netherlands for 14 different movies. We argue that the parameters give indications on how the movies can be classified and also that the parameters can be jointly interpreted. We use these results to forecast attendance for 2 movies, which were not included in the estimation sample.

4. Prediction of Traffic Load for Road Transport Classification and Control

Emil Pelikan, Mirko Novak and **Pavel Pribyl**, Joint Laboratory of System Reliability, Faculty of Transportation and Institute of Computer Science, Pod vodarenskou vezi 2, 182 07 Prague 8

The traffic load forecast with prediction horizon a few minutes or hours can appreciably improve the performance of the traffic control systems which are used for the regulation of urban networks. The adaptive regulation system includes usually a package of co-ordination plans and a decision algorithm choose the one to be applied. The frequency of such decisions is calculated in minutes (for example every 5 minutes). Therefore, the adaptability of the prediction modules, i.e. the ability to reflect quickly new "unexpected" situations, must be very high. On the other hand the traffic data show some periodical behaviour from one day or one week to another, which can be detected from a longer history. Thus, the reliable and powerful traffic prediction systems should be based on a trade-off between a "long-term-memory" based predictor and a "short-term-memory" based corrector modifying the forecast with respect to the actual situation. In our contribution we discuss basic principles and methods, which can be applied on the given problem and we show some preliminary results using real traffic time series signals.

5. Seasonal Movements Relating to Movable Feasts

I. Noyan Dereli, Liverpool Business School, Liverpool John Moores University, John Foster Building, 98 Mount Pleasant, Liverpool L3 5UZ.

The theme of this paper is that the core areas of analysis and practice of forecasting tend to be culturally biased towards the concerns and interests of advanced Western countries.

This is illustrated by looking as a case study to the examination of the seasonal effects observed in "workers' remittances from abroad" for Turkey. There is first a discussion about the types of seasonal effects observed and used in traditional analysis. The traditional techniques (incorporated into SPSS for Windows) are used on the Turkish data set and the estimated seasonal effects are compared. However, it is known that these do not capture the whole of the seasonal movement. There are well-known seasonal effects of two of the religious "movable feasts". The forecasting literature and practice are silent about these effects. These seasonal effects are periodic, but not according to the calendar year but according to the lunar year. Thus, the occurrence of feast days appears to change during the calendar year, coming about 11 days earlier each year as compared to the previous year. These seasonal effects are estimated by using a revised traditional technique.

It is concluded that one desired change in forecasting is that the cultural bias is recognised and the valid analytical concerns of "other" countries are incorporated into the core of knowledge and practice of forecasting.

Session Chair:
Dr. Tariq Muneer, Napier University, Edinburgh, Scotland

1 *Forecasting and Classification with Neural Networks: Application to Mortgage Market and Bond Rating*

Hennie Daniels, Department of Economics, Vakgroep Information Systems, 5000 LE Tilburg, The Netherlands, **Bart Kamp** and **William Verkooijen**

Feed forward neural networks receive growing attention as a data modelling tool in economic *forecasting and classification problems. It is well-known that controlling the design of a neural* network can be cumbersome. Inaccuracies may lead to a manifold of problems in the application such as higher errors due to local optima, overfitting and ill-conditioning of the network, especially when the number of observations is small. In this paper we provide a method to overcome these difficulties by regulating the flexibility of the network and by rendering measures for validating the final network. In particular a method is proposed to equilibrate the number of hidden neurons and the value of the weight decay parameter based on 5 and 10-fold cross-validation. In the validation process the performance of the neural network is compared with a linear model with the same input variables. The degree of monotonicity with respect to each explanatory variable is calculated by numerical differentiation. The outcomes of this analysis is compared to what is expected from economic theory. The methods are illustrated in two case studies: forecasting the mortgage market in the Netherlands and the classification of bond ratings.

2. Nonlinear Iterated Forecasting by Neural Networks with Confidence Intervals and Sensitivity Analysis.

David Lowe & Krzysztof Zapart, Aston University, Birmingham B4 7ET. UK

Developing artificial neural network techniques for noisy nonlinear time series prediction is typically developed in a state space formulation exploiting dynamical systems concepts. In this paper we show how an alternative feature space formulation of approximating the data generator is more robust to iterated forecasting. The advantages of approximating generators in feature space rather than state space include:

1) Robustness to noise, since the feature space provides a signal-noise subspace decomposition, and

2) Nonstationarity of the data generator can be modelled more easily since the feature space separates time-scale effects more explicitly.

We show how confidence intervals of predictions may be obtained directly from the neural network approximation to the generator, and we use these confidence intervals to produce a sensitivity forecast of iterated predictions. This latter point provides an alternative prespective to sensitivity as provided by Lyappounov exponents. The locally linear expansion assumptions implicit in Lyapounov exponents limit their relevance and the method discussed in this paper is more appropriate for iterated nonlinear forecasting. The approach is demonstrated on synthetic and econometric nonstationary time series.

3. Time Series Forecasting in the Presence of Structural Change: Artificial Neural Networks and Structural Models

Professor Marcelo Savino Portugal, Universidade Federal do Rio Grande do Sul Rua Felicissimo de Azevedo 568/202, 90540 110 Porto Alegre RS, Brazil
Wilson R. Correa, Universidade Federal do Rio Grande do Sul Rua Felicissimo de Azevedo 568/202, 90540 110 Porto Alegre RS, Brazil

The Brazilian price stabilisation polices and trade liberalisation measures of this decade have considerably increased the difficulty in generating accurate time series forecasts due to structural changes in the data generation processes. In this paper we provide an empirical evaluation of the forecasting performance of Artificial Neural Networks (ANN) and Structural Time Series Models (STS) in the presence of structural change. We are interested in evaluating the capability of ANN and STS models in terms of both identifying that a structural change has happened and the speed of adjustment of the one step ahead forecasts after change. We use both real and simulated time series in these exercises. The simulated series are generated from ARIMA processes with imposed structural changes in the mean and variance. We also use real time series data from Brazilian inflation rate and total imports series.

4. A Hierarchical Neural Network Predicting the Distribution of Empty Parking Spaces in a Distributed Car Parking System

Dr. Panagiotis Tzionas, Ass. Professor, Department of Automation, Technological Educational Institute of Thessaloniki 54101 Thessaloniki, Greece.

This paper presents the design and implementation of a hierarchical neural network (NN) model, capable of predicting the distribution of empty parking spaces in the sub-areas of a distributed car parking system. The uneven distribution of cars in such a parking system causes serious congestion problems. The form of this distribution is being affected by a number of factors, such as the employees timetable, the proximity of the parking sub-area to the workplace, weather conditions, security provided in the specific sub-area, specific celebration dates, etc. Thus, it is expected that monitoring of the car distribution in regular time intervals for a sufficient time period and the embedment of these information in a neural network model, can form the basis of a predictor system, capable of de-congesting the parking sub-areas.
The car distribution in the sub-areas of the distributed parking system of the Technological Educational Institute of Thessaloniki was monitored in regular time intervals and for typical dates and times. A hierarchical NN was designed and trained under the Levenberg-Marquardt learning algorithm, using these measurements, until convergence was achieved. Further monitoring of the car distribution provided measurements that were used to verify the operation of the model. It was found that the NN was capable of predicting the car distribution in the parking sub-areas with respect to the number of cars entrying and leaving the overall parking system, with considerable accuracy.

Session Chair:
Dr. Moira Watson, Napier University, Edinburgh, Scotland

The Trials and Tribulations of Implementing a Global Sales Forecasting Process/System

Dwight Thomas, Forecast Process Planning, Lucent Technologies

This presentation will focus on the experiences of Lucent Technologies in the deployment of their Customer Demand Planning (CDP) process, a global forecasting process and system used in over 30 countries. One of the important features of this process is that commitments are provided by the manufacturing organizations to the sales teams in response to the forecasts by the sales teams. These commitments are then used to manage customer order scheduling and prioritizing. Lucent has also included forecast accuracy objectives in the salary structure of top executives. The forecasting organizational design, process roles and responsibilities, system features, training approaches, measures of quality (metrics), reward and recognition issues, and deployment strategies will be discussed. Finally, this talk will address the value of the audit of the Lucent CDP process conducted by Dr. Mentzer in 1997.

Dealing with Seasonality and Promotions in Weekly Retail Sales Forecasting

Hans Levenbach, Delphus Inc., Morristown, NJ 07960, U.S.A.

When planning for replenishment of retail products in stores, forecasters encounter much data with complex patterns. The data for which forecasts are required are usually gathered in large quantities at the lowest level (Point-of-Sale) and are subject to seasonal influences, some trend, and significant promotional impacts. These patterns are not readily and efficiently modeled with standard approaches. This paper discusses a systematic decomposition of such time series into components that can be used to isolate key determinants of sales demand for analysis, modeling and forecasting.

3. Seasonal Indexing for Business Forecasting

Dr. Peter T. Ittig, College of Management, University of Massachusetts Boston, Boston, MA 02125-3393, U.S.A.

In a paper that was published in the Spring 1997 issue of *Decision Sciences* it was shown that the standard seasonal index used in business forecasting (based on a centered moving average) contains a systematic error in the presence of a trend (whether linear or nonlinear). That paper also introduces a multiplicative seasonal index that is often superior to common alternatives in business forecasting applications. This paper considers the relative advantages of several seasonal indexing procedures, including the Ittig seasonal index in some business forecasting applications. Some examples are presented together with some suggestions for forecasters. It is shown that it is often possible to improve forecast accuracy to some degree by improving the specification of the seasonal index.

4. Business Demand Forecasting using System Dynamics

Professor D. Davidson, Glasgow Caledonian University, Glasgow

If a new business operates in a rapidly expanding environment, decisions need to be made about resource acquisition. The shape of the demand profile facing the organisation is critical to the decisions to be made. Errors of forecasting this profile are expensive either in unused resources, if the forecast is optimistic, or lost business if the forecast is pessimistic. One advantage that the business has is its knowledge of how its organisation and its competitors operate. Using this information, Systems Dynamics models can be developed to give insights into the likely levels of demand and to enable quick responses to changes in the environment. Examples of forecasts and monitoring procedures using Systems Dynamics will be given and their value discussed.

Session Chair:
Professor Alan Porter, Georgia Technology Policy and Assessment Center,Georgia, USA

1. **The Influence of Personal Attitudes towards General Megatrends on the Estimation of the Future Development of Science and Technology.**

Dr. Knut Blind, Fraunhofer Institüt for Systems and Innovation Research, Karlsruhe, Germany.

In 1996, the second German Delphi study was started. The German Delphi II is a two-round Delphi expert survey which is conducted by the Fraunhofer Institute for Systems and Innovation Research (ISI) on behalf of the German Federal Ministry of Education, Research, Science and Technology (BMBF). The study was published in February 1998 and is now getting into its implementation phase.

Its inherent focus is on the development of science and technology in twelve thematic fields in the next 30 years. In order to arrive at a better understanding of the influence of personal attitudes towards general developments in our natural environment and our society, the respondents were asked in the first round of the Delphi exercise for their personal opinion towards several megatrends concerning our natural environment, economic, sociological and political developments. Over 2,000 answers lead to a very solid data base, which gives insights into the general thinking of the German R&D experts. On some topics, there is a high consensus, whereas on others two opposite groups appear. These results also serve as the data base for a factor analysis leading to the identification of five different expert types. In the second step, different patterns in answering the development in science and technology were looked for. In general, it turned out that differences in personal attitudes towards megatrends do not influence the estimation of developments in science and technology. However, differences exist in specific topics and the distribution of five expert types among the respondents differs significantly in the twelve fields.

2. **Innovation Forecasting: Counting Contextual Clues to Forecast Technology**

Alan L. Porter, Georgia Technology Policy and Assessment Center,

Trend analysis applied to technical parameters has been a popular mode of technology forecasting. We suggest that examination of trends garnered from counting R&D bibliographic activities can depict important influences on technological innovation. We gauge current status and rates of change in various indicators of the progress of technological innovation. We find the following to be useful indicators of the maturation of a technology:

- trends in R&D activity evidenced in different databases that tap innovation stages from research to commercialization
- within a database (e.g., Engineering Index), the extent of journal vs. conference activity on a particular technology
- trends in content emphases (e.g., extent of consideration of production issues in abstracts concerning a particular technology)
- issue maturation (e.g., extent of consideration of standards in relation to that technology)
- prevalence of the technology in index terms vs. in abstracts themselves

These sorts of information can help managers assess where a technology is and forecast where it's heading.

3. Complexity in the Service of Competition Management

Theodore Modis, 2 rue Beau Site, 1203 Geneva, Switzerland.

Biological models and in particular the Volterra-Lotka equations can be used to analyze market and internal data in order to determine the time and the type of action that will alter the competitive roles in the marketplace. At the same time, these mathematical formulations in a discrete form provide good descriptions for chaos and complexity phenomena. One should not be looking at monetary indicators such as prices, however. The true competition variables - those that obey the Volterra-Lotke equations - are the number of units sold and the amount of dollars spent. The evolution of price ensues as a consequence.

4. NET-SIMULAB: a Scenario-Engineering Laboratory in the Networked Hyper-multimedia Era

Enrico Nicoló, Bartolomeo Sapio, Fondazione Ugo Bordoni, Research Division of Telecommunications Evolution, 00142 Roma, Italy.

Scenario Engineering is a general corpus of methods and techniques of scenario analysis for strategic planning and forecasting. These methodologies may be both interpretative and project-oriented. They are quantitative and/or qualitative and they may be both analytical and simulative. SIMULAB (Scenario-engineering Interactive MUltimedia LABoratory) is an auxiliary system of technological tools which is intended to serve as an advanced technical aid to the implementation of scenario engineering. SIMULAB is equipped with advanced processing, memory, presentation and communication devices. It is made up of methodological, technical (hardware and software) and infrastructural resources necessary to generate, analyze, store, present and transfer scenarios usable in an interactive multimedia way, also from remote sites. The paper provides some characteristics and requirements of a generic SIMULAB together with the description of the SIMULAB hosted by Fondazione Ugo Bordoni (FUB), which is named SIMULAB-FUB.

Session Chair:
Professor John Haslett, Department of Statistics, Trinity College, Dublin 2, Ireland

1. GARCH(1,1) -- Exponential Smoothing of Volatility

Dr. Eddie McKenzie, University of Strathclyde, Glasgow G1 1XH, U.K.

The GARCH(1,1) model is probably the most commonly applied time series model of heteroscedastic behaviour, especially in the financial sector. Although it is a natural generalization of the original ARCH models, it is by no means obvious why it should enjoy such ubiquitous success. This talk will suggest one way in which the GARCH(1,1) model may arise naturally in such data. In one respect, at least, this derivation parallels that of another very popular and successful time series model, viz. simple exponential smoothing.

2. Arma-Garch Models and Trade Rules for Stock Returns

Joao Oliveira Soares, Instituto Superior Tecnico, 1000 Lisboa, Portugal.

This paper studies the behaviour of a large sample of stock returns time series from the Lisbon Stock Exchange -Portugal.

The main conclusion from the analysis is the common presence of conditional heteroscedasticity and the choice of ARMA(1,1)-GARCH(1,1) models to represent the behaviour of the series.

Forecasts from these models are then used to implement a trade rule based on the Alexander Filter - we call it the Anticipated Alexander Filter. This rule is afterwards compared to other filters, proving to outperform them in several cases.

3. "Hashing GARCH: a Re-assessment of Volatility Forecasting Performance"

George A. Christodoulakis, Department of Economics, Birkbeck College, University of London W1P 2LL, U.K. **Stephen E. Satchell,** Faculty of Economics and Trinity College, University of Cambridge, Cambridge, U.K.

A number of volatility forecasting studies has led to the perception that the ARCH-type and Stochastic Volatility (SV) models provide poor out-of-sample forecasts of volatility. This is primarily based on the use of traditional forecast evaluation criteria concerning the accuracy and the unbiasedness of forecasts.

In this paper we provide an assessment of ARCH and SV forecasting. We show how the inherent noise in the approximation of the actual -and unobservable- volatility by the squared return results in a misleading forecast evaluation. We characterise this noise and quantify its effects assuming Normal errors. We extend our results using more general error structures such as the Compound Normal and the Gram-Charlier classes of distributions. We argue that evaluation problems are likely to be exacerbated by non-normality of the shocks and conclude that non-linear and utility-based criteria can be more suitable for the evaluation of volatility forecasts.

4. **Time-varying Smooth Transition Autoregressive Models**

Stefan Lundbergh, Stockholm School of Economics, Stockholm, Sweden, and
Dick Van Dijk, Tinbergen Institute, Erasmus University, Rotterdam, The Netherlands.

Most of the extensions of linear (autoregressive) time series models which have been developed over the years can be classified as either models with time-varying parameters or nonlinear models. So far, these alternatives have largely been investigated separately, with little attention being paid to the distinction or relationship between the two. In this paper we present the novel class of Time-Varying Smooth Transition AutoRegressive [TV-STAR] models, which is able to captures both time-varying and nonlinear characteristics of time series. Both 'genuine' time-varying parameter and 'genuine' nonlinear models are embedded within the TV-STAR model. This allows the derivation of test statistics which can be used to decide if either of the two is sufficient to describe the dynamic behaviour of a particular time series. These tests form part of a specification procedure for TV-STAR models which is outlined in the paper. Applications to various macro-economic time series demonstrate the potential usefulness of the new model class.

Session Chair:
Professor Kajal Lahiri, Department of Economics, University at Albany – SUNY, 1400 Washington Avenue, Albany NY 12222, USA

Using the Past to Track Economic Conditions

Philip A. Klein, Department of Economics, Pennsylvania State University, University Park, PA 16802-3306, U.S.A. **John Cullity**, Emeritus Professor, Rutgers University,

Recovery analysis is primarily designed to facilitate the evaluation of prevailing business conditions by comparing a current expansion with corresponding expansions in the past. This is done by measuring changes of individual time series from their standing at cyclical turns and comparing current with past changes over a series of widening time spans. This paper presents information about the movements of a number of well-known and important economic time series during the long expansion of the 1990s and compares the movements with the changes in the same series during the long expansions of the 1960s and 1980s.

2. Forecasting Implications of Consumer Uncertainty

Michael Niemira, Bank of Tokyo-Mitsubishi Ltd.

We examine the implication of five structural changes on the business cycle. The factors considered are:
(1) the reduced volatility of reported U.S. economic growth;
(2) the role of JIT/computerization/supplier quality relationships in affecting the timing between orders, shipments and inventories;
(3) the role of exports;
(4) the role of imports, and:
(5) the role of prices.

3. A Hidden Markov Model as a Bayesian Classifier: An Application to Forecasting Business Cycle Turning Points

Lasse Koskinen, National Institute of Economic Research, Sweden, Stockholm School of Economics, Stockholm, Sweden. **Lars-Erik Oller**, National Institute of Economic Research and Stockholm School of Economics, Stockholm, Sweden.

We introduce a probabilistic turning point forecasting method that uses a hidden Markov switching regime model as a dynamic Bayesian classifier. A classification, or more broadly, a pattern recognition approach, where regime probabilities serve as forecasts, provides a natural interpretation of the turning point probabilities. The method proposed is a simple and computationally efficient way to utilise leading series in making probability forecasts of turning points, the focus being on first and second moments. Instead of using maximum likelihood in model selection, we apply a probability score, tuned to turning point forecasting. The method is used for forecasting turning points of Sweden's industrial production, where the stock market index and a business tendency survey series provide leading information.

3. Computation of the Beveridge-Nelson Decomposition for Multivariate Economic Time Series

Miguel A. Arino, IESE, Universidad de Navarra, 08034 Barcelona, Spain
Paul Newbold, Department of Economics, University of Nottingham, Nottingham, NG7 2RD, U.K.

In this paper we show how to compute the Beveridge-Nelson decomposition of a multivariate time series when the series are generated by a vector ARIMA model. The case when the vector time series is cointegrated is also treated. Our result extend those of Newbold (JME, 1990).

4. Structural Breaks and Model Selection with Marginal Likelihoods

Wolfgang Polasek, Institute of Statistics and Econometrics, University of Basel, 4051 Basel, Switzerland. **Lei Ren**, Institute of Statistics and Econometrics, University of Basel, 4051 Basel, Switzerland.

We consider AR processes with a possible break (regime shifts) at an unknown break point m. We derive the conjugate Bayesian analysis for informative and non-informative priors and allow also for heteroskedasticity in the regimes. Using the model selection approach of Chib (1995) we derive the marginal likelihood for all models with unknown lag length. The approach is also extended for the break point model of VAR processes which is formulated as a multivariate normal-Wishart models. We demonstrate the model selection ability of our approach by a simulated example and for Swiss macro-economic time series involving GNP and consumption.

Session Chair:
Dr. Frederick P. Wheeler, Management Centre, University of Bradford, Bradford BD9 4JL, England, U.K.

Forecasting Integrated World Stock Markets Using International Co-movements

Gulnur Muradoglu, Bilkent University, Faculty of Business Administration, 06533, Ankara, Turkey
Kivilcim Metin, Bilkent University, Department of Economics, 06533, Ankara, Turkey.

This paper aims at forecasting stock returns of a group of emerging markets using their interrelations to major world stock exchanges. First, international co-movements in stock price indexes are examined by employing the Engle-Granger two step co-integration technique. Accordingly, intra-continental and inter-continental movements between stock prices will be determined. Then, each national stock market will be forecast according to its international co-movements and using Autoregressive Distributed Lag (ADL), Error Correction Model (ECM), and Vector AutoRegressive (VAR) models. Our forecasts will be based on transmissions of price movements among international markets and the lead-lag relationships in different stock indexes. Daily stock price indexes in New York, London, and Tokyo are employed to represent the global and regional leaders. Daily stock price indexes of a group of emerging markets from different geographical locations as defined by the IFC are forecast according to their international co-movements.

2. Tracking the Transition to an Information-Efficient Stock Market: Simple Tools for the Investor in Poland

Dr. Frederick P. Wheeler, Management Centre, University of Bradford, Bradford BD9 4JL, England, U.K.

The paper reports the results of assessing the changes in pricing efficiency of the Warsaw Stock Exchange (WSE), the second stock exchange to be established in the former Eastern bloc. The WSE opened in 1991 and has expanded more than tenfold in the number of listed companies while experiencing both strong growth and collapse in market prices. The behaviour of individual stocks and published market indexes are analysed and compared in this study. As a practical matter, the market-pricing policies of specialist traders lead to interesting distributional properties of price returns, and pose questions for the time-series analyst. Bayesian modelling tools are used to assess the path toward increasing information-efficiency of this emerging stock market in a transitional economy. Departures from information-efficiency are noticed during highly volatile times but the trend to increasingly efficient pricing is generally evident.

3. Conditional Heteroskedasticity in Turkish Stock Returns: Evidence and Forecasts

Nesrin Okay, Management Department, Bogazici University, Bebek, 80815 Istanbul, Turkey.

This paper considers estimating the conditional mean and variance from a single-equation dynamic model with mean following an autoregressive moving-average ARMA(1,7)process, and conditional variance with time-dependent conditional heteroskedasticity as represented by a linear GARCH process. The autocorrelations and univariate statistical properties as well as variance ratio test results greater than one suggest that the time varying series at the Istanbul Stock Exchange is not a random walk or its increments are correlated. All these results provide evidence in favor of the rejection of the weak form of efficiency for the stock returns in Turkey. Furthermore, the Garch model does provide good volatility forecasts.

Session Chair:
Dr. Nigel Meade, Management School, Imperial College, London.

Evidence for Selection of Forecasting Methods

Nigel Meade, Management School, Imperial College, London.

Reid (1972) was among the first to argue that the relative accuracy of forecasting methods changes according to the properties of the time series. Comparative analyses of forecasting performance such as the M Competition tend to support this argument. The issue addressed here is the usefulness of statistics summarising the data available in a time series in predicting the relative accuracy of different forecasting methods. Nine forecasting methods are described and the literature suggesting summary statistics for choice of forecasting method is summarised. Based on this literature and further argument a set of these statistics is proposed for the analysis. These statistics are used as explanatory variables in predicting the relative performance of the nine methods using a set of simulated time series with known properties. These results are evaluated on observed data sets, the M Competition data and Fildes Telecommunications data. The general conclusion is that the summary statistics can be used to select a good forecasting method (or set of methods) but not necessarily the best.

2. Forecasting based on Very Small Samples and Additional Information

Professor Kurt Brannas and **Jorgen Hellstrom,** Department of Economics, Umea University, S-90187 Umea, Sweden

Generalized method of moments estimation and forecasting is introduced for very small samples when additional non-sample information is available. Small simulation experiments are conducted for the linear model with errors-in-variables and for a Poisson regression model. An empirical forecast illustration based on Ukrainian imports is included.

3. Time Series Forecasting: The Contribution of Seasonality, Cycle and Trend

Michele Hibon and Spyros Makridakis , INSEAD, Boulevard de Constance, 77305 Fontainebleau, FRANCE.

Time series contain seasonality, cycle, trend and randomness. Apart from randomness which is, by definition, unpredictable the remaining three components can be forecasted, with varying degrees of success, using different approaches or methods. In this paper the contribution of each of these three components to forecasting accuracy is assessed. Moreover, various approaches for calculating seasonality and different methods for extrapolating the trend, and the trend-cycle, are studied and their influence on overall forecasting accuracy is measured. The conclusions of the paper have critical implications for both the theory and the practice of forecasting.

4. The Importance Of Within-Sample Specification Tests When Analyzing Post-Sample Performance Of A Forecasting Model

Bernard J. Morzuch and **P.Geoffrey Allen,** University of Massachusetts, Amherst, MA 01003, U.S.A.

In two previous studies we stressed the importance of within-sample testing on a series to help discover its data generating process. Using all non-seasonal series of the Makridakis (1001) Competition, we tested the within-sample errors of the naive no-change method (random walk) for normality, autocorrelation, and heteroscedasticity. We sorted all series into those that passed all tests and those that didn't. We added a parameter constancy test and repeated the approach for a random walk plus drift. In both studies, the group where the model tested satisfactorily resulted in post-sample prediction intervals that were generally well calibrated and better than the other group, though in the second study results were not as favorable as we would have expected.

We now explore parameter constancy in greater detail, using simple exponential smoothing and Holt's method to perform the same testing and analysis.

Session Chair:
Dr John Adams, Napier University Edinburgh

Assessing the Impact of Government Legislation on "Mad Cow Disease" in the UK

Mr. Sandy D. Balkin, Penn State University University Park, PA 16802-1913, U.S.A

Bovine Spongiform Encephalopathy, a.k.a. Mad Cow Disease, is a brain wasting ailment found present in cattle in Britain and other European nations. Realizing the potential threat and feeling economic pressures from trade partners banning the import of beef, legislation was introduced in the UK to prevent further infection of cattle. Cooper and Harrison (1997) examined the impact of this legislation using the dynamic linear model.

In this paper, we contrast their analysis with several other techniques designed to uncover structural change, including structural modelling, traditional and automatic ARIMA modelling and Bayesian analysis (Gibbs Sampling).

Methods for Medium Term Forecasting of Cancer Incidence and Mortality Rates

Ian B. MacNeill, Department of Statistical and Actuarial Sciences University of Western Ontario. London, Canada N6A 5B7.

Cancer, already a major burden on the Canadian health care system, will become a much larger burden during the next several decades. The prime causes of this are: large increases in risk of cancer with increase in age; and a substantial increase in the proportion of the Canadian population in the high risk age-groups due to ageing of the baby-boom generation.

To understand the extent of the pending crisis, bivariate models are discussed for fitting to age-period cancer rate data. The models generally are intrinsically non-linear and the variance for most cancer data increases with increasing age. Hence, weighted non-linear regression methods are used to estimate the model parameters. The weights chosen are proportional to population; this ensures that estimates of the number of cases or deaths are unbiased. The models are extrapolated forward to provide forecasts of rates. The rate forecasts are combined with population projections to obtain point forecasts of counts. Error bounds are provided which take into account the standard errors of the parameter estimates and the variability inherent in the population forecasts.

The methodology is applied to Canadian male and female lung cancer data. Forecasts indicate that the ratio of female deaths due to lung cancer to those for males will increase from 1/2 in 1995 to 1.0 in 2010.

3. Bootstrapping Mortality Forecasts for the U.S.: Testing for Uncertainty through Resampling

Lawrence R. Carter, Department of Sociology, University of Oregon, Eugene, OR 97403, USA

This paper explores a non-traditional approach to examining the problem of forecast uncertainty in extrapolative demographic models. It builds on prior research on stochastic time series forecast models confidence limits, but also differs by examining the limits derived from resampling. Comparisons of the two approaches inform us of the validity of ex post-forecast uncertainty. Tests for uncertainty are applied using the Lee-Carter method for mortality forecasts for the U.S. I examine the Lee-Carter nonlinear demographic model, mx, t = exp (ax + bxkt + ex, t), which is decomposed using SVD to derive a single time-varying linear index of mortality, kt. From a 90-year (1900-1989) time series of kt, forecasts are generated 76 years ahead to the year 2065 using Box-Jenkins techniques. Stochastic confidence intervals are generated for these forecasts. Similarly, the 90-year index is resampled and forecasted 76 years ahead 500 times using bootstrapping techniques. These 500 realizatons approximate a sampling distribution of time series of kt. Preliminary results show that the bootstrap confidence limits are only marginally different from the stochastic forecast limits. These findings offer additional affirmation of the validity of the narrow stochastic confidence limits derived from Box-Jenkins techniques. Substantive issues about the best choice of the two approaches are presented in the paper.

Session Chair:
Fred Collopy, The Weatherhead School of Management, Case Western Reserve University

1. Expert Systems for Forecasting

Fred Collopy, The Weatherhead School of Management, Case Western Reserve University, **Monica Adya**, Dept. of Information Systems, University of Maryland - Baltimore, MD, **J. Scott Armstrong**, The Wharton School, University of Pennsylvania

Experts systems serve as a repository for knowledge about a domain or process. They automate the application of complex sequences of rules for a given situation and insure that the rules are applied consistently. In addition, developing an expert system often clarifies how experts think about a problem. Expert systems are useful in domains where there is a great deal of knowledge, where the performance of experts is distinguishable from that of others (and from one another), and where it is possible to elicit and represent the experts' knowledge. Sixteen papers have described expert systems developed to aid forecasters. Most of the expert systems reported on have been designed to assist forecasters in selecting among alternative forecasting methods. To acquire knowledge for expert systems on forecasting, researchers have relied upon textbooks, articles in research and management journals, interviews, surveys, and protocol analyses. In general they have used production systems to implement these systems. Evidence on the value of expert systems is limited, especially with respect to their effect on accuracy. Further, the diffusion of expert systems to aid forecasters has been hampered by the fact that the details of their designs have not often been made widely available.

2. The Use and Usefulness of Long-term Expert Forecasts

Annele Eerola, Swedish School of Economics and Business Administration, Department of Management and Organization, P.B. 479, FIN-00101 Helsinki, Finland.

This paper examines the organizational roles of long-term expert forecasts, focusing on the indirect and diffuse links between the forecasts and companies' strategy formation. The paper is based on a three-phase empirical study within the forest industry (Eerola, 1997). According to the research findings, the industry-wide forecasts by acknowledged experts are important and influential managerial tools, although they are not used as direct input for planning and decision making. They are consulted in companies'; strategy discussions and decision making processes, and they also enter the organizational processes implicitly - by directing managers' attention, by stimulating future-oriented thinking and by facilitating the creation of shared knowledge about company-specific issues. Thus they contribute to managerial visions and consensus building, and also potentially affect managerial risk taking. The findings give new insights into the reasons for using and producing expert forecasts, as well as into their potential influence on strategy formation.

3. Information Search Strategies of Novice and Expert Financial Forecasters

Fergus Bolger, Faculty of Business Administration, Bilkent University, Ankara 06533, Turkey.
Gulnur Muradoglu, Faculty of Business Administration, Bilkent University, Ankara 06533, Turkey

Expert financial forecasters and management undergraduates participated in a computer-controlled experiment to investigate information search prior to stock-investment decisions. Participants were presented with several stocks and invited to invest in one of them. Before making a selection the participants could access information on potentially relevant financial variables regarding each stock. Each piece of information could be viewed one-at-a-time by clicking on boxes on the computer screen. The selections made and the time spent considering each piece of information were logged. After an investment had been made feedback about the performance of the chosen stock was given then a new set of stocks presented. This procedure was repeated over several trials. The risk associated with each stock, the reliability of the available information for predicting yield, and the cost of obtaining information were manipulated. The effects of these manipulations on information search, and the practical implications of our findings, are discussed.

Session Chair:
Dr Tariq Muneer, Napier University, Edinburgh

Non-Linear Time Series Analysis with a Hybrid Linear-Neural Model

Marcelo C. Medeiros, Pontifícia Universidade Católica do Rio de Janeiro Rua Marquês de Sao Vicente, 255 - Gávea - 22543-900 Rio de Janeiro - RJ – BRAZIL **Alvaro Veiga**, Pontifícia Universidade Católica do Rio de Janeiro Rua Marquês de Sao Vicente, 255 - Gávea - 22543-900 Rio de Janeiro - RJ - BRAZIL

Non linear models of time series are useful in the analysis, forecasting and control of non-Gaussian or non-stationary processes. Many models have been developed to treat non linear time series. Two of the most famous are the Neural Networks (NN) and the Threshold Autoregressive (TAR) models. This work discusses a new approach to modelling time series regression with nonlinearities. This proposal, called ARX-N, is an ARX model with coefficients given by the output of a neural network. The ARX-N generalizes with some advantages the TAR model by allowing multivariable thresholds and a smooth switching between models. A formal algorithm to estimate the parameters has also been developed. The model was tested using some simulated and real data and its performance was compared with the traditional feed-forward neural network, the TAR model and the linear ARX.

Bayesian Analysis of Neural Networks for Time Series Analysis

A. Menchero, P. Muller, D. Rios Insua, Department of Artificial Intelligence, Madrid Technical University, CL Trefacio 19, 28043, Madrid, Spain

There has been recent interest in applications for Bayesian analysis of neural networks in classification and regression. We explore here several issues relative to their application to time series analysis, mainly to model nonlinear autoregression and their combination with traditional linear models. We emphasise the idea of variable architecture neural networks, providing a data driven procedure for architecture choice.

Forecasting Exchange Rates Using Neural Networks for Technical Trading Rules

Philip Hans Franses, Rotterdam Institute for Business Economic Studies, Erasmus University, NL-3000 DR Rotterdam, The Netherlands. (with Kasper van Griensven)

We examine the performance of artificial neural networks [ANNs] for technical trading rules for forecasting daily exchange rates. The main conclusion of our attempt is that ANNs perform well and that they are often better than linear models. Furthermore, the precise number of hidden layer units in ANNs appears less important for forecasting performance than is the choice of explanatory variables.

Session Chair:
Dr. Robert Raeside, Napier University, Edinburgh

1. Foresight and Beyond

Georghiou, M. Keenan & I. Miles, PREST, Mathematics Building, also of CRIC, Tom Lupton Suite, University of Manchester, Manchester M13 9PL, UK.

The UK's Foresight Programme (originally Technology Foresight programme) is generally reckoned to have set standards for this increasingly widespread approach to informing R&D priorities and establishing new networks and modes of communication among the actors in the innovation process. While the forecasts obtained through the programme are valuable, it is the forecastING process that has been critical, providing an institutional and cognitive framework for the exchange of knowledge about technological opportunities, social trends, and organisational capabilities. The UK government is now developing Foresight 2000 as the next exercise, and this is thus a good moment at which to examine the forces shaping Foresight and its methodologies, the impacts it has had on policymaking and organisational strategies, and the lessons that can be learned. We pose the question: what will Next Generation Foresight look like?

2. Complexity Science: Implications for Forecasting

Harold A. Linstone, Professor Emeritus, Systems Science, Portland State University, Portland, OR 97207-0751, USA.

The recent development of "complexity science" is of significant interest to forecasters who must deal with complex adaptive sociotechnical systems (CAS). These involve both order and disorder, as well as self-organizing ability. Complexity science clarifies the inherent limits of forecasting. It shows that apparent patterns may, in fact, be random, whereas systems that appear disorderly may, nevertheless, have an underlying order that yields some predictability. The vital linkage of chaos and order is observed in the S-shaped growth pattern that occurs so commonly in forecasting. Chaotic oscillations mark the beginning and end of the S-curve, that is, they characterize the transition from one curve to the next. The logistic equation in its continuous form defines the S-curve and in its discrete form it is basic to chaos theory. Complexity science also shows the inadequacy of the traditional linear mode of thinking exemplified by causal models and readily quantifiable measures of effectiveness. It thus underscores the practical value of multiple perspectives using distinct paradigms for each perspective in technological forecasting and assessment. Finally, the "bottom-up" computer simulation of CAS may yield insights on questions such as the desirable balance between system centralization and decentralization in an information technology age and the extent of foresight that is desirable.

Session Chair:
Dr. Ibrahim M. Abdalla, Napier University, Edinburgh

On the Sample Variogram and Sample Auto-covariance for Non-stationary Time Series

Professor John Haslett, Department of Statistics, Trinity College, Dublin 2, Ireland

It is well known that the classical estimators of the auto-covariance are biased even for stationary series: for series that may not be both mean and variance stationary they are not even defined. Covariance estimators based on residuals from an estimate of the drift are even more biased; estimators based on differences confound mean and variance non-stationarity. By contrast the variogram is defined for a wide class of processes that are neither mean nor variance stationary. The paper presents recent work on variogram estimators which are shown to be (almost) unbiased even when the process is mean and variance non-stationary. The procedure is illustrated in the context of a time series on the temperature of the earth since the mid-19th century.

2. Prediction of Long Memory Time Series Models: Monte Carlo Simulation. An Application.

Valderio A. Reisen, Departamento de Estatistica, University of Waterloo C.A., UFES, E.S., Brazil.
Bovas Abraham, Departamento de Estatistica, IIQP, University of Waterloo CCE, UFES, E.S., Brazil

In this paper we consider forecasts from long memory time series using the ARFIMA(p,d,q) model with $-0.5 < d < 0.5$. We also investigate through simulations, the bias in the estimate of the variance of the k-step ahead forecast. The ARFIMA model is also used to analyse and forecast a set of data and these forecast are compared with those from an ARIMA models.

3. Residual Properties and Applications in Time Series Models.

Professor J. A. Mauricio, Departamento do Economia Cuantitativa, Facultad de Ciencias Economias Universidad Complutense de Madrid, Campus de Somosaguas, 28223-Madrid, Spain.

An ARMA model for a given time series having been estimated, diagnostic checks are applied to residuals with the aim of uncovering possible lack of fit and diagnosing the cause. For these checks to be relevant, efficient use of the data has to be made at the estimation stage. It is now widely recognized that exact maximum likelihood estimation (EMLE) of time series models is preferable to other approximate estimation criteria. This subject has received much attention in the past. However, little is known about the properties of residuals arising from EMLE, which are used as the core tool at the diagnostic checking stage. This paper presents a derivation of some statistical and numerical properties of residuals arising from EMLE of univariate ARMA models. Detailed descriptions on computing residuals and establishing their properties are given. Applications of these results in preliminary model estimation and model diagnostic checking are also suggested.

Session Chair:
Professor Geoffrey Allen, University of Massachusetts, Amherst, MA 01003, U.S.A.

1. Tests for Equal Forecast Accuracy and Forecast Encompassing

David I. Harvey, Department of Economics, Loughborough University, Loughborough, Leicestershire LE11 3TU, UK. **Stephen J. Leybourne**, Dept. of Economics, University of Nottingham, Nottingham NG 2RD. Paul Newbold, Department of Economics, University of Nottingham, UK.

Given two sources of forecasts of the same variable, it is possible to compare prediction performance. In particular, it can be useful to test the companion hypotheses of equal forecast accuracy and forecast encompassing. A natural test for forecast encompassing is based on least squares regression; however, it is shown that the null distribution of this test statistic is not robust to non-normality in the forecast errors. Several alternative tests that are robust are discussed. One particular testing approach, which follows from a robust test for equal forecast accuracy, is recommended for practical applications. It is further shown that this preferred equal accuracy and encompassing testing approach experiences size distortions if the forecast errors exhibit ARCH. Adjusted test statistics are suggested to alleviate this problem.

2. Forecasting the Economic Evolution of a Small Open Economy using a Medium-Size Structural Econometric Model

Patrick Kent Watson, Department of Economics, University of the West Indies, St. Augustine, Trinidad & Tobago.

In this paper, the author examines the potential benefits and real pitfalls involved in forecasting the key economic variables of a small open economy, illustrated with the case of Trinidad & Tobago. Of particular importance are the inherent data limitations such as the non availability of data, the inadequate length of some time series and the constraints implied by the use of low frequency data. The fortunes of such economies are perhaps determined more by the international economic environment than by any intrinsic economic factor and structures are likely to change frequently. How useful then is the usual assumption of constancy of parameter values? Solutions to these and other problems are tentatively advanced using practical experience gained from the use of a model of the Trinidad & Tobago economy.

3. An Econometric Approach to the Measurement of Unrecorded Economy in Turkey

Prof. Dr. Zehra Kasnakoglu, Department of Economics, Middle East Technical University, 06531 Ankara, Turkey. **Munur Yayla**, State Institute of Statistics, Necatibey Caddesi 114, 06100 Ankara. Turkey.

During the past decade there has been a growing interest in the unobserved economy and unrecorded income. It has been argued that the size of the unobserved sector is significant and its omission may distort the macroeconomic variables such as national income and hence the policies to be undertaken.

The purpose of this paper is to measure the effect of the monetary unobserved sector on the national income in Turkey. Although national income estimates in Turkey are obtained by production method in most of the sectors, under-reporting and misinformation about income and rent earned for the purpose of tax and regulatory evasion in different sectors, income produced in illegal activities and the existence of relatively large non-market sectors where goods and services are produced for either barter or self consumption lead to a sizeable unrecorded sector in Turkey.

To measure monetary unrecorded income in Turkey between 1968 and 1996, two different approaches are adopted; (i) The Simple Currency Method; (ii) Demand for Real Currency, an econometric approach.

In the second approach, estimation of the size of monetary unrecorded income is based on the demand for real currency and mainly concentrates on the unrecorded income resulting from the efforts to evade and avoid taxes. The interrelationships between currency demand and the hidden economy is derived under two main assumptions: (i) the demand for currency has two parts, demand from the recorded economy and demand from the unrecorded economy; (ii) higher tax rates will introduce a higher tendency for tax evasion. The models given below are used in the study:

$$\ln CCR \quad \alpha_0 + \alpha_1 Y + \alpha_2 T + \alpha_3 \ln R + u_1$$
$$CCR = \beta_0 \quad \beta_1 \ln Y + \beta_2 + \beta_3 \ln R + \beta_4 \ln WPI + u_2$$
$$\ln CCR \quad + \gamma_1 \ln Y + \gamma_2 \ln T + \gamma_3 \ln R + \gamma_4 \ln WPI \quad u_3$$

where Y = Real currency in circulation, average income or total taxes, R interest rate, WPI = whole price index.

The models are estimated using the data obtained from the Central Bank of Turkey, the State Institute of Statistics, and the Ministry of Finance, and the magnitude and size of the hidden economy is obtained using the estimated functions.

4. A Periodic Cointegration Model for Swedish Private Consumption

Mårten Löf, Stockholm School of Economics, S- 3 83 Stockholm, Sweden

Quarterly Swedish private consumption is analyzed in a periodic cointegration model, where adjustment and long-run parameters are allowed to vary by season. The explanatory variables are disposable income and wealth, disaggregated as financial net wealth and housing wealth. Test results for periodic cointegration and various parameter restrictions suggest that dynamic adjustment towards steady-state targets is zero in quarters two and three. The long-run relationships are equal for quarters one and four. In order to examine the forecasting ability of the periodic cointegration model it is contrasted with a traditional error correction model.

5. Forecasting and Cointegration Tests when the True Data Transformation is Unknown

Valentina Corradi, University of Pennsylvania
Claudia Olivetti, University of Pennsylvania
Norman R. Swanson, Pennsylvania State University, University Park, PA 16802-3306, U.S.A.

Forthcoming macroeconomic variables remains an area of interest among applied economists and theorists. From an applied perspective, much of the recent literature focuses on nonlinear modelling, (asymmetric) loss functions, and model evaluation and selection, for example. From a theoretical perspective, two areas in which recent progress has been made are the construction of forecast model comparison tests (which may account for parameter variability) (e.g. Diebold and Mariano (1995), and West (1996)) and test size adjustment when multiple models are jointly evaluated (e.g. White (1997) and White and Timmerman (1997)). In this paper we address the issue of forecast model selection by proposing an extension of the test developed by West (1996) which allows for the comparison of forecast models constructed using cointegrated economic variables. Further, we show that standard cointegration tests are subject to severe test bias when data are generated according to linear models in levels, but are logged before constructing forecast models, or *vice versa*. In particular, we show that using so-called "incorrect data transformations" not only has an impact on unit root and cointegration tests which are constructed *prior* to *final* forecast model selection, but also has an impact on forecast model performance. Given these findings, we propose using a completely consistent procedure for selecting the "correct" data transformation *before* model construction and comparison of *ex ante* forecast performance. Our findings suggest that data transformation dies have a great impact on model selection, and that using our procedure for correct data transformation not only allows for the valid construction of standard cointegration and root tests, but also leads to the valid application of *ex ante* forecasting tests such as those proposed by Diebold and Mariano (1995), West (1996), and ourselves, thereby leading to the selection of "better" forecasting models based on standard model selection criteria such as mean-square forecast error. All of these findings are illustrated with a series of Monte Carlo and empirical experiments.

Session Chair:
Professor Roy Batchelor, City University Business School, London

1. Some Aspects of Stability and Forecasting for the Russian Stock Market

Dr. Nickolay V. Simakov, Central Economic & Mathematical Institute, Russian Academy of Sciences, 117418 Moscow, Russia.

The paper deals with problems concerning the stability and forecasting dynamics of the share market in Russia. Development of this market is a necessary condition for improving the efficiency of financial and banking policy, especially in Russia, where financial and banking reforms are one of the key elements of the transformation process from plan to market. The purpose of the present report is to explore problems in the forecasting of dynamics for the Russian stock market. Correlation between Russian and Western stock markets is considered. It is shown that the Russian securities market is not a stable system, which depends on political, economic and many other factors. Computational results with several approaches, using regressional and factor analysis are considered in this paper.

2. Simulated Price Characteristics of the Ten-Year U.S. Inflation Protected Security

Professor Albert E. DePrince, Jr., Department of Economics and Finance, Middle Tennessee State University, Murfreesboro, TN 37132, U.S.A.

On January 29, 1997, the US Treasury auctioned its first inflation-protected security (TIPS). Since then, US inflation declined, while the TIPS' yield rose. This seemingly perverse behavior raises questions regarding the security's likely behavior in the face of changes in expected inflation. This paper seek to fill that void through a simulation study. The estimation phase develops time series models of the daily TIPS yield and the spread between the TIPS and nominal yields. The spread depends upon the inflation premium and the inflation risk premium. As input to that spread, time series models are developed for both premiums. In the simulation phase, 100 samples of errors are drawn for each of the time series functions, and 100 simulations are conducted. In the analysis phase, distributions of the probable daily percent changes in the price of the TIPS and a conventional ten-year note over a one-year horizon are developed from the simulation results.

3. Forecasting Financial Sector Behaviour in the Small Island Economy of Trinidad and Tobago

Janice Christopher-Nicholls, Central Bank of Trinidad and Tobago, Port of Spain, Trinidad and Tobago. **Philip Colthrust** , Central Bank of Trinidad and Tobago, Port of Spain, Trinidad and Tobago. **Shelton Nicholls**, Lecturer in Economics, St. Augustine Campus, University of the West Indies.

This paper presents preliminary findings of the financial bloc of CBMOD2, the Central Bank of Trinidad and Tobago's quarterly econometric model of the Trinidad and Tobago economy. The paper addresses the methodological issues associated with modeling the behaviour of key actors in the financial sector such as the central bank, the commercial banks and the non-bank financial institutions in a newly liberalized financial environment. In this context, the model is designed to allow senior policy analysts of the Central Bank to analyze the implications of specific policy decisions as well as to generate medium-term forecasts of the major financial sector variables. The model assesses the implications of efficiency and competitiveness of the financial sector on the growth in national income, the rate of inflation and the stability of the foreign exchange market. Preliminary results of the model suggest that the increase in concentration of the financial sector in Trinidad and Tobago can have negative consequences for overall economic performance.

4. Estimating Volatility of The Brazilian Financial Market

Alvaro Veiga, Pontifícia Universidade Católica do Rio de Janeiro, - Gávea - 22543-900 Rio de Janeiro - RJ – BRAZIL **Lacir J. Soares**, Pontifícia Universidade Católica do Rio de Janeiro - Gávea - 22543-900 Rio de Janeiro - RJ - BRAZIL

One of the most important ideas in finance is the volatility of asset returns. Its correct estimation and forecasting is fundamental for portfolio management. Since the pioneering work of Engel (1982), where the ARCH model has been proposed, a lot of other volatility models have appeared in the literature. The most famous are the ARCH family (GARCH, M-GARCH, E-GARCH, T-GARCH) where the volatility is explained by the impact of the past values of squared returns and the past volatility itself - and the stochastic volatility models, proposed by Harvey et al. (1994), where the volatility is described by a stochastic process. In this work we compare some of the above models and the SS-ARCH model, proposed by Veiga et al. (1997), to estimate and forecast the volatility of some Brazilian stock returns. The results are shown and commented on and some statistical tests are used to identify the power of each model in the estimation and forecasting steps.

5. Forecasting Financial Indices using PMRS

Sameer Singh, School of Computing, University of Plymouth, Plymouth PL4 8AA, Devon, U.K.

The main aim of the paper is to develop the concept of pattern modelling and recognition in time-series forecasting. Pattern recognition methods in forecasting work by identifying historical patterns that match current series information. These matches can be used to approximate series behaviour at a local level which can then be used in forecasting. The Pattern Modelling and Recognition System (PMRS) will be detailed. The results will be produced on predicting financial indices of six countries and the results will be compared on the differenced series against the exponential smoothing method. The paper will also discuss in brief the desirable capability of PMRS technique to benefit from noise-filtering from time-series data using Fourier Analysis.

"Testing for a Nonlinear Long-Run Relajship bet Stock Prices and Dividends and Evaluating its Forecasting Performance"

Yue Ma & Angelos Kanas, Dept. of Economics & Dept of Accountancy & Finance Univ. of Stirling, U.K.

4. Estimating Volatility of The Brazilian Financial Market

Alvaro Veiga, Pontifícia Universidade Católica do Rio de Janeiro, - Gávea - 22543-900 Rio de Janeiro - RJ – BRAZIL **Lacir J. Soares**, Pontifícia Universidade Católica do Rio de Janeiro - Gávea - 22543-900 Rio de Janeiro - RJ - BRAZIL

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Testing for a Nonlinear Long-Run Relajship bet Stock Prices and Dividends and Evaluating its Forecasting Performance"

Yue Ma & Angelos Kanas Dept. of Economic & Dept of Accountancy & Finance Univ. of Stirling, U.K.

Session Chair:
Michael Lawrence, University of New South Wales, Sydney 2052, Australia.

Friday 15:30-17:30 Sidlaw

1. Estimation of Poverty Line in Turkey

Sevil Uygr, State Institute of Statistics, Middle East Technical University, 06531 Ankara, Turkey.
Prof. Dr. Zehra Kasnakoglu, Department of Economics, Middle East Technical University, 06531 Ankara, Turkey.

Poverty is still a major problem for most of the developing nations. More than a quarter of the people in the developing world live in poverty. Poverty means low income, thus poor health and education, usually inability to exercise human and political rights.

To define poverty line is difficult and closely related with the definition of poverty This paper will focus on measurement of the income poverty in Turkey.

An international poverty line of $1 a day per person (1985 PPP$) is used by the World Bank to compare and contrast poverty across the nations. To use a single international poverty line could be quite misleading and national poverty lines should be constructed whenever possible.

In this study we use the results of the 1994 Income Distribution Survey conducted by the State Institute of Statistics, and four different approaches to compute national and provincial poverty lines. The four approaches are: (i) food poverty; (ii) basic necessities; (iii) minimum calorie requirements; (iv) median and/or mean disposable income approaches. Absolute and relative poverty lines for the whole country and the selected provinces, Istanbul, Ankara, Izmir, Erzerum, Samsun, Adana and Diyarbakir are estimated.

The following hypotheses are tested in the paper: (i) the poverty lines estimated by different approaches do not vary significantly; (ii) percentage of poor people is inversely related to the level of industrialisation of a given province; (iii) households with women households are more vulnerable to poverty; (iv) households size and the age of the household head are important determinants of poverty.

Friday 15:30 - 17:30 Sidlaw

2. How Errors in Forecasting Explanatory Variables Affect the Variance of Regression Forecasts

Len Tashman, Thorodd Bakken and Jeff Buzas, University of Vermont

It is well understood that standard prediction intervals (PI) for regression forecasts are too narrow, insubstantial part because they assume that future values of the explanatory variables (X) are known with certainty. Forecast error in a stochastic explanatory variable introduces another source of uncertainty, implying a larger forecast error variance and hence widened PI.

Less well understood, however, is how errors in forecasting X affect the forecast error variance for Y. The empirical literature supplies a disparate variety of bits and pieces of evidence; however, these results have not provided useful guidance to practitioners of regression-based forecasting.

In this paper, we extend a theoretical framework first offered by Feldstein (1971) to analyze how forecast error variances in Y are related to forecast errors in X. Our results show that straightforward adjustments can be made to standard PI algorithms to account for errors in forecasting X. An empirical case study is presented to illustrate how substantial the adjustments can be.

3. On Climatological Change Forecasting

Professor Georgii Kuzjmenko, Odessa State Maritime University, 34 Mechnikov Street, Odessa, 270029 Ukraine

The great significance of quasi-cyclic geophysical changes is shown on the basis of a wave-mechanical solitonics approach. The connection with solar activity is calculated for century and two-century intervals: its prolonged decreases correspond to cold spell and definite geological activity. Under such an approach, the solitonically-wave-mechanical Fenjes-Kuzjmenko-Skorobogatov equation which describes phenomenonologically a self organisation in the Solar System and on the Earth – climatic and tectonic and the quasi-cyclic gravitational regime of solar activity – plays the principal role.

The expected cold spell during the period of two-century's minimum (1995-2010) as compared with the previous 15-year period depends on real anthropological influences. The period 1995 – 2010 is more dangerous in a global sense because of the increase of educible seismic energy, despite the decrease of earthquake frequency.

4. Time Series Prediction by Using a Syntactic Method

Dr. C. Jalobeanu, Mathematics Department, Technical University Cluj-Napoca, Romania

The paper presents a method inspired from the theory of formal languages to analyze time series in order to extrapolate the values and to predict the future.
Considering that the time series is segmented and a classification of the segments is done, we will label every class with a symbol from an alphabet. Then the time series will become a word from the semigroup generated by the alphabet. The analysis of the word could supply a language to which the word belongs and the corresponding grammar. The extrapolation problem imposed to find conditions on the language such that a guess of the future continuation of the word would be possible. The main aim of the present study is to find such conditions.
In order to illustrate our method, we analyze some time series delivered, for a competition in 1991, by the Santa Fe Institute.

5. How Long-run Projections of Greenhouse Gas Mitigation Costs are Conditioned by Assumed Production Structures

Terry Barker and **Marcelo Villena**: Department of Applied Economics and Department of Land Economy, University of Cambridge

In the assessment of mitigating the problem of global warming by means of reductions in greenhouse gas emissions, considerable use has been made of top-down models (macroeconomic, general equilibrium and energy-engineering) to estimate costs and benefits (eg IPCC Report, Climate Change 1995). A crucial element in the assessment of these costs is the treatment of production of goods and services at an industrial, national and global level using energy, other materials and services, labour and capital (the production function of economic theory). This paper argues that assumptions in this treatment are crucial in the assessments, giving rise to inevitable costs. When the empirical evidence is examined for the assumptions, it is clear that they are not strongly justified and that the prevalence of economies of scale, indivisibilities and technical change in the use of carbon-based fuels and their substitutes requires a more flexible and open-ended approach in the modelling.

Session Chair:
Dr John Adams, Napier University, Edinburgh

1. Intelligent Electric Load Forecasting

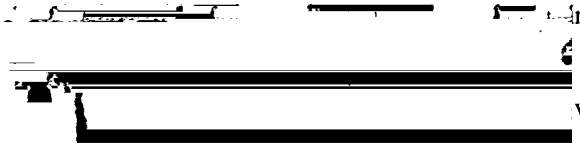
Dr Zbigniew Gontar, University of Lodz, Department of Computer Science, 90-214 Lodz, Poland.

This paper presents results of application neural network paradigm to the problem of one-hour ahead electric load forecasting. The load time series comprise daily, weekly, and annual cycles and the irregularities influenced by the weather conditions. This concerns: temperature, humidity, wind velocity, and sky condition. So as to examine the embedded periodicity in the load trend and reliably determine the necessary historical load data, we introduced the time series analysis procedure. The study indicates, that the load data from previous hour, and the same hour of the previous day and week are required. So the starting point is the equation:

$$LF(t) = j(LV(t-1), LV(t-24), LV(t-168)) + e(t)$$

where:

LF - is one hour ahead load forecasting,
LV - is load value,
t - is the hour of prognosis,
j - is assumed mapping, modelled by multilayer perceptron like neural network with backpropagation learning rule
e - is stochastic component.



nfluence of weather indicators and the nature of we conduct the analysis which let us answer the is result of deterministic chaos, (2) if influence of we introduced Takens theory and neural model to

2. Forecasting Daily Electricity Demand Using Splines

Dr. Fabiana Gordon, Pontifícia Universidade Católica do Rio de Janeiro, 225 - Gávea - 22543-900 Rio de Janeiro - RJ - Brazil.

This paper presents a model that deals with daily observations applied to the problem of forecasting daily electricity demand. This approach is based on a structural time series model with the annual seasonal pattern being modelled by a Periodic Spline. The method of Splines was first used in Harvey and Koopman (1993) to analyse hourly load observations, including temperature as an explanatory variable which is also modelled by a spline. The main contribution of this paper is the treatment of holidays and the temperature response modelled by a spline which considers the possible variations that the effect of temperature has on electricity demand within the year.

3. Forecasting, Pricing and Risk Management in the New Deregulated Electricity Industry

Emma Hoy, IBM T.J. Watson Research Center, Yorktown Heights, NY 10598, U.S.A.
Samer Takriti, IBM T.J. Watson Research Center, Yorktown Heights, NY 10598, U.S.A.
Lilian S.Y. Wu, IBM T.J. Watson Research Center, Yorktown Heights, NY 10598, U.S.A

The electric power industry will soon be deregulated. Instead of an electric utility controlling the market in a specific region, energy suppliers will compete in an open market allowing customers to choose their providers. Electric power will be exchanged at certain points and supply and demand variables will determine its price. In such an environment, generating companies rely on price forecasts to determine their generating and contractual strategies. In this talk, we discuss our findings as they relate to electricity prices in the Southwest Power Pool. This encompasses the relationship between price and electric supply and demand variables, which include: temperature, gas prices, and excess generating capacity. For a given season, we adopt a threshold model that partitions the data into two sets using temperature. Each set is modeled using linear regression. Our analysis concludes that such models are highly effective in forecasting electricity prices.

We will also discuss how risks and uncertainties can be managed in this deregulated electricity market.

4. Comparison and Combination of Day-Ahead Electricity Demand Forecasts

James W. Taylor, Decision Sciences Department, London Business School, London NW1 4SA.

Day-ahead forecasts are required for operational planning and for calculating the daily electricity pool price. One approach predicts turning points on the demand curve, and then produces half-hourly forecasts by a smoothing procedure based on a past demand curve. In this paper, we critically assess the procedure and compare it with alternatives. One such alternative is to use separate regression models for each half-hour of the day based on past data for that half-hour. When several forecasts have been constructed from different information sources, a combination of them has intuitive appeal. We consider methods for combining demand curves, including a new procedure which uses cubic smoothing splines.

Session Chair:
J. Keith Ord, Department of Management Science and Information Systems, Pennsylvania State University, 303 Beam, University Park, PA 16802, USA

1. Analysis of Inbound Tourism Demand in South Korea: a Cointegration and Error Correction Approach

Haiyan Song , School of Management Studies, University of Surrey, Guildford GU2 5XH, UK.
Seokchool Kim, School of Management Studies, University of Surrey, Guildford GU2 5XH, UK.

This study uses the cointegration and error correction approach to analyse the long-run and short-run inbound tourism demand in South Korea by four major tourist generating countries: Japan, USA, UK and Germany. The ex post forecasts with four different time horizons are generated from seven model specifications and the results show that the error correction model in general outperforms other models though the ARIMA (p,q) and VAR models provide reasonable forecasts for certain time horizons. Contrary to other studies, the empirical results of this study suggest that the naive model is the worst among the competing alternatives.

2. Modelling and Forecasting Business Trips Using Cointegration Analysis

Dr. N. Kulendran, Department of Applied Economics, Faculty of Business, Victoria University of Technology, Melbourne, Victoria 8001, Australia. **Professor Ken Wilson**, Department of Applied Economics, Faculty of Business, Victoria University of Technology, Melbourne, Victoria 8001, Australia.

Business trips improve bilateral trade. The main aim of this study is to identify the economic variables that influence business trips to Australia from USA, UK, Japan and New Zealand. The factors such as origin country income, openness to trade, real imports, relative price level and holiday travel are considered as the explanatory variables of business trips. Johansen's full-information maximum likelihood was used to estimate the long-run relationships between business travel and the factors that influence business travel. We find that importance of these economic variables varies from country to country. Openness to trade is an important variable for explaining business trips. We also find that business travel from Japan has a high relative price elasticity. The forecasting performance of error-correction model is compared with the no-change model.

3. Forecast Performance of Tourism Arrivals

Oral Williams, Research Department, Eastern Caribbean Central Bank **Leah Sahely**, Research Department, Eastern Caribbean Central Bank

Tourism expenditures provide significant proportions of total foreign exchange earnings in the economies of the Caribbean. Forecasts of tourism arrivals are critical to projections of tourism expenditures, foreign exchange earnings, output growth and longer-term infrastructural projects for development planning. This paper discusses the role of the tourism sector in the economies of a sample of Caribbean countries and examines the forecast performance of some time series models on quarterly tourism arrivals data. Smoothing and Box-Jenkins models are compared in terms of tracking performance, misses and false signals, and ex-post forecast ability. The initial results indicate that in the context of data deficient economies, where explanatory series are unavailable at the required frequencies, time series models are very useful for forecasting various economic aggregates.

4. Forecasting Needs for Local Tourism Development

Tony Harrison, Clare Speed and **Neil Bowie,** Department of Hospitality and ourism Managemen Napier University, Craighouse, Edinburgh EH10 5LG.

This paper aims to explore the information needs of local level organisations in forecasting tourism demand for planning and development. The paper has three premises as to the pertinence of such an exploration:

(a) as decision making authority for development becomes increasingly decentralised, then the real users of demand forecasts are local planners;

(b) the private sector has been increasingly involved in policy making and funding of local tourism development - typically, supply is highly fragmented with many small local firms;

(c) tourism as a national or international phenomenon is difficult to define given the multifarious motivations and constraints (economic, social, political and technological) that exists at such levels of demand.

The paper attempts to exemplify the information needs of local planners through investigating the case of Scotland, and the particular forecasting problems faced by its constituent shareholders in tourism policy development.

Session Chair:
Dr. Chris Chatfield, Department of Mathematical Sciences, University of Bath, Bath BA2 7AY, U.K.

1. Estimating the Probability Density Function of Financial Asset's Returns for Handling Nonstationarity

David Lowe and Ragnar Lesch, Neural Computing Research Group, Aston University, Birmingham B4 7ET. UK

Using neural networks to predict a financial asset's return in the future conditional upon past behaviour has only received limited success. In part this is due to either assumptions of deterministic behaviour or problems due to the stochastic nature and long memory effects leading to high input dimensions and the consequent vast numbers of data points required to estimate conditional probability density functions. However, requiring a long time history is a problem as financial time series processes are nonstationary.

In this paper we consider an alternative approach to the problem. We accept the intrinsic stochastic nature of returns by modelling the data generator as a probability density function. This is of unknown form and hence we need to construct semiparametric estimators of the unknown unconditional pdf.

The explicit assumption that the unconditional pdf is slowly varying allows us to model the nonstationarity of the time series. This can be achieved by constructing dynamic models which track the drift of the underlying parameters of the approximating pdf. The forecasting problem then becomes one of propagating forwards the unconditional pdf of returns and sampling from the distribution.

We concentrate upon the problem of reconstructing the pdf of returns taken from 100 years of the Dow Jones Industrial Average (DJIA) index. We compare and contrast several techniques for unconditional estimation of the returns pdf. These include Gaussian Mixture models as a semiparametric case and fixed and adaptive kernel density estimators as nonparametric models. In addition we present preliminary results on three nonparametric methods based on approximating the characteristic function rather than estimating the pdf directly.

2. Combining Dynamic Trend Regression and Radial Basis Function Models

Antonio J. Rodrigues and **Patricia X. G. Silva**, DEIO and CIO, Faculty of Sciences, University of Lisbon, Edif.C2, Campo Grande, 1700 Lisboa, Portugal, E-mail: ajr@fc.ul.pt

We address the do's and don'ts of neural-based forecasting of non-stationary time series, and compare ways of combining Dynamic Trend Regression (DTR) models, estimated by the Kalman Filter, and Radial Basis Function Network (RBFN) models, estimated through the Recursive Least Squares method.
Specifically, we discuss two new approaches: (1) a two-phase estimation process, where the data is prefiltered by DTR and the RBFN model seeks to eliminate small-lag residual correlations; and, (2) the recursive estimation of a DTR-RBFN model.
Some empirical results are reported, and compared to the separate application of either DTR or RBFN, or the simple weighted combination of estimates from those two models.
We also briefly discuss the underlying identification and optimization issues, and the extension of the new approaches to periodic time series.

3. Neural Networks for Time-Series Forecasting

Bill Remus, University of Hawaii, Honolulu. HI 96822 USA

This paper provides guidelines for when best to use neural network models. Neural networks perform best when used for:

1. Monthly and quarterly time series
2. Discontinuous series
3. Long term forecasts
4. Previously seasonalised data
5. Applications where automation is important

Neural networks, however, require a minimum number of data points so that overfitting does not occur. Guidelines are also provided for estimating the model.

Discussants:

Sandy Balkin
Chris Chatfield
William Gorr

Session Chair:
Dr. Moira Watson, Napier University, Edinburgh

Sales Forecasting: Benchmarks and Audits

Dr. John T. Mentzer, University of Tennessee, **Dr. Mark A. Moon**, University of Tennessee

This presentation will report on two complementary research projects that have been conducted over the last four years: the sales forecasting benchmarking studies and a program of forecasting audits. The benchmarking studies consist of in-depth analysis of the forecasting practices in 20 organizations. The primary contribution from this research is the identification of four distinct dimensions of forecasting practice: functional integration, approach, systems, and performance measurement.

On each of these dimensions, companies tend to operate at one of four stages, ranging from the lowest level of sophistication (stage one) to the highest level of sophistication (stage four). The presentation will describe each of the dimensions, and give recommendations on how companies can improve their performance by striving toward stage four in each dimension. The second part of the presentation will describe the methodology that our research team has used to conduct sales forecasting audits at a number of organizations. These audits are designed to help companies understand how their current forecasting practices compare to the companies in the benchmarking studies. The presentation will also discuss several strategic themes that have emerged from these audits, along with specific recommendations on how companies can improve their forecasting performance.

2. Strategic Management and Forecasting Implementation

Chandra Aleong , Department of Economics and Business, Lincoln University of Pennsylvania, PA 19352, U.S.A. and **John Aleong**, Department of Mathematics and Statistics, University of Vermont, Burlington, VT 05405, U.S.A.

The current discussion of core competencies; strategic fit; trade-offs; managing for value versus market share and "best practices" business processes are the recommended tools that organizations use for strategic planning.

The question for the average person in a for-profit company, large or small; a university, public or private; a non-profit institution, federal or state is where to begin. How does this very powerful set of tools being discussed by the academics and consultants become a grass-roots movement? The discussion is still reserved for academics and select groups of individuals. The average worker in business, government or the university still thinks of strategy as "pie in the sky" thinking. What is the most feasible mechanism for filtering the message of Strategic Management throughout the organization? How does the engineer, the statistician, the medical doctor, the accountant integrate their daily work with the strategic plan of the company? It is only by finding this technique that the message can really influence policy making.

The forum will discuss forecasting techniques that can be useful in the implementation of strategic planning in business, non profit, and government environments.

3. Development of a Multifunctional Sales Response Approach with the Diagnostic Aid of Neural Network Modelling

Stefania Pandelidaki, London Business School, London, NW1 4SA.
Professor Derek Bunn, London Business School, London NW1 4SA.

Sales response modelling, in contrast to the traditional time-series based sales modelling or market share modelling, has received relatively little attention in the literature. To deal with this deficit, an approach is proposed that (1) models and forecasts sales through a new flexible parametric response function (multifunctional), allowing for behavioural assumptions of the response determinants to be specified, and (2) uses neural network modelling as re-specification tool for the multifunctional (or any other parametric) response model for improving forecasting performance. An initial experiment on a sample of sales data demonstrates its feasibility and gives comparative insights via alternative model specifications.

Session Chair:
Dr. Ibrahim M. Abdalla, Napier University, Edinburgh

1. Forecasting (non-)stationary Economic Data with OIIR-filters and Composed-Threshold-Models.

Dr. Marco Wildi, University of St. Hallen, FEW-HSG, 9000 St. Hallen, Switzerland
Dr. W. Stier

We propose a new forecasting technique well suited to stationary and non-stationary economic data. Two methods are used which together generalize the Box-Jenkins ARIMA technique: Optimized-Infinite-Impulse-Response-Filters generalize difference-filters *by extracting components without altering them* and composed-threshold (piecewise linear) models generalize linear ARIMA-models by taking account of unconditional as well as *conditional first and second order moments* in the extracted stationary components. First we introduce filter concepts together with an example in which frequency characteristics of an OIIR-filter are compared to the difference filter of the ARIMA-model, showing that OIIR-filters clearly better match the detrending problem of economic time series. We then briefly introduce CT-models used in forecasting the extracted stationary component of a non-stationary time series. Two examples will show the forecasting accuracy of the new method when compared to ARIMA forecasts. Finally we give some deeper insight into the extraction problem of the stationary component resulting in the design of OIIR-filters.

3. Model Identification in Multivariate Time Series. A Simplified Procedure Based on Canonical Correlation

Ela Mercedes M. Toscano, Dra. Departamento de Estatística, ICEx Universidade Federal de Minas Gerais **Dr. Valderio Anselmo Reisen**, Departamento de Estatística, CCE Universidade Federal do Espírito Santo, Goiabeiras - Vitória, E.S., Brasil

This paper is concerned with the problem of identifying the order of multivariate ARMA models. We briefly present the methods of Cooper and Wood, Tsay and the Scalar Component Model (SCM), which are based on the canonical correlation technique. We propose a simplified procedure to the Scalar Component Model, which can be used as an alternative method to identify the order of a vector ARMA model. The methods are compared by using simulated multivariate time series and illustrated on a real set of data.

4. Bootstrap in Time Series: A Comparison between 3 Implementations in ARIMA Models Estimation

Leonardo R. Souza, Electrical Engineering Department, Pontifícia Universidade Católica do Rio de Janeiro, Gávea - 22543-900 Rio de Janeiro - RJ - BRAZIL

Model estimates require a measure of reliability, and, in this field, bootstrap procedures are valuable tools for standard deviation estimation of parameters. Here, we compare the performance of three implementations of bootstrap in AR(2) structures. These implementations concern mainly the estimation of the standard deviations of the parameters, but not only. The first implementation resamples the estimation matrices. The others resample the estimated residuals of the model. The difference is placed in the way that the residuals are treated. One approach is the input of a linear filter, as it comes from the original Box & Jenkins modelling. Another approach is the random part of a sum, where the other part is deterministic, as it comes from a regression. In these two implementations, stationary bootstrap is tested in a way to offset some limitations. The advantages and limitations of each implementation are discussed.

Session Chair:
Professor Ken Holden, Liverpool Business School, 98, Mount Pleasant, Liverpool L3 5UZ, UK

1. Unit Roots, Change, and Decision Bounds

Robert M. Kunst, Institute for Advanced Studies, Vienna, and Johannes Kepler University, Linz, Austria.

The problem of optimal decision between unit roots, trend stationarity and trend stationarity with structural breaks is considered. Each of the three classes is represented by a hierarchically random process whose parameters are distributed in a non-informative way based on a simple rule. Given a well- accepted parameterization, parameters are distributed uniformly if they are bounded by admissibility conditions, and standard normally if they are unbounded. The prior frequency for all three processes is the same. Classification of observed trajectories into any of the three classes is based on two information condenser statistics z1 and z2 . z1 is the traditional Dickey-Fuller t-test statistic that allows for a linear trend. z2 is a heuristic statistic that condenses information on structural breaks. Two loss functions are considered for determining decision bounds within the (z1, z2) space. Firstly, quadratic discrete loss expresses the interest of a researcher attempting to find out the true model. Secondly, prediction error loss expresses the interest of a forecaster who sees models as intermediate aims. For both loss functions and a variety of empirically useful sample sizes, optimal decision contours are established by means of Monte Carlo simulation.

2. Using Time-Series Models to Correct Econometric Model Forecasts

Michael P. Clements, Department of Economics, University of Warwick, Coventry, and
David F. Hendry, Nuffield College, Oxford.

Time-series models characterised by unit roots may adapt more rapidly to structural change or regime shifts in the economy than econometric models that attempt to model long-run relationships between variables. Clements and Hendry (1996) indicate how appropriate corrections can reduce the bias of econometric model forecasts at periods of change, but often at the cost of inflating the variance component. In this paper we show that time-series model forecasts can sometimes be used to correct the econometric model forecasts with a smaller effect on the forecast-error variance.

3. The Effects of Data Revisions on the Evaluation of UK Economic Forecasts

Professor Ken Holden, Liverpool Business School, 98, Mount Pleasant, Liverpool L3 5UZ, UK

Macroeconomic forecasts are usually evaluated a short time after the outcomes that were forecast are known. However, after the first estimates of macroeconomic data are published, they are frequently revised several times before becoming the final estimates which are assumed to be close to the (unknown) true values. These revisions can have a big impact on measures of accuracy of the forecasts. In this paper the effects of using different outcomes series are examined for UK forecasts of growth of GDP, inflation and unemployment. The evaluation of the forecasts uses quadratic, linear and directional loss functions, and attempts to answer the question of whether data revisions matter.

4. The Forward Premium Anomaly is not as Bad as You Think

Richard T Baillie, Department of Economics, Michigan State University, East Lansing, MI 48824. **Tim Bollerslev,** University of Virginia & NBER

The forward premium anomaly refers to the widespread empirical finding that the estimated slope coefficient in the regression of the change in the logarithm of the spot exchange rate on the forward premium is invariably less than unity, and often negative. This "anomaly" implies the apparent predictability of excess returns over uncovered interest rate parity, (UIP), and is conventionally viewed as evidence of a biased forward rate and/or of evidence of a time varying risk premium. This paper presents a stylised model that imposes UIP and allows the daily spot exchange rate to possess very persistent volatility. Although the slope coefficient estimates in the corresponding anomalous regressions with monthly data are found to be centred around unity, they are very widely dispersed, and converge to the true value of unity at a very slow rate. As such this theoretical evidence is consistent with the empirical findings for the monthly sample sizes reported in the existing literature. Furthermore, using shorter sub-samples and more recent data the empirical slope coefficients are frequently found to be positive. Hence, the celebrated unbiasedness regression does not appear to provide as much evidence as previously believed concerning the possible bias of the forward rate.

5. Economic Policy in EMU.

Dr. Markku Kotilainen, The Research Institute of the Finnish Economy (ETLA), Lönnrotinkatu 4B.

Membership in the Economic and Monetary Union (EMU) implies the absence of national monetary and exchange rate policy tools. The remaining policy instruments are mainly fiscal policy and incomes policy (generally, measures which affect the costs of firms). At the union level monetary and exchange rate policies are, however, still available. In this paper the effects of these different national and union-level economic policy tools are analyzed in a three-country theoretical macroeconomic model. In the model we have two large countries ("EMU" and "the USA") and a small country ("Finland"). The model is recursive in the sense that the large economy model is solved first, and the effects are then inserted into the small country model. The exchange rate between "EMU" and "the USA" is floating. "Finland's" membership in the "EMU" is modelled through a common exchange rate with "EMU". The results are partly obtained a priori, but because of the complexity of the model the majority of the results are based on numerical simulations. For a small EMU country fiscal policy is an effective policy instrument, assuming that the country is not heavily indebted. Adjustment in the cost level through changes in wages or different kinds of indirect labour costs is also a good tool. The choice of the instrument depends on the shock against which the tool is directed. At the union level fiscal policy is efficient in those countries where the measures are implemented. The size of the effect depends on the responsiveness of prices and wages. The spill-over effects on the output of other EMU countries are small because the exchange and interest rate effects tend to eliminate the effect due to foreign demand. Fiscal policy is thus an appropriate tool in dealing with asymmetric economic developments, assuming that the public economies are sound. Monetary policy is a very efficient instrument which should be used carefully. Its use in stabilizing output is appropriate when all countries are in the same cyclical situation. If the situations differ, monetary policy measures will create problems for those countries whose economic development differs from that of the majority. Measures affecting production costs are also a strong instrument when implemented in many countries at the same time. This type of simultaneous policy has, however, strong spill-over effects on other EMU countries, whose economic situation might not require such a policy. Measures affecting costs are thus more suitable for specific problems of individual countries, unless there is a union-wide shock, whose effects are very similar in all member countries.

Session Chair:
Professor Andrew Hughes Hallet, University of Strathclyde, Glasgow,

1. Financial Price Forecasting in Brazil

Tara Keshar Nanda Baidya, Pontificia Universidade Catolica do Rio de Janeiro, Gavea, CEP 22453-010, Rio de Janeiro, Brazil. **Paulo Henrique Soto Costa**, Pontificia Universidade Catolica do Rio de Janeiro, Gavea, CEP 22453-010 Rio de Janeiro, Brazil.

The objective of our research is to model financial time series returns by non- linear, non-stationary stochastic processes. Tests are done to verify if the random walk hypothesis can be rejected. Studies are made to see if the price trend models explain better the empirical behavior of the financial series than the random walk model. We have used the price series of Indice de Bolsa de Valores de Sao Paulo (IBOVESPA), US Dollar and Gold in our research. We conclude that the price trend models work better during the period with a high inflation rate (1986-1994) and the random walk model during the inflation controlled period (1994-1997).

2. Forecasting Stock Market Performance and Investor Behaviour in an Emerging Market with High Inflation

Aysce Yuce, Bilkent University, Department of Management, Ankara, Turkey.
Zeynep Onder, Bilkent University, Department of Management, Ankara, Turkey.
Can Simga-Mugan, Bilkent University, Department of Management, Ankara, Turkey.

Models for stock market forecasting are based on rational investor behaviour with relatively predictable financial environment. However, in general, investors and financial environment in emerging markets are very unpredictable because of uncertain political and economic environments.

This paper examines the Turkish market that has had chronic inflation over 70 percent since the 1970s. Before modelling stock market performance, it is important to analyse investor behaviour under high inflation and uncertainty that derives demand in these markets. This study will provide information to both native investors and investors of developed countries who diversify internationally with high inflation rates.

In this study, investor behaviour in the Turkish market is examined. The results of survey show that small investors invest in stocks for short term purposes and some of them perceive stock market investment as a gamble. Secondly, using the results obtained in this study, the small investor behaviour and the stock market performance are modelled.

3. Forecasting Credit-Card Losses

Professor Kamal M. El-Sheshai, Department of Decision Sciences, Georgia State University, Atlanta, GA, USA

One of the major problems currently facing credit-card issuers is the mounting losses from cardholders' default on their debt. Recent data show that delinquencies and losses continue to grow over time at a greater rate than outstanding debt. Contributing to this trend is the increased competitiveness among card issuers which has led to acceptance of riskier customers, and the existence of liberal procedures for personal bankruptcy filings which provide debtors protection from creditors. To manage credit-card portfolios, there is a growing need to provide accurate forecasts of anticipated cardholder losses. This study examines models for forecasting cardholder losses at the macro and the micro level. At the macro level, the study examines models for forecasting total credit-card losses in the US. At the micro level, the study examines strategies for building loss-forecasting models at a major card issuer in the US. The study assesses the accuracy of different methodologies as well as different models in forecasting cardholder losses.

4. Forecasting Municipal Budgets

Johann Broethaler, Institute of Public Finance and Infrastructure Policy, E267, University of Technology, Vienna, Karlsgasse 11, A-1040, Vienna, Austria

Public budget forecasts which go beyond the obligatory one-year budget estimates are of particular importance reflecting the increasing burden on public budgets and the actual efforts for budgetary consolidation to meet the Maastricht criteria for the European Currency Union. Concerning the local government budgets, there is a need for reliable forecasts both for individual local governments in the context of financial planning and on the provincial and national level as a base for financial and economic policy. This paper discusses the current framework conditions and shortcomings of municipal budget forecasting (in Austria) and presents the conceptual approach of a budgetary analysis and forecasting system for all local governments.

The main problems and challenges to municipal budget forecasting are the 2-year delay of municipal financial statistics, the lack of relevant socio-economic data on local government level, complex budgetary interdependencies between all levels of the public sector (e.g. more than 60% of the tax revenues of local governments come from the share of shared taxes) and the problem of estimating the local effects of legal or global socio-economic changes. The conceptual approach to deal with these problems is based on a financial information and evaluation system of actual disaggregate budget data of all local governments which is currently implemented for one federal province. The forecasting procedures to be discussed for the different budgetary categories, respectively, especially rely on trends of groups of local governments (e.g. according to size or economic and locational attributes). To estimate the effects of legal changes or predicted national budgetary values (e.g. shared taxes) on individual local governments a financial dataflow network model representing corresponding legal regulations (e.g. Revenue Sharing Law) is used.

5. Inflation Expectations and Bank Savings in the Caribbean

Michelle Doyle, The Central Bank of Barbados (Research Department) Tom Adams Financial Centre, P. O. Box 1016, Bridgetown.

This paper investigates the impact of inflation expectations and other factors on deposits in a number of Caribbean territories. For Barbados in particular, at the beginning of 1997 the indirect tax system was revamped and a Value Added Tax implemented. In response to a possible surge in the price level, agents accumulated bank deposits. Using alternative expectation schemes, a cointegrated approach is employed to estimate elasticities and forecast bank deposits.

Session Chair:
Peg Young, Immigration and Naturalisation Service,Washington D.C., 20536, USA

1. Monitoring An Election Campaign via Bayesian Model - The Brazilian Experience

G. H. Brasil, UFES, Vitória, ES, Brazil
R. C. Souza, NEC, DEE, PUC-Rio, Rio de Janeiro, RJ, Brazil.

The Bayesian approach to model and forecast the final results of an election uses a sampling design technique different from the one traditionally adopted on the classical counterpart. The selection of sampling units (states, cities, electoral zones, etc.) is carried out via the Kullback-Leibler divergence measure which chooses the most representative areas of the universe to be sampled. Within each one of these selected sampling units a random sample of voters is chosen. This approach, originally proposed by Bernardo to monitor the Spanish election of 1982 has been adapted to the brazilian electoral system througout the years by the authors and used in various elections in Brazil (local, state and national levels). In this paper we describe some the theoretical developments of the method, as well as its performance on the brazilian elections we have used it.

2. Forecasting Irregular Demand in a Paper Mill

Antonio J. Rodrigues, DEIO and CIO, Faculty of Sciences, University of Lisbon, Edif.C2, Campo Grande, 1700 Lisboa, Portugal

Forecasting demand represented by non-stationary and unevenly spaced time series is a relatively common problem in business and industry, but almost overlooked in the literature and in the mainstream forecasting software.
Usually, a large number of items are involved, and solutions are required to be both effective and efficient. To address this problem, exponential smoothing methods can be adapted and customized in several ways, depending on the characteristics of the series.
To illustrate these issues, we present the looks and works of an irregular demand forecasting system, which was designed to support marketing and production planning decisions in a large paper manufacturing company.

3. Role of TQM in Forecasting Process

Dr. Emese Molnár, University of Miskolc, Hungary.
Dr. Ilyés Csaba, Tiszai Vegyi Kombinát Ltd., H-3851 Tiszaujvaros, Hungary.

Changes taken place in the Hungarian economy which has experienced and continuing to experience. The connection between the past and the future comes to problems both in macro- and micro-level, because in the past do not continue into the future. Essential social changes moved in line with economic changes. The role of Total Quality Management is larger than years before. The companies which want to be successful in the market (both in domain and abroad) have to modify their structure in every point of view. To reach the ISO standards is very important in the international market and not only in the production sphere. In this paper I would like to present the characteristics of the present Hungarian companies from the point of view of using TQM. (OTKA F20270 project)

4. Forecasting Techniques and Methods in the Cyclical Chemical Industry in Hungary

Dr. Ilyés Csaba, Tiszai Vegyi Kombinát Ltd., H-3851 Tiszaujvaros, Hungary

TVK is the largest chemical company in Hungary which was privatised in 1996. The goal of this paper is to present and emphasise that which fields of forecasting are important in case of a chemical company.

First I would like to show the process of evaluating corporate value emphasising the necessity of forecasting. When we try to supply the top management with information how can we gain reliable information of the raw material and product prices, inflation etc. How to supply the managers with the required informations about the company's activities, the market and the future changes. Which informations are necessary to make a good plan for any time horizon.

I try to show the possible methods to solve the former problems, e.g. to forecast future prices. Finally I show the methodological and practical background of forecasting and planning system in our company. (OTKA F20272 project)

5. An Analysis and Prediction of Fish Consumption in Turkey

Erkan Erdil, Middle East Technical University, Department of Economics, 06531 Ankara, Turkey.
Prof. Dr. E. Zehra Kasnakogu, Middle East Technical University, Department of Economics, 06531 Ankara, Turkey.

The subject of this study is to analyse the expenditures on fish relative to substitute food items in Turkey. The analysis is carried out for different species as well as aggregate fish by regions and income groups. The SIS 1987 Household Income and Consumption Expenditure Survey and 1995 Zet Nielsen Fish Survey are employed to estimate income and price elasticities for selected food items and fish species. Based on the estimated price and income elasticities, domestic consumption expenditure for fish are predicted for the 1995-2000 period.

Income elasticities at different aggregation levels are estimated and presented. Although our main aim is to estimate income and expenditure elasticities for different species of fish, we have presented the income and expenditure elasticities for main food expenditure groups to give a complete picture of the household food expenditure patterns. As a next step we have selected certain food subgroups which may be considered as competitive products for fish and estimated their income and expenditure elasticities. The elasticities for fish subgroups and kinds are obtained. Income (expenditure) elasticities are obtained for different income groups on the assumption that income elasticities may differ between different income classes.

Session Chair:
Dr. Ibrahim M. Abdalla, Napier University, Edinburgh

1. Telecommunication Revisited

Bruno Eklund, Stockholm School of Economics, S-113 83 Stockholm, Sweden.

In this paper we will take another look at the telecommunication from Sweden to three destination countries: Germany, the United Kingdom and the USA. The original study was performed by Hackl, P. and Westlund, A. (1996) using various versions of Kalman filtering techniques and moving local regression analysis. They found that the hypothesis of constant parameters is not realistic for any of the three country models. Furthermore, the outcome of the Kalman filtering was shown to be very sensitive to the specification of the state-space model. This study will instead assume that the parameters are constant over time and use the nonlinear smooth transition regression model to explain structural change.

2. A Software Package for Multi-Rate Unobserved Component Forecasting of Telephone Call Demand

Wlodek Tych, Peter Young, Diego Pedregal and **John Davies,** CRES, Dept. Environmental Science, Lancaster University, Lancaster, LA1 4YX, U.K.

The paper will describe a software package developed for Barclaycard PLC which analyses and forecasts hourly telephone calls received by Barclaycard Customer Service Centres. This adaptive forecasting system is based on a special Unobserved Component (UC) model with low frequency trend, Dynamic Harmonic Regression (DHR) and irregular components, all defined in stochastic state space terms. A novel feature of the model, which is intended for forecasting at lead times ranging from several hours to several weeks in advance, is its exploitation of a novel multi-rate approach which involves the combination of short and long-term forecasts obtained from models identified and optimised at different sampling rates.
The hyper-parameters in the UC model are estimated by a novel optimization procedure which minimises the difference between the pseudo-spectrum of the model and the autoregressive spectrum of the data. This approach to optimization has very rapid and well defined convergence characteristics when compared with traditional approaches, such as maximum likelihood based on prediction error decomposition. Combined forecasting and signal extraction is accomplished by a combination of recursive Kalman Filter and Fixed Interval Smoothing algorithms based on the optimized stochastic UC model. These recursive algorithms have inherent adaptive capabilities and are capable of automatically handling missing data and marked outliers.
The adaptive forecasting system is written and implemented in the Matlab programming environment using its Graphical User Interface tools. This allows for off-line and on-line interactive analysis of the strongly periodic telephone call series. Interactive facilities allow for the user-selection and analysis of data sub-sets, as well as the comprehensive evaluation of the forecasting performance on historical data. An additional data-viewing and selection panel gives the user the ability to select and mark unusual and missing data in order to exclude them from model estimation. The results visualisation includes facilities for evaluating both temporal/spectral model fits and forecasting performance, as well as the statistics associated with this forecasting performance. Facilities are also available for saving and restoring user-specified results obtained during various stages in the analysis.
Although developed primarily for on-line forecasting purposes, the off-line signal extraction facilities have proven very useful in practical terms, providing information of behavioural patterns that are not obvious from the raw data series and are most useful in management and planning terms.

3. Mobile Telephone Traffic Forecasts

Jean Pierre Indjehagopian, Professor of Statistics, **Sandrine Macé**, Lecturer of Statistics, ESSEC, B.P. 105 – P95021 Cergy-Pontoise, Cedex

For its mobile telephone network, the SFR Telephone Company has set up a hot-line service which is open 7 days a week, and whose purpose is to field calls from subscribers with question about the answering machine service, the geographic extent of the network, invoices etc.
The study carried out for the company seeks to build a system which will provide monthly forecast of such traffic. Its practical purpose is to enable SFR to accurately predict the number of operators required for the hot-line service each month.

We use two methods to meet the objective. The first is based on the Holt-Winters technique to make traffic forecasts while taking into account the fact that all the days in a given month are not the same. Using a system of evolutionary weighting, days in the months are transformed so as to account for Saturdays and Sundays.

The second method involves building a dynamic linear model which gives the number of calls calculated from the number of subscribers and the flow of new subscribers from the previous period. Also included in this model are dummy variables which take into account seasonal variations.

The accuracy forecasts of the two models are compared.

4. Forecasting Telephony Demand against a Background of Major Structural Change

Clive Mason, Manager, Forecasting Systems, Strategy & Business Services Division of British Telecom, 2-12 Gresham Street, London EC2V 7AG Tel: 0171 356 7621 Fax: 0171 356 7051

The last 10 to 15 years have seen enormous structural change in the UK telephony market. The challenge to forecasters has been to retain the traditional strengths of whole market models, while adding the ability to flex a range of product and carrier development scenarios. They have also had to balance the need to understand and model the increasing complexity of the market place with the commercial pressures for greater forecasting accuracy & efficiency.
Within BT, this has led to the development of a unified forecasting system, TIDeS, written in SAS, working on a UNIX platform. It enables econometric based whole market demand to be segmented by customer, product & carrier, before applying generic price and optional discounting assumptions to derive revenues. It is underpinned at all stages by comprehensive on-screen diagnostics and a report writing capability. This paper discusses:-

* The need for a modular structure and the choice of SAS/UNIX as a technical solution.
* Some of the practical difficulties which were encountered in developing the system.
* TIDeS as a practical forecasting tool and future development plans.

The paper concludes with a checklist of issues helpful to others contemplating a similar development, aimed at overcoming the technical and practical problems posed when developing such a complex system.

5. Modelling and Forecasting Television Viewing Behaviour

V. Assimakopoulos, J. Anastasakos, A. Patelis

This paper proposes a realistic mathematical model for forecasting short term TV viewing by audience profile, television station and by day of the week. The forecasts concern the program ratings as well as the ratings of the nonprogram content of TV.

As a first step the audience availability is analysed in order to identify and construct the general viewership pattern. Viewership curves are similar in shape between seasons, indicating that the time dedicated to television by the audience follows a general pattern little affected by seasonal changes. This is a consequence of the fact that free time during the day is limited and clearly defined.

The second step is the partition of the total availability to specific programs and TV stations. This is conducted through a preference mechanism which can be confronted as a market sharing problem.

The time dimension plays an important role to the partition since the changes in the program environment are more than frequent during the day.

Session Chair:
Professor George Wright, Graduate Business School, Strathclyde University, Glasgow G4 0QU, U.K.

Combining Biased Forecasts: When Are We Led Astray?

Clare Harries and **Nigel Harvey,** University College London, London WC1E 6BT.

In the first of a series of studies looking at the effect of biased forecasts in judgmental combination of forecasts, 40 subjects combined estimates from four forecasters over forty trials. For half the subjects two of the forecasters had constant errors consistent with trend biases: they tended to overestimate the outcome in this negatively trended series; for the other half of the subjects the bias was opposite to that usually seen: they tended to underestimate the outcome in this negatively trended series. Absolute error in the resulting combined forecasts was greater for those who had seen forecasts with the bias in the direction usually exhibited by forecasters (including, presumably the subjects themselves). The role of implicit forecasts in combining forecasts will be discussed with reference to trend and other forecasting biases.

2. The Impact of Forecasts on Decisions

William Remus, University of Hawaii, Honolulu, HI 96822 USA **Kai Lim**, University of Hawaii
Marcus O'Connor, University of New South Wales, Sydney, Australia.

Forecasts are important inputs to the decision process. In this experiment we compared the impacts of judgmental forecasts, optimal forecasts, and biased forecasts when used as inputs to a decision modelled as a Multiple Cue Probability Learning (MCPL) task. Major findings include that the gains from using optimal forecasts were along different dimensions than the losses from using judgmental forecasts. Also, we found that the subjects were able to compensate for forecasts that unbeknownst to them were biased. The subjects' self assessments of accuracy and confidence did not correspond to their performance in the decision task nor did the subjects' self assessments of accuracy and confidence improve as their performance improved.

3. Expert Judgements and Adjustments in New York State Revenue Forecasting

Yu-Ying Kuo, State University of New York at Albany, Albany, NY , U.S.A.

Revenue forecasting has long been studied as an econometric problem, and little attention has been paid to the role of human judgement in the process. The purpose of the research reported here is to examine the role of expert judgements and adjustments in revenue forecasting. Personal interviews were conducted with 11 respondents at the director or deputy director level in the New York State the Division of the Budget, the Assembly Ways and Means Committee, and the Senate Finance Committee. The results show that expert judgements and adjustments are important in a variety of ways, including: 1) constructing models, 2) adjusting models when something abnormal occurs, 3) filling in gaps of information, 4) "reality check," and 5) forecasting the impacts of changes in legislation. Economic variables, tax structure and taxpayer behaviour are important variables in the process. Strengths and weaknesses of New York State experience will be identified and discussed.

4. (Un)predictability in decision making

Henk J. van Zuylen, Delft University of Technology, 2600 GA Delft, The Netherlands Transport Research Centre, Ministry of Transport **Marina S. van Geenhuizen**, TRAIL, Delft University of Technology, Delft, The Netherlands. **P.Nijkamp**, Free University Amsterdam, The Netherlands.

Decision makers like to know what the future will bring in order to anticipate problems, assess the quality of their decisions and tailor decisions such that optimal impacts can be expected. Uncertainty about the future is reduced by all kinds of techniques ranging from extrapolation to sophisticated predictive modelling.

A study is made of the limitations of predicting the future and on the impact of this limitation on decision making.

Ill predictability is distinguished in the following categories: - ill predictability of the dynamics of the system,
- the complexity of the interaction between a system and its environment
- lack of knowledge about the system - human behaviour
- evolution of views, values and goals of decision makers.

The paper discusses the relevant processes which are ill predictable and its consequences. Ill predictability can lead to different ways of decision making. Two views are:

the revisionist's view: predictability is the rule and ill-predictability is anomalous behaviour which has to be remedied; and the radical view, where the world is seen as complex, chaotic and unpredictable with small domains where reliable forecast are possible. The paper discusses several strategies to cope with uncertainties. The role of information in decision making is analysed. Not all kinds of decision making have the same need for reliable information. For the open policy development process an analysis is given of the techniques to be used and the possible consequences, especially for multi-actor decision making.

5. Insolvency in America's Public Retirement Funds: An Evaluation of Judgement, Time Series and Econometric Approaches to 70 Year Forecasts of Mortality Improvements

John Phelps and **Ralph Monaco,** HealthCare Financing Administration, N3-24-14, 7500 Security Blvd, Baltimore, Maryland, 21244, USA

Future Retirement Trust Fund insolvency is primarily driven by projections of mortality decline. The SSA mortality rate projection looks at death by disease category, but ultimately uses a judgemental approach. We (John Phelps and Ralph Monaco) show that an ARIMA model fit for 1900-1965, forecasts mortality rates in1995 perfectly and shows a very different future than SSA's judgement approach. We then show an econometric approach which uses cross section relationships to tie future mortality improvements to economic variables. The primary advantage of an econometric approach is the ability to then affect future values of the forecast variable via policy. The size and economic and racial variation in America is of considerable help in estimating these cross section relationships

Session Chair:
Konstantinos Sirlantzis, Operational Research Group, Canterbury Business School, University of Kent at Canterbury, Canterbury, Kent, CT2 7PE

Interval Forecasting using Neural Networks Trained by Markov Chain Monte Carlo Methods

Konstantinos Sirlantzis, Operational Research Group, Canterbury Business School, University of Kent at Canterbury, Canterbury, Kent

Recent work showed that Bayesian formulation of the neural networks' training problem provide a natural way to account for the uncertainty associated with the resulting predictions.
This study employs Markov Chain Monte Carlo methods, which make possible feasible implementations within the Bayesian framework, to produce a conditional predictive distribution in time series forecasting. It exploits the advantages of the 'mean absolute deviations' error function (as opposed to the 'mean squared error' used in backpropagation) to address the non-trivial cases where uniformity of the prediction error bounds over the state space or where the assumption of normally distributed error terms do not hold. The conditional quantiles of the predicted variable are then natural estimators of the 'prediction intervals' associated with a prespecified probability level. The length of these intervals is subsequently used to monitor the evolution of the prediction uncertainty over the state space as well as in m-step ahead predictions.
To illustrate the properties of our estimators we discuss results in the following cases: (a) an AR(1) model with Gaussian and non-Gaussian disturbances, (b) the logistic map (chaotic) with added Gaussian noise, and finally, (c) a real-world financial time series.

2. Neural Networks for the Description of Structural Changes in Object Classes

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Neural network approaches are widely used for the categorization of objects of different nature. In applications these objects can correspond to countries, political parties, markets, companies etc. Revealing the inherent structure of corresponding sets of objects can be done using different neural paradigms. However little efforts have been done to develop neural networks tools for predicting and describing the changes in corresponding object communities. We propose to use for this purpose energy minimizing neural networks which are able not only to categorize objects in human-like (prototype) manner, but also to find empty classes with no examples so far. Such kind of classes can be considered as predicted structutres which can be actualized in future. Including the prototypes of such empty classes in categorized set gives the ability to trace possible changes in object classes structure, in particular, to predict splitting and merging of different object groups. This approach have been applied to analysis of different objects sets including country groups, characterized by their voting in UN.

3. A Stochastic Neural Network based Extended Kalman Filter for Forecasting Nonlinear Time Series

Chokri Slim, Université E9 de Tunis III, 2000 le Bardo, TUNISIA

The application of artificial neural networks to problems of nonlinear time series has been dominated largely by static network architectures trained by gradient descent. In this paper we propose a stochastic network to analyze such a system. The net is based on multilayer feedforeward architecture with tangent hyperbolic functions. The model can then be converted to its equivalent state-space representation. Using this state space form, a bayesian inferential algorithm based on Extended Kalman Filter is derived to estimate the state. A detailed step by step description of the methodology is presented to facilitate the use of this new method as a forecasting tool. We apply the proposed model to several data sets and show that the resulting models substantially improve postsample multi-step ahead of forecasts over other models.

4. Investigating the Forecasting Performances of Backpropagation Neural Network Models

Kua-ping Liao, The Management School, Lancaster University, Lancaster LA1 4YX, U.K

The forecasting performances of the backpropagation neural network models will be compared with those of some other standard forecasting approaches by using 263 series taken from a telecommunications data set. Before building a backpropagation neural network forecasting model, there are many things to be done. These may include choosing the number of hidden nodes, choosing the learning rates, and giving initial values to the weights and biases of the neural network etc. A 3-stage training approach is proposed to deal with these and train a neural network automatically. This approach is aimed at converting the complexity and subjectivity inherent in the neural network model building process into a more flexible and objective methodology. This is intended to enhance the reliability of the neural network models and make comparisons of forecasting performance more meaningful.

Session Chair:
Dr. Robert Raeside, Napier University, Edinburgh

Short Life-Cycle Forecasting using Sales Plans

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Obtaining accurate short life-cycle product forecasts is very difficult and standard statistical time series forecasting models frequently don't offer an adequate solution for many retailers. Major problems in automatically developing these forecasts include (1) the lack of substantial sales history for a product (which especially makes obtaining seasonal forecasts very difficult), (2) the difficulty of automatically matching a new product to a previous product or profile, and (3) the inability to include planners' intuition (e.g., the overall sales level of the product, how quickly the product will take off, how the product's sales will be affected by planned promotions) into a forecasting model. Using a Bayesian approach, we have developed a short life-cycle forecasting model that begins with a product's seasonal sales plan (that is developed externally to the system by the planner). As sales information arrives during the first few days or weeks of the season, the model generates a forecast by merging the information contained in the sales plan with the information contained in the initial sales data. These forecast updates can be critical to a company's success and can be used to increase or cancel vendor orders, reallocate merchandise among stores, or optimize sales and promotional schedules.

2. Estimating the Bias in Forecasts of Intermittent Demand

A. A. Syntetos, Buckinghamshire Business School, Buckinghamshire University College, Newland Park, Chalfont St. Giles, Bucks HP8 4AD, England. **J. E.. Boylan**, Buckinghamshire Business School, Buckinghamshire University College, Newland Park, Chalfont St. Giles, Bucks HP8 4AD, England.

Intermittent demand appears at random, with many time periods having no demand. Moreover when a demand occurs the request is sometimes for more than a single unit. As such, intermittent demand creates significant problems in the manufacturing and supply environment as far as forecasting and inventory control are concerned. Croston, for the first time, in 1972 proposed a new method according to which intermittent demand estimates can be built from constituent events, namely the demand size, when demand occurs, and the inter-demand interval. His method is discussed and the theoretical background associated with the method's application is presented. Certain limitations are identified and a correction in his estimate of the expected demand per time period is introduced along with the associated mathematical derivation. Moreover a modification in his method that gives unbiased demand per period estimates is developed. Finally with the use of a data simulation experiment the bias associated with Croston's method is quantified and the conclusions are presented.

3. Forecasting in an Operations Environment

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ARIMA, Neural Networks, Exponential Smoothing, Multiple Regression and Croston's intermittent demand technique are all forecast methods. Which to use? Forecasting in an operations environment is radically different than forecasting in an academic arena. The one luxury you do not have in an operations environment is time. If you accept the assumption that no one mathematical forecast method can be universally applied to all forecast situations, you must ask yourself which method will forecast a specific time series most accurately (given a definition of accuracy) in an acceptable time frame.

In an operations environment, it is not uncommon to forecast 100,000 time series. The time frame for these series may be monthly or weekly and it is usually unlikely that one will see more than two annual cycles of historical data. This is especially true in the electronics industry. The forecast for 100,000 lowest level record, i.e., SKU/Distribution Center, are usually run overnight and reviewed by exception the next day. We do not have the time luxury of analyzing a time series and its various characteristics. An operational forecast may need to be generated in a bottom up, top down and/or middle out process in a relatively short period of time. What are the appropriate forecast methods that will meet these objectives? Accuracy combined with time efficiency are the critical elements in an operational forecast environment.

This presentation will use real life examples to describe the objectives to be supported by forecast accuracy, various forecast methods used by industry and common selection criteria on which the best forecast method is determined.

4. Improving Quality to make Production More Predictable

John Walker, Solectron Scotland Ltd., Queensferry Road, Dunfermline, Fife, U.K.

The Electronic Manufacturing Services industry is a complex dynamic organisation affected my many external stimuli which are not readily influenced by the industry. Key to the success of this business is the ability to design and maintain control of all business processes within this environment, particularly those affecting the manufacturing operation. Many organisations use Statistical Process Control (SPC) and in particular Control Charts as a means of seeking to secure process robustness particularly through process improvement. Since the processes involved in "state-of-the art" electronics manufacturing have reached yield values which correspond to noise levels. The use of SPC in isolation is no longer sufficiently responsive to process variation to ensure yield levels are maintained. This paper is based on work which has developed a new process control model based on the findings of Box and Kramer (1992). The model dispenses with the more traditional approach of control charts and uses a combination of Statistical Process Monitoring and Engineering Process Adjustment to provide a fast response system adaptable to continuous change. Key to the success of the model is its ability to forecast the expected process performance within the next time period thereby promoting action before the effects of variation are fully developed.

Session Chair:
Dr. Eddie Mackenzie, University of Strathclyde, Glasgow G1 1XH, U.K.

Unit-root Testing, Model Selection and Forecasting

Nuno Crato, Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, NJ 07102, U.S.A. **Pedro J.F. de Lima**, Department of Economics, The Johns Hopkins University, Baltimore, MD 21218, U.S.A.

In the ARIMA modeling and forecasting of time series, a major step is the determination of the stationarity or nonstationarity of the series under consideration. This is usually done by applying unit-root tests to the data. The determination of the model order and the estimation of the parameters is usually done in a second step. This way, the forecasting model selection is done within a class of models determined at the first step of the analysis.

We contrast different approaches to this unit-root testing and model selection process. They all have problems when dealing with nearly nonstationary series, such as autoregressive processes with a near unit root and long memory processes. By performing a Monte Carlo experiment, we show that improvements in forecasting accuracy can be obtained by using both stationary and nonstationary models, instead of separating the two steps described above.

2. An Examination of the Sign and Volatility Switching Arch Models under Alternative Distributional Assumptions

Dr. M. F. Omran, Dept. of Actuarial Mathematics and Statistics, Heriot-Watt University, Edinburgh EH14 4AS, U.K.

This paper relaxes the assumption of conditional normal innovations used by Fornari and Mele (1997) in modelling the asymmetric reaction of the conditional volatility to the arrival of news. We compare the performance of the Sign and Volatility-Switching ARCH model of Fornari and Mele (1997) and the GJR model of Glosten et al. (1993) after allowing for two non-normal conditional distributions, the Student's t and the Generalized Error. The results suggest that ignoring the non-normality of financial data can have a significant impact on the inferences drawn.

3. Can Intensive Search Beat Intensive Modelling?

David Browne, Kingston Business School, Kingston University, Kingston-upon-Thames.

Modelling high frequency data has been tried using function complexity, with, for example, neural networks, multiple adaptive splines (both used in electricity modelling - see for example Connor et al (94) and Harvey et al (94)) or variants of ARCH models for financial time series data. The use of k nearest neighbour techniques replaces model complexity with search complexity over the state space. The Gamma test (Aaolborg, Koncar and Jones (1997)) provides a technique based on k nearest neighbours for identifying the minimum mean square error possible using any modelling technique, provided that there is some underlying smooth data generation process. The Gamma test was originally developed to provide training targets for neural networks. Electricity demand (The Pugot Sound Data set) and Financial Times Series (FTSE) index are modelled to illustrate how the Gamma test can be modified to provide forecasts which improve on current models with the added benefit of identification of outliers. Tests are developed to identify the linear or non-linear nature of the underlying data.

4. ARMA and Structural Models: A New Method to Find the Equivalent ARMA Model of a Structural Model

Roland G. Shami, Department of Econometrics and Business Statistics, Monash University - Clayton 3168, Australia. **Ralph D. Snyder**, Monash University, Clayton 3168, Australia.

The structural models are generally equivalent to convenient representations of ARMA models. A new procedure is proposed to find the equivalent ARMA model of a structural model underlying the exponential smoothing methods in what is called the innovation form of state space forms. The proposed method exploits the properties of similar transformations in order to capture the level of the equivalent ARMA process. One by-product of this procedure is the evaluation of the relationships between the smoothing parameters of the structural models and the moving average coefficients of its equivalent ARMA process. The new method is extended to the general structural models with multi-disturbances. The benefit from applying this method over the conventional method is the easy automation on computer, hence quicker results for larger models such as the seasonal and cyclical models. This benefit is investigated on several examples.

5. On 'leave k out' Residuals in Time Series Diagnostics

Professor John Haslett, Department of Statistics, Trinity College, Dublin 2, Ireland

In most applied research in time series modelling, the term residual is defined in terms of the one-step ahead forecast error; variations include recursive residuals. Both are firmly based on the comparison of the present with the past. This is entirely natural if the underlying model is auto-regressive, for then the one-step ahead residual coincides with an estimate of the underlying iid innovations which drive the process; it is natural in other circumstances when the focus of the study is on short term forecasting. Recent research in Generalised Least Squares suggests that a more natural and more general residual for model criticism is the leave-one-out prediction residual; the Y(t) is predicted from both past and future realisations. This may be generalised to leave-k-out residuals. The paper presents aspects of this work in the context of a time series on the temperature of the earth since the mid-19th century.

Session Chair:
Professor Lars-Erik Oller, National Institute of Economic Research and Stockholm School of Economics, Stockholm, Sweden.

1. Forecasting U.S. Recessions: Some Further Results with Probit Models

Robert Lamy, Department of Finance, Esplanade Laurier Building, 18 floor, East Tower, Ottawa, Canada K1A OG5.

Arturo Estrella and Frederic S. Mishkin (1995) have assessed the predictive capacity of macroeconomic indicators in forecasting recessions. The paper, which builds from their work, evaluates the predictive content of economic indicators that were not examined by them. We also assess the performance of probit models in forecasting U.S. recessions with a horizon of one to four quarters.

The results show that an alternative index of leading indicators of U.S. economic activity has strong predictive capacity in forecasting recessions one-quarter ahead. It has much more predictive capacity than of monetary indicators, interest rates, stock prices, and the Conference Board's index of leading indicators. Furthermore, the predictive capacity of the alternative leading indicator is strongly enhanced when it is used in combination with other financial indicators. The probit models perform generally well in predicting U.S. recessions. For example, the probit model two-quarters ahead was the most accurate in predicting past recessions. Furthermore, and more importantly, the probit models two- and three-quarters ahead give (in-sample) warning signals for the last five recessions and (out-of-sample) warning signals for the 1981-1982 and 1990-1991 recessions. Lastly, the four models never produced a false signal of a recession.

2. A New Approach to the Evaluation and Selection of Leading Indicators

Andreas Gottschling, Deutsche Bank Research, 60325 Frankfurt am Main, Germany.
Thomas Trimbur, Deutsche Bank Research, 60325 Frankfurt am Main, Germany.

Leading indicators represent typical constructs of applied macroeconomic forecasting. While frequently considered pivotal in policy decisions, they are commonly of an ad hoc nature and rarely possess consistent and well-defined statistical foundations. In this paper we illustrate the potential pitfalls of determining a leading indicator by OLS (choosing a specific lag of a particular exogenous variable). We provide an alternative approach based on the notion that the most important feature of a leading indicator is the correct anticipation of the turning points of the time series of interest. We derive a transformation which orders the data according to its turning point significance and base an error weighting scheme on this measure. We then use our framework to analyze several examples of published leading indicators for US and German macroeconomic time series.

3. Turning Points Detection and Forecasting Using Unobserved Components Models with Qualitative Leading Indicators.

Antonio Garcia-Ferrer, Depto. de Analisis Economico: Economia Cuantitativa, Universidad Autonoma de Madrid, Spain. **Marcos Bujosa**, Depto. de Analisis Economico: Economia Cuantitativa, Universidad Autonoma de Madrid.. Spain.

An alternative approach that stresses the importance of timing in forecasting turning points is proposed here. In this paper, a turning point signal is considered as a two-stage decision process: a statement that a turning point is likely to occur (anticipation of the recession), and a statement of when it will occur (confirmation of the recession). To address this strategy this paper takes on previous works by Garcia-Ferrer et al. (1994) and Garcia-Ferrer and Queralt (1997) based on a class of univariate unobserved component models using time variable parameters (TVP) developed by Young (1994). In particular, they use the derivative of the unobserved trend component as a device for qualitative anticipation of peaks and troughs, as well as providing a simple method for improving quantitative point forecasts in the vicinity of turning points that uses the information embedded in the trend derivative forecasts. This paper shares the same methodological approach as the above cited references but enlarges their results by allowing the possibility of reducing the univariate forecast risks by using qualitative survey data leading indicators. We show that by finding a high coherence between its low frequency component and the one corresponding to the economic variable of interest we can use this non-linear relationship to obtain improved forecasts in the presence of turning points. Empirical results are obtained for the case of the monthly Spanish Industrial Production Index using recent data.

4. Predicting Turning Points of Business Cycles by Statistical Surveillance

Eva Andersson, Department of Statistics, Göteborg University, SE 405 30 Göteborg, Sweden.

The aim of this paper is prediction of turning-points in the business cycle by surveillance of a leading indicator. Observations are gathered and at each additional observation there has to be a decision of whether the evidence is enough to conclude that a turning-point has occurred. An alarm function and decision rule are used to conclude if the time series has reached a turning-point. Earlier research on robust regression with a monotonic restriction is used. The alarm function is developed to minimise both the risk of a false alarm and the time from the real-turning point to the time of alarm. No assumption is made about any functional relationship between Y (business indicator) and L (leading indicator). The only restriction is that the L series has its turning-points before the Y series.

The time series are measured monthly and seasonally dependent. Seasonal adjustment methods, suitable for a surveillance situation, are discussed.

5. Does Spanish Quarterly National Account Incorporate Useful Information of Indicators?

Gema de Cabo Serrano, Facultad de Ciencias Economicas y Empresariales, Universidad Complutense de Madrid, Campus de Somosaguas, 28223 Madrid, Spain.

This paper presents a study of the limitations of available indicators for building Spanish Quarterly National Account (QNA) and of their effects on estimated QNA series. It is usually assumed that indicators exist for building QNA series, but the consequences of limited availability and/or incomplete covering of indicators on the estimated QNA series are not analyzed. In this work it is shown that for Supply and some of Demand variables there are no indicators in all or part of the sample, and that available indicators are of variable quality with respect to coverage and reliability, even between different revisions. We also inform potential users on the negative effects that the use of series with these features may cause in empirical applications and in forecasting and monitoring operations.

Session Chair:
Roy Batchelor, City University Business School, London

1. Do Extreme Falls Help Forecasting Stock Returns? Evidence from World Markets

Erdem Basci, Department of Economics, Bilkent University, 06533 Bilkent, Ankara, Turkey.
Sidika Basci, Department of Economics, Bilkent University, 06533 Bilkent, Ankara, Turkey.
Department of Economics **Gulnur Muradoglu**, Department of Management, Bilkent University, 06533 Bilkent, Ankara, Turkey.

This paper explores the performance of a trading strategy based on a non-linear time series model that captures the effects of extreme falls in stock returns. The model helps in improving forecasts of mean returns and also reduces, to some extent, the GARCH effects in the residuals of Istanbul Stock Exchange weekly returns. Two possible explanations are: (i) the empirical regularity is spurious and is a result of data mining, (ii) there is an underlying behavioural model to justify the regularity. In order to evaluate the two alternative explanations, we resort to data from world stock markets. We apply the same trading strategy to the weekly returns from a number of stock markets of the world, including emerging and developed ones. We report the forecasting ability of the model, and the success of the corresponding trading strategy for these stock markets.

2. Auditor Conservatism and Analysts' Fourth Quarter Earnings Forecasts

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Ching-Lih Jan, The City University of New York, New York, NY 10010, U.S.A.
LeeSeok Hwang, The City University of New York, New York, NY 10010, U.S.A.

We argue that accounting conservatism makes earnings forecasting difficult by introducing transitory components in reported earnings. These transitory components are likely to be disproportionately represented in firms reporting losses. We show that analysts' mean forecast errors and absolute forecast errors for loss firms are substantially greater than those for profit firms in every single quarter, regardless of the forecast horizon. We argue that auditors' legal liability incentives make it likely that fourth quarter earnings are more conservative than interim quarter earnings. Forecast errors are always higher for loss firms in the fourth quarter compared to earlier quarters. Using special items to proxy for transitory components induced by conservatism, we document similar results for firms reporting special items, partitioned by the sign of the special items. Our results are consistent with auditor conservatism affecting fourth quarter earnings differentially, which causes analysts' earnings forecasts to be poorest for the fourth quarter.

3. A Vector Error Correction Approach to International Short Term Interest Rates

Guy Ta, Associate Director, Institute for International Studies and School of Finance & Economics, University of Technology, Lindfield 2070, Sydney, Australia

This paper investigates the transmission of short term interest rate fluctuations among major currencies in Asia Pacific and Western Hemisphere financial centres using a vector error correction model. The formulation of a vector error correction model includes short term interest rates of these major currencies in different locations and financial centres. The methodology of Johansen is used to find cointegrating space between major currencies interest rate variables. Variance decompositions are computed for the vector error correction model of the entire system to find the impact of one set of short term interest rates on another between centres. The basic objectives of the paper are thus, to verify the links between interest rates of major currencies and, to ascertain the transmission process of short term interest rates between currencies and locations.

4. Forecasting Exchange Rates and Interest Rates with a BVAR Time-Varying Parameters Model

Professor Nicholas Sarantis, Department of Economics, London Guildhall University, London EC2M 6SQ, UK..

Yonghao Pu, Bank of China International.

In this paper we use a Bayesian vector autoregressive model with time-varying parameters (BVAR-TVP) to examine the predictability of exchange rates, short term and long term interest rates, and stock returns in four large industrial countries. This modelling framework introduces complex nonlinearities in the moments of all variables, and addresses the problems of parameter instability, simultaneity, information structure, and learning. The BVAR-TVP model displays remarkable out-of-sample forecasting performance and dominates the random walk model. One-month-ahead forecasts track accurately the direction of change in all variables throughout our prediction period. The model's exceptional out-of-sample forecasting performance is due primarily to the time variation of coefficients, and secondly to interdependences across countries and financial markets. We show that international investors could have made statistically large excess profits in rate predictions, even after allowing for unrealistically high transaction costs and the turbulence in the currency markets in the aftermath of the 1992 ERM crisis.

5. Statistical Learning in an Emerging Stock Market

Celal Aksu, Koc University, 80860 Istinye, Istanbul, Turkey and **Vedat Akgira,** Bogzici University, 80815 Bebek, Istanbul, Turkey

As an emerging stock market develops, its institutional and transactional structure is naturally expected to become more and more similar to that of a developed market. However, it needs to be investigated how the stochastic structure of prices in a developing market changes over time. As the transaction volume and frequency increases, it may be expected to observe manifestations of probability limit theorems as they regard the distributional and time series properties of price changes. This study investigates the stochastic evolution of prices in the Istanbul Stock Exchange (ISE) during the 10-year period since its establishment in 1986. Empirical findings show very clearly that the central limit theorem and its extensions are indeed at work. Empirical prices processes have been converging in structure to the normal process, at least after certain suitable adjustments in the moments. This finding has important implications not only for investment managers but also for forecasting and general econometric models applied on ISE prices.

Session Chair:
Dr. Chris Chatfield, Department of Mathematical Sciences, University of Bath, Bath BA2 7AY, U.K.

1. Calculating Prediction Intervals

Dr Chris Chatfield, Department of Mathematical Sciences, University of Bath, Bath BA2 7AY, U.K

This talk reviews the importance of interval forecasts and introduces the various approaches to calculating them. The latter include the use of theoretical formula calculated conditional on a best-fit model, various approximate formulae (which are not recommended) and empirically-based and resampling methods.

Some general comments are made as to why prediction intervals tend to be too narrow in practice. Ways of overcoming uncertainty about the model are discussed including using a mixture of models and using methods which are designed to be robust to changes in the underlying model.

2. Prediction Intervals for ARIMA Models

Anne B. Koehler, Department of Decision Sciences and Information Systems, Miami University, Oxford, OH 45056, USA.
J. Keith Ord, Department of Management Science and Information Systems, Pennsylvania State University, 303 Beam, University Park, PA 16802, USA
Ralph D. Snyder, Department of Econometrics and Business Statistics, Monash University, Clayton, Victoria, 3168, Australia

The problem of constructing prediction intervals for linear time series (ARIMA) models is examined. The aim is to find prediction intervals which incorporate an allowance for sampling error associated owith parameter estimates. The effect of constraints on parameters arising from stationarity and invertibility conditions is also incorporated. Two new methods, based to varying degrees on first-order Taylor approximations, are proposed. These are compared in a simulation study to two existing methods: a heuristic approach and the `plug-in' method whereby parameter values are set equal to their maximum likelihood estimates.

3. Nonparametric Conditional Predictive Regions for Stochastic Processes

Jan G. De Gooijer, Department of Economic Statistics, University of Amsterdam, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands.

Several nonparametric predictors based on the Nadarya-Watson kernel regression estimator have been proposed in the literature. They include the conditional mean, the conditional median, and the conditional mode. In this paper, we consider three types of prediction regions for these predictors - the conditional percentile interval (CPI), the shortest conditional modal interval (SCMI), and the maximum conditional density region (MCDR). Further, we introduce a data-driven method for the choice of the optimal bandwidth. This method is based on the minimization of a local cross-validation criterion given three different types of predictors. When the underlying conditional distribution is skewed or multi-modal, we show that the MCDR is much shorter in length than the CPI or SCMI irrespective of the type of predictor used. This point is illustrated using both simulated and real data sets.

Session Chair:
J. Scott Armstrong, University of Pennsylvania, Philadelphia, PA 19104, U.S.A.

Forecasting Market Share: Under What Conditions are Price Elasticities Constant?

Roderick J. Brodie, Department of Marketing, University of Auckland, Auckland, New Zealand
Peter J. Danaher, Department of Marketing, University of Auckland, Auckland, New Zealand
Celeste Anderton, Department of Marketing, University of Auckland, Auckland, New Zealand

An important aspect of developing accurate forecasts of market share is to understand the nature of the price responsiveness of competing products and brands. Of particular interest is under what market conditions is the price elasticity constant. In the last three decades there has been considerable research about the nature of the price responsiveness of branded products. For example reviews by Blattberg and Neslin (1990), Gijsbrechts (1993), Hanssens, Parsons and Schultz (1990) and Tellis (1988) found a large number of econometric and marketing studies exhibiting considerable variation in price elasticities. The meta-analysis by Tellis (1988) looked at 42 studies that were published between 1961 and 1985. The elasticities ranged from -10 to 2 with the majority having values between -4 and 0, with a mean of -2.5 and standard deviation of 1.7. With the widespread use of optical scanners in supermarkets more recent research on price elasticities has focused on just frequently purchased packaged goods (Bemmaor and Mouchoux 1991; Bolton 1989; George et al 1996; Hamilton et al 1997; Hoch et al 1995; Raju 1992). In this paper we extend this research by examining price elasticities for supermarket packaged goods for 112 brands across 27 categories. By extending this research to many more categories and brands we produce generalisations about the impact of various market factors on price elasticities. The market factors include the nature of the product category, the level and type of competition within the product category and the size of market share.

2. Principles of Market Share Forecasting

Roderick J. Brodie, Department of Marketing, University of Auckland, Auckland, New Zealand
Peter Danaher, Department of Marketing, University of Auckland, Auckland, New Zealand
V. Kumar, University of Houston

Ten principles are derived from theoretical and empirical evidence to guide the forecasting of market share. The principles relate to issues to do with the explanatory power and precision of the models, estimation techniques, constrained versus unconstrained parameter estimation, aggregation level of the data, variability of the data, measurement errors in the predictor variables, sample size, forecasting competitor's actions, forecasting horizons and brand versus category level forecasts. While strong theoretical and empirical evidence is available to support a few of the principles, the evidence to support the remaining principles was not as strong thus highlighting the need for further research.

3. Forecasting Sales With Cross-National Diffusion Models

V. Kumar, University of Houston
Jaishankar Ganesh, University of Central Florida,

Managers always face a major challenge when generating sales forecasts for new products or recently introduced products. This is due to the lack of sufficient data points for generating reliable forecasts. Further, if sales forecasts have to be developed for countries (lag countries) other the country (lead country) in which the concerned product has been introduced, it is all the more difficult. While forecasting based on analogies have been used in the past, in this study we present a methodology that help managers develop forecasts for relatively new products in multiple (lag) countries when either little or no data are available for those countries. This is made possible with the knowledge of product sales in the lead country, and a host of other factors for both the lead and the lag countries. In other words, our methodology proposes that the diffusion process of a product in the lag countries may depend on the diffusion process of the same product in the lead country depending on various factors. The value of the proposed methodolgy for forecasting sales is illustrated using the case of both durables and technology.

4. Forecasting Decisions with Role Playing versus Game Theory: It's No Contest

J. Scott Armstrong, University of Pennsylvania, Philadelphia, PA 19104, U.S.A.

Role-playing and game theory can be used to forecast decisions and the outcomes of decisions. The basic design principle for game theory and role-playing is similar: t hey should match the actual situation in key respects. The conditions are also similar: these methods are expected to be most effective for predictions in conditions involving large changes and conflicts among a small number of parties. Role-playing differs in that it puts subjects into the same frame of mind as the decision-makers and it allows for a realistic simulation of the interactions among the conflicting groups. Unlike game theory, it makes few assumptions about motivations and rules. Role-playing was shown to be effective in matching results from five of six classic experiments in psychology. It was more accurate than judgment in predicting the outcomes of two other experiments. Five studies compared the accuracy of role-playing with alternate procedures, typically expert opinions; role-playing was more accurate for predicting the decisions in each study, with 56% correct predictions on average versus 16%. Finally, three studies concluded that role-playing was more accurate in predicting the outcomes of decisions. Now, who can make a case for game theory? I found no tests of the predictive validity of game theory.

5. Energy Consumption, Survey Data and the Prediction of Industrial Production in Italy: A Comparison and Combination of Different Models.

Domenico J. Marchetti, Research Department, Banca d'Italia, Via Nazionale 91, 00814 Rome, Italy.
Guiseppe Parigi, Research Department, Banca d'Italia, Via Nazionale 91, 00814 Rome, Italy.

We investigate the prediction of Italian industrial production. We first specify a model based on electricity consumption, which provides a satisfactory forecasting performance. We show that the cubic trend in such a model captures mostly the evolution over time of the electricity coefficient, which can be well approximated by a smooth transition model a là Terasvirta (1994 and 1996), with no gains in predictive power, though. We also analyze the performance of models based on data of different business surveys. According to standard statistics of forecasting accuracy, the linear energy-based model cannot be outperformed by any other single model, neither by a combination of forecasts. However, a more comprehensive set of evaluation criteria sheds light on the advantages of using combined forecasts. Overall, the best forecasting performance is achieved by estimating a combined model which includes among regressors both energy consumption and survey data.

Session Chair:
Dr. Robert Raeside, Napier University, Edinburgh

1. Models for British Inflation and the Kalman Filter

Zainudin bin Arsad, Department of Statistics, Heriot-Watt University, Edinburgh EH14 4AS.

British inflation was originally modelled as part of the Wilkie Investment Model. The model which was based on annual data of the retail price index (RPI) stated that the difference in the logarithms of the RPI each year could be modelled as a first order autoregressive series AR(1). A model which can be analysed using Kalman Filter techniques is proposed and investigated. The technique allows the local mean reversionary level of inflation to be modelled simultaneously. Comparisons of results between AR(1) and Kalman Filter are made. Sensitivity analysis on parameters in Kalman Filter are investigated. Finally forecasts of future inflation are carried out based on models best suited to financial interpretations.

2. Forecasting Inflation in the US Healthcare Sector: Possible Use of the Phillips Curve.

J. P. Scott MSc, MD, Critical Care Medicine, St Mary's Hospital, Rochester, MN 55905, U.S.A.

The rate of inflation within the healthcare sector of many economies has created serious budgetary difficulties in many industrialised nations, including the US, within the popular Medicare and Medicaid programs. The determinants of such inflation have been poorly understood, with profit taking and novel technology widely cited but infrequently substantiated.

Using the Bureau of Labor Statistics database for unemployment rates by industry for both healthcare diagnostic and healthcare therapeutics professionals categories of workers as well as the US consumer price index over the period 1983-96, it is possible to plot the rate of inflation against the unemployment rate in an unmodified Phillips curve. During this time aggregate unemployment for the US healthcare industry varied over the range 0.8-1.7% (median 1.2%) and healthcare sector inflation over the range 4.5 - 9% (median 6.6%). The plotted data are consistent with the general shape and position of the original Phillips curve. This result is supportive of the hypothesis that relatively high US healthcare sector inflation can be predicted from the very low unemployment rate within the same sector of the US economy.

3. A Simple Methodology for Predicting the Need for Additional Teachers in the United States

William J. Hussar, United States Department of Education, Washington, D.C. 20208-5654, U.S.A.

There should be a need for many additional teachers in the United States over the next ten years as large numbers of teachers are expected to retire and enrolments are expected to increase. We examine this need using an algebraic model with no econometric analysis. We use age-specific continuation rates of teachers from several different School and Staffing Surveys (SASS) of the National Center for Education Statistics to predict how many teachers will continue teaching from one year to another. The demand for teachers is taken as exogenous and several scenarios are examined. We assume that the supply will meet the demand and that the age distribution of new teachers will be the same as the 1993-94 SASS distribution. The model predicts that over 2 million additional teachers will be needed by 2008-09. Most of these additional teachers will be needed to replace those leaving the profession.

4. Forecasting Asymmetric Real Estate Cycles

Max Stevenson, School of Finance and Economics, University of Technology, Sydney, Australia

This paper determines whether asymmetry is present in the real estate cycle, along with the effectiveness of both linear and non-linear models to generate and to forecast the type of cyclical behaviour assessed. Using the monthly Richard Ellis UK real estate series over 1979-1997, real estate dynamics and asymmetry in the UK office, retail, industrial and the aggregate series were examined. Evidence of asymmetry was found in the UK retail and industrial series, to a lesser degree in the aggregate series but not in the office series. To accommodate this real estate cycle asymmetry, non-linear autoregressive models were estimated. While the non-linear models provided a marginally better fit to the data, the linear alternative models were found to be as effective as the non-linear models for forecasting purposes.

5. Forecasting the Turkish Private Sector Manufacturing: Industry Price Index

Kivilcim Metin, Bilkent University, Department of Economics, Bilkent-Ankara, Turkey.
Hakan Kara, The Central Bank of Turkey, Ulus-Ankara, Turkey.

This paper forecasts the Turkish private manufacturing sector price index for the period 1982(1)-1996(5). An information set includes macroeconomic variables: private manufacturing sector price index, the public sector wholesale price index, Turkish lira dollar exchange rate, broad money, and the private manufacturing sector production index. During the sample period the Turkish economy experienced the 1994 financial crisis and the price series and exchange rate co-breaked. Before modelling the time series, properties of the series are examined. Co-integration and identification are tested and accepted. For the forecasting exercise, firstly, two VAR models are introduced: VAR in levels with intercept correction is applied and VAR in differences where the data is mapped to I(0) space. Secondly, a single ECM equation is specified using the variables of interest is mapped to I(0) space and the ECM's are obtained from cointegration analysis. Forecast parameter constancy tests are used to compare the relative forecast performances of the VAR models and the ECM model. ECM outperforms and predicts the 1994 crisis perfectly well.

Session Chair:
Michael Lawrence, University of New South Wales, Sydney 2052, Australia.

1. The Asymmetry of Judgemental Confidence Intervals

Marcus O'Connor, School of Information Systems, University of New South Wales, Sydney 2052, Australia. **William Remus**, University of Hawaii. **Kenneth Griggs**, MITRE.

In forecasting a time series, there is some expectation of the likely distribution of the future actual value, often expressed as a confidence interval. Whilst the accuracy (calibration) of these intervals has dominated most studies to date, this paper is concerned with other possible characteristics of the intervals. This paper reports a study in which the prevalence and determinants of the symmetry of judgemental confidence intervals in time series forecasting was examined. Most prior work has assumed that this distribution is symmetrically placed around the forecast. However, this study shows that people are extremely disposed towards estimating asymmetric confidence intervals where the forecast is not the midpoint of the estimated interval. Many of these intervals are grossly asymmetric. Results indicate that the placement of the forecast in relation to the last actual value is a major determinant in the direction and size of the asymmetry.

2. Improving the Integration of Judgment with Statistical Forecasts when Series are Subject to the Effects of Special Events

Paul Goodwin, Dept. of Mathematical Sciences, University of the West of England, Bristol, BS16 1QY, U.K.

When a stable time series pattern is subject to discontinuities caused by special events the integration of judgmental and statistical methods would appear to be appropriate. The statistical method should be superior at extrapolating the regular time series pattern, while the judgmental forecaster can anticipate the effects of the special events. But how is this integration best achieved? This paper uses empirical data to compare and evaluate a number of approaches ranging from 'voluntary integration', where the judge is simply informed of the statistical forecast, to 'imposed' integration methods. In the latter approach, statistical methods are used to correct the judgmental forecasts or statistical forecasts are mechanically combined with judgment. A number of techniques for improving both 'voluntary' and 'imposed' integration methods are also evaluated.

3. The Delphi Technique as a Forecasting Tool

Gene Rowe, Dept. of Psychology, University of Surrey, Guildford, Surrey GU2 5XH, U.K.
George Wright, Graduate Business School, Strathclyde University, Glasgow G4 0QU, U.K.

Delphi has been described as a technique of the 'last resort' for use in situations where statistical and modelling procedures are difficult or impossible. It is one of a variety of ways of eliciting and combining expert judgements, and involves controlled information exchange between anonymous panellists over a number of 'rounds', with the judgement or forecast determined by averaging panellist estimates on the final round. Recent research has attempted to assess Delphi's effectiveness by comparing the accuracy of judgements from groups using this technique to the accuracy obtained from other procedures - such as from interacting groups. Research results have been summarised here in terms of a number of principles concerning how to conduct Delphi and when it may be appropriate to use the technique. Suggestions about the directions of future research are made.

4. An Example of the Difficulty of Improving Financial Forecasting

Michael Lawrence, University of New South Wales, Sydney 2052, Australia.
William Sim, University of New South Wales, Sydney 2052, Australia.

This paper explores, by means of a laboratory study, the ability of a financial forecasting system of known theoretical merit to improve decision making for currency and interest rate forecasting where typically the task is to forecast direction of movement and to assess confidence. The study finds that while the decision making of subjects using the financial forecasting system is improved in comparison with a control, most of the potential value of the system is lost. In addition, no improvement in confidence assessment is observed. Both the forecasting system users and the control group exhibit very poor calibration with confidence assessments uncorrelated with accuracy.

Session Chair:
Professor Ron Masson, Napier University, Edinburgh

Modelling and Prediction of Software Maintenance

David Morrison, 600 Lathes, Leeds, U.K. and **Robert Raeside**, Department of Mathematics, Napier University, Edinburgh

Software maintenance costs are absorbing an increasingly large proportion of total software engineering and management costs. As a consequence of this there is a need to recognise their magnitude at the on set of a software development project. Methods of modelling and predicting this cost are reviewed in this paper. Software lifecycle models fall into three principal categories; static single variable (SSV), static multivariable (SMV) and dynamic multi-variable (DMV) and the results of a small survey of 22 software projects conducted to determine the usefulness of the models is reported on. Of these SSV models such as COCOMO are the easiest to use and are the only category which explicitly addresses maintenance. In an attempt to incorporate maintenance into a wider class of models and to develop a suitable model of future costs a survey of 22 software projects has been conducted to identify product and process factors which affect maintenance. Initial indications are that their are factors which exhibit strong correlation with the level of maintenance activity and these findings are reported on this study.

Innovation Forecasting using Functional/Capabilities Analyses

Robert J. Watts, U.S. Army Tank-automotive and Armaments Command
Alan Porter, Ph.D., Georgia Tech Technology Policy and Assessment Center

To forecast a next generation technology requires understanding of numerous interrelated innovation processes, one is technology substitution. Technology substitution can be evaluated using a generic approach defined by the authors for analysis of open-source literature abstract databases. This paper focuses the defined process on the function/capability of "fuel efficiency" as applied to databases with records spanning the technology lifecycle from basic and applied research to product development. This "fuel efficiency" functional analysis serves dual purposes: to provide strategic direction for the Army's National Automotive Center (NAC) Research and Development (R&D) initiatives, while refining the analysis approach for automation in the Technology Opportunities Analysis System (TOAS). The TOA concept originates from research conducted by the Georgia Tech Technology Policy and Assessment Center (TPAC). The Tank-automotive and Armaments Command (TACOM) performs technology assessments by applying TOAS on critical technologies and operational requirements. TOAS embodies a software system that aids the user in literature research. TOAS, not a search but an intelligence engine, analyzes fixed field records from any search engine to synopsize that information and create related groupings of record components or complete records. This paper describes the TOAS and its application on literature abstracts to forecast innovations related to the function of "fuel efficiency."

3. Logistic Curve of N-th Order and its Application to Forecasting

Professor Mikhail Postan, Odessa State Maritime University, Odessa 270029, Ukraine.

Among different generalizations of usual logistic curve [1,2] the so-called logistic curve of N-th order that was introduced in work [2] plays a special role. Its equation is

$$X(t) = X(t) + e(t)$$

where

$$x(t) = L[1 + \sum_{n=1}^{N} b_n \exp(-g_n t)]^{-1}$$

L is saturation level; b_n, g_n are positive coefficients, $g_1 < g_2 < ... < g_N$; e(t) is the error term. The important property of this curve is the existence of several points of inflection. It can be proven that curve (1) may possess 1, 2, ... , or 2N-1 such points if

$$g_k > \left(2 + \sqrt{3}\right) g_{k-1} \qquad k = 2, 3, \quad N$$

and has only one point of inflection if $g_N \leq 2g_1$

The problem of parameter (L , b_n , g_n) estimation on the basis of statistical data for a sample period is discussed. To get unbiased and consistent estimators it is sufficient to apply a weighted least square procedure.

The possible applications of curve (1) are considered for forecasting and compound growth modelling

4. Forecasting the Benefits of Manufacturing Automation

Prof. Mo Onsi, Syracuse University, Syracuse, NY 13244, U.S.A.

The economic benefits of manufacturing automation at the micro level are analyzed based on an empirical study of large-size divisions of U.S. companies. The quantitative and qualitative measures of benefits due to implementing new technologies are identified. The responses of engineering and technology managers are analyzed. Different models are used to forecast the accuracy and ranking of various benefits. While there is a strong correlation between the quantifiable, financially focused benefits and economic performance, the qualitative benefits have demonstrated varying impacts. The interrelationship between both types of benefits is positive.

Manufacturing automation at the firm's level, in a global economy, is pursued strategically with long-term objectives. Forecasting the economics of technology change is significant for corporate resource allocation.

Session Chair:
Dr. Neil Hay, Napier University, Edinburgh

Robust Testing for Fractional Integration using the Bootstrap

Michael K. Andersson, Department of Economic Statistics, Stockholm School of Economics, Stockholm, Sweden. **Mikael P. Gredenhoff**

Asymptotic tests for fractional integration are usually badly sized in small samples, even for normally distributed processes. Furthermore, tests that are well-sized under normality may be severely distorted by non-normalities and ARCH errors. This paper demonstrates how the bootstrap can be implemented to correct for such size distortions. It is shown that a well-designed bootstrap test based on the MRR and GPH tests is exact, and a procedure based on the REG test is nearly exact.

2. Bayesian Dynamic Factor Models for Forecasting and Portfolio Allocation with Financial Time Series

Professor Mike West, Institute of Statistics & Decision Sciences, Duke University, Durham, NC 27708-0251, U.S.A. **Omar Aguilar**, ISDS, Duke University, Durham, NC 27708-0251, U.S.A.

We discuss the development of dynamic factor models for multivariate financial time series, and the incorporation of stochastic volatility components for latent factor processes. Bayesian inference and computation is developed and explored in a study of the dynamic factor structure of daily spot exchange rates for a selection of international currencies. The models are direct generalisations of univariate stochastic volatility models, and represent specific varieties of models recently discussed in the growing multivariate stochastic volatility literature. We also discuss connections and comparisons with the much simpler method of dynamic variance discounting that, for over a decade, has been a standard approach in applied financial econometrics in the Bayesian forecasting world. We review empirical findings in applying these models to the exchange rate series, including aspects of model performance in dynamic portfolio allocation. We conclude with comments on the potential practical utility of structured factor models and future potential developments and model extensions.

3. Empirical Bayesian Methods For Combining Forecasts

K. R. Kadiyala, Department of Management, Purdue University, West Lafayette, IN 47906, U.S.A.
K. Tomak, Department of Management, Purdue University, West Lafayette, IN 47906, U.S.A.

Forecast combination is an efficient tool if the models that generated the forecasts are known a priori. A simple average was suggested by various authors to be the most viable method in combining forecasts based only on the actual forecast values. In this paper, we compare various methods for combining several independent, possibly biased, forecasts. When the weights are used for individual forecasts, coefficients are known to present stability problems. For the Blue Chip Economic Indicators dataset that we have employed, as the forecast points increase in number, the coefficients settle on a stable path for a Kalman filter based method that we have employed. We will compare various Bayes procedures by calculating mean square error of prediction and mean absolute error of prediction. We use forecasts from sources like the Blue Chip Economists Survey and actual macroeconomic data such as real GNP, CPI, GNP deflator and unemployment reported by different US government agencies, the Bureau of Economic Analysis and Bureau of Labor Statistics in evaluating the forecast methods that are employed.

4. Seasonal Models

Tommaso Proietti, Dipartimento di Scienze Statistiche, 06100 Perugia, Italy

In this paper we propose several equivalent representations for a seasonal component that encompass all the models of stochastic seasonality proposed in the literature (dummy, trigonometric, Harrison & Stevens); this enables us to compare their time and frequency domain properties in a unified framework. In particular, we provide general algorithms for computation of the autocorrelation function and the spectral density of the seasonal sums, which allows the issue concerning the smoothness of a particular representation to be tackled. By this argument we are lead to conclude that the trigonometric seasonal model, due to the "excess" power attributed at frequency p, is outperformed in terms of smoothness by other seasonal models, including the Harrison & Stevens' model.

Along with a more thorough understanding of the time series properties of each model, in this set-up we have investigated how further flexibility in modelling a seasonal component can be achieved by letting the data speak about the parameters responsible for those properties. Application of this principle to a set of quarterly series has produced empirical evidence providing stronger support for the Harrison & Stevens' model than for the trigonometric model.

An empirical comparison of four seasonal models in terms of goodness of fit, post-sample predictive performance and in terms of the properties of the extracted seasonal pattern, with respect to a set of 23 US industrial production series, concludes the paper.

5. Noise Detection in Interpolation of Second-Order Stationary Sequences

A. R. Soltani, Department of Statistics, College of Science, Shiraz University, Shiraz, Iran

Session Chair:
Professor Derek Bunn, London Business School, London NW1 4SA.

Multivariate Long Memory Modelling of Temperature Data and Tree Rings with Implications for Economic Policy.

Richard T Baillie, *Department of Economics, Michigan State University, East Lansing, MI 48824, USA*
Sangkuck Chung, *Department of Economics, Michigan State University, East Lansing, MI 48824, USA*

Annual temperature series since 1854 and tree ring series from 3,000BC are found to be remarkably well modelled by long memory, ARFIMA processes. We discuss the properties of an approximate MLE of a trend stationary, fractional white noise model and provide detailed simulation evidence. As noted by Seater (1993) the relatively short temperature series appear to have a significant and positive trend term, while tree ring series, observed over much longer time spans, do *not* have significant time trends, are also extremely well represented by two parameter ARFIMA models. We also estimate multivariate ARFIMA models which provide more efficient estimates of the long memory parameter. Raw tree ring data exhibit time dependent heteroskedasticity and are modelled by ARFIMA-GARCH models, while the adjusted tree ring data often used by dendrochronologists has no ARCH effects and is sometimes less correlated with observed temperature data. However, shorter realisations of about 100 years of tree ring data also appear to have positive time trends. The long cycles inherent in the temperature and tree ring series prevent definitive conclusions from samples of 100 years or less, on the presence of a time trend. Hence the temperature data does not offer any real evidence of global warming.

Session Chair:
P.Geoffrey Allen, University of Massachusetts, Amherst, MA 01003, U.S.A.

1. Forecasting Free and Official Market Rates in an Emerging Market: The Turkish Case

Can Simga-Mugan, Bilkent University, Department of Management, Ankara, Turkey 06533.
Ayse Yüce, Bilkent University, Department of Management, Ankara, Turkey.

In this paper, we examine the long-run dynamics of the official and free market exchange rates (US dollar and Deutschmark) in an emerging market, Turkey, through cointegration analysis and formulate error correction models to forecast one of the cointegrated series by using the historical values of the other.

All series are found to be nonstationary and integrated of order 1,1[1]. The results of the cointegration tests indicate that the official rates and the free rates of the two currencies are not cointegrated with each other. Therefore, long-run equilibrium relationships do not exist between these series. On the other hand, free and official rates of the same currency are cointegrated indicating long-run equilibrium. Error correction models are estimated with which both official and free rates are explained as functions of past values of the other. We use these models to check their forecasting abilities and compare the results with those of the random walk models. Our models outperform the random walk models in forecasting and predicting the future values of currencies.

2. Maximum Likelihood Estimation of the Multivariate Fractional Cointegrating Model

Johan Lyhagen, Department of Economic Statistics Stockholm School of Economics, S-113 83 Stockholm, Sweden

One economic justification for a cointegrating system is that one may model long run relationships. Departures are often assumed to be integrated of order zero but this is too restrictive. It is sufficient that these are integrated of an order less than one, i.e. they may be fractionally integrated. A fractionally cointegrated system is developed. Further, estimation and testing are discussed.

3. The Equivalence of Graphical Iteration and the Growth Model of GNP

Vesna Jablanovic, Faculty of Agriculture, 11081 Belgrade, Yugoslavia.

The basic objectives of this paper are: first, to establish the logistic model of the gross national product (GNP) growth, and second, to show how the iteration process for the logistic equation is equivalent to the iteration of this growth model. By some slight modification the standard rate of growth of real GNP will lead to chaotic behaviour of the endogenous variable. Within the chaotic region the time path of real GNP is highly sensitive to variation in parameter values or initial values.

Okun's law is adopted. Okun (1962) established the relationship between unemployment and the loss in GNP. Namely, one percentage point more in unemployment means 3.2 percent less in GNP.

4. Empirical Likelihood and Equilibrium

Dr. Carlos Sanchez-Gonzalez, Universidad de Granada, Granada, Spain.
Dr. Pilar Fernandez-Sanchez, Universidad de Granada, Granada, Spain.

This paper focuses on applications of Empirical Likelihood in approaching equilibrium solutions by utility maximising consumers. We try to find the most likely vector prices that maximise the probability to get empirical given quantity outcomes for consumers' income. We use a multinomial distribution on prices and derive necessary conditions to be satisfied by prices in order to get observed quantities as the result of a utility maximising decision problem.

5. Seasonal Unit Roots and Forecasts of Two Digit European Industrial Production

Denise R. Osborn, School of Economic Studies, University of Manchester, Manchester M13 9PL, UK. **Saeed Heravi**, Cardiff Business School, Cardiff. **Chris Birchenhall**, University of Manchester.

Monthly industrial production in important sectors of the German, French and UK economies are shown to exhibit very strong seasonality, such that typically 80% or more of the variation in monthly growth can be attributed to seasonal effects. Seasonal unit roots results imply that most of these series should be modelled using conventional first differences with the inclusion of monthly dummy variables, rather than as specifications involving other types of differencing. However, when the post-sample forecast accuracy is compared for models based on various levels of differencing, annual difference specifications often produce the most accurate forecasts at horizons of up to a year. First difference specifications appear to be most accurate at short forecast horizons for series where seasonality is particularly marked.
The study also examines the impact of updating coefficient estimates and model re-specification within the forecast period.

[Acknowledgements: This paper has evolved from work carried out on a project commissioned by Eurostat. The constructive comments of Berthold Feldmann and Bjorn Fischer of Eurostat throughout that project have influenced many aspects of this subsequent analysis.]

Session Chair:
Professor Andrew Hughes-Hallet, University of Strathclyde, Glasgow.

1. Mean Reversion and the Forecasting of Country Betas: A Note

Michael Gangemi, Robert Brooks, Robert Faff, Department of Economics and Finance, Royal Melbourne Institute of Technology, Melbourne, Victoria 3001, Australia.

Blume (1971 & 1975) found individual equity betas to have a "regression" tendency towards the grand mean of unity. His original results have been widely accepted to the extent that a literature has developed on applying Bayesian techniques to beta estimation so as to adjust for mean reversion. The more recent literature has focused on risk estimation and the applicability of asset pricing models in the international finance setting where the focus has been on the aggregate country level risk. Given the increasing popularity of country beta models an interesting but, as yet, unexplored issue is whether aggregate country betas display mean reversion tendencies similar to that found for individual company betas. The examination of this issue is the central aim of the current paper. In short, this analysis reveals strong evidence of mean reversion of country betas, similar to that documented for individual companies in the existing literature.

2. Estimating Beta

Dr. Haim Shalit, Department of Economics, Ben-Gurion University of the Negev, Beer-Sheva, Israel.
Shlomo Yitzhaki, Hebrew University of Jerusalem, Israel.

This paper presents evidence that Ordinary Least Squares estimators of beta coefficients of major firms are highly sensitive to extreme observations of market returns. This sensitivity is rooted in the inconsistency of the quadratic loss function in financial theory. By introducing considerations of risk aversion into the estimation procedure, one can overcome this lack of robustness and improve the reliability of results using alternative estimators derived from Gini measures of variability.

3. The Price-Volume Relationship on Two Caribbean Stock Exchanges: Some Estimates and Forecasts

Hyginus Leon, International Monetary Fund and University of the West Indies, St. Augustine
Shelton Nicholls, International Monetary Fund and University of the West Indies, St. Augustine

Certain financial innovations have highlighted the fragility of securities markets as valid alternatives for the effective mobilisation of investment finance in developing equity markets. Recent research suggests that developing equity markets may exhibit temporal correlation of returns and that volatility of returns is a function of trading volume. This paper uses weekly data on a vector autoregression with a bivariate-GARCH process to model the price-volume relationship on the stock exchanges in Jamaica and Trinidad and Tobago. The initial results indicate that (1) stock returns are correlated, (2) changes in volume affect the volatility of returns, and (3) volatility appears to have been greater during periods of macroeconomic instability. Some implications for forecasting returns and for the sustained mobilisation of investment finance in developing economies are discussed.

4. Steering Interest by Demographics of Inflation--OECD 1960-94

Thomas Lindh, Institute of Housing Research, Uppsala University, S-751 20 Uppsala, Sweden.
Bo Malmberg, Institute of Housing Research, Uppsala University, S-751 20 Uppsala, Sweden.

The demographic age structure influences the aggregate of individual economic decisions. Although not generally recognized this implies that inflation pressures co-ovary with variation in the age groups. We estimate the relation on annual OECD data 1960-94 in a panel of 20 countries. The coefficient patterns are consistent with the hypothesis that increases in the population of net savers dampen inflation, while especially younger retirees fan inflation as they start consuming out of accumulated pension claims. This hypothesis is consistent with standard macroeconomic analysis. Life-cycle saving behavior combined with a cumulative process of inflation suggests that there is considerable scope to improve on monetary economic policy by using demographic inflation pressure forecasts to steer loan rates of interest in order to achieve medium-term inflation stability

5. Financial Analysts' Earnings Forecast Dispersion and Intraday Stock Price Variability Around Quarterly Earnings Announcements

Gerald J. Lobo, Professor, Syracuse University School of Management and **Samuel S. Tung** Professor, University of Hong Kong School of Business

This study investigates the relation between the dispersion of financial analysts' earnings forecasts and intraday stock price variability around quarterly earnings announcements. Consistent with analytical models of stock price behaviour, the empirical results show that price variability around earnings announcements is positively related to the degree of analysts' earnings forecast dispersion. Relative to their non-announcement period levels, price variability around earnings announcements is lowest for firms ranked in the bottom third on the basis of analysts' forecast dispersion and highest for firms in the top third. The results also demonstrate that firms ranked in the top third on the basis of analysts' forecast dispersion exhibit significant increases in price variability from eight days before to five days after the earnings announcement. These results suggest that there is information about the earnings announcement that becomes available to at least a subset of investors prior to the earnings release. That the increased level of price variability continues for up to five days following the earnings announcement suggests that market participants take different amounts of time to process the information conveyed by the earnings announcements.

Session Chair:
John Adams, Napier University, Edinburgh

The Outlook for Employment by Occupation

Philip D. Adams, Centre of Policy Studies, Monash University, Clayton, Victoria 3168, Australia.
Tony Meagher, Centre of Policy Studies, Monash University, Clayton, Victoria 3168, Australia.

For training purposes, it is important that the future demand for labor of different skill types be forecast. It takes time to conduct a training course, and the skills that result are generally expected to retain their social usefulness for an extended period of time. A decision to implement a training program must be informed by a view about the future, either explicitly or implicitly.

The demand for labor depends on many factors. It depends on the macroeconomic health of the economy. It depends on the amount of capital investment and on its allocation between industries. It depends on the pace of technical change and on changes in government policy. All these factors are interconnected. In this paper, we use the MONASH model of the Australian economy, which incorporates all these factors in a formal way, to produce forecasts of the medium term prospects for labor demand by industry and occupation.

2. Forecasting Employment and Unemployment in Spain: A Comparison among Alternative Models

Silvia Relloso Pereda, Dpto. An E1lisis Econ F3mico II, Campus de Somosaguas, 28223 Madrid. Spain.

In this paper it is shown that both the disaggregation of employment into productive sectors and the study of relationships among the resulting components are relevant tools for obtaining important improvements in understanding and forecasting employment and unemployment in Spain. Towards this end, forecasting performance of a variety of univariate and transfer function models is investigated and compared with that of a multivariate model in which disaggregation and relationships are incorporated in a rather innovative way.

The study of employment disaggregated into productive sectors makes it possible: (1) to highlight the different behavior of each component, (2) to analyze the relationships among the resulting components and (3) to evaluate the different effects of each component on total employment, active population and unemployment.

A model building methodology is used which eliminates any possible confusion between stochastic tendency and seasonality, and allows for seasonality of a given series to be deterministic in some frequencies and stochastic in others.

3. **A Structural Model of Forecasting the Retail and Labor Market Development in Macro- and Micro-economic Respects when the Technical Level Increases.**

Erik A Cervén, Krokbacksv. , 680 63 Likenas, Sweden

The retail trade and labor market balance points comprising nominal price, turnover, paid salary and employment level are investigated as functions of the technical level, inflation and interest rates, consumers' budgets, payroll budgets, VAT and direct taxes, and the propensities to consume, to sell, to pay for work, and to work, which function variables are either measurable or given judgemental ratings. Numerical forecasts are obtained about perturbations of the turnovers and prices caused by market differentiation on the buyer's side and technical investment for production on the seller's side and about how these perturbations may be buffered using the other function variables. The idealized statistical distribution of items turned over in the various value categories is determined as a function of item value, technical level, inflation, and deposit interest rates with examples of empirical data corroboration. Numerical forecasts of total nominal value turned over in all value categories and the nominal value of the commonest item turned over are obtained, and, by taking into account subsistence, estimations of the consumers' margins for spending in new niches.

4. **Forecasting Employment in Southern California: A Bayesian VAR Model**

Anil Puri, Department of Economics, School of Business Administration and Economics, California State University-Fullerton, Fullerton, CA 92834, USA.
Gökçe Soydemir, Department of Economics and Finance, College of Business Administration, University of Texas-Pan American, Edinburg, TX 78539, USA.

A Bayesian vector autoregression (BVAR) model is developed to forecast the unemployment figures belonging to the major industries of Southern California Economy. The model includes both national and state variables. The Bayesian prior is selected on the basis of the accuracy of the out-of-sample forecasts. The results show that a loose prior generally produces more accurate forecasts than a tight prior does. The BVAR model used in this study predicts the direction of change better than VAR models in general.

Session Chair:
Dr. Moira Watson, Napier University Edinburgh

Evaluating Predictive Performance of Judgmental Extrapolations from Simulated Currency Series

Andrew C. Pollock, Dept. of Mathematics, Glasgow Caledonian University, Glasgow G4 0BA, U.K.
Alex Macauley, Dept. of Mathematics, Glasgow Caledonian University, Glasgow G4 0BA, U.K.
Dilek Önkal-Atay, Faculty of Business Administration, Bilkent University, Ankara 06533, Turkey.
Mary E. Wilkie-Thomson, Dept. of Mathematics, Glasgow Caledonian University, Glasgow G4 0BA U.K.

Judgmental forecasting of exchange rates is critical for financial decision-making. Detailed investigations of the potential effects of time-series characteristics on judgmental currency forecasts demand the use of simulated series where the form of the signal and probability distribution of noise are known. The accuracy measures Mean Absolute Error (MAE) and Mean Squared Error (MSE) are frequently applied quantities in assessing judgmental predictive performance on actual exchange rate data. This paper illustrates that, in applying these measures to simulated series with Normally distributed noise, it may be desirable to use their expected values after standardising the noise variance. A method of calculating the expected values for the MAE and MSE is set out, and an application to financial experts' judgmental currency forecasts is presented.

2 Prediction Intervals for Delphi Forecasts

J. Keith Ord, Pennsylvania State University University Park, PA 16802, USA

Prediction intervals for subjective forecasts developed by a Delphi-like process are often conspicuous by their absence. Even when such intervals are computed, they usually use inappropriate measures of variation, such as the variance among experts' point forecasts. We first demonstrate the inherent bias in such methods and then develop a new procedure that provides consistent prediction intervals. We apply the method to experts' forecasts of stock market growth.

3. The Influence of Time Pressure on Judgmental Forecasting: Effects of Problem Frame

Nigel Harvey, University College London London WC1E 6BT
Fiona Smith, University College London, London WC1E 6BT.

People were asked to regard themselves as directors of a consumer-products firm and to forecast future sales from a time series of past sales. Some were told that the sales they were forecasting were those of their own brands of the products; others were told that they were forecasting their main competitor's brands. In each group, half performed the task at their own rate. The other half were told that, as long as their error levels and task completion times were no greater than the average values of the people working at their own rate, they would be paid more the faster they finished the task. This time pressure improved performance of people forecasting sales of their own brands but impaired that of those forecasting sales of their main competitor's brands. These results are discussed in the context of recent models of the effects of time pressure on judgment.

4. Time Pressure in Judgemental Forecasting: An Empirical Examination

Meliha Handzic, University of New South Wales, Sydney 2052, Australia

This paper reports the results of an empirical investigation of the effect of time pressure on the quality of judgemental forecasting in a time series task context. Overall results indicate that high time pressure had a detrimental effect on judges' forecast accuracy. However, those judges who responded to time pressure by adopting extrapolation method made more accurate forecasts than those who performed causal judgement. Findings suggest that more thorough implementation of a simpler judgemental forecasting method may be a more appropriate mechanism for coping with high time pressure than less rigorous implementation of a more complex method.

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Session Chair:
Professor D. Davidson, Glasgow Caledonian University, Glasgow.

1. Forecasting Willingness to Pay for Better Quality Drinking Water: Some Results from a Contingent Valuation Survey

James A. Brox, Ramesh C. Kumar and Kenneth R. Stollery, Department of Economics, University of Waterloo, ON, Canada, N2L 3G1

The paper reports on an attempt to forecast the social benefits of improving the quality of drinking water in a fast urbanizing river watershed in the province of Ontario on the basis of a large contingent valuation survey of the area's residents.
Threats to drinking water quality are seen to arise from reduced water flow in the river, unsafe agricultural practices and industrial mishaps and accidents. Utilizing econometric models that relate willingness to pay to current water quality levels, the extent of perceived risk and a host of socio-economic variables, the paper estimates that conditional mean willingness to pay of $8.75, representing an increase of nearly 32% in the current average water bill. The size of this estimate is consistent with those reported by similar studies in the U.S.

2. Business Forecasting in the Caribbean: An Empirical Assessment

Dr. Roland C. Craigwell, Central Bank of Barbados, Bridgetown, Barbados, W.I.
Cyrilene A. Odle, Sheryl A. Peter, R. Delisle Worrell, Central Bank of Barbados, Bridgetown, Barbados, W.I., **Andrew S. Downes**, Institute of Social and Economic Research.

Using data from Barbados and a limited number of returns from other Caribbean countries, the results of a survey of forecasting practice indicate that qualitative or judgmental techniques (e.g. a percentage of last year's value, subjective estimates of management, trend extension) are the main forecasting techniques used. Forecasting is seen as vital to strategic planning, investment decision, general business planning, managing cash flow and product development. Caribbean business companies focus their attention on forecasting sales revenue, demand, cost and cash flow over relatively 'short' horizons (less than two years). Little use is made of computer programs; where these are used LOTUS and EXCEL are the most popular. The paper includes a review of Barbados' business environment, an introduction to forecasting tools for business, a discussion of previous Caribbean research on this topic and some implications for the training of business managers.

3. Canadian Firms Forecasting Practices: Survey Results

Dr. Robert Klassen, University of Western Ontario. Canada
Benito Flores, Texas A&M University, U.S.A.

The purpose of this paper is to report the results of a survey of Canadian firms both in the manufacturing and service sector to evaluate their forecasting practices.

A stratified sample was drawn randomly from the Compact Disclosure database in the following manner: equal number of manufacturing and service firms; and equal numbers of small and large firms. At the low end, firms having a minimum sales level or number of employees, i.e., $10 million or 100 employees. Of the companies that responded to the survey 41% were manufacturing firms and 59% service companies. The average and median sales of the companies was $775 and $249 million respectively. The mean and median number of employees were 2483 and 576 respectively indicating the presence of large companies.

The results of the survey indicate that:

* Canadian firms are more likely to use judgmental forecasting methods.

* Other popular forecasting methodologies are counting methods based on survey work.

* Association or causal methods are next in the ranking of usage with the exception of the use of leading indicators.

* Time series methods are not practised as frequently as the other methods with the exception of moving averages.

* The 'newer' or more 'sophisticated' methods have not impacted the forecasting practices of Canadian firms.

4. Does Data Mining Improve Business Forecasting?

Dr. David Chereb

Under some circumstances data mining results reduce the accuracy of business forecasts. The conditions under which this occurs are common in business projections that must include structural change. This data-mining anomaly can be prevented with proper design techniques. The circumstances under which this anomaly occurs are presented in this paper, along with the techniques needed to prevent this undesired result.

The paper presents examples and practical guidelines for improving forecasting results through data mining. The analysis centers on Bayesian techniques for incorporating a priori knowledge into the data set. This preconditioning of the data set reduces the negative impact of naïve assumptions. In addition the guidelines show how to incorporate structure change through a feedback mechanism. The net result is a robust, adaptive forecasting system. Examples from demographics are used to forecast housing starts by region.

Session Chair:
John Walker, Solectron Scotland Ltd., Queensferry Road, Dunfermline, Fife, U.K.

Forecasting Issues in Supply Chain Management

Professor Robert Fildes, Department of Management Science, Lancaster University, Lancaster LA1 4YX, U.K.

Formal forecasting methods see their greatest area of application in systems to support production and operations. This paper presents research in progress examining the design of such systems. Areas of weakness are highlighted and those aspects of current methodology where there is the greatest opportunity for improvement identified. The relationship with the design principles of effective decision support systems is also considered including the incorporation of managerial judgement. The presentation concludes with a discussion on the value of improved forecasting and why companies and software suppliers do not achieve the improvements that both sides claim to want.

2. Automated Empirical One-Tailed Prediction Intervals for Determining Safety Stocks

Bill Sichel, Monet Group, Inc. Empire State Building, 350 Fifth Avenue, 16th Floor, New York, NY 10118 USA. **Hans Levenbach**, Delphus Inc., 103 Washington Street, Morristown, NJ 07960 USA.

Manufacturing industries, characterized by large volumes of SKUs (Stock Keeping Units), require automated systems to determine safety stock levels satisfying high customer fill rates. With cost and profitability pressures increasing in the Supply Chain, accurate safety stock determinations (a.k.a. prediction intervals, target inventory) becomes critical in maintaining customer fill rate while decreasing inventory levels. In this paper we present an empirical approach to estimating, in an automated fashion, one-tailed prediction intervals required for maintaining efficient inventory/fill rate levels applied to the fashion jewellery industry.

3. The Application of Modern Statistical Techniques to the Discipline of Materials Management.

James D Picksley, Mercia Software Ltd., Holt Court North, Heneage Street West, Aston Science Park, Birmingham B7 4AX, UK Tel: 44 (0)121 359 5096 Fax: 44 (0)121 359 0375

The ability to manage finished goods inventory levels in a cost effective and efficient manner is of vital importance to many companies. Crucial to the control of inventory for many of these companies is demand planning decision support software. Central to any demand planning system is the statistical forecast and more particularly the variance associated with it. Mercia Software have recently incorporated a new forecasting technique, Bayesian forecasting and the Dynamic Linear Model (DLM) as originally implemented by Pole, West and Harrison. This paper will examine enhancements that have been made to the DLM in order to facilitate the forecasting of large numbers of time series, which need to be processed automatically (large means hundreds of thousands). The problem with forecasting products with intermittent demand is of major importance to many industries. This paper will also examine a variation of the method suggested by Johnston and Boylan for dealing with such products.

4. Measuring The Impact of Improved Forecasting Management

Carlo D. Smith, The University of Tennessee

Effective sales forecasting contributes to increased customer satisfaction, lower inventories, supporting efficient production, reduced product obsolescence, determining future capital requirements, improved distribution operations, and enhanced channel relationships. This session will outline preliminary results of a major research project conducted with support provided by The Coca Cola Company, Lucent Technologies, The Longaberger Company, Michelin Tire, Monsanto, and Motorola. The study establishes measures of forecasting management performance and uses those measures to evaluate the impact of improved forecasting management on supply chain operating performance. Conclusions on how companies may begin to assess current levels of forecasting management performance and quantify the value of forecasting improvement will also be presented.

Session Chair:
David Morrison, 600 Lathes, Leeds, U.K.

1. Prioritizing R&D Projects in the Face of Technological and Market Uncertainty: Combining Data Envelopment Analysis and Scenario Analysis.

Luis Miguel Lapão, Instituto Superior Tecnico, 1096 Lisboa, Portugal. **Sten Thore**, Instituto Superior Tecnico, Lisbon, Portugal.

Assessing the priorities of a portfolio of R&D projects, uncertainty pertains not only to the narrow outcome of the product development efforts but also to the state of future technology and market conditions in general. A set of alternative scenarios is spelled out and each project under each scenario is rated using data envelopment analysis (DEA).

In an application using data from a European company, a set of development and investment projects in the field of telecommunications was rated under alternative scenarios for the future fortune of the company. Each scenario was characterized by a set of technology, market and social "drivers" such as the technological progress in optical communications, the success of the planned EU common currency etc. Each individual event (a single project under a particular scenario projected for a particular future time period) was recorded as a vector of inputs and a vector of outputs. The events were ranked using DEA. The final prioritization and selection of the R&D projects was established using a nonparametric statistic.

2. Modelling Diffusion of Technological Change: Model Selection or Combination?

Ronald Bewley, University of New South Wales, Sydney, Australia.

There have been numerous surveys comparing the forecasting performance of various S-shaped growth curves. Obviously the preferred model must be data-specific in any one case study but it is argued that certain features may be more generally applicable. This paper describes the diffusion process of the demand for sound recordings in Compact Disc format, highlighting the common features across countries. Finally, a Bayesian point of view is taken which does not attempt to select the best model for a given data set but to retain the important characteristics of each model. The resultant posterior distributions provide more meaningful confidence intervals for saturation levels and the location of any point of inflection.

3. Forecasting the Unpredictable! Planning for Contingencies

Professor Ernest Jordan, Macquarie Graduate School of Management, Macquarie University. Sydney, N.S.W., Australia.

This paper uses survey results of actual interruptions that have occurred to business operations. The count of interruptions and their duration for many organisations can give guidelines for preparedness. Hardy's well-established framework (1992) categorises organisationally disruptive events as predictable/unpredictable and controllable/uncontrollable. He suggests that contingency planning is needed for events that are unpredictable and uncontrollable. Many organisations ignore such planning, perhaps because of the 'unpredictability' of disasters.

The US Federal Emergency Management Agency uses the term "emergency" to describe these unpredictable, uncontrollable events. It defines emergency as:
"Any unplanned event that can cause death or significant injuries to employees, customers or the public; or that can shut down your business, disrupt operations, cause physical or environmental damage, or threaten the facility's financial standing or public image." (FEMA, 1996)

This paper uses actual data to develop risk measures that may be used to increase management awareness of the potential and usefulness of 'forecasting the unpredictable'.

Session Chair:
Dr. Ibrahim M. Abdalla, Napier University, Edinburgh

Decomposition of Seasonal Time Series: A Forecasting Problem with ARIMA Models

L. Gallego, Universidad de Cantabria, 39 005 Santander, Spain.

This paper proposes a procedure to pass from generalized seasonal ARIMA models to classical models, in which a seasonal time series is thought of as the sum of three unobservable components, namely the trend-cycle, seasonal and irregular components. The procedure is based on the eventual forecasting function of a general class of seasonal linear models that allows for deterministic, stochastic or mixed trend-cycle and seasonal components. Classical models could be useful in interpreting the seasonal ARIMA models' forecasting function, and potentially relevant in detecting regular and seasonal cointegration. As an illustrative example, the unobserved components for the Spanish quarterly series of labour force, employment and unemployment are estimated and compared with the components reported by the Spanish Instituto Nacional de Estad.

2. Forecasting Personal Consumption Expenditures: Structural and Time Series Models

Prof. Dr. Saleh Amirkhalkhali, St. Mary's University, Halifax, Nova Scotia, Canada.
Samad Amirkhalkhali, St Mary's University, Halifax, Canada

Consumers' expenditure constitutes the largest component of the aggregate expenditures in almost all countries. Any analysis of the factors determining the level of aggregate output and expenditures must be concerned with personal consumption expenditures. In its first part, this paper examines the relative forecasting performance of several methods which may be used to forecast consumers' expenditure within a real dynamic system such as the Canadian economy. In other words, our study compares the small sample properties of estimators within a model-structure that takes account of economic realism. In its second part, stochastic time-series models are used to forecast personal consumption expenditures in Canada. Their best results will then be compared with those of the structural models to see whether time-series models can extract any more from the existing data and perform better in forecasting.

3. Forecasting Analogous Time Series

George Duncan, Wilpen Gorr, Janusz Szczypula
H. John Heinz III School of Public Policy and Management, Carnegie Mellon University, Pittsburgh. PA 15213-3890

Within the population of variables forecasted by an organization, we can expect that there will be groups of analogous time series that follow similar, time-based patterns. The co-variation of analogous time series is a largely untapped source of information that can improve forecast accuracy. This paper takes the Bayesian pooling approach to drawing information from analogous time series to model and forecast a given time series. Provided are basic principles for applying pooling methods and supporting empirical results. Major benefits of this approach are that it 1) minimizes the number of parameters to be estimated, 2) builds on conventional time series models already familiar to forecasters, and 3) combines time series and cross-sectional perspectives in flexible and effective ways.

4. Stochastic Modelling of Solar Radiation Data

N. C Hay BSc., PhD., CEng., MIMechE **Muneer** PhD. 'Eng., MIMechE., FCIBSE Napier University, Edinburgh, Scotland

Solar irradiation data measured at intervals of 5 minutes during all days in a month are investigated. As in many continuous measurements, interruptions resulted in lost data. The objective of this work was the development of models which would generate data that could replace the missing data and in the extreme case, generate data for days during which no measurement was made at all. A models for the data has been developed and it efficacy in replacing missing data tested.

5. Experiments with a Symbolic Framework for Time Series Prediction and Visualization

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A symbolic framework for time series prediction is proposed. First of all, an enhanced dataset is created by replacing each datum by a vector (known as a feature vector or FEVA) which is a snapshot of the "shape" of the local neighborhood of the datum. The vector attempts to capture how a given datum is embedded in its surrounding. Preprocessing is followed by a clustering procedure that groups together data points that are embedded in similar surroundings. A symbolic representation of the given time series is obtained by representing each datum by an appropriate cluster number (a "symbol") and then two separate modeling paradigms are used to approximate the dynamics of the underlying process:

(a) an Elman recurrent neural network model and
(b) a higher order Markov Chain.

In a separate step, we use a string matching algorithm and several simple visualization models to identify (hidden) structure in the given time series. The approximate pattern matching technique gives a reduced form representation of the time series in terms of a set of strings of symbols (words). Efforts are currently underway to develop techniques that would exploit this structural information to improve the prediction performance. The symbolic framework is tested on two real datasets and the preliminary results are encouraging.

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