# ISF '97

## INTERNATIONAL SYMPOSIUM ON FORECASTING

# ISF 97

## The Seventeenth

# INTERNATIONAL SYMPOSIUM ON FORECASTING

# BRIDGETOWN, BARBADOS

## June 19 - 21, 1997

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# ACKNOWLEDGMENTS

The ISF 97 Organizing Committee would like to thank the following organizations for their support

The Central Bank of Barbados
BARTIC
Barbados Tourism Authority (BTA)

The ISF 97 Organizing Committee would also like to thank the following individuals for their assistance

Scott Armstrong
Glenn Caffery
Robert Fildes
Gene Leon
Barbara Talenda
Sonia Mayers
Yvonne Parris

## THE SEVENTEENTH INTERNATIONAL SYMPOSIUM ON FORECASTING

Bridgetown, Barbados
June 19 - 21, 1997

## WELCOME FROM THE GOVERNOR OF THE CENTRAL BANK OF BARBADOS

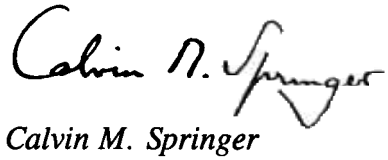
*Dear Colleague*

*On behalf of the Central Bank of Barbados, it gives me great pleasure to welcome you to Barbados. We at the Bank are particularly happy that the 1997 International Symposium on Forecasting is being held in Barbados, the first Caribbean country to be accorded this honour. Accordingly, we will do our utmost to maintain the high standards which have been associated with previous gatherings.*

*The sponsors have put together an interesting programme to ensure that your stay is a memorable one and I trust that, in spite of your busy schedule, you will find time to enjoy our Barbadian hospitality as well as the culture and scenic beauty of the island.*

*Once again, welcome to Barbados.*

*Sincerely,*



*Calvin M. Springer*
*Governor, Central Bank of Barbados*

# MESSAGE FROM THE GENERAL CHAIR

## Forecasting: Art Science and Policy Instrument

The theme for ISF97 was suggested by Dr. Gene Leon of the International Monetary Fund. It reflects his continuing association with central banks, dating from his stint as Research Director at the Central Bank of Barbados a decade ago. Central bankers forecast in order to inform policy decisions. Forecasting as policy instrument is their rationale for forecasting. Almost twenty years of economic forecasting at the Central Bank of Barbados (Craigwell, 1997) have convinced us, if we were ever in any doubt, that forecasting is as much art as science. At the same time we must be as scientific as is practicable in order to produce forecasts which are consistent over time. ISF97 is an opportunity to discover whether, and to what extent, these views are shared among economic and business forecasters from widely different backgrounds.

Policy makers must forecast, explicitly or implicitly. Policies are designed with a view to future events even when they are a reaction to circumstances already past. In the absence of a systematic forecast, there remain unstated assumptions about the ways in which policies will affect outcomes, the magnitudes of those effects and what outcomes might have been had policy remained unchanged. A systematic forecast makes these assumptions explicit.

Very soon after it began operations almost 25 years ago, the Central Bank of Barbados initiated efforts that were to lead to the current forecasting model. We determined to use the most appropriate simultaneous equation methods available at the time, to use few equations to ensure tractability and to define variables carefully to closely match their theoretical specification. In a word, we hoped to be as scientific as possible.

That approach produced some interesting academic results (e.g., Holder & Worrell, 1985) but proved useless for policy purposes. For one thing a high level of aggregation was needed in order to keep the model tractable. For example, only three prices were used - a deflator and prices of tradeables and non-tradeables - and there was no provision for the effect of taxes on prices. Policy variables that might have had significant effects did not appear in the model or were subsumed so their effects could not be detected. Moreover, what appeared to be reasonable margins of error from a statistical point of view were sometimes unacceptable from the policy maker's perspective. An error of five percent in an annual import bill of $1,200 million is $60 million. A statistician might be reasonably satisfied if he underestimated imports by no more than five percent. The central banker may not be so complacent if he falls short of his target for foreign exchange reserves by $60 million.

In the end, the first forecasts formally used by the Central Bank of Barbados for policy purposes were sufficiently detailed but purely judgmental. That may be regarded as the triumph of art over science. This forecasting system proved equally problematic: there were differing forecasts for

the same variable from different members of the forecast team and it was not always possible to find reason to prefer one over another. When actual data came in it was impossible to measure the effect of policy changes in the absence of linkages between policies and outcomes. Furthermore it was impossible to maintain the consistency of forecasts over time. The year's forecast prepared in April often bore little resemblance to the previous forecast prepared in January, because forecasters could not recall a rationale for the number offered in January.

It

Eventually we succeeded in marrying art and science in the forecast which is now in use. It incorporates insights borrowed from the small models - for example to illustrate how non-tradeable activity depends on tradeable activity - along with the detail required by policy makers. At various stages of the forecasting process there is provision for the forecast to be modified based on views solicited from specialists. The model is still more art than science and we continually try to upgrade it.

Others may not need models as detailed as official policy makers require but all business and economic decision makers may benefit from systematic forecasts. It is an important aspect of what makes firms competitive in a world where knowledge is a source of comparative advantage. It is therefore important that business and government decision makers equip themselves with the best tools for forecasting and that forecasting theorists improve the power of the available tools and their accessibility to practitioners. I trust that ISF97 will answer to both types of need.

References

Craigwell, Roland, 1997, "Stormy Weather: Economic Forecasting at the Central Bank of Barbados" in Harold Codrington, Roland Craigwell and Cleviston Haynes editors *Central Banking in Barbados: Reflections and Challenges*, Central Bank of Barbados

Holder, Carlos and DeLisle Worrell, 1985, "A Model of Price Formation for Small Economies," *Journal of Development Studies*, pp 411-428.

May 20, 1997

DeLisle Worrell

# ISF 97 ORGANIZING COMMITTEE

GENERAL CHAIR

**DeLisle Worrell**
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**USA**
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E-mail: allen@resecon.Umass.edu

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ADMINISTRATIVE CHAIR

**Jerome Ishmael**
Bartic Tours
Dover Convention Centre
Christ Church
**BARBADOS**
Tel: (246) 428-5980
Fax: (246) 428-9271

# GENERAL INFORMATION

## Registration

434-3000

The Symposium registration area is located in the main lobby of the Sherbourne Centre between the Post Office and Gem Travel. It will be open on Tuesday (from 3:00 to 8:00 pm), Wednesday (from 8:00 am to 8:00 pm) and Thursday (from 7:30 to 5:00 pm).

Dover Convention Center → 428-9434

## Hospitality Services

For information and assistance, please contact our Concierge Desk/Message Centre, which is located in the main lobby and is in operation during session hours. The Concierge Desk will assist in requests for sightseeing/island tour information and dinner reservations.

## Meeting Rooms

Plenaries and sessions will be held at the Sherbourne Conference Centre, Two Mile Hill,St. Michael. For detailed information please refer to your programme.

## Conference Staff

Conference Staff will be at the Concierge Desk for dinner reservations, to book tours and give general Island Information. Conference Aides will be in the Centre to give general directions and assistance.

## Message Centre

A notice board will be located by the Concierge Desk for programme changes and updates. A special board for "Paper Requests" will be at your disposal. Paper Request Forms will be in your registration envelope.

## Badges

Your name badge serves as a pass for all program sessions, exhibit displays, refreshment breaks and conference events. ***Delegates are requested to wear their personal badges at all times in the conference areas.*** For easy identification, ribbon colours are as follows:-

| | | | | | |
|---|---|---|---|---|---|
| *Delegates* | - | *burgundy* | *Presenters* | - | *gold* |
| *Conference Staff* | - | *yellow* | *Visitors* | - | *purple* |
| *Exhibitors* | - | *green* | *Spouses* | - | *red* |

All conference attendees are encouraged to approach both Organizing Committee Members and Directors with suggestions for IIF and future ISF Conference.

## Conference Secretariat

Fax, telephone, personal computers and limited photocopying services will be provided through the Conference Secretariat.

## Additional copies of the programme book

Additional copies of this programme book may be purchased at the registration centre for US $20 After the conference, copies may be purchased for US $30 from

Neville Pollard
Central Bank of Barbados
P. O. Box 1016
Spry Street, St. Michael
Barbados

Please use bank draft, international money order, postal cheque, check drawn on a US bank payable to the Central Bank of Barbados.

## Coffee Breaks

Coffee breaks are listed in your programme. Coffee will be available on a continuous basis in the exhibition area.

## Luncheon(s)

Lunch will be served in the Flamboyant Room north and south. Colour coded lunch vouchers are enclosed in your registration envelope. Please make sure that you carry these daily as they are required to partake in meals. We suggest that you keep all vouchers/passes in your badge pouch.

## Official Hotel(s)

| | | |
|---|---|---|
| Barbados Hilton Hotel | Needham's Point, St. Michael | Tel.:426-0200 Fax: 436-8946 |
| Grand Barbados Hotel | Aquatic Gap, St. Michael | Tel.:426-4000 Fax: 429-2400 |
| Accra Beach Hotel | Rockley, Christ Church | Tel.:435-8920 Fax: 435-6794 |
| Blue Horizon Apt. Hotel | Rockley, Christ Church | Tel.:435-8916 Fax: 435-8153 |
| Sandy Beach Island Resort | Worthing, Christ Church | Tel.:435-8000 Fax: 435-8053 |
| Divi Southwinds | St. Lawrence, Christ Church | Tel.:428-7181 Fax: 428-4674 |
| Southern Palms Beach Resort | St. Lawrence Gap, Christ Church | Tel.:428-7171 Fax: 428-7175 |
| Bresmay Apt. Hotel | St. Lawrence Gap, Christ Church | Tel.:428-6131 Fax: 428-7722 |
| Dover Beach Hotel | St. Lawrence, Christ Church | Tel.:428-8076 Fax: 428-2122 |
| Sea Breeze Beach Hotel | Maxwell, Christ Church | Tel.:428-2825 Fax: 428-2872 |

Participants are requested to settle their bill with the hotel's cashier before checkout Hotel checkout time is 12:00 noon.

## Social Events

| | | |
|---|---|---|
| Thursday, June 19 | 7:30 - 9:30 p.m. | Welcome Cocktail Reception hosted by the Central Bank of Barbados at the Barbados Hilton Hotel |
| Friday, June 20 | 2:15 p.m. | Shopping/Island Tour |
| Saturday, June 21 | 8:00 p.m. | Farewell Cruise aboard the MV Harbour Master |

## Spouse's Programme

| | | |
|---|---|---|
| Thursday, June 19 | 10:00 a.m. -2:00 p.m. | Jolly Roger Lunch & Snorkeling Cruise Departs hotel departs hotel between 9:00 and 9:15 a.m. Pirate Ship Cruise (4hrs) including snorkeling, a trip to the beach on the Jolly Barge, lots of music, drinks, and a Barbecue lunch. Price: US$62.50 per person. |
| Friday, June 20 | 2:30 - 6:00 p.m. | Harrison's Cave & Flower Forest |

## Transportation

A shuttle service will be provided to and from Sherbourne Centre. For further details please refer to your programme.

## Island Tours

Optional guided tours will be offered on Monday, Tuesday and Friday. Tour fees include experienced guides, entrance fees to places of interest, lunch and 15% VAT. For all pre-booked tours, your voucher(s) should be included in your registration package. Tours can also be booked at the Concierge Desk.

**Monday, June 16 (9:00 a.m. - 3:00 p.m.)**
Discover the diverse beauty of the island on this scenic tour. Visit historical Holetown and Speightstown, picturesque Bathsheba and East Coast and enjoy the breathtaking view from Cherry Tree Hill and St. John's Church with lunch at the most popular Great House, Sunbury Plantation.

**Tuesday, June 17 (9:00 a.m. - 2:00 p.m.)**
Visit to a Rum Distillery and Heritage Park. Shopping in historic Bridgetown with lunch along the waterfront.

**Friday, June 20 (2:30 - 6:00 p.m.)**
For nature lovers .... a visit to the Harrison's Cave and the Flower Forest is a must.

## Pre & Post-Conference Tours

**Monday, June 16 (9:00 a.m. - 3:00 p.m.)**

One day tour to some of our neighbouring islands, the Grenadines. A perfect day of relaxation sailing, swimming and snorkelling in natures spectacular acquarium. Breakfast, lunch and unlimited drinks are included. Bus departs hotel at 6:30 a.m.

**Sunday, June 22-23**

Visit picturesque St. Lucia and enjoy island tour including a visit to the Pitons. Package also includes airfare, one night's accommodation and breakfast on the second morning.

Vouchers for all pre-booked tours are enclosed in your registration envelope. Please ensure that you have a voucher for each tour booked. If the necessary vourchers are missing from your package, please see the Concierge. Post-Conference Tours may be booked at the Concierge Desk.

**The Art on display in the Centre is for sale**

## Currency and Payments

The monetary currency in Barbados is the dollar. The current rate of exchange at commercial banks is $1.98 to the U.S. dollar, most hotels offer a rate of $1.95. Barbados has a Value Added Tax of 15% which is included in all purchases.

## Banking Facilities

The nearest banking facility is The Bank of Nova Scotia located at the Juli N' Complex nearby. Your Concierge Desk will direct you. Royal Bank of Canada, CIBC and Barclays Automatic Teller Machines provide access to overseas accounts, and are located island wide. Brochures are available at the Concierge Desk.

## Church Services

There are many denominations to choose from, please ask the concierge Desk for a list

## Important Telephone Numbers

| | | |
|---|---|---|
| Police - | Emergency Only | 112 |
| | Other Enquires | 436-6600 |
| Ambulance | | 115 |
| Hospitals | | |
| | Queen Elizabeth | 436-6450 |
| | Bayview | 436-5446 |

# EXHIBITORS AT ISF 97

Exhibits will be located on the First Floor. A wide variety of educational materials and software will be on display. Exhibit hours are 9:00 a.m. to 5:30 p.m., from Wednesday, June 18 until Saturday, June 21.

**Meeting ID badges will be required for admission. Exhibitors will wear a GREEN "Exhibitor" ribbon attached to their badge.**

| | | |
|---|---|---|
| Automatic Forecasting Systems, Inc. | Address: | P.O.Box 563<br>Harboro<br>PA 19040, USA<br>Tel: 215-675-0652<br>Fax: 215-672-2534<br>E-mail: irishstat@aol.com |
| | Contact: | David Reilly |
| Blackwell Publications | Address: | 108 Cowley Road<br>Oxford, OX4 IJF<br>UK<br>Tel: +86-538-2225<br>Fax: +86-538-1225<br>E-mail: LNutt@Blackwellpublishers.co.uk |
| | Contact: | Louisa Nutt |
| Business Forecasting Systems | Address: | 68 Leonard Street<br>Belmont<br>MA 02178, USA<br>Tel: 617-484-5050<br>Fax: 617-484-9219<br>E-mail: 76773.1634@compuserve.com |
| | Contact: | Keira Lorentzen |
| Caribbean Centre for Monetary Studies | Address | University of the West Indies<br>ISER Bldg.<br>St. Agustine<br>Trinidad<br>Tel: 809-662-2002<br>Fax: 809-645-6329 |
| | Contact: | Dr. Lawrence Clarke |

| | | |
|---|---|---|
| Elsevier Science Publishers | Adddress: | 655 Ave of the Americas<br>New York<br>N.Y. 10010, USA<br>Tel: 212-633-3815<br>Fax: 212-633-3820 |
| | Contact: | Sandra Pierre-Lys |
| International Institute of Forecasters | Address: | C/o CTIP, Syracuse University<br>The Maxwell School<br>400 Eggers Hall<br>Syracuse, NY 13244<br>USA<br>Tel: 315-443-1890<br>Fax: 315-443-1075 |
| | Contact: | Stuart Bretschneider |
| International Symposium '98 (ISF'98) | Address: | Dept. Of Mathematics<br>Edinburgh EH11 4BN<br>UK<br>Tel: +131-444-2266<br>Fax: +131-455-4232 |
| | Contact: | Dr. Robert Raeside, General Chair |
| John Wiley & Sons<br>Display phamplets | Address: | Baffins Lane<br>Chichester<br>Sussex PO19 1UD<br>UK<br>Tel: +24-377-0351<br>Fax: +24-377-0429<br>E-mail: gbjwscm3@ibmmail.com |
| Oxford University Press | Address: | Great Clarendon Street<br>Oxford OX2 6DP<br>UK<br>Tel: +86-555-6767<br>Fax: +86-555-6646 |

# PRE-CONFERENCE WORKSHOPS

## Econometric Modelling of Time Series: A Review Workshop

This workshop will emphasise the methodological foundations and practice of the econometric modelling of economic time series. Topics covered will include an overview of modelling; description of data, including integration and cointegration; dynamic specification and error correction models; and, model evaluation. Participants will be expected to have some familiarity with econometric techniques. The principles and techniques will be demonstrated with econometric software in an interactive case study format. The workshop will focus on the interpretation and rationale for various modelling concepts

*Presenter:* Hyginus Leon
International Monetary Fund.
USA

*Location*: Poinsettia Room

*Time*: Wednesday, June 18, 9.00 a.m. - 12:00 noon

*Cost*: US $ 150.00

## Examination of Forecasting Models: Trends, History and Causal Variables

This seminar will be fast paced introduction to modern approaches used in building forecasting models/equations. Emphasis will be placed on the integration of the three elements found in statistically based forecasting equations. A study will be made of historical procedures and emphasize recent innovations. Straight foreword approaches will be used to construct powerful models using real world data. As part of their enrolment package attendees will be given a copy of AUTOBOX with a free trial period of 90 days.

*Presenter:* David Reilly
Automatic Forecasting Systems
P.O. Box 563, Hatsboro, PA 10040, USA

*Location*: Poinsettia Room

*Time*: Wednesday, June 18, 2:00 - 5:30 p.m.

*Cost*: US $ 250.00

**Please note:** Workshops are not part of the regular ISF program. Separate registration fees are required and are payable in advance or at the registration desk.

# COMMITTEE MEETINGS

## EDITORS AND ASSOCIATE EDITORS

Friday, June 20
2:30-4:30 p.m.
Ginger Lily Room

## DIRECTORS

Friday, June 20
4:30-6:30 p.m.
Ginger Lily Room

Joint Meeting of
**ORGANIZING COMMITTEE,**
**DIRECTORS, and**
**EDITORS & ASSOCIATE EDITORS**

Saturday, June 21, 1997
2:00-3:30 p.m.
Ginger Lily Room

## PAST PRESIDENTS OF THE IIF

| | |
|---|---|
| Estelle Dagum<br>University of Bologna, ITALY | 1988-1989 |
| Robert Winkler<br>Duke University, Durham, USA | 1989-1990 |
| Everette S. Gardener, Jr.<br>University of Houston, USA | 1990-1992 |
| Stuart I. Bretschneider<br>Syracuse University, USA | 1992-1994 |
| Hans Levenbach<br>Delphus Inc., USA | 1994-1996 |
| Michael Lawrence<br>University of South Wales, AUSTRALIA | 1996- |

## PREVIOUS ISF CONFERENCE VENUES

| Year | Place |
|---|---|
| 1981 | Quebec City, Canada |
| 1982 | Istanbul, Turkey |
| 1983 | Philadelphia, USA |
| 1984 | London, UK |
| 1985 | Montreal, Canada |
| 1986 | Paris, France |
| 1987 | Boston, USA |
| 1988 | Amsterdam, Holland |
| 1989 | Vancouver, Canada |
| 1990 | Delphi, Greece |
| 1991 | New York, USA |
| 1992 | Wellington, New Zealand |
| 1993 | Pittsburgh, USA |
| 1994 | Stockholm, Sweden |
| 1995 | Toronto, Canada |
| 1996 | Istanbul, Turkey |
| 1997 | Bridgetown, Barbados |

# HISTORY OF INTERNATIONAL INSTITUTE OF FORECASTERS

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

- **Research** Develop and unify forecasting as a multi-disciplinary field of research drawing on management, behavioral, 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 al nations together to improve the quality and usefulness c forecasting.

The IIF has held sixteen International Symposia on Forecasting in cities around the worl beginning with Quebec City in 1981 and most recently in Istanbul, Turkey. The next symposiu

**Chair:** ***R. DeLisle Worrell***

Central Bank of Barbados, P.O. Box 1016, Bridgetown, Barbados, West Indies

## Opening Remarks

**The Rt. Hon.** ***Owen Arthur,*** **Prime Minister of Barbados**

Owen Seymour Arthur is a graduate of the University of the West Indies, Cave Hill and Mona Campuses.

He holds a Bachelor of Arts (BA) degree (Upper Second Class Honours) in Economics and History, and a Master of Science degree in Economics. He held the positions of Chief Economic Planner, National Planning Agency, Jamaica 1974-79, Director of Economics, Jamaica Bauxite Institute, 1979-81, Chief Project Analyst, Ministry of Finance, Barbados 1982-84 and Parliamentary Secretary, Ministry of Finance and Planning 1985.

The Prime Minister assumed office in September 1994, and he also serves as Minister of Finance and Economic Affairs. He was made a member of the privy Council in 1995.

Chair: ***R. DeLisle Worrell***
Central Bank of Barbados, P.O. Box 1016, Bridgetown, Barbados, West Indies

## Tourism Forecasting

*Stephen F. Witt*
European Business Management School
University of Wales, Swansea
Singleton Park, Swansea, SA2 8PP, United Kingdom

Modeling and forecasting international tourism demand have attracted considerable attention sin the pioneering studies of the mid-1960s. Most of the empirical research on forecasting accura relates to highly aggregated tourist flows (country to country) and concentrates on the short medium term. Several forecasting techniques have proved popular, with time series mode ranging from simple naive models through exponential smoothing to ARIMA and structur models. However, the major emphasis has been on econometric models. The main empiric findings on relative forecasting performance are presented. No single forecasting meth performs consistently best across different situations. Furthermore, assessment of the relati performance of different tourism forecasting techniques is highly dependent on the choice accuracy measure, and therefore the tourism forecasting requirement must be considered carefu before deciding on a forecasting method.

Steven Witt is Lewis Professor of Tourism Studies in t European Business Management School at the University Wales, Swansea, UK. His research interests centre on touri demand forecasting and the economics of tourism. He h published numerous papers in academic journals, and h written six books including the *Tourism Marketing a Management Handbook*, *Modeling and Forecasting Demand Tourism* and *The Management of International Tourism*. H also Visiting Research Professor at Mid-Sweden Univers Östersund, Sweden.

Chair: ***Roland Craigwell***
Central Bank of Barbados, P.O. Box 1016, Bridgetown, Barbados, West Indies

## Current Issues in Macroeconometric Modelling for Forecasting and Policy Analysis

***Kenneth F. Wallis***
Department of Economics
University of Warwick
Coventry CV4 7AL, United Kingdom

In many OECD member-countries, fiscal and monetary policies are currently directed towards the achievement of sound public finances and the control of inflation, among other things. This talk reviews the ways in which these leading policy concerns have been incorporated into the economy-wide and global models that provide the framework for much macroeconomic forecasting and policy analysis. Particular attention is given to recent developments in the modelling of expectations, the reporting of uncertainty, and transparency.

Kenneth F. Wallis was educated at Manchester University and Stanford University. He has held the Chair of Econometrics at the University of Warwick since 1977; before this he was for eleven years on the staff of the London School of Economics. He was elected a Fellow of the Econometric Society in 1975, and served as Co-Editor of its journal, Econometrica, from 1977 to 1983. He is Director of the ESRC Macroeconomic Modeling Bureau, established at Warwick by the Economic and Social Research Council in 1983. He has been a member of HM Treasury Academic Panel since 1980, and served as its Chairman from 1987 to 1991. He is a Fellow of the British Academy.

Chair: ***Hans Levenbach***
Delphus Inc., 103 Washington Street, Suite 348, Morristown, New Jersey 07960, USA

## The Art and Science of Forecasting in the Federal Reserve System

***Stephen K. McNees***
111 Towbridge Street, #8
Cambridge, Massachusetts 02138 USA

This paper is essentially a case study of the role that forecasting plays in the formulation of monetary policy in the United States. It suffers from the limitations of a case study but also seeks to achieve the richness of detail and specificity that a good case study can offer. It opens by exploring why forecasting is a necessary part of the rational formulation of monetary policy -- why, in current parlance, the Fed engages in "preemptive strikes." The paper then presents evidence that the Federal Reserve does in fact set policy in response to economic forecasts as well as actual, historical data. The paper discusses how the economic variables which have taken on primary importance have changed as the financial system has evolved over the last thirty years ago. Next, the speaker is unable to resist the temptation to evaluate the forecasts made by the Federal Reserve relative to those coming from private, commercial forecasters. Finally, the author gives his impressions of how Fed forecasts are formulated -- the relative importance of institutions, structural modeling, and judgment, that is, their blend of art and science.

Among the conclusions that emerge are (i) that attention to institutional detail has often been a crucial element in formulating and, therefore, understanding monetary policy, and (ii) that even though changes in the financial system have led to different "regimes" in policy, (iii) monetary policy in recent decades can be interpreted as falling easily within the framework of (old-fashioned?) mainstream macroeconomics. A judicious blend of art and science has contributed both to the accuracy of Federal Reserve forecasts and to the performance of monetary policy in the United States.

Stephen McNees is an economic consultant, specializing in macroeconomic forecasting and monetary policy. He was formerly a Vice President and Economist at the Federal Reserve Bank of Boston where his responsibilities included briefing the President and Board of Directors of the Bank on the economy and attending meetings of the Federal Open Market Committee. His major research interests are the evaluation of macroeconomic forecasts and monetary policy. He has served as a senior staff economist for the President's Council of Economic Advisers, chief economist of the Bureau of Economic Analysis, and as a consultant to the Congressional Budget Office and the General Accounting Office. Mr. McNees has taught economics at Harvard University, Northeastern University, the Massachusetts Institute of Technology, and Williams College. He received his Ph.D. from the Massachusetts Institute of Technology and bachelor's degree from Swarthmore College. He is currently an associate editor of the *International Journal of Forecasting*.

Chair: ***David F. Hendry***
Institute of Economics and Statistics, Manor Road, Oxford, OX1 1NF, United Kingdom

## The Future of Macroeconomic Forecasting

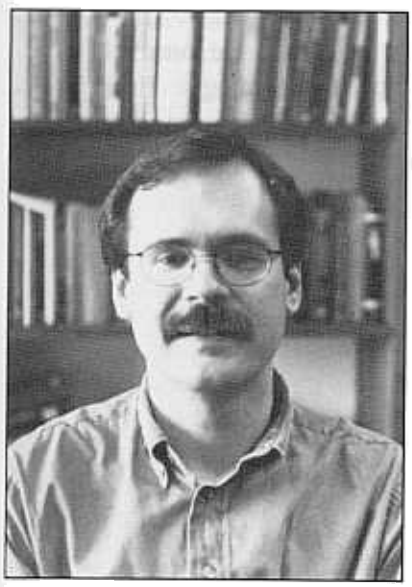
***Francis X. Diebold***
Department of Economics
University of Pennsylvania
3718 Locust Walk, Philadelphia, Pennsylvania 19104-6297 USA

To understand the future of forecasting, the key is to understand the interplay between economic theory and measurement, as well as the evolution of the nonstructural and structural approaches to measurement and forecasting. I advance and defend a two-part thesis:

(1) Nonstructural econometric forecasting has progressed steadily over the last century and continues to do so. Moreover, the pace of progress in nonstructural forecasting distinctly accelerated following the decline of the large-scale models.

(2) Structural econometric forecasting receded in the 1980s and 1990s but is beginning to reemerge. The emerging structural forecasting models, however, do not and will not resemble their ancestors.

In short, macroeconomic forecasting, broadly defined, is alive and well. Nonstructural forecasting has always been well and continues to improve, while structural forecasting has been dormant for some time but is poised for resurgence.



Francis X. Diebold is Professor of Economics at the University of Pennsylvania and Faculty Research Fellow at the National Bureau of Economic Research. He works in forecasting, econometrics, quantitative finance, and macroeconomics. Diebold received his B.S. in finance and economics from the Wharton School of the University of Pennsylvania in 1981, and he received his Ph.D. in economics in 1986, also from the University of Pennsylvania. He then worked as an economist at the Board of Governors of the Federal Reserve System before returning to the University of Pennsylvania in 1989. Diebold has published widely, and he has served on the editorial boards of leading journals, including Journal of Forecasting, Econometrica, International Economic Review, and Review of Economics and Statistics. His awards include a Sloan Foundation Research Fellowship and the University of Pennsylvania's Kravis Prize for Outstanding Teaching. Diebold has held visiting appointments at the University of Chicago Graduate School of Business and the London School of Economics Financial Markets Group, and he has served as a consultant to numerous national and international firms and organizations.

Chair: ***DeLisle Worrell***
Central Bank of Barbados, PO Box 1016, Bridgetown, Barbados, West Indies

## The Future of Telecommunications

***Dawson Walker***
Cable & Wireless, PLC

Dawson Walker is Commercial Director, Regional Business at Cable & Wireless PLC. During the 1970's he managed a London-based unit responsible for accounting rate negotiations with overseas carriers and developing tariff policies for Cable & Wireless, PLC worldwide. He was seconded to Mercury Communications, in 1982 (Britain's alternative public longline telecommunications carrier) and was responsible for negotiations with British Telecom. He returned to Cable & Wireless in 1988 as Head of Competitive Strategy. He is an acknowledged expert and strategist in the areas of telecommunications interconnections, tariffing and competition.

# Forecasting Standards And Practices

Chair: **P. Geoffrey Allen**
Department of Resource Economics, University of Massachusetts, Amherst, Massachusetts 01003, USA

**Forecasting Standards and Practices**

*J. Scott Armstrong*
The Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6371 USA

Is an organization using the best available methods for forecasting? I address this issue by providing a checklist based on well-established forecasting principles. This would show an organization how to improve their forecasting procedures. It can also be used by an organization to demonstrate that it is following the best procedures when faced by a lawsuit related to poor forecasts. The principles are drawn from empirical research, most of it published since 1960. In addition, I have drawn upon the advice of experts who have done research in various areas of forecasting.

Discussants:

**Robert Fildes**
Department of Management Science, The Management School Lancaster University, Lancaster LA1 4YX United Kingdom

**Wilpen L. Gorr**
H. John Heinz III School of Public Policy and Management, Carnegie Mellon University, Pittsburgh Pennsylvania 15101, USA

**Marcus O'Connor**
School of Information Systems University of New South Wales, Sydney 2052, Australia

**Stephen K. McNees**
111 Towbridge Street, #8, Cambridge, Massachusetts 02138 USA

Friday
00-12:30

Caribbean.
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forecasting

**Panel Discussion**

Room: Bouganvillaea

Saturday
4:00-5:30

# Tourism Forecasting in Practice

Chair: **Denny Lewis**
Central Bank of Barbados, PO Box 1016, Bridgetown, Barbados, West Indie

**Experience in Tourism Forecasting in the Caribbean - Forecast to 2007**

*Arleigh Sobers*
Caribbean Tourism Organization, Bridgetow Barbados, West Indies

**Experience in Tourism Forecasting in the Caribbean: Barbados Tourism Forecast 2010**

*Eric A. Adams*
Caribbean Futures Ltd., 50 Richmond Street, Port of Spain, Trinidad, West Indies

**Tourism Forecasting: A ong Wave' Approach**

*Auliana Poon*
Caribbean Futures Ltd 50 Richmond Street, Port of Spain rinidad, West Indies

## Sessions in Order by Track

### Finance

| | |
|---|---|
| Methods | Marigold A |
| Interest Rates | Marigold B |
| Exchange Rates | Foyer Annex |
| Earnings Forecasting I | E109 |
| Volatility - Exchange Rate | Ginger Lily |
| Earnings Forecasting II | Ginger Lily |
| Volatility - Additional Models | Foyer Annex |

### Forecasting Practice

| | |
|---|---|
| Managing The Sales Forecasting Function | Marigold B |
| Technology Forecasting | E109 |
| Organizational Issues | Flamboyant South |
| Forecasting In The Supply Chain I | Frangipani |
| Panel: Forecasts For Project Appraisal And Management | Bouganvillaea |
| Applications | E109 |
| Utility Forecasting | Foyer Annex |
| Organizational Issues II | Foyer Annex |
| Industry Forecasts | E109 |

### Judgmental Forecasting

| | |
|---|---|
| Scenario Analysis And Strategic Planning | Foyer Annex |
| Experimental Results | Ginger Lily |
| Assessment Of Methods | Ginger Lily |
| Issues In Improving Effectiveness | Ginger Lily |

### Neural Nets

| | |
|---|---|
| Methods | Ginger Lily |
| Electric Load Forecasting | E109 |
| Applications | E109 |

### Principles

| | |
|---|---|
| Panel And Presentation: Forecasting Standards And Practices | Marigold A |
| Quantitative Forecasting Methods | Poinsettia |
| Qualitative Forecasting Methods | Poinsettia |

## Sessions in Order by Track

### Macroeconomic Policy

| | |
|---|---|
| The Econometrics Of Macroeconomic Forecasting | Bouganvillaea |
| Assessment | Poinsettia |
| Method Issues | Foyer Annex |
| Leading Indicators I - Turning Points | Bouganvillaea |
| Leading Indicators II - Incorporating Probability | Marigold B |
| Modeling Approaches | Marigold A |
| Leading Indicators III - Methods And Usefulness | Marigold B |
| Large-Scale Policy And VAR Models | Marigold A |
| Panel: Business And Economic Forecasting In The Caribbean | Marigold A |
| Forecasts And Policy | Poinsettia |

### Methodological Issues

| | |
|---|---|
| Method Selection | Poinsettia |
| Bayesian | Ginger Lily |
| Exponential Smoothing | Bouganvillaea |
| ARMA Models I | Marigold B |
| Probabilistic Forecasts And Prediction Intervals | Marigold A |
| Recent Advances In Unobserved Components Modelling | Frangipani |
| Econometric Theory Developments | Poinsettia |
| ARMA Models II | Frangipani |
| VAR And State Space | Marigold B |
| Univariate Modelling | Marigold B |
| High Frequency Data | Marigold A |

### Tourism

| | |
|---|---|
| Modeling Issues | Flamboyant North |
| Forecasting Workshop | Poinsettia |
| Model Comparisons I | Foyer Annex |
| Model Comparisons II | Bouganvillaea |
| Panel: Tourism Forecasting In Practice | Bouganvillaea |

## Sessions in Chronological Order

**Thursday 9:30 - 10:05**

| | |
|---|---|
| Opening Session | Frangipani |

**Thursday 10:05 - 11:00**

| | |
|---|---|
| Keynote: Stephen Witt | Frangipani |
| *Break* | 2nd Floor Foyer |

**Thursday 11:25 - 12:45**

| | |
|---|---|
| Finance: Methods | Marigold A |
| Forecasting Practice: Managing The Sales Forecasting Function | Marigold B |
| Forecasting Practice: Technology Forecasting | E109 |
| Judgmental Forecasting: Scenario Analysis And Strategic Planning | Foyer Annex |
| Macroeconomic Policy: The Econometrics Of Macroeconomic Forecasting | Bouganvillaea |
| Methodological Issues: Method Selection | Poinsettia |
| Neural Nets: Methods | Ginger Lily |
| *Lunch* | Flamboyant |

**Thursday 1:45 - 2:45** IIF Business Meeting

**Thursday 2:45 - 3:45**

| | |
|---|---|
| Keynote: Kenneth Wallis | Frangipani |
| *Break* | 2nd Floor Foyer |

**Thursday 4:10 - 5:30**

| | |
|---|---|
| Finance: Interest Rates | Marigold B |
| Forecasting Practice: Organizational Issues I | Flamboyant South |
| Macroeconomic Policy: Assessment | Poinsettia |
| Macroeconomic Policy: Method Issues | Foyer Annex |
| Methodological Issues: Bayesian | Ginger Lily |
| Methodological Issues: Exponential Smoothing | Bouganvillaea |
| Neural Nets: Electric Load Forecasting | E109 |
| Principles: Panel And Presentation - Forecasting Standards And Practices | Marigold A |
| Tourism: Modeling Issues | Flamboyant North |

**Thursday 7:30 - 9:30 p.m.**

Welcome cocktail reception at the Barbados Hilton Hotel

**Friday 9:00 - 10:30**

| | |
|---|---|
| Finance: Exchange Rates | Foyer Annex |
| Forecasting Practice: Forecasting In The Supply Chain | Frangipani |
| Judgmental Forecasting: Experimental Results | Ginger Lily |
| Macroeconomic Policy: Leading Indicators I - Turning Points | Bouganvillaea |
| Methodological Issues: ARMA Models I | Marigold B |
| Methodological Issues: Probabilistic Forecasts And Prediction Intervals | Marigold A |
| Neural Nets: Applications | E109 |
| Tourism: Forecasting Workshop | Poinsettia |
| *Break* | 2nd Floor Foyer |

**Friday 11:00 - 12:30**

| | |
|---|---|
| Finance: Earnings Forecasting I | E109 |
| Forecasting Practice: Panel - Forecasts For Project Appraisal And Management | Bouganvillaea |
| Judgmental Forecasting: Assessment Of Methods | Ginger Lily |
| Macroeconomic Policy: Leading Indicators II - Incorporating Probability | Marigold B |
| Macroeconomic Policy: Modeling Approaches | Marigold A |
| Methodological Issues: Recent Advances In Unobserved Components Modelling | Frangipani |
| Principles: Quantitative Forecasting Methods | Poinsettia |
| Tourism: Model Comparisons I | Foyer Annex |
| *Lunch* | Flamboyant |

**Friday 1:30 - 2:30**

| | |
|---|---|
| Keynote: Stephen McNees | Frangipani |

## Sessions in Chronological Order

**Saturday 9:00 - 10:30**

| | |
|---|---|
| Finance: Volatility - Exchange Rate | Ginger Lily |
| Forecasting Practice: Applications | E109 |
| Forecasting Practice: Utility Forecasting | Foyer Annex |
| Macroeconomic Policy: Leading Indicators III - Methods And Usefulness | Marigold B |
| Macroeconomic Policy: VAR And Other Model Comparisons | Marigold A |
| Methodological Issues: Econometric Theory Developments | Poinsettia |
| Methodological Issues: ARMA Models II | Frangipani |
| Tourism: Model Comparisons II | Bouganvillaea |
| ***Break*** | 2nd Floor Foyer |

**Saturday 11:00 - 12:00**

| | |
|---|---|
| Keynote Frank Diebold | Frangipani |
| ***Lunch*** (12:00-2:00) | Flamboyant |

**Saturday 1:00 - 2:00**

| | |
|---|---|
| Keynote Dawson Walker | Frangipani |

**Saturday 2:00 - 3:30**

| | |
|---|---|
| Finance: Earnings Forecasting II | Ginger Lily |
| Forecasting Practice: Organizational Issues II | Foyer Annex |
| Forecasting Practice: Industry Forecasts | E109 |
| Macroeconomic Policy: Panel - Business and Economic Forecasting In The Caribbean | Marigold A |
| Methodological Issues: VAR And State Space | Marigold B |
| Principles: Qualitative Forecasting Methods | Poinsettia |
| ***Break*** | 2nd Floor Foyer |

**Saturday 4:00 - 5:30**

| | |
|---|---|
| Finance: Volatility - Additional Models | Foyer Annex |
| Judgmental Forecasting: Issues In Improving Effectiveness | Ginger Lily |
| Macroeconomic Policy: Forecasts And Policy | Poinsettia |
| Methodological Issues: Univariate Modelling | Marigold B |
| Methodological Issues: High Frequency Data | Marigold A |
| Tourism: Panel - Tourism Forecasting In Practice | Bouganvillaea |

**Saturday 8:00 p.m.**

Farewell Dinner Cruise aboard the M.V. Harbour Master

Chair: **Ronald L. Giles**
Business School, South Bank University, London SE1 0AA, United Kingdom

## Extreme Price Clustering in the London Equity Index Futures and Options Markets

Owain ap Gwyllm
EBMS, University of Wales, Singleton Park, Swansea, Wales, United Kingdom SA2 8PP
Andrew D. Clare
ISMA Centre, Reading University, Whiteknights, PO Box 218, Reading RG6 6AA, United Kingdom
*Stephen Thomas*
School of Management, University of Southampton, Highfield, Southampton, United Kingdom

We report that quotes and trades in the FTSE futures and options contracts are concentrated at full index points despite a minimum tick of 0.5 index points. The FTSE250 futures contract also exhibits clustering at the decimals 0 and 5 for the fourth digit of the index value. The options show a tendency for any trades and quotes at odd tick values to be for low priced contracts. We also examine variations in clustering on an intraday basis. For the FTSE100 futures contracts, we report a significant relationship between the percentage of trades at an odd tick and mean trade size, and find that the proportion of odd ticks is significantly lower near the market open. Further, a significant inverse relationship is reported between the bid-ask spread and the number of odd ticks, and bid-ask spreads cluster at even-tick values.

## Forecasting U.S. Bank Deposit Rates Using a Switching Cointegration Model

Milton Marquis and ***Stefan C. Norrbin***
Department of Economics, Florida State University, Tallahassee, Florida 32306, USA

This paper examines the suggestion that bank deposit rates lag behind the T-bill, during a time of rising interest rates, but the deposit rates fall fast in times of falling interest rates. We examine this proposition treating all the interest rates as nonstationary processes. Thus the long-run relationship is captured by the cointegrating vectors, and the short-run response is modeled using a Vector Error Correction Model (VECM) framework. We use a new type of VECM, namely a switching factor VECM to capture the different response to rising and falling interest rates. This switching factor VECM model is then used to forecast the bank deposit behavior in the early 1990s to see if the model can predict the bank behavior better than the models presently used by the U.S. Federal Reserve.

## Forecasting With Fibonacci Time Targets: A Technical Analysis Approach to Policy Instruments

Michael J. Edwards and ***Ronald L. Giles***
Business School, South Bank University, London SE1 0AA, United Kingdom

Fibonacci numbers are used extensively in technical analysis and interpretation of charts for financial forecasting, especially in Elliott's adaptation. Considered least reliable of the three forecasting methods, the time element plays the minor role of confirming wave patterns and ratios. Yet this remarkable property, to mirror wave patterns in market fluctuations, calls for reformulation of the Fibonnacci ratio into a time target.
The artists's Golden Section format suggests representing straight Fibonacci fan lines as a curving logarithmic spiral to generate some common short and medium term cycles, all stemming from different combinations of the same variables. This new interpretative approach, namely Fibonacci time targets, has equal validity for financial forecasting and for economic projections. It is applied here to judging the ebb and flow of inflation and interest rates in Barbados.

Chair: Mohamed Onsi
School of Management, Syracuse University, Syracuse, New York 13244-2130, USA

## Special Problems in Forecasting Government-Sponsored R&D Impacts: Lessons from the R&D Value Mapping Project

*Barry Bozeman*
School of Public Policy and Technology Policy, Georgia Tech, Atlanta, Georgia 30332, USA

While forecasting industrial R&D impacts is difficult, at least there is a focus in most instances on firms' ability to appropriate benefit. But in much government-sponsored R&D the intent is to provide public domain benefits. The public domain benefits of R&D are more difficult to conceptualize, measure and track. This paper draws from experiences of the "R&D Value Mapping Project," an on-going effort to track the impacts of basic research supported by the Department of Energy. It articulates the R&D Value Mapping method (see Kingsley, Bozeman and Coker, Research Policy, 1996), an approach which involves in-depth case studies, quanitification of the attributes of the cases, and the plotting of those attributes on various impact models. The early empirical results from the project are used to highlight some of the special problems in assessing and forecasting impacts of government-sponsored R&D projects. Various approaches to dealing with the problems are outlined.

## Technology Opportunities Analysis

*Alan L. **Porter*** and Nils Newman
ISyE, Georgia Tech, Atlanta, Georgia 30332-0205, USA

Technology Opportunities Analysis (TOA) embodies an effort to exploit bibliographic electronic information sources to monitor and forecast technological progress. Our preferred forecast horizon is 3-5 years. Using software developed at Georgia Tech over the past four years, the TOA Knowbot, we are able to profile emerging technologies quickly, effectively, and efficiently. The TOA process begins with searching suitable electronic databases (e.g., "Engineering Index," "U.S. Patents") and downloading the resultant set of abstracts (as many as 10,000 or so in some instances). Using TOA Knowbot we then profile the topic in terms of identifying related technologies and attendant issues, prominent contributors, and temporal activity patterns.
We illustrate application of TOA by exploring "technology maps" of an environmental technology issue over time. Shifts in research publication emphases appear in comparing technology maps over time, providing an interesting basis for forecasting.

## The Predictive Ability of Manufacturing Technology Frontier and Strategic Cost Systems

*Mohamed Onsi*
School of Management, Syracuse University, Syracuse, New York 13244-2130, USA
Gail L. Cook
University of Wisconsin-Parkside, Wisconsin, USA

This research investigates the relationship between manufacturing technology and the attributes of strategic cost systems design. A manufacturing technology frontier was developed, defining the different stages of technology implementation from simple to advanced stages of computer integrated manufacturing systems. The relationships between these different stages of technology frontier and those corresponding changes in the attributes of strategic cost systems were hypothesized.

A questionnaire was distributed to 120 managers, selected randomly from 8 large-sized companies, who were involved in the design, justification, implementation, and evaluation of these technologies.Findings indicate a positive relationship between different stages of technology frontier and different attributes of cost systems design. The relationship was stronger when different managerial policy changes were added. The optimal benefits of a technology strategy will be realized with corresponding changes in design of the cost system, changes in compensation plans, control criteria, and information distribution.

Chair: **Bartolomeo Sapio**
Fondazione Ugo Bordoni, Via Baldassarre Catiglione 59, Roma, 00142, Italy

**Some Techniques for Incomplete Data Analysis**

Claudio M. Rocco S.
DIOC, Facultad de Ingenieria, Universidad Central de Venezuela, c/o Poba International No. 100 PO Box 02-525
Miami, Florida 33102-5255, USA
Natasha E. Castro
Electricidad de Caracas, Caracas, Venezuela

Every planning process requires information that identifies key variables and quantifies their impact on each scenario describ by the planner. This kind of information, assembled in a data base, is obtained, for example, from several model runs a in each run a single variable is changed from its base case value.

This paper shows the use of three techniques to perform incomplete data analysis. These techniques allow the expansion the information contained in an initial data base (a data base based on a subset of possible scenario or an "incomplete" d base), without using additional model runs. The techniques reviewed are: simulation, modeling, regression and trade- evaluation (SMARTE), high order linear interpolation (HOLI) and incomplete data analysis (IDA).

**Simplifying the Experts' Task During Scenario Analysis: The R-Wise (Reduced-Weighted Impact Structur Evaluation) Method**

*Bartolomeo Sapio*
Fondazione Ugo Bordoni, Via Baldassarre Castiglione 59, 00142 Roma, Italy

During the early phases of quantitative scenario analysis, experts are required to assess subjective data, such as probabilitie impact levels, compatibilities and so on. They are often asked to fill square matrices with as many rows and columns as t number of variables in the scenario. Although this kind of consultations are useful during extensive (and time-consumi studies, the necessity often arises of working on a reduced set of data in order to simplify both the experts' and the analys task. This paper presents a new method, called R-WISE (Reduced - Weighted Impact Structured Evaluation) to reduce t complexity of data collection and selection during the process of scenario analysis.

**Scenario Planning Using Signed Evaluations: Distance Education into the New Millennium**

*Ron Roberts*
University of the West of England, Faculty of Computer Studies and Mathematics, Frenchay Campus, Coldharbo Lane, Bristol BS16 1QY, United Kingdom
Bartolomeo Sapio
Fondazione Ugo Bordoni, Via Baldassarre Castiglione 59, 00142 Roma, Italy

The advent of new technologies has spawned a growth in Open and Distance Education in various parts of the world. Excit new ways of information storage and communications have offered greater choice of where, when, what and how studen study.

This paper applies the Signed - Weighted Impact Structural Evaluation (S-WISE) method to a range of technological, marke environmental and regulatory variables thought to influence the take up of Distance Education globally. Structured interactio using signed assessments and related values are identified, aimed at producing a simplified scenario and which ranks the relati importance of identified variables.

**Chair: Kenneth F. Wallis**
Department of Economics, University of Warwick, Coventry CV4 7AL, United Kingdom

## THE ECONOMETRICS OF MACROECONOMIC FORECASTING

***David F. Hendry***
Nuffield College, Oxford, United Kingdom

The theory of economic forecasting is well developed for situations when an econometric model coincides with the mechanism generating the data in an unchanging world. However, econometricians have established less about forecasting properties when model and mechanism differ in a non-stationary and changing world. Despite the relative weak assumptions that the economy under analysis is non-stationary and subject to unanticipated structural breaks, that the model may differ from the mechanism in unknown ways, and that it requires estimation from available data, many useful insights can be derived. The resulting implications often differ considerably from those derived when the model is assumed to coincide with a constant mechanism.

The paper addresses the basic concepts of (un)predictability and forecastability underlying forecasting, and shows they point towards many of the problems confronting successful forecasting. For example, as unpredictability is not invariant to inter-temporal transformations, there are no unique measures of forecast accuracy, although some measures are not even invariant across isomorphic model representations. Further, it is shown that causal variables need not outperform non-causal in forecasting when the model and mechanism differ in a world subject to structural breaks.

There is a case for increased parsimony when making multi-step forecasts in constant-parameter worlds, but it is unconvincing, particularly given the absence of any role for collinearity per se. However, even when the forecasting model remains constant, a break in the correlation structure of the regressors can induce poor forecasts due to variance effects from the least-significant variables retained. This is consistent with a need to eliminate non-systematic effects, so parsimony may have a justification in non-constant processes.

A taxonomy of sources of forecast error clarifies the roles of model mis-specification, sampling variability, error accumulation, initial condition mis-measurement, intercept shifts, and slope- parameter changes. The consequences of many forms of break can be derived analytically, and different models may be differentially susceptible to structural breaks. Shifts in the long run means of the (non-integrated) transformed variables are the main cause of forecast biases, so the taxonomy helps explain why differencing and intercept corrections (non-zero values for a model's error terms over the forecast period) robustify forecasts against shifts in deterministic factors. Thus, intercept corrections have a theoretical justification in a world subject to structural breaks of unknown form, size, and timing by 'robustifying' forecasts. This result is illustrated in a separate paper, and reveals that the best forecasting model is not necessarily the best economic-policy model.

Co-breaking suggests the possibility of eliminating structural breaks by taking linear combinations of variables, which may help produce more robust subsystems. A formal theory is presented in a separate paper. We conclude that a formal theory of forecasting for mis-specified models under irregular and substantive structural breaks requires development, but is feasible.

Chair: **Fred Collopy**
Weatherhead School of Management, Case Western Reserve University, Cleveland, Ohio 44106, USA

**Forecasting and Data Mining Methods**

Emil Pelikan
Inst. of Computer Science, Czech Academy of Sciences, Pod vodarenskou vezi 2, 182 07 Prague, Czech Republic
Mirko Novak
Czech Technical University, Konviktska 20, Prague 1, Czech Republic
***Petr Berka***
Faculty of Informatics and Statistics, University of Economics, W. Churchil Sqr. 4, 13067 Prague, Czech Republic

In this study, we discuss the possibilities of applying data mining methods to the problem of prediction. We employ two data mining systems: Knowledge Explorer (KEX) and General Unary Hypotheses Automaton (GUHA). KEX is a system designed for systematic analysis of multidimensional categorical data and the GUHA is a system originally developed for automatic generation of "all interesting hypotheses" based on empirical data. In this paper we discuss an approach in which data mining methods are applied to the extraction of prediction rules from the data. During a forecasting epoch, the active rules (rules with fulfilled left-hand sides) are applied to new data and their weights are composed by the inference mechanism to the resulting weight of the final prediction. The approach presented is tested on real data from the banking and energy sectors.

**Heuristic Identification of Time Series Features: An Extension of Rule-Based Forecasting**

***Monica Adya***
University of Maryland Baltimore County, Catonsville, Maryland 21250, USA
***Fred Collopy*** and Miles Kennedy
Weatherhead School of Management, Case Western Reserve University, Cleveland, Ohio 44106, USA

Rule-based forecasting is dependent, in part, upon the identification of features of the historical time series. To date this has been done judgmentally. In this study, we developed feature detection heuristics to identify six features of time series. These features are outliers, level shifts, change in basic trend, unstable recent trend, unusual last observation and functional form. Simple statistics such as first differences and regression estimates are used to detect the features. Heuristic codings were compared with those from experts. In an analysis based on forecasts from 126 time series, use of the heuristic codings produced forecasts that were about as accurate as those that resulted when expert codings were used. This result suggests that some of the benefits of rule-based forecasting can be achieved even with more highly automated systems.

**M3-IJF Competition - First Results**

Spyros Makridakis and ***Michèle Hibon***
INSEAD, Boulevard de Constance, 77305 Fontainebleau, France

The aim of this study is to verify if the four major conclusions of the M-Competition can apply.

1. Statistically sophisticated or complex methods do not necessarily produce more accurate forecasts than simpler ones.
2. The rankings of the performance of the various methods vary according to the accuracy measure being used.
3. The accuracy of the combination of various methods outperforms, on average, the individual methods being combined and does well in comparison with other methods.
4. The performance of the various methods depends upon the length of the forecasting horizon.

We then aim to extend the results of the M- and M2-Competitions to include more researchers, more methods (in particular neural nets and expert systems) and more countries. In addition, it will verify if the four major conclusions of the M-Competition still apply in the enlarged, new database of 3000 series.

Chair: **Antonio J. Rodrigues**
DEIO and CIO, Faculdade de Ciencias, Universidade de Lisboa, Edificio C2, Campo Grande, 1700 Lisboa, Portugal

**Neural-based Forecasting of Nonstationary Time Series**

*Antonio J. Rodrigues* and Patricia X. G. Silva
DEIO and CIO, Faculdade de Ciencias, Universidade de Lisboa, Edificio C2, Campo Grande, 1700 Lisboa, Portugal

There are pitfalls in directly applying neural networks, as nonlinear autoregressive models, to forecast nonstationary time series. The classic differencing and deterministic detrending procedures are inadequate and we propose some alternative approaches. We consider the composition of dynamic regression submodels, to account for the low-frequency effects in the data, and radial basis function submodels, to handle the higher-frequency linear and nonlinear autocorrelations. The neural submodel parameters are also made time-varying, and described by random walk processes. To further induce stationarity in the sequence of training patterns, in particular to favour generalization within the convex hull defined by the input patterns, we consider preprocessing those patterns through appropriate shape-preserving transformations. We illustrate the application of these methodological ideas to some Portuguese economic and financial time series.

**Using Recurrent Neural Networks for Time Series Forecasting**

*Sandy Balkin*
Smeal College of Business Administration, Pennsylvania State University, 303 Beam BAB, University Park, Pennsylvania 16802, USA

In the past few years, artificial neural networks (ANN) have been investigated as a tool for time series analysis and forecasting. The most popular architecture is the multilayer perceptron, a feedforward network often trained by backpropagation. The forecasting performance of ANNs relative to traditional methods is still open to question although many experimenters seem optimistic.

One problem with the multilayer perceptron is that, in its simplest form, it is similar to a pure autoregressive type model, so it lacks the ability to account for any moving average structure which may exist. By making a network recurrent, it is possible to include such structure.

We present several examples showing how an ANN can be used to represent an ARMA scheme and compare the forecasting abilities of feedforward and recurrent neural networks with traditional methods.

**Neural Based Time Series Forecasting of Retail Demands**

*R. Hale Brown, Daniel H. Ockerman* and Linda M. Whitaker
Neil Thall Associates, 7 Piedmont Center, Suite 501, Atlanta, Georgia 30305, USA

We frequently employ hybrid approaches (neural techniques in conjunction with standard statistical models) to forecast future demands for retail clients. Since there are many ways that neural variables can be incorporated into a forecast, and since every retail situation is somewhat different, it is not routine, even for experienced modelers, to develop hybrid models. Among the approaches that we have tried, some have clearly outperformed others. We describe several of these methods and we provide theoretical motivation for, and empirical results supporting, why certain ones tend to be successful. We develop guidelines for selecting among various hybrid approaches.

**The Choice of Symptoms for a Reconfiguration Control of High-reliable Systems by Neural Networks**

*Vaclav Prenosil*
Military Academy in Brno, K-303, PS 13, 612 00 Brno, Czech Republic

The synthesis of high-reliable systems requires the use of a special design methodology, consisting of the application of over-dimensioned system components, improvement of component and system production technology, the use of redundant system structures and application of a predicting diagnostic. A new methodology for predicting how systems evolve is proposed in this paper. It could be used by some forecasting methods, for example, by artificial neural networks.

The predicting diagnostic consists of a special block (a predictor-arbiter) which uses predictions for control of the reconfiguration and regeneration of the system. The main problem in predicting the state of the system is that it is defined by a large number of parameters. Therefore, a basic task when predicting the state of the system is to choose the more significant parameters that define it.

Chair: **Guy Ta**

Associate Director, Institute for International Studies and School of Finance and Economics, University of Technology, Sydney (UTS), Kuring-gai Campus, Lindfield 2070, Australia

**Forecasting Offshore and Onshore Interest Rates: The Case of Major Eurocurrencies**

*Guy Ta*

Associate Director, Institute for International Studies and School of Finance and Economics, University of Technology, Sydney (UTS), Kuring-gai Campus, Lindfield 2070, Australia

In the past 20 years, financial development and deregulation in the major currency countries have given rise to seemingly greater integration of international financial markets. The linkage between offshore and onshore interest rates, therefore, has been the subject of many empirical investigations. This study attempts to use cointegrated VAR systems to forecast both offshore and onshore interest rates in some major Western and Asia-Pacific financial centers. The study also has the objective of comparing the performance of cointegrated VAR systems forecasts with those of structural models of interest rate determination. Finally, the study attempts to explain how forecasts of offshore interest rates could be used to set onshore interest rates, which has implications for both macroeconomic policy and microeconomic decision making.

**Intermediate-Term Forecasts of Interest Rates: An Evaluation of Alternatives**

*Albert E. DePrince, Jr.*

Department of Economics and Finance, Middle Tennessee State University, Box 27, Murfreesboro, Tennessee 37132, USA

Studies of interest rate forecasts typically consider a short horizon, but business planning and financial management require a longer-term view. This study examines the accuracy of forecasts over horizons up to three years. Three alternative forecasts are used for the 1-year horizon: the futures market, an interest rate survey, and forward rates based on the yield curve. Futures and forward rates are used
as forecasts for the 2-year and 3-year horizons.

Preliminary results show that (1) forecasts were more highly correlated with rates prevailing at the time the forecasts were made than with the eventual outcome and (2) accuracy deteriorated as the horizon lengthened which is traced to the term premium in the yield curve. Survey data had characteristics similar to forecasts based on futures and forward rates, suggesting that individuals collectively utilized a methodology that resembled adaptive expectations. Even so, survey results seemed preferable to futures and forward rates as forecasts.

**Measuring the ECU Capital Market Integration: An Investigation of the ECU Benchmark Yield Curve**

*Nikolaos Mylonidis* and Michael Bowe

Manchester School of Management, UMIST, P.O. Box 88, Manchester M60 1QD, United Kingdom

In the advent of Europe's single currency (the EURO), the European financial markets should exhibit the characteristics of a well co-ordinated market system. The purpose of this paper is to examine the extent of integration currently existing in the ECU International bond market, which is the acknowledged precursor of the EURO debt market. Looking at the way ECU bond yields converge and diverge across the maturity spectrum provides information about the market's expectations concerning the future of the European Monetary Union. In the present setting, three forms of capital market integration can be identified, depending on the number of common trends driving the ECU bond yield system and the existence of stationary yield spreads; *weak*, *semi-strong* and *strong* forms of capital market integration. Maximum likelihood cointegration techniques are applied for the empirical analysis and the results provide support for the *semi-strong* form of capital market integration.

Chair: **Moira C. Watson**
Department of Mathematics, Napier University, Sighthill Court, Edinburgh EH11 4BN, United Kingdom

**Forecasting Practice: Organizational Issues**

*Moira C. Watson*
Department of Mathematics, Napier University, Sighthill Court, Edinburgh EH11 4BN, United Kingdom

Although many surveys have been conducted on forecasting practice, the majority of surveys have investigated the utilization of forecasting methods and relatively few have studied the role of forecasting in changing organizational structures.

The aim of this paper is to address this issue by expanding on earlier case studies which suggested the need for a re-location of the forecasting function within the organization. Current research has shown how the role of forecasting has changed as organizations adapt to meet the business needs of their customers. The evidence reported on in this paper was gathered by structured interviews carried out in the electronics industry and financial industry in Scotland.

**Is There a Role for Forecasting in Strategic Planning?**

**C. Aleong**
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***J. Aleong***
University of Vermont, Burlington, Vermont 05405, USA

We will review the literature on the current discussion of whether Total Quality Management and re-engineering yield better forecast data for OPERATIONAL EFFECTIVENESS or for long run STRATEGIC PLANNING. Strategic planning as practised by corporations relies heavily on projecting historical data. Given the backlash against incrementalism, we will attempt (a) to answer the question of whether forecasting only serves the purpose of operational effectiveness but cannot be used in the area of strategic planning and (b) if forecasts are to be used for strategic planning what statistical tools may be suitable and in what context.

The paradigm shifts that have resulted from global competition and electronic communication might have resulted in the current forecasting tools being inadequate for strategic planning.

**Management of Risk: Allocating Resources to Marketing Sales Forecasts**

***Douglas C. West***
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Despite the evidence that objective techniques improve forecast accuracy there is considerable evidence that such techniques are not widely used. This paper examines the issue from the perspective of risk-taking behavior by companies. Drawing on prospect theory and the wider literature of risk management, a model of risk-taking and sales forecast resource allocation is proposed. The model examines risk-taking and tolerance of poor forecast accuracy. The argument is straightforward: companies take more risks when they underachieve sales forecasts (and less risk when they achieve or over-achieve forecasts). On underachieving a forecast, companies are more likely to take a risk and devote less resources to an accurate forecast. Factors influencing the propensity to take risks include the environment, income stream uncertainty, objectives, company characteristics, sales forecast data sources, organizational processes, marketing activity and knowledge and experience. Managerial recommendations are made relating to assessing risk vulnerability and sales forecast audits.

Chair: D.J. Smyth
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**Does the OECD Correctly Forecast Recessions?**

*D.J. Smyth*
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This paper analyzes the accuracy of OECD forecasts of gross domestic product (GDP) growth for the seven largest economies: Canada, France, Germany, Italy, the United Kingdom and the United States. In most comparative studies of the OECD's forecasting accuracy, all observations are assigned equal importance. Should they be? A forecast of a growth rate equal to the average generates an acceptable error when output is growing close to its average rate. But the OECD forecasts output declines less accurately than increases and it often fails to anticipate recessions. Another type of error is to forecast a decline in output that does not happen. The OECD rarely makes this mistake.

While viewing with concern the OECD's failure to predict declines in output with any degree of accuracy, we demonstrate that it is not alone. For example, the US Administration simply missed the deep recession in 1982 in the US. The OECD forecast was more accurate.

**Macro-Economic Forecasting with Bayesian VAR Models for the Major Four EU Countries**

*Jacob A. Bikker*
European Monetary Institute, PO Box 102031, 60020 Frankfurt am Main, Germany

This paper presents BVAR models for Germany, France, Italy and the United Kingdom, and examines their forecast performance, based on two sequential ex post forecast test exercises, the first one to set the values of the hyperparameters, and the second one to assess the BVAR model's unbiased forecast performance. The ex-post forecast test over 1993-1995 shows that the BVAR forecast errors of key-economics variables are comparable to those of international institutions, such as IMF and OECD, which is satisfactory, given the relatively simple structure of the BVAR model. Actual BVAR forecasts for the next two years look rather plausible. BVAR models reveal stylized facts with respect to the economies considered. The results suggest that the BVAR approach can be a useful tool to cross check forecasts of large-scale structural models.

**The Forecasting Experience of a Small Open Island Economy: The Trends, Analysis and Projections Systems at the CBTT (1981-1996)**

*Janice Christopher-Nicholls and Philip Colthrust*
Research Department, Central Bank of Trinidad and Tobago, PO Box 1250, Port-of-Spain, Trinidad and Tobago

This paper discusses the forecasting system used at the Central Bank of Trinidad and Tobago (CBTT) to generate forecasts for all major sectors in the Trinidad and Tobago economy. The paper examines in detail, the structure of the Trends, Analysis and Projections (TAP) system and its various methodologies and looks closely at forecasting performances in the various sectors of the economy over the period 1981-1996. The system has proved to be quite successful in projecting developments in the petroleum sector, inflation, money and interest rates, labor force, employment and trade and payments. The paper concludes with recommendations for an appropriate forecasting methodology and data architectures for a small open island economy.

**Fiscal Policies for the 21st Century**

*Thordur Fridjonsson*
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This paper deals with fiscal requirements in 21st century. The analysis is based on an assessment of fiscal developments and fiscal trends. An emphasis is laid on projections related to the ageing of populations and its potential effects on government budgets. After outlining scenarios based on the assumptions that present policies continue, alternative scenarios are contemplated taking account of different policy responses. In this context it is attempted to capture potential changes in the political economy of budget restraints. Thus, the discussion is within a relatively wide framework of both projections and policy evaluations.

Chair: Lars-Erik Öller

National Institute of Economic Research, P.O. Box 3116, S-103 62 Stockholm, Sweden, and Department of Economic Statistics, Stockholm School of Economics, P.O. Box 6501 S-113 83 Stockholm, Sweden

## A Technical Analysis Approach to Forecasting Policy Instruments: Combining Art and Science

*Ronald L. Giles* and Michael J. Edwards
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The question of whether technical analysis is an art or a science is an ongoing debate in the literature. The discussion has centered around financial data. However the recent disappointing growth performances of some industrial and developing countries in 1995-6 and the successive revisions of the IMF's growth estimates for several regions have highlighted the margins of uncertainty surrounding economic projections - in particular the paths of business cycles. This has lead IMF staff to conclude that economic forecasting is an art, not a science and reason that economic outcomes are often influenced by unanticipated events, and data may be inadequate, particularly for developing countries. This article considers how a technical analysis approach adds to the debate of improving economic forecasts especially but not exclusively for financial related variables and shifts in sentiment with limited time frames. The robustness of technical analysis methodology under a data revision regime is also discussed.

## Introducing Almost Contemporaneous, Total Coverage National Accounts

Karl-Gustav Hansson and *Lars-Erik Öller*
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Today, practically all economic transactions are saved electronically. However, data for the National Accounts (NA) still use manually handled and mailed questionaires and sampling. For the forecaster, this slow, inaccurate and expensive data production is a nuisance, see, for example, Öller and Tallbom, 1996. We propose that the Central Statistical Office (CSO) distributes software for volume and price indexes, compatible with NA standards. These indexes can be delivered electronically from the firm to the CSO, immediately when the period has expired. They are based on contracts and are total coverage, hence no revisions are needed. Accurate data can be fed into forecasting models, and the forecast horizon can be extended because final data are almost contempraneous. Lorry transports in Sweden are given as an example of where the system already works.

## Prediction of Country Risk by Multivariate Statistical Models

Ramazan Aktaş
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*Gönül Özer and Funda Demirel*
Undersecretariat of Foreign Trade, General Directorate of Economic Research and Assessment, Bahçelievler, Ankara, Turkey

In this study, financial failure for a country was defined as having hyperinflation, a standby agreement with IMF and the inability to pay debts on their due dates. Successful countries were defined as those not having these problems. Sample countries were selected from among the countries listed in the World Table Data published by the World Bank. A number of qualitative and quantitative variables were obtained by means of this publication. These indicators were then used as independent variables to develop the financial failure models used for discriminating failed countries from the successful ones. Logit, probit and discriminant analyses were used as the multivariate statistical techniques to develop the models predicting the financial failure one year ahead of financial failure date or discriminating the failed countries from the successful ones. Also, the usage of alternative techniques enabled us to compare their performance with respect to each other.

**A Quantitative Ab Initio Model of Forecasting the Effects of Policy Measures on the Employment Level, Trade Market Turnover, and Trade Balance**

Erik Cerven
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The domestic retail trade and labor market balance points are defined in terms of the macroeconomic variables inflation, interest rates, technical level including trade and labor market differentiation, average disposable incomes, average payroll budgets, and the propensities to consume, to sell, to hire, and to work. The difference between the trade turnover and the work input on the closed domestic market is first minimized at standard conditions and then studied as a function of these variables. This method yields numerical estimates of trade market turnover, employment level, margins for export, necessity for import, and cash flux.

Chair: **Ronald Bewley**
School of Economics, University of New South Wales, Sydney 2052, Australia

**Bayesian Inference for Time Series with Infinite Variance Stable Innovations**

*Nalini Ravishanker*
Department of Statistics, University of Connecticut, Storrs, Connecticut 06269, USA
Zuqiang Qiou
Vital Computer Services International, Inc., New Jersey, USA

This paper describes the use of sampling based Bayesian inference for infinite variance stable distributions and for time series with infinite variance stable innovations. For time series, an advantage of the Bayesian approach is that it enables the simultaneous estimation of the parameters characterizing the stable law, together with the parameters of the univariate or multivariate linear ARMA model. One difficulty with stable distributions is that their density is not available in closed form. Our approach uses a Metropolis-Hastings algorithm to generate samples from the joint posterior distribution of all the parameters. We discuss model selection and forecasting using predictive distributions and illustrate our methodology with both simulated and real examples.

**The Performance of the Estimators for Random Coefficients Models**

*Yasemin Bal*
General Directorate of Economic Research, Undersecretariat of Treasury, and Bilkent University, Ismet Inonu Bulvari, Hazine Mustesarligi EKA(18.kat), 06510 Emek Ankara Turkey
Asad Zaman
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Use of random coefficients models in econometric applications has been far less than the theoretical appeal of these models would suggest. A random coefficients model, being a Bayesian procedure in nature, specifies information about unknown coefficients in the form of a density. Random coefficients models may provide an adequate approximation to a broad class of functional forms and handle effectively the indirect effects of omitted variables and aggregation bias. There are numerous methods for estimating the random coefficients models such as maximum likelihood, methods of moments, Swamy method, Gibbs Sampler, and Bayesian estimators. Currently there is no study comparing the performance of these methods in estimating parameters. Our study aims to set up a Monte Carlo experiment to compare the estimation performance of currently available and some new methods. We also suggest some observable criteria for choosing which method to use in the actual estimation process.

**State Space Models, Vector Autoregression and Bayesian VAR: A Competition for the Forecasting of French Economic Variables**

*Alain Maurin and Jean Gabriel Montauban*
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In this paper we examine the forecasting performance of a wide variety of methods. Many authors have shown that forecasts from a VAR model are better than those from a macroeconomic model. While investigators have explored the possibilities of obtaining improved forecasts from different VAR specifications, very few recent studies have attempted to compare the performance of these different approaches. Moreover, some researchers have found that state space models produce good forecasts. Consequently, our study compared the following forecasting methods: Sims VAR, BVAR, cointegrated VAR, and state space procedures, using both quarterly and monthly French data. Results indicate a substantial gain in forecasting performance from choosing the most appropriate model.

**Bayesian Priors for VEC Forecasting Models**

*Ronald Bewley* and Minxian Yang
School of Economics, University of New South Wales, Sydney 2052, Australia

Vector Autoregressive (VAR) modeling has become increasingly popular as a method for forecasting multiple time series. However, one major problem that frequently occurs in such modeling is that a large number of parameters have to be estimated from relatively small samples. A number of suggestions have been made to reduce the parameter space In one line of research, the VAR model is reparameterised and a subset of parameters is excluded from this new space [Box and Tiao (1977), Ahn and Reinsel (1990)]. In another line of research, Bayesian priors are imposed, but typically in a manner which implies that no long-run economic relationships exist [Doan, Litterman and Sims, 1984]. In this paper an approach that preserves any cointegrating relationships while reducing the parameter space for the short-run dynamics is considered. Moreover, both exclusion and stochastic restrictions are considered in this Box-Tiao framework. The methods are illustrated using Shoesmith's (1995) data.

**Bayesian Priors for VEC Forecasting Models**

*Ronald Bewley* and Minxian Yang
School of Economics, University of New South Wales, Sydney 2052, Australia

Vector Autoregressive (VAR) modeling has become increasingly popular as a method for forecasting multiple time series. However, one major problem that frequently occurs in such modeling is that a large number of parameters have to be estimated from relatively small samples. A number of suggestions have been made to reduce the parameter space. In one line of research, the VAR model is reparameterised and a subset of parameters is excluded from this new space [Box and Tiao (1977), Ahn and Reinsel (1990)]. In another line of research, Bayesian priors are imposed, but typically in a manner which implies that no long-run economic relationships exist [Doan, Litterman and Sims, 1984]. In this paper an approach that preserves any cointegrating relationships while reducing the parameter space for the short-run dynamics is considered. Moreover, both exclusion and stochastic restrictions are considered in this Box-Tiao framework. The methods are illustrated using Shoesmith (1995) data.

Chair: **Richard Lawton**
University of Bristol, Clifton, Bristol BS8 1TH, United Kingdom

**Level Adjusted Exponential Smoothing: A Method for Judgmentally Adjusting Exponential Smoothing Models for Planned Discontinuities**

*Dan W. Williams*
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Don M. Miller
School of Business, Virginia Commonwealth University, P.O. Box 844000, 1015 Floyd Avenue, Richmond, Virginia 23284-4000, USA

Forecasters often make judgmental adjustments to the forecasts of exponential smoothing models to account for the effects of a future policy change. While this approach may produce sound initial forecasts, it can result in diminished accuracy for forecast updates and misleading signaling effects. A proposed technique lets the forecaster include policy change adjustments within an exponential smoothing model. For 20 real data series representing Virginia Medicaid expenses, forecasts are developed using the proposed technique and several alternatives, and they are updated through various simulated level shifts. The proposed technique was more accurate than the alternatives in updating forecasts when a shift in level occurs approximately as planned. Other advantages of the proposed technique include automation through final reporting when a shift occurs as planned, better detection capability when a planned shift does not occur, and ease of adjusting the forecast when new assumptions about a planned change are warranted.

**Unified Holt/Winters/Brown Exponential Smoothing**

*Klaus Zoller*
Universität der Bundeswehr Hamburg, Institut für Logistik und Organisation, Germany

A unified exponential smoothing formulation for linear trend models is proposed. It is computationally efficient, extends to both types of seasonal effects, and comprises Holt/Winters and Brown models. Comparative computational results for business data (line item sales) are presented.

**Re-Normalising the Seasonal Estimates in the Additive Holt-Winters Method**

*Richard Lawton*
University of Bristol, Clifton, Bristol BS8 1TH, United Kingdom

The Holt-Winters method of forecasting is known to have a drawback in that seasonal estimates may, over time, become contaminated with some element of the level estimate. The solution to this has been to re-normalise the seasonal estimates. One aim of this paper is to show why the method does not maintain seasonal estimates independent of the other terms in the model. It is found that a change in the trend estimate affects both the level and the seasonal estimates. These effects are counter-balancing and do not have an effect on forecasts. The paper discusses the rationale for re-normalising and explains how to do this without adversely affecting the forecasts. The paper goes on to present two variants of the method that are self-normalising and discusses their relation to the usual procedures for re-normalising. The stability, or invertibility, of the method and its variants is also discussed.

Chair: **Reinaldo C. Souza**
Grupo de Sistemas, DEE, PUC-RIO and Companhia Vale de Rio Doce, Rua Marquês de São Vicente 225 Gávea, 22453, Rio de Janeiro, RJ, Brazil

**Comparative Studies of Short Term Load Forecasting Using Hybrid Neural Networks**

Guilherme Ferreira Ribeiro, Vitor Navarro A. L. da Silva, Plutarcho Maravilha Lourenco, Celia Regina S. H. Lourenço
CEPEL - Electrical Energy Research Center
*Ricardo Linden*
UFRJ - Federal University of Rio de Janeiro

In this paper we describe a neural network that classifies and forecasts the electrical load required in one Brazilian stat throughout three years. We used mixed types of Neural Networks.

In the first case we used a standard Kohonen Self-Organizing Map (SOM) to classify the load into self-similar groups and Backpropagation network to make forecasts. In the second case we replaced the Kohonen SOM with a Neural-Gas counterpart We also provide some data for the comparison of both methods and show that loads were forecast with very small errors, which may encourage the continuation of research in this field.

**Practical Application of Neural Networks to Short-term Electricity Demand Forecasting**

*Shanti Majithia*
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Electricity demand forecasting within the National Grid Company (in England and Wales) in the operational time scale is carried out using various mathematical models. These models then use comprehensive weather forecasts supplied by the UK Meteorological Office to produce demand forecasts. These demand forecasts then become the vital input to schedule generating plants from 15 minutes to 36 hours ahead. In recent years, neural networks (NN's) have been increasingly used as an additional tool to perform short-term forecasting. They have forecast the 9 or 10 turning points in the daily electricity demand schedule (Cardinal Point demand), rather than half-hourly values. The paper discusses the process for creating an NN model and the problems encountered. Areas of potential improvement are suggested.

Accurate demand forecasts are a prerequisite to secure economic management of the power system both in terms of system security and commercial signals.

**NeuroPrev: A Neural-Net Tool for Electric Load Forecasting**

Ricardo Salem Zebulum, Marley Maria Vellasco, Marco Aurélio Pacheco
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*Reinaldo C. Souza*
Grupo de Sistemas, DEE, PUC-RIO and Companhia Vale de Rio Doce, Rua Marquês de São Vicente 225, Gávea 22453, Rio de Janeiro, RJ, Brazil

We present the software "NeuroPrev" which is used by 32 Brazilian power electric companies for forecasting monthly electric load. The "NeuroPrev" system features an Artificial Neural Network (ANN) modeled to perform the load forecasting. The ANN model employs the BackPropagation Algorithm for network training and uses a binary codification for the month as auxiliary ANN inputs. The software offers several options to the user: a demo for the toy series x+sin(x); training load series; forecasting load series; and general purpose graphs. When training and forecasting, the user may choose among the 32 companies of the Brazilian system.

To evaluate training performance, two statistics are shown graphically: the Mean Squared Error of the training process, and the forecasting error for the last observed load data, which are not included in the training process. The tool is currently used to forecast one month ahead, having as origin the last observed load value.

# Very Short Term Load Forecasting System Using Neural Networks

Luiz Sabino Ribeiro Neto

*Divisão de Apoio a Operação Energética, Depto de Planejamento e Análise de Operação, Energética, Centrais Elétricas Brasileiras S.A.* - ELETROBRÁS, Rio de Janeiro - Brazil

Marley Maria Vellasco, Marco Aurélio Pacheco, Ricardo Salem Zebulum

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This work investigates Artificial Neural Networks in Very Short Term (VST) load forecasting, with prediction leading times of 10 minutes.

A neural network VST load forecasting system has been developed and tested with real load data from CEMIG Power Electric Co., Brazil. The system involves: pre-processing, training and forecasting. Pre-processing the load series consists of two steps: preparing the load data values for training and forecasting; and interpolating missing values and fixing wrong values of the time load series. Training the artificial neural network involves submitting load patterns to the neural net using the Backpropagation algorithm. Forecasting corresponds to the neural network recall phase. The performance of the VST load forecasting system has been evaluated using the multi-step procedure, in which forecasted load values are fedback as Neural Network inputs.

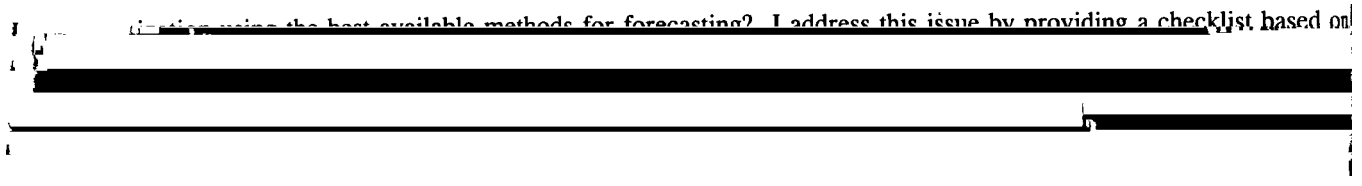
A mean absolute percentage error of 1.17% has been achieved when predicting load 144 steps ahead (24 hours).

## Panel And Presentation - Forecasting Standards And Practices

Chair: **P. Geoffrey Allen**
Department of Resource Economics, University of Massachusetts, Amherst, Massachusetts 01003, USA

**Forecasting Standards and Practices**

*J. Scott Armstrong*
The Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6371, USA



Discussants:

**Robert Fildes**
Department of Management Science, The Management School, Lancaster University, Lancaster LA1 4YX United Kingdom

**Wilpen L. Gorr**
H. John Heinz III School of Public Policy and Management, Carnegie Mellon University, Pittsburgh, Pennsylvania 15101, USA

**Marcus O'Connor**
School of Information Systems, University of New South Wales, Sydney 2052, Australia

**Stephen K. McNees**
111 Towbridge Street, #8, Cambridge, Massachusetts 02138 USA

Chair: **Robert Raeside**
Department of Mathematics, Napier University, Sighthill Court, Edinburgh EH11 4BN, United Kingdom

### Does International Trade Granger-Cause International Tourism?

*N. Kulendran* and *K. Wilson*
Department of Applied Economics, Victoria University of Technology, PO Box Box 14428 MCMC, Melbourne, VIC 8001, Australia

This study uses quarterly international trade (both imports and exports) data between Australia and four of its major trading partners: USA, Japan, UK and New Zealand to test whether there is a relationship between international travel flows (both holiday and business), and international trade.Using appropriate cointegration and Granger-Causality test procedures, the study finds that international trade Granger-causes international travel, though the extent of the relationship varies between the trading partners. These findings have important implications for the forecasting of international travel flows.

### Forecasting Domestic Tourism to Scotland

*Robert Raeside*
Department of Mathematics, Napier University, Sighthill Court, Edinburgh EH11 4BN, United Kingdom

Information is hard to obtain on the extent of tourist travel to Scotland from the rest of the United Kingdom. This problem confronts those attempting to assess the level of domestic tourism to Scotland; it is applicable to most areas of the world. Often, surveys of holidaymakers provide the main data source for producing quantitative forecasts. Attempts to model domestic tourism made by the Scottish Tourist Board using such data are reviewed in this paper. Although information used in forecasting is dubious and maintained in a cumbersome manner, forecasts can be made which are useful. A causal modelling approach is used in an attempt to determine the duration of stay of different types of individuals and the factors that might influence their decision making. Finally, I consider how to make the data set more useful for planning. As example, forecasts are produced of expenditure in different market segments.

### The Impact of a MEGA-Event: The World Championship in Athletics, Göteborg 1996

*Lars Hultkrantz*
Centre for Research on Transportation and Society, Dalarna University College, S-781 88 Borlange, Sweden

This paper studies monthly accommodation numbers data to Sweden (foreign visitors) and to Göteborg (foreign and domestic visitors) 1978-96, focusing on the impact of the World Championship July-August 1996 in Göteborg. The statistical estimations are made using two approaches: (1) transfer function modeling with seasonal ARIMA (SARIMAX) and (2) general-to-specific estimation of autoregressive distributive lags (ARDL) models.

### The Use of Composite National Indicators for Tourism Forecasting

*L. Turner, N. Kulendran* and Hubert Fernando
Department of Applied Economics, Faculty of Business, Victoria University of Technology, PO Box 14228 MCMC, Melbourne 8001 Australia

This paper identifies the usefulness of available national indicators in forecasting tourist arrivals to Australia from the USA, Japan, UK and New Zealand. Income, unemployment, forward exchange rate, money supply, price ratio, industrial production, imports and exports of the tourist's country of origin are potential leading indicators of the tourist arrival series. A composite indicator is developed to forecast tourist arrivals. To establish the causality between the indicator and international tourist arrivals to Australia, the performance of the transfer function model incorporating this national indicator is compared with ARIMA forecasts

Chair: **Hyginus Leon**
Statistics Department, International Monetary Fund, Washington, DC USA

**Forecasting Spot Exchange Rates From Futures Markets**

*John Thompson and Jason Laws*
Liverpool John Moores University, Liverpool Business School, 98 Mount Pleasant, Liverpool 5UZ United Kingdom

This paper is in the spirit of earlier literature examining the predictability of future spot exchange rates from current forward rates. However our analysis differs in its use of futures contracts traded on the Chicago Mercantile Exchange rather than using forward rates traded on the international foreign exchange market. The paper outlines the institutional framework of the contracts and examines how prices change for (i) US Dollar/Deutsche Mark; (ii) US Dollar/British Pound; (iii) US Dollar/Japanese Yen foreign currency futures. The series are tested individually for the presence of unit roots, for

**Forecasting the Dynamics of Exchange Rate Movements Using GMM and Estimating Function Methods**

*H. D. Vinod*
Professor of Economics, Fordham University, Bronx, New York 10458, USA
P. Samanta
Department of Finance and Economics, School of Business, Manhattan College, Riverdale, New York 10471, USA

A stochastic differential equation is at the heart of exchange rate dynamics. Various parameter restrictions on it lead to nine special cases which are: Merton, Vasicek, Cox-Ingersoll and Ross square root process, Dothan, geometric Brownian motion, Brennan and Schwartz, Cox Ingersoll and Ross variable rate process, and constant elasticity of variance process. We evaluate

**Modeling the Dynamic Behavior of the International Currency Market**

*Shin-ichi Tsuda*
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The Japanese economy has been affected by the international currency market People in the private sector in particular have been concerned about its movement for more than two decades.

Dynamic behavior of the international currency market shows very strong correlation between exchange rates and Japanese economic fundamentals. For example, the correlation between exchange rate and volume of exports was greater than 0.95, based on annual average of the exchange rate and data from the white paper on the Japanese economy. The analysis is intended to filter out short term fluctuations and to characterize the long term dynamics. Dynamic modeling of the currency to represent the market is also described.

It is concluded that the market principle has worked properly after the collapse of the Bretton-Woods monetary scheme importance of moderate trading is noted.

Chair: **Hans Levenbach**
Delphus Inc., 103 Washington Street, Suite 348, Morristown, New Jersey 07960, USA

### Achieving Forecasting Excellence in the Supply Chain

*Hans Levenbach*
Delphus Inc., 103 Washington Street, Morristown, New Jersey 07960, USA

To acquire excellence in forecasting in the supply chain requires a process that supports the dual objective of maximizing customer satisfaction while lowering investment costs. This presentation will provide a ten-step process to help sales forecasters and demand planners achieve more accurate, reliable and credible forecasts of product demand in their firms. Emphasis will be placed on newer methods, systems and models that have worked in practice for manufacturers and distributors in a wide range of industries. We will deal with such topics as (a) creating the forecast, (b) handling exceptions, and (c) improving accuracy through review and performance analysis.

### Forecasting in a Rapidly Changing World

*Lilian Shiao-Yen Wu*
IBM, Thomas J. Watson Research Center, Yorktown Heights, New York 10598, USA

Due to rapid product cycles and rapidly changing demand, companies are increasingly facing problems where demand is hard to forecast and where forecast errors are enormously costly. Many companies are turning to operational methods to get around this problem. Forecasters will either be participants in analyzing these new operational methods or they may not participate at all. I will give two examples of this integration of forecasting and operations. One is from the PC industry and the other from the electric power industry.

### Prediction Intervals (Safety Stock) as the Dynamic Component in Fashion Industry Forecasting

*Bill Sichel*
The Monet Group, Inc., Empire State Building, 350 Fifth Avenue, 16th Floor, New York, New York 10118, USA
*Hans Levenbach*
Delphus Inc., 103 Washington Street, Suite 348, Morristown, New Jersey 07960, USA

In the fashion industry, characterized by large sku numbers, automated forecasting systems generally reach an asymptotic level of accuracy, dependent on short-term trend cycles and aberational retail activity. Therefore, with cost and profitability pressures increasing, prediction intervals (safety stock) become increasingly important and need to be generated within automated processes and producing maximal inventory efficiency. However, error terms are not generally independent nor normally distributed, implying general statistical methods of estimating prediction intervals might not be appropriate. In this paper we suggest a simple method for determining an efficient error measure unit and how to use that measure in determining target inventory/safety stock levels in an empirical manner, providing a dynamic appendum to the forecast process in meeting customer service levels.

Chair: **Marcus O'Connor**
School of Information Systems, University of New South Wales, Sydney 2052, Australia

**Information Acquisition Strategies in the Presence of Costly Forecast Information: Experimental Evidence**

*Adrian Gardiner, M. O'Connor and R. Edmundson*
School of Information Systems, University of New South Wales, Sydney 2052, Australia

Recent research has shown individuals to be poor judges of information value. When deciding on information acquisitio strategies, they fail to offset adequately the cost of acquiring information against the possible financial gain from using th information in the decision-making process. However, research evidence supporting this conclusion is limited. Using judgmental time series forecasting task, this study provides experimental evidence on task conditions that promote and hinde individuals' evaluation of information value. The results show that individuals treat costly information differently from fr information in the decision-making process. Furthermore, individuals appeared to be more sensitive to the normative valu of the forecast information when task conditions allowed a more effective comparison between the judgmental forecast base on the historical time series and the costly forecast information.

**It Ain't What You Do, It's The Way That You Do It**

A. Alexander, ***M. O'Connor and R. Edmundson***
School of Information Systems, University of New South Wales, Sydney 2052, Australia

This paper examines the impact on forecast accuracy of task structure in a judgmental forecast. It empirically compares th accuracy of forecasts produced using three different techniques. Subjects were randomly assigned to one of three groups "smoothers", "forecasters" or "smoothers and forecasters". In the first group, subjects were asked to fit a linear "smooth" line to the cue time series and to extrapolate a similar line into the forecast horizon. In the "forecasters" group, subjects wer merely asked to forecast from the time series, and in the final group they were asked to perform the same task as th "smoothers" but to continue to develop a final forecast. Results indicate that the instructions given to a person had a significan effect on the quality of the forecasts produced. Implication for the process of forecasting are discussed.

**Judgmental Combination of Forecasts: Results from Simulation Studies**

*Ilan Fischer and Nigel Harvey*
Department of Psychology, University College London, Gower Street, London WC1E 6BT, United Kingdom

People often have to combine forecasts from different sources. A simple average can be taken. However, when some forecasters are more accurate than others, a better combined forecast can be obtained by taking individual forecasters' past performance into account. Are people able to use their judgment to do this and, if so, what factors influence its effectiveness? We report results from simulation studies designed to answer these questions.
Predictions for sales volume of a consumer product from four sources that varied in forecasting ability were displayed. People used their judgment to combine these into a final forecast. They were then informed of the product's actual sales volume for the forecast period. This procedure was repeated for a sequence of products. Mean error in the judgmentally combined forecasts depended on a number of factors, such as whether or not errors in four individual forecasts had been made explicit

Chair: Peg Young
Office of Inspector General, Department of Veterans Affairs, 810 Vermont Ave., NW, Washington, DC 20420, USA

**Composite Leading Indicators of Core Inflation for Seven EU Countries**

*Jacob A. Bikker* and Neale O. Kennedy
European Monetary Institute, Monetary, Economics and Statistics Department, PO Box 102031, 60020 Frankfurt am Main, Germany

This paper presents short-term and long-term composite leading indicators (CLI) of core inflation for seven EU countries, namely Belgium, Germany, France, Italy, the Netherlands, Sweden and the United Kingdom. CLI and CPI reference series are calculated both in terms of growth rates and in deviations from its trend. The composite leading indicators are based on leading basic series, such as sources of inflation, series containing information on inflation expectations and prices of intermediate goods and services. Neftci's decision rule approach has been applied to transfer movements in the CLIs into a measure of the probability of a cyclical turning point, which enables the screening out of false turning point predictions. Finally, CLIs have been used to analyze the international coherence of price cycles. The forecast performance of CLIs of inflation over the past raises hope that this forecast instrument can be useful in predicting future price movements.

**Detecting Turning Points from the Leading Series**

*Herman O. Stekler*
Department of Economics, George Washington University, Washington, DC, USA
*Peg Young*
Office of Inspector General, Department of Veterans Affairs, 810 Vermont Ave., NW, Washington, DC 20420, USA

The index of leading series has previously been used to predict turning points in economic activity. In the past, turning points have been identified either by using adhoc rules, such as three consecutive months of decline (advance), or by using techniques which calculate the probability that a recession (advance) will occur. Our paper investigates whether simple time series methods, which have proved useful in quality control in indicating when a process is moving outside the predetermined bounds, might also be useful in detecting when the economy is beginning to depart from its previous pattern. We present the results obtained from using tracking signals (both the CUSUM and Trigg's smoothed signals) to predict the turning points, and then compare these results to those obtained from the adhoc rules.

**Predicting Turning Points in the U.S. Economy Using a Bayesian-based Information Theoretic Model**

*Mehdi Mostaghimi*
Economics and Decision Sciences, Southern Connecticut State University, New Haven, Connecticut 06515, USA

In this research, I will present an application to the US economy of a new Bayesian methodology developed by this author for producing probability prediction of a turning point using information theory. I will show that, when composite leading indicators (CLI) are used for predictions, the optimum probability of a downturning point is reached when only two consecutive CLI are used. I will also show that the information contents of the autocorrelations for upturn and downturn are almost the same and cancel each other in producing probability of a downturn.

Chair: **Anne B. Koehler**
Department of Decision Sciences and MIS, Miami University, Ohio 45056, USA

**Testing for Short Memory in a VARIMA Model**

Timothy Oke
Department of Statistics, Uppsala University, P.O. Box 513, S-751 20 Uppssala, Sweden
***Lars-Erik Öller***
National Institute of Economic Research, P.O. Box 3116, S-103 62 Stockholm, Sweden, and Department of Economic Statistics, Stockholm School of Economics, P.O. Box 6501 S-113 83 Stockholm, Sweden

We suggest a way of testing the short-term memory of a time series model, when in addition to significant estimates of univariate parameters, a linear relationship to an exogeneous variable is found to be significant. This generalizes the univariate short memory in Öller (1985). Cointegration may also add to the memory. A VAR model of Swedish exports and OECD demand illustrates the method.

**Using Step Interventions to Detect Shifts in Laboratory Instruments**

***Fred Andres*** and Melinda Walker
Anheuser-Busch, Inc., One Busch Place, St. Louis, Missouri 63118, USA
Stephen Cole
Trilogy Consulting Corp., 850 S. Greenbay Road, Waukegan, Illinois 60085, USA
***David Reilly***
Automatic Forecasting Systems, Inc., P.O. Box 563, Hatboro, Pennsylvania 19040, USA

We compare two techniques for detecting shifts in the response of laboratory instruments such as a Gas Chromatographs. The first is classical control charts. We show that it has several shortcomings. The second is to build an ARIMA transfer function model of the process including input series representing factors which may effect measurements such as changes in instrument equipment, instrument calibrations, or control samples. Then we search for step interventions in the residuals. The latter are indicative of the unexplained shifts we seek. The second technique, although intricate, is easily implemented using AUTOBOX.

**EWMA Tracking Signals for ARMA Models**

***Anne B. Koehler*** and Neil B. Marks
Department of Decision Sciences and MIS, Miami University, Ohio 45056, USA

The goal of this paper is to adapt the Lucas and Saccucci methodology for determining EWMA control charts to tracking signals when forecasting with ARMA models. Tracking signals for ARMA models are related to algorithmic control charts.

Algorithmic control charts fit ARMA models to the time series data to be controlled and use Shewhart control charts on the residuals. For the tracking signals in this paper, EWMA control charts replace the Shewhart charts. First, previous knowledge about the effect of a shift in the mean of the time series on the residuals from an ARMA model is used to compute the formulas for the residuals. Then it is shown how these formulas can be combined with the Markov chain approach of Lucas and Saccucci to compute the average run lengths required to detect a shift in the mean of the time series. Results of ARMA (p,0) models are generated, and an approximation method is developed for the more difficult ARMA (0,q) models.

Chair: **Len Tashman**
School of Business, University of Vermont, Burlington, Vermont 05405, USA

**Can You Trust the Prediction Intervals in Forecasting Software?**

*Len Tashman*
School of Business, University of Vermont, Burlington, Vermont 05405, USA

When applying the same method to the same data, most forecasting packages will provide very similar point forecasts. What differences remain are due mainly to variations in the technical settings for the computation algorithms (e.g., starting values). When it comes to interval forecasts - the confidence intervals about the point forecasts - the discrepancies between programs can be huge and their underpinnings fundamental rather than technical. Nor do software manuals typically detail the methodologies employed for calculation of prediction intervals.

This presentation will illustrate the discrepancies in the prediction intervals we see in forecasting software, discuss the main sources and offer an alternative approach to assessing the uncertainty surrounding the point forecast. The discussion will be non-mathematical and aimed at the forecasting practitioner

**Further Evidence On Why Prediction Intervals Are (Almost) Always Too Narrow**

*Bernard J. Morzuch and P. Geoffrey Allen*
Department of Resource Economics, University of Massachusetts, Amherst, MA 01003 USA

In a previous study we used the naive no-change forecast method on the non-seasonal series of the Makridakis 1001 series. We performed within-sample misspecification tests to detemine the adequacy of post-sample prediction intervals. Evidence suggested that using a forecasting method only when it is appropriate does improve post-sample performance. Where the model was well-specified, post-sample prediction intervals for the group of series were generally well-calibrated; when tests revealed that the model was a misspecification, prediction intervals were not well-calibrated. For this random walk model, only one hyperparameter (the variance) needs to be estimated.

Parameter variability in models that assume parameter constancy appears to be a key reason for poor post-sample performance. We repeat our exercise with a more complex model which contains parameters assumed to be constant through time. Under these circumstances, parameter constancy tests are required as well. Post-sample comparisons are made in a similar way.

**Probabilistic Revenue Estimates for State and Local Government Budgeting**

*Ray D. Nelson*
Institute of Business Management, Brigham Young University, Provo, Utah 84602, USA

Recent innovations in simulation software and methodology show potential for improving state and local government planning and budgeting. Depicting revenue forecasts as probability distributions augments the decision makers information set in two very significant ways. First, it allows planners to consider the median and mode as well as the expected value as central tendency measures of potential outcomes. Second, it encourages planners to consider the implications of dispersion and asymmetry on budgeting decisions. Readily available add-in spreadsheet software facilitates the assignment of probabilities by state and local decision makers to a full range of possible fiscal outcomes. The discussion of the application of probabilistic forecasts to tax revenue estimates first considers probability distributions as implemented in the simulation software. Then, alternative methods for interpreting simulation results follow. Throughout the discussion, an example of the major tax revenue sources for the State of Utah illustrates the proposed methodology.

Chair: **Len Tashman**
School of Business, University of Vermont, Burlington, Vermont 05405, USA

## Can You Trust the Prediction Intervals in Forecasting Software?

*Len Tashman*
School of Business, University of Vermont, Burlington, Vermont 05405, USA

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Chair: **Wilpen L. Gorr**
H. John Heinz III School of Public Policy and Management, Carnegie Mellon University, Pittsburgh, Pennsylvania 15101, USA

**Ibovespa Neuro-Fuzzy Forecasting a Case Study in the Brazilian Capital Market**

Maria Augusta Soares Machado
Department Engeering Elétrica, Pontícia Universidade Católica, Rio de Janeiro, Brazil
Luiz Alfredo Rodrigues Gaspar and Antônio de Araújo Freitas
Information Systems Reasearch Dept., Brazilian Institute of Capital Markets, Rio de Janeiro, CEP 20040-001, Brazil
*Reinaldo Castro Souza*
Grupo de Sistemas, DEE, PUC-RIO and Companhia Vale de Rio Doce, Rua Marquês de São Vicente 225, Gávea, 22453, Rio de Janeiro, RJ, Brazil

This paper presents an application of a neuro-fuzzy model, which is a fuzzy inference system implemented in the framework of neural adaptive networks, developed to make crisp predictions for the very liquid IBOVESPA nominal spot index values occurring at each five minutes in every trading day in BOVESPA's STOCK EXCHANGE. The obtained results are preliminaries, and we are now working in two different lines of research, modifying the time windows and including technical and fundamental input numeric values treated as linguistic variables.

**Neural Networks, Discriminant Analysis and Corporate Performance: Do they have Predictive Capability for the Barbados Case?**

*Marion Williams*
Central Bank of Barbados, P.O. Box 1016, Bridgetown, Barbados
John Nankervis
Department of Economics, University of Surrey

Neural networks systems are intended to provide automatic diagnosis of corporations so as to estimate their performance and predict their future state of health. This paper examines the extent to which a neural network system can assist in the diagnosis of the performance of the corporate sector in Barbados and whether discriminant analysis is more appropriate. It examines the case of banks as a starting point for building a neural network system, and analyses the difficulties of applying this system in a small sample environment. Comparisons are conducted with the standard discriminant analysis technique as a means of prediction, with special regard to relative transparency, precision and reliability. An empirical analysis is conducted for the case of banks in Barbados through application of the technique of multiple discriminant analysis

**Spatial Neural Network Forecasting Methods with Application to Municipal Crime Early Warning Systems**

*Wilpen L. Gorr* and Andreas Olligschlaeger
H. John Heinz III School of Public Policy and Management, Carnegie Mellon University, Pittsburgh, Pennsylvania 15101, USA

Cellular automata and chaos theory provide a framework for the design of a spatial neural network model. The model uses inputs from a space/time series of aggregate monthly data observations over a uniform spatial grid assembled using geographic information system processing. Inputs to a single hidden layer are from the current observation cell and its eight (queens case) contiguous neighbors. A standard sigmoid activation function is used, along with feed forward/back propagation estimation. The forecast model is a multivariate model with crime leading indicators, and provides one-month ahead forecasts - exactly what police need for tactical deployment. Empirical results on hold-out forecast performance compare the random walk, standard spatial econometric models, and spatial neural network models based on a data set with over 14,000 space/time observations from the Pittsburgh Drug Market Analysis Program.

**Forecasting the Effect of Proliferation Policies and their Neuro-Fuzzy Validation**

Claudio D. Antonini
University of Pretoria, South Africa

Although the Cold War is over, the proliferation of weapons of mass destruction continues unabated, though for different reasons and using different mechanisms, calling for the development of new policies. The objective of this study is to validate a regional proliferation model with historical data, using an adaptive neuro-fuzzy inference scheme. Proliferation dynamics in a country were described by constructing a fuzzy model based on a number of premises (typically including economical, political and social aggregated variables). Interaction with models of other countries, made the model regional.

Limitations in the current modelling approach are highlighted, such as the overuse of aggregated variables and the limited temporal validity of assumptions. Whenever appropriate, alternative approaches are suggested. Examples of validated models are presented.

The methodology considered in this article is applicable wherever one needs to forecast the effects of policies and to validate the models used in the simulation.

Chair: **Gerald J. Lobo**
School of Management, Syracuse University, Syracuse, New York 13104, USA

**Accuracy of Alternative Methods of Forecasting Compensation Expense Related to Stock Options**

*Gerald J. Lobo*
School of Management, Syracuse University, Syracuse, New York 13104, USA
Joseph C. Rue
School of Business, Florida Gulf Coast University, Fort Myers, Florida 33902, USA

A source of controversy among accounting policy-makers and professionals is whether stock options should be recognized as an expense and the appropriate measurement of the expense. We provide evidence on the accuracy of compensation expense estimates obtained from two models for measuring compensation expense: the Minimum Value model and the Black-Scholes model. Using a sample of 116 firms we find wide variation in the compensation expense estimates obtained from the Black-Scholes and the Minimum Value models. While the Black-Scholes model significantly overestimates the actual compensation expense, the Minimum Value model significantly underestimates it. A sizable decrease in income would result from recognizing compensation expense, especially if the Black-Scholes model is used for measuring it. The current accounting method of not recognizing compensation expense when the exercise price is greater than or equal to the market price on the grant date has the potential for significantly overstating reported earnings.

**Auditor Conservatism and Analysts' Fourth Quarter Earnings Forecasts**

*Sudipta Basu* and LeeSeok Hwang
Baruch College, The City University of New York, 17 Lexington Ave., New York, New York 10010
Ching-Lih Jan
California State University - Hayward

Prior research shows that analysts' earnings forecast errors for the fourth quarter are significantly larger than those for any other quarter. Arguing that auditors determine earnings more conservatively than managers do, we show that the frequency of losses and negative special items is highest in the fourth quarter. 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 of our sample, regardless of the forecast horizon. Further, forecast errors are always higher for loss firms in the fourth quarter compared to earlier quarters. We document similar results for firms reporting special items, partitioned by the sign of the special items. Our results are consistent with our predictions for how auditor conservatism affects fourth quarter earnings differentially, compared to earlier quarters, which in turn causes analysts' earnings forecasts for the fourth quarter to be poorest.

**Informativeness of SFAS No. 14 Segment Information: Evidence From Financial Analysts' Forecasts**

Sung S. Kwon
School of Business, Rutgers University--Camden, Camden, New Jersey 08102, USA
*Gerald J. Lobo*
School of Management, Syracuse University, Syracuse, New York 13104, USA
Gordian S. Ndubizu
School of Business, Drexel University, Philadelphia, Pennsylvania 19104, USA

This study examines the effects of segment information disclosed under SFAS No. 14 on the accuracy and divergence of financial analysts' earnings forecasts. It hypothesizes that financial analysts' earnings forecasts will be more accurate and less divergent following SFAS No. 14 disclosures which provide additional information about segments beyond extant disclosures. The study uses a matched-pairs design to compare earnings forecast accuracy and divergence in periods prior to and following disclosure of SFAS No. 14 segment information. The empirical analysis, conducted on a sample of 78 firms that reported segment information, indicates that analysts' earnings predictions were more accurate following disclosure of this information. Additionally, there was less divergence across financial analysts' forecasts after these segment disclosures. Based on these results, we conclude that the information in SFAS No. 14 segment disclosures is utilized by financial analysts to generate more accurate earnings forecasts which have lower levels of uncertainty.

## Panel: Forecasts For Project Appraisal And Management

Session organized by the Barbados Economics Society

Chair and Moderator: **Peter Whitehall**
Central Bank of Barbados, PO Box 1016, Bridgetown, Barbados West Indies

The panel discussion will focus on the use of forecasts in project appraisal and management in Barbados and the Caribbean. It will address practical and contemporary issues in forecasting of relevance to Caribbean officials. For instance the observation that some seemingly good projects have become spectacular failures and in general the need to encourage more Caribbean businessmen to engage in serious forecasting. Consideration will also be given to the different forecasting approaches used by lenders, business managers and venture capitalists in the Caribbean.

Discussants

**Darcy Boyce**
Managing Director, KPMG Consulting, Barbados

**David Shorey**
Chief Executive Officer, David Shorey Associates, Barbados

**Clairvair Squires**
Chief Projects Officer, Caribbean Development Bank, Barbados

Chair: **Nigel Harvey**
Department of Psychology, University College London, United Kingdom

**The Effectiveness of Contextual Information in Judgemental Time Series Forecasting: An Empirical Investigation**

*Meliha Handzic*
School of Information Systems, University of New South Wales, Sydney 2052, Australia

The contingent model of human information processing suggests that the effectiveness of contextual information in improving judgmental forecast performance may be dependent upon various task and environment factors. Using a contingent framework, a laboratory experiment was conducted to investigate whether the utilization and performance impact of contextual information in a time series setting would vary as a function of information reliability and cost function. The findings indicate that high-reliable information led to performance superior to low-reliable information despite more reduced and selective information utilization. The response to cost function was in the appropriate direction suggested by the normative model. Accuracy-and-time based cost, as opposed to accuracy-only cost, led to accelerated information processing without a significant detrimental effect on performance. These findings provide an optimistic view of human adaptivity in terms of the ability to take advantage of task and context to perform at competitive levels while saving the cognitive effort.

**Are Judgmental Forecasts Characteristically Overconfident?**

*Peter Ayton*
Department of Psychology, City University, London, United Kingdom
Alastair McClelland
Department of Psychology, University College London, London, United Kingdom

The overconfidence phenomenon, reported in numerous calibration studies (e.g., McClelland and Bolger, 1994), has often been explained as a characteristic of human information processing. Some researchers have implicated the operation of the anchor and adjust heuristic (Ferrell and McGooey, 1986); ignorance of processing limitations (Pitz, 1974); motivation (Milburn, 1983) and cognitive optimism (Dawes, 1980). However, "ecological" theorists claim that overconfidence is essentially an artifact. Gigerenzer et al (1991) argue that individuals are well adapted to their environments and do not make biased judgments. Overconfidence is observed because the typical general knowledge quiz used in experiments contains a disproportionate number of misleading items. More recently another group (Erev, Wallsten and Budeçu, 1994) have suggested that overconfidence may reflect a stochastic component of judgment that creates a regression that appears as overconfidence in calibration analysis. In this paper we consider the implications of these developments for accounts of judgmental forecasting.

**Heuristics and Biases in Judgmental Forecasting**

*Fergus Bolger*
Centre for HCI Design, City University, Northampton Square, London EC1V 0HB, United Kingdom
*Nigel Harvey* and Alastair McClelland
Department of Psychology, University College London, United Kingdom

Armstrong (1985) has proposed the following stages in the forecasting process: implementation (i.e. formulation of the forecasting problem); choice of method; application of method; comparison and combination of forecasts; adjustment of forecasts; and evaluation. Judgment, for instance, of probabilities or of the values of important variables must be exercised at each of these stages. More than two decades of research in the psychology of judgment and decision making has shown that people often rely on heuristics to make unaided judgments and that this can lead to bias (see e.g. Kahneman, Slovic and Tversky, 1982). Some heuristics which are relevant to forecasting are representativeness, anchor-and-adjust, and availability. In this paper we will present evidence from our own research, and that of others, of the use of these heuristics both within the application of judgment as the principal forecasting method, and at other stages in the forecasting process.

## Leading Indicators II - Incorporating Probability

Chair: **Roy Batchelor**

Department of Banking and Finance, City University Business School, Frobisher Crescent, Barbican London, EC2Y 8HB, United Kingdom

### A Further Note on the Three Phases of the US Business Cycle

*Allan P. Layton*
School of Economics and Finance, Queensland University of Technology, GPO Box 2434, Brisbane, Australia 4001

Using a number of alternative approaches, Sichel (1994) demonstrated evidence supporting the notion that the US business cycle is best characterised as having three distinct phases, viz contraction, followed by rapid expansion during the early stages of the recovery phase, followed by a period of more normal expansionary growth, with the cycle then repeating itself. This contrasts with the more usual expansion/contraction, two phase characterisation but is more in keeping with the original notion of the business cycle as conceived by Burns and Mitchel (1946). Here an alternative approach is employed for shedding light on this issue. Following the original suggestion of Hamilton (1989, 1990, 1991), a simple non-linear, three phase, regime switching markov model is compared against its simpler two phase version to determine which version is statistically more consistent with the business cycle historical evidence. The evidence seems to clearly support the three phase characterisation and that this characterisation yields interesting information on business cycle dynamics which is necessarily missed by the two phase model formulation.

### Confidence Indexes and the Macroeconomy: A Markov Switching Model

*Roy Batchelor*
Department of Banking and Finance, City University Business School, Frobisher Crescent, Barbican London, EC2Y 8HB, United Kingdom

This paper investigates timing relationships between indexes of consumer and business confidence and indexes of the state of the economy, using data from the U.S. and a number of European economies. The time series involved are characterized as Markov switching processes with time-varying switching probabilities. Almost all the confidence indexes contain information helpful in anticipating switches from good to bad macroeconomic regimes (from normal times to recession). Business confidence indexes are more significant for the more open European economies, and consumer confidence performs better in the U.S. Paradoxically, the overall confidence indexes generally outperform apparently forward-looking indexes of business and consumer expectations. And simple two-regime switching models appear more insightful than more complex multi-regime models, and models with superimposed autoregressive processes.

### Forecasting Turning Points with Probabilistic Leading Indicators

*Lasse Koskinen*
National Institute of Economic Research, P.O. Box 3116, S-103 62 Stockholm, Sweden
*Lars-Erik Öller*
National Institute of Economic Research, P.O. Box 3116, S-103 62 Stockholm, Sweden, and Department of Economic Statistics, Stockholm School of Economics, P.O. Box 6501 S-113 83 Stockholm, Sweden

A Markovian state-switching time series model is applied to construct leading indicators for the Swedish economy using a Hamilton estimation method. This method gives probability forecasts for the leading indicators and states of the economy. A rule is derived for deciding on the business phase of the lagging series, which in turn yields probability forecasts for turning points. An analogous method is used in pattern recognition. Here the main emphasis is on developing probabilistic decision rules. This work is closely related to the evaluation of probability forecasts, since careful evaluation makes it possible to avoid ad hoc rules. In general, the probabilistic approach used provides a flexible and informative way to make forecasts.

Chair: **K.G.P. Matthews**
Cardiff University, Colum Drive, Cardiff CP1 3EU, United Kingdom

**Can a Nonlinear Model Improve Forecasts of UK Private Consumption?**

*Ann-Charlotte Eliasson*
Stockholm School of Economics, PO Box 6501, S-113 83 Stockholm, Sweden

Several studies claim that the so-called DHSY model for UK private consumption fails to explain consumption behavior outsid the original observation period. In this paper, we argue that this failure is because the DHSY model disregards aspect o nonlinearity. Performing a linearity test, we find evidence of nonlinearity even in the original observation period. A smoot transition regression (STR) model is used for modeling the nonlinearity. Out-of-sample forecast performance of the STR mod is compared to that of the original ECM specification as well as that of a time-varying parameter autoregressive (or structura model.

**On the Partial Adjustment Model When Time Series Variables are Unstable**

*Cuthbert George*
De Montfort University Milton Keynes, The School of Social Sciences, Department of Economics, Hammerwood Gat Kents Hill, Milton Keynes MK7 6HP, United Kingdom

This paper evaluates the partial adjustment model in the light of recent developments in the econometric analysis of th individual and joint properties of time series variables. The model nests random walk, equilibrium, stability and instabilit tests as special cases; depicts the basic model for deriving a latent long-run or cointegration relationship between time serie variables; and suggests the long-run and short-run approaches to testing for cointegration between time series variables to b found in the literature. Empirical evidence on money demand reported and analyzed suggests that money causes income and not vice versa in Barbados - a less developing country.

**Rational Expectations, Partial Current Information and Macroeconomic Forecasting**

*K.G.P. Matthews*
Cardiff University, Colum Drive, Cardiff CP1 3EU, United Kingdom
A.P.L. Minford and S.C. Blackman
Liverpool University

Previous attempts at modeling current observed endogenous financial variables in a macroeconomic forecasting model have concentrated on only one variable - the short term market rate of interest.

Forecasting efficiency of key macroeconomic variables was improved by between 1% and 25%. This paper applies th techniques of signal extraction to all the observed current endogenous variables (interest rates and exchange rate) in a rational expectations model of the United Kingdom economy. The informational advantage of applying the signal extraction algorithm to all the current observed endogenous variables is evaluated in terms of the forecasting efficiency of the model.

Chair: ***David F. Hendry***
Institute of Economics and Statistics, Manor Road, Oxford, OX1 1NF, United Kingdom

## RECENT ADVANCES IN UNOBSERVED COMPONENTS MODELLING

***Peter C. Young and Diego J. Pedregal***
Centre for Research on Environmental Systems and Statistics
Lancaster University, Lancaster LA1 4YQ, UK

This paper presents some recent advances in Unobserved Component (UC) model identification, optimisation and estimation. The UC model is considered in two basic versions: a univariate Dynamic Harmonic Regression (DHR) form, where the series is represented by the usual sum of low frequency trend, cyclical, seasonal and irregular components, but with the seasonal component modelled by a non-standard, time variable parameter, harmonic regression relationship; and a more comprehensive Data-Based Mechanistic model form, where these components are expanded to allow for linear or non-linear effects arising from the variations in measured input or exogenous variables. In this latter case, the additional components can take the form of static (possibly nonlinear) regression relationships involving the exogenous variables; or they may arise from dynamic influences, with the exogenous variables affecting the series through (possibly nonlinear) dynamic models. Optimisation of the hyper-parameters in the UC models (e.g. the noise variance ratio and other parameters in the stochastic state-space models of the various components) is carried out in a variety of ways, depending upon the nature of the model. In the univariate case, the exceptional spectral properties of the DHR model allows for the development of a novel method of estimation in the frequency domain, where the logarithm of the model pseudo-spectrum is fitted to the logarithm of the empirical AutoRegressive (AR) spectrum

This overall approach to UC modelling has proven successful in the analysis, forecasting and seasonal adjustment of many different kinds of nonstationary and nonlinear time series in a variety of different areas. The practical examples discussed in the paper will include electricity load demand forecasting in UK; tourism demand in Spain; phone calls offered by a UK credit card company; unemployment in the US over the past 50 years; seasonal adjustment of the UK Labor Force Survey data; the analysis of long term temperature variations in a US river catchment; and nonlinear rainfall-flow modelling in a variety of Countries

Chair: **J. Scott Armstrong**
The Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6371, USA

**Forecasting the Diffusion of Innovations**

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Innovation diffusion is a complex process occurring under many different circumstances. These include straightforward diffusion of a new technology, substitution of a new technology for an old or a new generation in an evolving technology. This study draws on several empirical evaluations of forecasting performance of different diffusion models with the aim of providing guidelines for model choice and model evaluation.

**Principles for Applying Adaptive Bayesian Pooling Methods**

George Duncan, ***Wilpen Gorr***, and Janusz Szczypula
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Often an organization's decision and forecasting problems involve multiple, related time series; e.g., related products or services, and/or multiple sales or service territories. Adaptive Bayesian pooling methods use cross-sectional data from such related series for improving both the forecast accuracy and adaptiveness of individual, univariate time series models. This paper presents principles for applying pooling methods on issues including 1) use of full Bayesian methods versus heuristic methods, 2) clustering methods for pooling time series based on causal models versus co-movement of series, 3) monitoring cluster membership over time and 4) handling the first forecast after a pattern change. Empirical support comes from two comparative studies, one on school district revenues and one on infant mortality. The second case provides negative results for pooling and demonstrates an important principle that must not be violated.

Discussant: **Ronald Bewley**
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Chair: **Stephen F. Witt**
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## A Comparative Study of the Forecasting Performance of Tourism Demand Models

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Considerable advances in econometric methodology during recent years have largely been ignored in the area of tourism modelling and forecasting. This paper aims to examine the applications of recent developments in econometrics, such as cointegration, error correction, VAR and time varying parameter techniques, to the analysis and forecasting of international tourism demand. The results of the forecasts generated from these models are compared with those of the traditional tourism demand specifications.

## Forecasting Tourist Arrivals to Barbados

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Accurate forecasts of tourist arrivals are vital - particularly for macroeconomic policy-planning - given that tourism is Barbados' leading foreign-exchange earner and a significant contributor to GDP. Past studies [Clarke (1978), Metzgen-Quemarez (1976), Carey (1991)] have focussed on explaining, rather than forecasting tourism demand, although recently some researchers [Dharmaratne (1995) and Dalrymple-Greenidge (1996)] have used ARIMA modeling to generate tourist forecasts

In this paper, a theoretical model which seeks to explain long stay tourist arrivals to Barbados is first formulated. This model is then estimated using VAR methodology and subsequently used for forecasting. The accuracy of this multivariate model is tested against an ARIMA model - which is used as a benchmark - and if proved to be superior, various criteria are employed to judge and possibly improve its accuracy. The final model should provide reasonable forecasts of tourist arrivals to Barbados and also be a guide for tourism policy-makers

## Modeling and Forecasting UK Outbound Tourism

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Cointegration analysis is used to model UK outbound tourism. This approach examines the long-run relationship between the demand for holiday visits and the factors that influence holiday travel such as income, destination prices, airfares and prices of substitutes. Demand functions are estimated using quarterly data on tourist flows from UK to USA, France, Greece, Italy, Netherlands, Portugal and Spain. The forecasting performance of the error correction model (ECM) is compared with regression models.

Chair: **Hyginus Leon**
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**Forecasting Exchange Rate Volatility: Evidence from Three Caribbean Countries**

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During the last five years, three Caribbean countries adopted floating exchange rate systems. This paper examines the abili of both linear and non-linear models to forecast exchange rate volatility for Guyana, Jamaica, and Trinidad and Tobago. Dail exchange rates from 1993 are analyzed using different parameterisations for the mean, variance and error distribution of th GARCH model. The results show evidence of significant GARCH effects, but also suggest that other factors may be neede to account for the unexplained variability. One concern facing policy makers is whether small changes in the exchange ra may lead to large changes in ensuing periods. This possibility of chaotic behavior is explored using the correlation dimensio and Lyapunov exponents. Our initial results support evidence of non-linear stochastic behavior, do not provide strong eviden of chaotic behavior, and suggest that reliable forecasts may only be possible on a limited short-term basis.

**Nonlinear Modeling of Return Series of Daily Exchange Rate**

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There is evidence of nonlinear behavior in return series of daily exchange rate. This paper focuses on the modeling of bo the nonlinear conditional mean and the nonlinear conditional variance of high-frequency data. A STAR model is used fo modeling the conditional mean with a GARCH type parametrization for the conditional variance. The STAR and GARCH par of the model are jointly estimated by maximum likelihood. Out-of-sample forecast performance of the models is compare with a pure GARCH parametrization with a constant conditional mean.

**The Informational Content of Weighted Implied Volatilities Derived from Foreign Currency Options**

*Jason Laws and John Thompson*
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This paper examines the efficacy of "weighted implied volatility" as a good pinpoint estimate of future volatility using foreig currency options quoted on the PHLX. Often, many options whose characteristics differ only in respect to the strike price a written at any one time. If the Binomial Option Pricing Model (BOPM) held exactly these options would be priced so that th have exactly the same implied volatilities. However systematic deviations from the predictions of the BOPM are frequent observed. The implied volatilities of each of these options can then be combined using various weighting schemes to formula a point estimate of future volatility. We test whether the implied volatility information contained in these "volatility skew contribute a statistically significant amount of information about future volatility over a short-term forecasting horizon. I particular we compare their forecasting performance against volatility forecasts derived from at-the-money options and fro a simple GARCH(1,1) model.

**Smoothing Data Using Locally Weighted Regression: Applications to Forecasting Exchange Rates in Trinidad an Tobago**

Charles de Matas
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Many non-linear models have been tested in an attempt to improve on forecasts over the random walk. These models hav often been used to predict exchange rates. So far none of the models tried has shown statistically significant improvement ov the random walk. In this paper we try to justify in a theoretical way the use of weighted least squares in predicting exchang rates. Estimators for parameters in a nonlinear model are obtained using weighted least squares. Sufficient conditions for the estimators to be asymptotically unbiased are derived. The TT/U.S. dollar daily exchange rates for 1993/1994 were used as da to obtain out-of-sample estimates for exchange rates and these were compared with actual data to obtain R.M.S. errors. A parameter used in the weighting function was varied to check whether there was an optimum value of this parameter. Th results indicate that such an optimum weighting parameter exists but that this optimum value is dependent on the data set.

Chair: **H.O. Stekler**
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**Are Sports Seedings Good Predictors?**

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Very little attention has been given to many of the predictors of the outcomes of sporting events. While studies have examined the accuracy of alternative methods of predicting the outcomes of thoroughbred horse races, some obvious predictors of the outcomes of other sporting events have not been examined. In particular we will evaluate whether rankings (seedings) are good predictors of the actual outcomes in two sports: (1) US collegiate basketball and (2) professional tennis. In this analysis we will use statistical probit regressions with the difference in rankings as the predictor of the outcome of games and/or matches.

**"Foreteler": A System for Forecasting Television Ratings**

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Television viewing behavior is considered to be composed of three major components: the daily viewing habit, the competitive environment and programs of special interest. A specific decomposition technique has been developed in order to quantify each of these components.

As soon as the next month's program for each channel becomes available, the competitive environment and special interest shows, are identified and for any given quarter hour and any age and gender, the major components are combined to produce a ratings forecast for the following 30 days.

Specialized software, named "FORETELER," has been developed to process the very large data base of daily viewing records and to produce detailed periodic records. Forecasting accuracy is within the acceptable error of $\pm$ 2 GRP's (Gross Rating Points) more than 80% of the cases.

**The Sources of Variation in Medicaid Forecasting**

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This paper examines the sources of variation in Medicaid forecasting. There are 55 Medicaid programs in the United States and territories. Each program submits from 7 to 11 (depending on the federal rules in place) forecasts to the Health Care Financing Administration for each fiscal year, one each quarter beginning approximately 10 quarters before the end of the fiscal year. A 1993 survey identifies some forms of variation in forecasting approaches among 45 of these Medicaid programs. In this paper variation in forecasting techniques, management practices and governmental conditions are examined for their impact on forecasting accuracy.

**Modeling Air Pollution in Vitória, Brazil, Using Techniques of Long Memory Models**

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This work presents some results of modeling air pollution using techniques of long memory models. The data analyzed, $SO_2$ (sulfur dioxide), was collected in a monitoring station in the area of the Great Vitória City, E.S., Brazil. Our analyses consist of choosing an appropriate model of long memory or short memory to fit the data. The final decision is based on the mean square error forecasts. The above technique is also used to analyze simulated data generated by a Gaussian Plume Equation. These data describe the dispersion of air pollutants emitted by the 96 major chimneys of the region under meteorological conditions that represents its atmospheric dispersion capacity during a fourteen months period.

Chair: **Robert Fildes**
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## A Comparison of Forecasted to Actual Values of Central Processing Unit Workloads for an MCI® Data Center Using the Autoregressive Integrated Moving Average Methodological Construct

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The marriage of MCI® and British Telecommunications has created an enormous worldwide computing network with over one billion dollars in computing assets. It serves thousands of distributed interactive users and is managed from several very large central electronic complexes containing arrays of central and distributed computers. In order to effectively manage these corporate assets, decision makers need accurate forecasts of mainframe workload performance in order to justify requests for acquisition of new central processing units.

This paper describes our use of the Autoregressive Integrated Moving Average technique to accurately forecast workload consumption of mainframe resources with 95% statistical confidence. Moreover, in order to facilitate calibration of these models, and to demonstrate their robustness, we demonstrate how we use them to recursively compare forecasted to actual values of CPU consumption. Finally, in order to graphically illustrate the models' performance, we have written an interactive, data driven SAS® Executive Information System.

## An Evaluation of Models of Telecommunications Demand

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Paul Bottomley
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The last decade has seen rapid advances in telecommunications technology. These developing markets typically consist of new entrants taking up the generic service for the first time, established users changing their usage patterns, users of competing services shifting to the new service and those exiting from this segment of the market altogether. This paper examines a number of telecommunications services and evaluates various models that have been used to understand the market's dynamics. Alternative classes of model include a disaggregate choice modeling approach or an aggregate diffusion based model but the successful modeling of these markets has been limited by data problems. The paper concludes with some suggestions as to how these problems can best be overcome.

## Residential Electrical Energy Consumption Profile in Brazil

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The explosive growth in electrical energy consumption in Brazil for the past 3 years has made demand analysis fundamental for planning and control. Several efforts are currently being made to create a residential consumer profile in different areas of the country. Due to the diversity in social and economic indicators throughout the country, an ordinary sample plan based on the number of consumers in each town is not appropriate, even when analyzing individual states. We propose an alternative sampling plan, where stratification is based on clustering. These clusters are created from the notion of an "electrical distance" which compares consumption in each town with average values for each utility company.

**Forecasting the Development of the Market for International Telecommunications in France**

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The problem of producing medium to long-term forecasts of the market for international telecommunications in France is examined. This market is particularly sensitive to the highly competitive and deregulated world market.

Two approaches are investigated: growth curves with a fixed saturation level and with saturation levels determined by explanatory variables. In the second approach, linear econometric models are used for medium and long-term forecasts, while ARIMA models are used solely for medium-term forecasts. The first approach is appropriate for forecasting developing markets, generally for international traffic from France to many developing countries. The second approach is appropriate for mature markets, that is, for traffic among European Union and OECD countries.

The accuracy of forecasts generated by different forecasting models is examined and used to build a selection strategy for optimal forecasts at different lead times.

Chair: **Antonio Garcia-Ferrer**
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**Consumer Price Perceptions and Expectations Derived from Survey Data and Their Usefulness for Monetary Policy**

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This paper discusses the information content of the monthly EU consumer anticipations survey for inflation in the Netherlands. We first show how to translate these qualitative data to quantitative information regarding expected inflation. After discussing the empirical properties of these inflation expectations, the empirical relationship between current inflation expectations and future inflation is investigated. This could be an important guideline for monetary policy, and relevant in the face of the discussion regarding direct inflation targeting strategies.

**The Use of Leading Indicators in Short-Term Forecasting**

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In Switzerland most of the quantitative macroeconomic time series serving as indicators of real economic activity are published only quarterly. Also, some are released by the National Statistical Office with a time lag of almost a quarter. To meet the need for regular monthly information about the current and future status of the economy, a composite coincident and leading index has been developed at the Swiss Institute for Business Cycle Research (KOF/ETH).

Starting with a set of macroeconomic indicators covering the economy's real and financial sectors, typical coincident and leading indicators are identified using cross-correlation analysis. Next, the coincident indicators are aggregated into one single monthly index. The leading indicator's information content with respect to the coincident indicator is examined more accurately using descriptive statistics (coherence and phase shift, turning point analysis) and Granger-tests. Finally, its ability to forecast gross domestic product's growth rates is investigated for various prediction horizons.

**Combining an Early Warning Indicator and Qualitative Turning Point Information**

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The starting point of a forecast generated by the method in Garcia-Ferrer (1994) can be moved forward in time by using business tendency survey data and the model in Öller and Tallbom (1996). Turning point forecasting accuracy can be expected to increase by running the two models in parallel.

Chair: **Patrick Kent Watson**
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**Development of the Malaysia Agriculture Sector Analysis Model**

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Several studies in Malaysia have developed commodity-specific agricultural sector models for forecasting and policy simulation. But such models may not capture the dynamics of linkages within the agricultural sector, and between that and other sectors of the economy. For these reasons, we developed the Malaysia Agriculture Sector Analysis (MASA) model, a multi-commodity, multi-sectoral forecasting and policy simulation model of the Malaysian agricultural economy. The MASA model contains 17 commodities. Each commodity is linked to other commodities through competition for land and, in some cases, substitution in demand. Thus when the equilibrium of one commodity is obtained, it reflects simultaneous equilibrium in all other commodities. The model can project supply and demand of the Malaysian agricultural commodities for 5-15 years (currently from 1996 to 2010). For scenario analysis, the model will measure the impact of changes in technology, policy (agricultural or economic), internal or global economic conditions and world market conditions.

**Macroeconomic Forecasting in Data Deficient Developing Countries: A Case Study of St. Lucia**

*Hyginus Leon*
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*O. Williams*
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A three step approach is used for policy analysis in a four sector macroeconomic model. First, time series and error correction modeling techniques are used to forecast variables in the fiscal, monetary, external, and real sectors. Second, the macroeconomic consistency of these forecasts is checked within a flow-of-funds framework. Third, the estimated model is used to investigate the simulation impacts of changes in imports and government expenditures, and to explore possible changes in policy variables that could achieve a desired target rate of output growth or a required level of reserves. A prototype model for the Organization of Eastern Caribbean States (OECS) is estimated using quarterly data for St. Lucia. The initial results indicate that imports can be an important target variable as it is significant in both output and government revenue equations, and alternative forecasting techniques can be combined, especially in economies with limited data, to obtain adequate conditional forecasts.

**Forecasting Macroeconomic Time Series in the Caribbean: VAR and Univariate ARIMA Models Compared**

*Patrick Kent Watson* and Sharri Cecile Byron
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In this paper, the authors set out to forecast some key economic time series for a typical Caribbean economy (Trinidad & Tobago). Two approaches are taken and compared: the first involves the use of a VAR model while the second involves fitting the individual series to a multiplicative ARIMA model. Forecasts are made and compared to actual realizations.

# Financial Sector Reform and its Impact on Investment and Economic Growth: An Econometric Approach

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While the financial sector is central to economic development, in Pakistan however monetary policies, till late 1980s, remained repressive. In the early 1990s as part of an overall structural adjustment programmed (SAP) State Bank of Pakistan introduced financial sector reforms with the objective to improve the effectiveness of monetary policy. This study develops a consistent medium sized 25 equation macroeconometric model for the financial sector of Pakistan. With a view to not only generating ex-ante forecasts but, more importantly, it will provide answers to numerous interesting and critical counterfactual policy questions in the context of Pakistan's financial sector reforms. For example, if the reforms had to take place in the early eighties rather than the nineties, the model will quantitatively estimate the counterfactual loss foregone in terms of lower GDP, savings and investments in Pakistan. It is expected that these counterfactual policy simulation results may be useful to the policy makers in designing more accurate and practical future monetary policies in Pakistan.

Chair: **Neil R. Ericsson**
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**A Theory of Co-breaking**

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When regime shifts occur in several variables, these may or may not be related. We consider the removal of such regime shifts in systems of forecasting relationships using linear combinations of variables. The general formulation establishes a reduced-rank condition, analogous to cointegration. The properties of co-breaking are explored, and both common trends and cointegration vectors are shown to be examples of co-breaking vectors for specific regime shifts in the intercepts of equations. Leading indicators that are not causally related to variables undergoing breaks are likely to show predictive failure under regime shifts.

**A Framework for Simulated and Analytical Properties of Economic Forecasts**

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This paper proposes a tripartite framework of design, evaluation, and post-evaluation analysis for generating and interpreting economic forecasts. The value of this framework is illustrated by re-examining the properties of mean square forecast errors from dynamic models, and of forecasts from empirical models of U.S. external trade. Properties of interest include the possible nonmonotonicity and nonexistence of the mean square forecast error, and the nonlinearity bias of deterministic forecasts. Each property has been previously studied in isolation from other aspects of the forecasting process, resulting in the use of inefficient techniques or the appearance of seemingly puzzling phenomena. The framework developed helps reveal how each property results from integrating all the activities that generate the respective forecasts.

The paper aims to draw together theoretical, empirical, and policy aspects to forecasting in a unified approach. The empirical discussion includes the Helkie-Hooper model of U.S. trade, which has been extensively used at the Fed.

**Forecasting Economic Processes**

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When the assumption of parameter constancy fails, the in-sample fit of a model may be a poor guide to ex-ante forecast performance. We exposit a number of models, methods and procedures that both illustrate the impact of structural breaks, or non-constancy, on forecast accuracy, and offer an improved forecast performance. We consider approximating a process with a break by a variety of types of 'model', ranging from predicting the sample mean of the process, to 'no change' forecasts, and include members of the ARIMA class. The estimators considered include least squares and instrumental variables for 1-step and multi-step (or 'adaptive forecasting') criteria; and the forecasting procedures include unmodified models as well as intercept corrections. The choice of evaluation criterion is also considered. The analytical simplicity brings to the fore the conceptual issues involved. An empirical example of UK consumers' expenditure is used throughout to illustrate the performance of the methods on an actual data series, demonstrating in most cases a remarkable concordance Consequently, we argue that a theory of forecasting which allows for structural breaks is feasible, and may provide a useful basis for interpreting and circumventing predictive failure in economics.

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### Bootstrap Testing for Fractional Integration

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The forecasting performance of the Fractionally Integrated ARMA (ARFIMA) model, compared with the common ARMA model, depends on the unknown true process. Consequently, it is important to pre-test for fractional integration. Asymptotic tests, such as the Geweke-Porter-Hudak test, the modified rescaled range test and Lagrange multiplier type tests, do however exhibit size-distortions in small-samples. This paper investigates the use of a parametric bootstrap testing procedure, as a technique for size-correction, by means of a computer simulation study. The bootstrap provides a practical method to eliminate finite-sample size-distortions in the case of an asymptotic pivotal statistic while the power, in general, is close to the corresponding size-adjusted asymptotic test. The size and power of the stated tests and their bootstrap analogs are scrutinized.

### Estimation and Forecasting of Non-linear SETARMA-Models

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Although many authors give a definition of SETARMA-models, the estimation procedure remains restricted to SETAR-models only. Here the usual and two new definitions of SETARMA-models will be given with corresponding estimation techniques. The specific properties and relative advantages of these different model-classes will be analyzed and it will be shown that they share an uncertainty-principle. While Least-Squares, Weighted Least-Squares and quasi-Maximum-Likelihood estimates are all asymptotically equivalent for linear models, the analogies disappear for SETARMA-models and the specific differences will be analyzed in detail in this paper. Finally, whereas AR-models of high orders can arbitrarily well approximate ARMA-models, it will be shown that this is not true for SETAR- and SETARMA-models. This implies that SETARMA-models form a distinct class of models with their own specific dynamics and forecasting performance.

### Unit Root Testing and Forecasting

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The choice of the appropriate degree of differencing to apply to a time series is an important question in ARIMA and ARFIMA forecasting. This choice is particularly difficult in the presence of nearly nonstationary time series and the available testing procedures may be rather unreliable. We investigate how the choice of the degree of differencing based on unit root testing affects the forecasting accuracy for out of sample data.

### The Use of Canonical Analysis to Identify the Order of Multivariate ARMA Models

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In the analysis of multivariate time series, the problem of model identification has attracted the attention of researchers because of difficulties in identifying the order of vector ARMA models. We present some results of comparing different methods, which are related to the canonical correlation approach, to identify the order of the vector ARMA models, i.e., to modeling multivariate series. These methods are: the method of Cooper and Wood, the approximate Kronecker's Index, the method of Tsay and the method of Scalar Component Model (SCM). They are compared by simulation and applied to real series. We also simulate the use of these techniques by showing that the methods can be easily applied to modeling multivariate time series.

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**A Note on Forecasting International Tourism Demand in Spain**

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In this paper we have evaluated the extent to which price and income proxy variables help in forecasting tourist demand in Spain. Contrary to some recent studies, we found that the contribution of the explanatory variables in terms of fitting and forecasting is nil when compared with alternative univariate models. Whether these findings are the results of restrictions embedded in building the proxy inputs or in a poor specification of the dynamics of these models remain to be seen. We also contend that when dealing with medium, long-term forecasting comparisons, the use of the traditional aggregate accuracy measures like RMSE and MAPE helps very little in discriminating among competing models. In these situations, predicted annual growth rates may be a better alternative.

**Analyzing and Forecasting International Tourism Demand in Sweden**

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In this study I use a multivariate structural time series model to estimate the external demand for Swedish tourism services. The estimated structural model includes stochastic trends (representing the changes in tourist tastes) and stochastic seasonal components. Explanatory variables such as income and price indexes with respect to the visitors' country of usual residence and with respect to competitor countries are included in the model. Endogenous variables are tourist nights spent in hotels, youth hostels and holiday villages from the largest national categories. Tests for common levels and homogeneity are done. The paper evaluates the predictive power of the multivariate structural model and compares it with the predictive power of other multivariate and univariate models.

**Real Time Estimation of Italian Tourist Demand**

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Despite the relevance of the tourism sector, the Italian statistical institute publishes official data of the realized sectoral output with a delay ranging from 15 to 27 months. Provisional data are available with a shorter delay (4-6 months) but they are inaccurate. This justifies the estimation of market dynamics in "real time". Such a forecast represents a necessary tool for both professional and institutional operators to take prompt and effective decisions.

In this work we apply the Kalman filter to obtain an accurate and timely estimate of the monthly variation in the number of overnight stays in the Italian tourism sector. This recursive method allows us to effectively exploit all available information from both final and provisional data. Results are successfully compared with those obtained using provisional data directly with ARIMA models. Comparisons are made in terms of out of sample bias and accuracy.

**The Supply by Hoteliers of New Accommodation: An Econometric Analysis for Four Regions of Queensland**

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Do suppliers of tourist services react to increased demand by raising prices, increasing output, or some combination of the two? This paper reports an econometric analysis of the supply of new hotel rooms in four "tourist" regions of Queensland: The Gold Coast; Noosa; Whitsunday; and Cairns. The growth rate of new rooms, between the same quarter of two successive years, was taken to be dependent upon the growth rate of earnings per room and of room occupancy rates and the change in real interest rates. Careful attention was paid to the appropriate lag structure on the dependent variables and on the error terms. The dynamics of hotelier response was found to vary between the regions, with hoteliers in The Gold Coast and in Noosa displaying much shorter response times than their counterparts in Cairns and in Whitsunday

Chair: **Yaw M. Mensah**
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How Clairvoyant **Are the Capital Markets in Anticipating Changes in Corporate Profitability?**

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Considerable evidence exists that the capital markets often anticipate turning points in the economy. However, much of this work was done at the aggregate level, and the conclusions about the time interval over which the markets anticipate turning points vary. This paper reexamines the issue using individual firm level data and a more precise methodology. Specifically, the paper uses market prices immediately after earnings announcements to estimate how far ahead prices after the announcement anticipate future firm profitability.

Using quarterly data from 1986 to 1995, we show that the capital markets correctly anticipate cross-sectional differences in firm profitability up to two years ahead (8 quarters) in stable economic environments. However, in recessions and recoveries from recessions, the predictive ability of the capital markets is shortened to six months ahead.

International **Transmission Mechanism of Stock Market Movements: Evidence From Emerging Equity Markets**

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This paper investigates the transmission patterns of stock market movements between developed and emerging economies by estimating and testing a five variable VAR model. The underlying economic fundamentals and trade links are considered as possible determinants of differences in patterns of transmission. The results of the impulse response functions and variance decompositions indicate that significant links exist between the stock markets of U.S. and Mexico and weaker links between the markets of U.S. and Argentina, Brazil. The results show that differences in the pattern of stock market responses are consistent with the differences in trade patterns. The response of emerging markets to a stock in the U.S. market lasts longer than the response of a developed market such as U.K. which can be linked to differences in the speed of information processing and to the institutional structure governing the market. Overall the findings suggest that the transmission of stock market movements are in accord with underlying economic fundamentals rather than irrational contagion effects.

Modeling and Forecasting **Dividend Payments**

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The purpose of this research is to provide a simple, user friendly and comprehensible model to predict dividend payments, and to help investors choose the firms where they invest. More specifically, we built a model using five explanatory variables of dividend. Then, using cross-section (170 Canadian listed firms) and time series (10 years) data, we estimated the parameters of deterministic and probabilistic models using respectively OLS and the maximum likelihood methods. Finally, we validated the model with a "control" group of 57 firms that were not in the sample. The predictability of dividends based on our model was accurate in 98.25% of the cases. The dividend payments of a company can be predicted knowing its size, its past growth, the voting rights of its major shareholder and its regulatory status. Limitations placed on the output by the quality of the input will also be discussed

Chair: **Hans Levenbach**
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**The Value of Forecasting in Manufacturing**

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Companies invest substantial sums in forecasting systems to support manufacturing. This paper discusses the effect of improving forecasting accuracy on the costs of manufacturing in alternative systems. In particular, it is argued that the value of forecasting is large in certain common circumstances. Commercial systems are criticized for their failure to recognize the value of improved forecasting accuracy and how improvements in such systems could best be achieved. In short, too little attention is given to improving forecasting accuracy despite the payoff being potentially high.

**Price-forecasting at TVK Ltd**

*Csaba Ilyés*
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The goal of this paper is to show how TVK manages the most important problems connected with its planning process. TVK is the largest chemical company in Hungary. It was privatized in the last year. Examples of important problems are how to get reliable information on raw material and product prices, how to supply the managers with the required information about the company's activities, about the market and about future changes. To address these problems, the company developed in 1995 a new management information system. It provides the data to forecast the activities of the company, for example, to forecast prices. Another system supports the planning and controlling process. I discuss these systems and the methodological and practical background of forecasting and planning in our company (the database of forecasting and planning, computer technical support, etc.).

**Collaborative Forecasting and the Supply Chain: Where are we Headed?**

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The need to be responsive and reliable in meeting customers' demands is leading to a heightened interest in sharing demand plans and collaborating in their creation. Increasingly, multiple functional groups, as well as trading partners, will be involved in the demand planning process. How will this change the way forecasters do their jobs? How will technology be applied to enable collaborative forecasting? How will packaged forecasting applications evolve to meet the demands of supply chain management? We discuss these and other key issues that are leading to a renewal of interest in forecasting by enterprises.

**Development of a Forecasting Tool in Supply Chain Management**

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This paper investigates a key area of wide interest, that of developing new forecasting procedures. The emphasis is on sales forecasting applied to Supply Chain Management. Earlier studies indicated that the commercially available systems, when tested against selected data, yielded similar predictions and that profiles are frequently based on experience or the use of highly aggregated information. The Singular Value Decomposition (SVD) method was investigated in great depth. A tool has been developed for automatic profiling based on the SVD technique. This has allowed the modelling of weekly profiles and yearly trends and has also allowed the study of the effects of various main categories of promotions. The estimation and control of forecasts for special events such as Christmas and Bank holidays have been assessed. Also, the management of seasonal products (e.g. affected by the weather) has been investigated. The paper concludes with a discussion of the forecast measurements and accuracy.

**Service Elasticities for Ferry Demand in the State of North Carolina**

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There is an extensive body of literature relating to the characteristics of and factors affecting transport demand. Few of these studies have concentrated on empirical estimates of transport service demand elasticities. Service demand elasticities have the great attraction of being empirically estimable, easily understood, and directly usable for policy assessment. Effective decision making in the transport market will require that policy-makers be informed in all areas of service demand.

The data for this research is from the ferry division of the North Carolina Department of Transportation. It will be used to create several demand elasticities with respect to maximum patronage given the operating budget. This research will provide an estimate of service demand elasticities for the ferry system and discuss the results and implications of the coefficients of interest.

Chair: **Andrew Downes**
Institute of Social and Economic Research, University of the West Indies, Bridgetown Barbados, West Indies

**Business Forecasting in the Caribbean: An Empirical Assessment**

*Roland Craigwell* and *DeLisle Worrell*
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Andrew Downes
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Forecasting is an integral part of business but it is not always acknowledged as an activity requiring special skills. Marketing strategies, budgeting, cash flow projections and the preparation of investment projects involve the use of forecasting techniques. Forecasting is therefore at the core of modern business decision-making. There is a wide variety of forecasting techniques, none of which is good for all circumstances. The empirical assessment examines the forecasting practices in Caribbean companies. Through the use of a sample survey, information is collected on such issues as how marketing executives set sales targets; how far ahead companies plan; what techniques are used; how are targets reviewed and revised, etc. The survey covers a range of companies in three Caribbean countries - Barbados, Jamaica and Trinidad and Tobago.

**Forecasting - An Integral Part of the Decision Making Process**

*Gwenocia Chandler*
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It is argued by some that a forecaster is nothing more than "a creator of numbers with a crystal ball" whose predictions can be detrimental to the well being of a business. This paper shows how BARTEL by integrating forecasting into its decision-making process is meeting the challenge of network planning in a rapidly changing and informed market. Data and forecasting difficulties encountered and the methods used to overcome them are presented.
The point is made that despite inherent limitations, forecast models, simple or complex when used to the fullest potential can help management adapt to change. To achieve this acceptance by the decision-makers is crucial. The forecaster must therefore be creative and flexible, working closely with the various users to achieve the best translation of the abstract framework as presented by the organization and its environment, into a manageable setting.

**An Evaluation of the Barbados Economics Society Forecasting Procedure**

*DeLisle Worrell*
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Each year the Barbados Economics Society (BES) produces two forecasts, at the beginning of the year and at mid-year, of changes in output, the principal economic sectors, inflation, interest rates, the fiscal outturn and the balance of payments. The forecast is prepared from the responses to questionnaires sent to economists and to organizations representing workers and businesses. The paper describes the process and sums up the performance of the BES forecast.

**Reflections on Macroeconometric Modeling and Forecasting in the English-Speaking Caribbean**

*Roland Craigwell*
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This paper suggests requirements for a successful forecasting effort in the Caribbean. Recommendations include the need for institutional commitment to the modeling effort, an integrated resource approach both within institutional departments and across regional institutions, and a more concerted effort on developing data and system architectures. It is argued that a structured approach to modeling and a forecasting environment that fosters collaboration of effort and dissemination of results and skills are necessary. A review and critique of previous macroeconometric models in the region are provided.

Chair: **Miguel A. Ariño**
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**Forecasting the Levels of Vector Autoregressive Log-Transformed Time Series**

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In this paper we give explicit expressions for the forecasts of levels of a vector time series when such forecasts are generated from (possibly cointegrated) vector autoregressions for the corresponding log-transformed time series. We also show that simply taking exponentials of forecasts for logged data leads to substantially biased forecasts. We illustrate this using a bivariate cointegrated vector series containing US GNP and investments.

**On the Numerical Properties of Forecasting Methods: The Case of VAR and State Space Procedures**

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The aim of this paper is to compare the performances of VAR and state space models in the context of numerical precision. In the first section, the effects of round-off error on results provided by econometric algorithms performed by a computer are discussed. Then, the VAR and state space forecasting procedures are presented along with some related discussions on their numerical accuracy. In the second section, we evaluate these methods by determining the number of exact and significant figures in the results. In this case, we use the Permutation-Perturbation method, also called CESTAC (Contrôle et Estimation Stochastique des Arrondis de Calcul) method which is said to be one of the best for round-off error analysis.

**State Space Model Representation of Integrated Time Series and Trend-Cycle Decomposition**

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It has been common practice to decompose an integrated time series into a random walk trend and a stationary cycle using the state space model. Application of state space trend-cycle decomposition, however, often results in a misleading interpretation of the model, especially when the basic properties of the state space model are not properly considered. In this study, it is shown that spurious trend-cycle decomposition, discussed by Nelson (1988), results from an unobservable state space model, and the usual assumption of independent noise processes in the model results in parameter redundancy.

Equivalence relationships for the ARIMA(1,1,1) process and the state space model consisting of a random walk trend and an AR(1) cycle, where the noise processes of the trend and of the cycle are generally correlated, are also derived.

: **Michael Lawrence**
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**Expert Systems and Bootstrapping: A Review and Some Principles**

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Expert systems represents a promising approach to integrating human expertise and models. We reviewed the literature on the use of expert systems both in prediction tasks (where it is often referred to as bootstrapping) and in time series forecasting. We found that despite validation problems with a considerable share of the literature, some important principles have emerged. Attention to details, for example, appears to produce gains in forecasting accuracy. Another example is the principle that there are identifiable conditions under which trend estimates are unlikely to be meaningful. In this paper we describe criteria for evaluating expert systems studies, review the studies that have been published, and summarize the resulting principles.

**Improving Judgmental Forecasts**

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People producing judgmental forecasts from time series data are susceptible to certain characteristic errors. First, their point forecasts are biased in various ways: extrapolation from the trend, level and autocorrelation in the data series are all subject to systematic distortion. Second, their point forecasts may be noisy. For example, there may be some scatter around rather than regression on to an underlying trend. Third, confidence in point forecasts is biased. The direction of the bias (towards overconfidence or underconfidence) depends on how confidence is elicited.

My aim here is twofold. First, I shall summarize evidence showing that error in judgmental forecasts can be reduced by transforming data from its raw numerical format into a graphical form. Second, I shall suggest simple ways in which forecasting from these graphical representations could be improved and outline some recent experimental work on their effectiveness.

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Chair: **Roy Batchelor**

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**A Smooth Transition ARCH Model for Asset Returns**

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In the classical ARCH model of Engle [1982] the conditional variance is a linear function of lagged squared residuals. In this paper we introduce nonlinearity, by adding a term that consists of a constant parameter multiplied by a transition function. Two different transition functions are considered, a logistic and an exponential. Furthermore, following Bollerslev [1986], we extend the model by introducing lagged conditional variances in the conditional variance equation. This specification reduces the number of parameters in the model, which proves to be important for successful estimation. The paper also describes a number of specification tests, that can determine if our model can be the data generating process of a time series. The proposed techniques are illustrated on data from four stock index series, DJIA, FT-all, DAX, and OMX.

**Test of Non-linearity & Forecasting using LIFFE High Frequency Transactions Data**

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This paper presents and implements a number of tests for non-linear dependence and a test for chaos using high frequency transactions data on a set of three LIFFE futures contracts. Evidence of non-linearity in these series will have three important implications; firstly, non-linear dynamics in the residuals of an appropriately conditioned linear model must surely question the linear model as being an adequate representation of the data; secondly, the presence of non-linear dynamics implies that one could obtain superior forecasts of the future value of the variable of interest by using non-linear rather than linear time series models; and thirdly, non-linearity may have important implications for the Efficient Markets Hypothesis, since the existence of non-linear patterns might imply that it is possible to devise a trading strategy yielding positive risk-adjusted returns. Our results indicate irrefutable evidence of non-linearity in two of the three contracts, although we find no evidence of a chaotic process in any of the contracts.

**Smoothing Data Using Locally Weighted Regression: Applications to Forecasting Exchange Rates in Trinidad and Tobago**

Charles de Matas
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Many non-linear models have been tested in an attempt to improve on forecasts over the random walk. These models have often been used to predict exchange rates. So far none of the models tried has shown statistically significant improvement over the random walk. In this paper we try to justify in a theoretical way the use of weighted least squares in predicting exchange rates. Estimators for parameters in a nonlinear model are obtained using weighted least squares. Sufficient conditions for these estimators to be asymptotically unbiased are derived. The TT/U.S. dollar daily exchange rates for 1993/1994 were used as data to obtain out-of-sample estimates for exchange rates and these were compared with actual data to obtain R.M.S. errors. A parameter used in the weighting function was varied to check whether there was an optimum value of this parameter. The results indicate that such an optimum weighting parameter exists but that this optimum value is dependent on the data set.

**Time Varying Term Premia and Risk: The Case of the Spanish Interbank Money Market**

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It is well known that the standard solution to the problems of estimating term premia and evaluating the importance of their possible determinants is not the most appropriate when those determinants are dynamically related to interest rates.

In this paper we propose an alternative procedure for evaluating the importance of risk in term premia variability. This procedure is based on the ability of this variable to forecast interest rates and explicitly takes into account the likely presence of dynamic relationships among all variables in the information set.

As an illustration, we use the family of risk measures proposed by Luce (1980) and studied by Granger and Ding (1993 and 1994) and investigate their relevance in explaining the behavior of some important term premia in the Spanish interbank money market.

Chair: **R. Edmundson**
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**Does the Use of Forecast Software Improve Forecasting?**

*Michael Lawrence and Marcus O'Connor*
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This paper examines two issues: can a DSS to support forecasting provide useful advice, and, when provided with good advice is the decision maker able to take advantage of it and add value to it? A number of studies are drawn on to reflect on these questions including studies recently carried out by the authors. A field study of sales forecasting practice in 13 manufacturing organizations who develop their forecasts judgmentally, reveals that DSS advice could have been useful in a majority of these companies. But managers make poor use of good advice provided to them. This may arise from a difficulty in integration of the advice with the subjective opinion. To investigate this a study was carried out in which the user was given help to integrate the DSS advice with subjectively formed opinions. However this did not improve the use of the information.

**Strategic Inertia, Scenario Planning and Strategy Evaluation: Process and Prescription for Strategic Renewal**

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This paper reviews knowledge of "strategic inertia" and proposes an underlying systemic model of the causal psychological processes underpinning empirical demonstrations of inappropriate commitment to failing strategies. We argue that the resting state of the system is that of a low perceived level of environmental threat leading to a low stress level, which leads to inertia. If the environmental threat is so severe it is perceived as threatening unconflicted adherence to the current strategy then psychological coping patterns act to lower the perceived level of threat. Next, we argue that a scenario planning intervention contains the necessary components to overcome inertia, but that this practitioner-derived methodology would benefit from the incorporation of multi-attribute value analysis techniques to facilitate strategy evaluation. In a final section, we propose and demonstrate the efficacy of such an approach. Overall, our investigation of the processes underpinning strategic inertia, scenario planning and strategy evaluation allow us to advocate a new prescription for strategic renewal.

**The Effectiveness of Decision Support Techniques in Complex Forecasting Tasks**

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This paper addresses the role of a DSS in a forecasting task that requires consideration of time series disturbed by non-systematic external events such as short term strike action affecting the enterprise and/or its competitors. The complexity of the task is varied by adjustments to the trend and "soft" event cues and subjects are randomly assigned to either a "DSS Supported" treatment or "Unsupported" treatment. The accuracy of the effectiveness of the DSS across a complexity spectrum ranging from relatively low to relatively high. The implications for the design and deployment of decision aids in the judgmental forecasting task are considered.

Chair: **Roy L. Pearson**
Chancellor Professor of Business, College of William and Mary, USA

**Accuracy, Biases, Rationality and Public Policy Impacts of General Revenue Forecasting: The Virginia Executive Branch Forecasts**

*Roy L. Pearson*
Chancellor Professor of Business, College of William and Mary, USA

Extensive analysis (sometimes with conflicting results) of multi-state panel data has been done on the accuracy, biases, and rationality of state general revenue forecasts [especially Bretschneider et al., IJF 5(1989) and 7(1992); Cassidy et al., IJF 5(1989); and Mocan and Azad, IJF 11(1995)]. However, these analyses do not explore the linkage between those forecast attributes and public policy decisions by the users of those forecasts.

This paper is a case study describing the Virginia revenue forecasting process and analyzing the forecast error, over time and in the context of prior research findings regarding accuracy, bias, and weak rationality. The study also examines the public policy impacts of the forecasts and forecast errors, using information from public records plus surveys of, and interviews with, the forecast users, such as state executives (e.g., governors, secretaries of finance, directors of planning and budget), and legislative committee chairs and chiefs of staff.

**Parsing Composites to Give Forecasts Meaning: Sales Taxes in Georgia, 1981-1996**

*Henry Thomassen*
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Annual forecasts of a state's sales taxes are commonly tracked on periodic (monthly) collections. However, path conformance alone seldom establishes user confidence. State officials want to "understand" the conformity. At the very least, they want backcasts separating differently-driven but intermingled collections from households and businesses.

This paper attempts to capture the prospective and precedent dynamics imbedded in a time series of sales tax collections. The Janus representation converts a testable stochastic model into state-space form suitable for specification using a Kalman filter. The novelty arises from the simultaneous handling of the observed, what will become observable, and what will never be observed.

The forecasting model builds on Georgia's 1981-1990 record. Its service in forecasting, backcasting, and interpreting the 1991-1996 sales tax path provides an ex post test. The approach appears practical when tracking conformance is not explainable by the behavior of composite data alone.

**Money Demand in Barbados, Belize and Guyana 1980-1994**

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This paper reports and analyses empirical results of estimates and tests of money demand functions for Barbados, Belize and Guyana (Caribbean Common Market (CCM) member countries) during the period 1980-1994, based on the recent econometric techniques for analyzing the individual and joint stability properties of time series variables. The results suggest that narrow nominal money and gross domestic product at market prices are integrated and cointegrated of order one in Barbados, compared to Belize and Guyana where narrow and broad nominal money, gross domestic product at market prices, the price level and the average deposit interest rate are integrated and cointegrated of order two. The policy implications of the results are also addressed.

Chair: **Lawrence R. Carter**
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**Analyzing Quarterly Economic Time Series - Design and Use of Stable Low-Pass Filters for Diagnosing and Forecasting**

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Determining the current status and long-term trend of macroeconomic variables is important for government agencies, as is forecasting their future pattern. Since most macroeconomic series show seasonality, they are usually seasonally adjusted before further analysis. Unfortunately, the resulting smooth components taken as a basis for diagnosis and forecasting are not stable at the ends of their series. Consequently, after updating, smoothed values can change dramatically, especially their most recent values, thus possibly invalidating former diagnostics and forecasts. Here, a new low-pass filter for quarterly data is proposed. It produces absolutely stable smoothed components, which have acceptable amplitude and whose phase-shift in the low-frequency domain is smaller than a quarter. Practical use of the method is demonstrated on important Swiss quarterly series.

**Imparting Structural Instability to Mortality Forecasts: Testing for Sensitive Dependence on Initial Conditions with Innovations**

*Lawrence R. Carter*
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This paper describes a non-traditional measure of forecast uncertainty, focussing on a non-linear, extrapolative model and the sensitive dependence of its forecasts on initial conditions. From a 90-year series of a time-varying linear index of mortality, forty-nine 40-year realizations are sampled and Box-Jenkins techniques are used to estimate the Lee-Carter nonlinear demographic model. In each sample, the parameter estimates and the first observation are the initial conditions for a nonlinear iterative transformation. The Lyaponuv exponents of the 49 iterated series are all negative, indicating a stable, non-chaotic system. Augmenting with additive stochastic innovations (a surrogate for some unanticipated time series event such as an epidemic) creates a stochastic dynamical system in which Gaussian white noise innovations cause only small, brief departures from equilibrium. The system remains stable until the mean of the innovations reaches .35, when deterministic chaos and instability in the forecasts occur in some series. The substantive implications of this instability are discussed.

**Improving the Accuracy of Sales Forecasts when Dealing with Seasonal Time Series**

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We investigate the effectiveness of an adaptive Winters forecasting model, which has proved to be simple, robust and accurate in a number of studies. The most important problem faced when using Winters method is setting the three smoothing parameters of the updating equations (for the mean, trend and seasonal factors). This was generally accomplished by back-forecasting over a grid of possible values and selecting the set with the lowest mean squared error (MSE), which allowed no adjustments to the smoothing parameters after new data. The proposed approach uses an adaptively smoothed constant for the mean level, derived from deseasonalised forecast errors. To evaluate its performance compared with the original Winters approach, numerical tests were conducted on a set of monthly time series. Results show the proposed method to be superior to the original Winters model for lead-times above one period, while avoiding instability when significant changes in the series occur.

Chair: **M.A. Kaboudan**
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**Load Forecasting Via Structural Models with Splines**

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The problem of making hourly or daily load forecasts is well known in the literature. Many approaches have been proposed ranging from exponential smoothing to neural networks formulations. In this paper we use the traditional structural approach to model daily load observations. However, due to the two seasonal periods present in the data (i.e., weekly and annual) we face the problem of the huge dimension of the state vector, particularly that caused by the annual seasonal influence (s=365). In order to make possible the implementation of such an approach we use the cubic spline technique to approximate this seasonal variation, resulting in considerable reduction in the dimension of the state vector.

This new approach is applied to daily load data of some Brazilian utilities.

**Modeling of Calendar Effects in Daily Series of Economic Activity**

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Daily series of economic activity show particular features of trend and different simultaneous seasonalities. These require treatment different from that needed in series with a higher level of time aggregation. Treatment of the calendar effect is the most important. Daily series are, in general, very sensitive to the presence of public holidays, holiday periods and special events. In addition, the consequences of these effects are complex because of the influence of trend and the weekly cycle.

Starting from a wide set of dynamic structures, dummy variables and dynamic filters are used to explain each of the possible calendar effects, by following (1) a method to select the more appropriate scheme for each effect and (2) a strategy to contrast restrictions among the parameters in the same effect and among different effects. The final model will incorporate the whole calendar complexity with the fewest parameters. The method is illustrated with an application to the daily prediction of the demand for electricity.

**Classifying the Dynamics of High Frequency Stock Returns**

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A simple fuzzy classifier algorithm, proposed in this paper, provides an approximate characterization of time series' dynamical systems. It perceives time series' dynamical systems as one or more data generating processes: linear, nonlinear, and stochastic. The algorithm is used to characterize the data generating process of stock returns with different frequencies. The results indicate that low-frequency returns are more complex and probably less predictable than high-frequency ones.

## Panel - Tourism Forecasting in Practice

Chair: **Denny Lewis**
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**Experience in Tourism Forecasting in the Caribbean - Forecast to 2007**

*Arleigh Sobers*
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**Experience in Tourism Forecasting in the Caribbean: Barbados Tourism Forecast 2010**

*Eric A. Adams*
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**Tourism Forecasting: A 'Long Wave' Approach**

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