**International Institute of Forecasters**
in collaboration with
**Business & Economic Research Ltd**

# The Twelfth International Symposium on FORECASTING


**7 - 10 August 1992**

**PLAZA INTERNATIONAL HOTEL**

**Wellington**

**New Zealand**

International Institute of Forecasters
in collaboration with
Business & Economic Research Ltd

# The Twelfth International Symposium on FORECASTING


7 - 10 August 1992

PLAZA INTERNATIONAL HOTEL

Wellington

New Zealand

# INTERNATIONAL INSTITUTE OF FORECASTERS

*The International Institute of Forecasters (IIF) was founded in 1981 to promote forecasting as a multidisciplinary as well as interdisciplinary activity for the purpose of aiding operational and planning decisions. IIF is a not for profit organisation devoted to unifying the field of forecasting, and especially to narrowing the gap between theory and practice.*

## INTERNATIONAL JOURNAL OF FORECASTING (IJF)

The IJF is the official journal of the IIF and is supported by an outstanding board of Associate Editors. Papers are typically reviewed by 3 referees. The journal is abstracted by key services. The papers published are among the most highly cited in the social sciences. A heavy emphasis is placed on empirical and applied work that is reported in an understandable manner.

## INTERNATIONAL SYMPOSIUM ON FORECASTING (ISF)

The annual ISF is the primary vehicle for bringing research to the attention of practitioners. Based on a follow-up survey, the symposium has been rated as highly successful by academics and practitioners. Previous symposiums, begun in 1981, have been held in Quebec, Instanbul, Philadelphia, London, Montreal, Paris, Boston, Amsterdam, Vancouver, Athens, and New York.

## DIRECTORS OF THE INSTITUTE ARE:

| | |
|---|---|
| Dr Everette S. Gardner, Jr | University of Houston, USA |
| Dr Stu Bretschneider | University of Syracuse, USA |
| Dr Hans Levenbach | Delphus, Inc, USA |
| Dr Jan de Gooijer | University of Amsterdam, Netherlands |
| Dr Wilpen Gorr | Carnegie Mellon University, USA |
| Dr Lilian Y-S Wu | IBM, USA |

To join the IIF, send cheque or MO for US$65, drawn on US Bank, to:

**International Institute of Forecasters**
C/- Delphus, Inc
103 Washington Street, Suite 348
Morristown, New Jersey 07960
USA

---

Please register me for membership in the IIF US$65.00
*(This includes the issues of the International Journal of Forecasting)*

Please print or type

Name:..... Initials.

Affiliation:.....

Address: .....

Country: ..... ... Postal code:

Telephone No: .. Fax No:

.... Academic Practitioner

# TABLE OF CONTENTS

OFFICE OF THE MAYOR

WELLINGTON NEW ZEALAND

SIR JAMES BELICH

28 July 1992

Dear Friends

Personally, and on behalf of the City as a whole, a warm welcome to Wellington. We are delighted that you have chosen New Zealand's capital city as the venue for your International Symposium on Forecasting.

If I may presume to hazard a forecast, New Zealand as a whole, and Wellington in particular, are poised for future growth.

I do hope that while you are here you will look at some of the recent developments in Wellington such as the Civic Centre, which includes a large, new library, Civic Square and a restored heritage Town Hall. Do also note the first New Zealand Children's Science Museum at the eastern end of Civic Square, mostly underground, but with a pedestrian link due to be built soon to connect the developing waterfront area with the City. The new National Museum of New Zealand is to be built on the waterfront end of this bridge.

I hope that you will enjoy your stay with us and that your symposium in Wellington will be a memorable experience for you all.

Best wishes

Sincerely

MAYOR

# THE TWELFTH INTERNATIONAL SYMPOSIUM ON FORECASTING

Wellington New Zealand

August 7 to 10 1992

7 August 1992



## Message from General Chairperson

On behalf of the International Institute of Forecasters, BERL, and the members of the ISF 92 Organising Committee, I welcome you to the Twelfth International Symposium on Forecasting. Many of you have come long distances and it speaks well of earlier symposia and of the camaraderie that has been built up over the years that you have done so.

As with all of our symposia the purpose is to present research findings to forecasters in a wide variety of fields in the expectation that ideas developed in specific areas will find application more generally. On this occasion the range of expertise has been widened to include those working in the areas of seismology and volcanology who, together with meteorology, a long standing branch of the Institute, comprise a large part of the "major risk" forecasting area which is the theme of ISF-92. Speaking for myself, as an economic forecaster, I am sure that I shall benefit from insights emanating from the natural sciences. I would like to think that there will also be some traffic the other way.

Another purpose of all IIF symposia is to enhance the application of theory to real world forecasting. On this occasion the mix of theorists to practitioners is about 50/50 and we trust that full advantage will be taken by theorists to obtain feedback on the needs of practitioners while the latter become more familiar with the techniques that are available.

Finally, let us not forget the extent to which IIF symposia in the past have enabled participants to make new and lasting friendships. The Organising Committee of ISF-92 trusts that this occasion will be no exception.

**Allan Catt**
Chair, Organising Committee, ISF 92



SPONSORED BY THE INTERNATIONAL INSTITUTE OF FORECASTERS IN COLLABORATION WITH BUSINESS AND ECONOMIC RESEARCH LTD
PO Box 10-277 Wellington, New Zealand. Telephone: +64-4 472-5564 Facsimile: +64-4 473-3276

# List of Organising Committee for ISF 92

GENERAL CHAIRPERSON

**Allan J.L. Catt**
Business & Economic Research Ltd (BERL)

CO-PROGRAMME CHAIRPERSONS

**Fraser Jackson**
Victoria University of Wellington

**Rod Brodie**
University of Auckland

**Dennis Ahlburg**
University of Minnesota

FINANCIAL JOINT CHAIRPERSONS

**Paul Frater**
Business & Economic Research Ltd

**Hans Levenbach**
Levenbach Associates Ltd

CORPORATE CHAIRPERSON

**C J (Stan) Vandersyp**
NZ Institute of Economic Research

EXHIBITS CHAIRPERSON

**Don Barnes**
Business & Economic Research Ltd

PUBLICITY CO-ORDINATOR

**Ashley Lienert**
Reserve Bank of New Zealand

CANADIAN CONTACT

**Peter Kennedy**
Simon Fraser University

CENTRAL/SOUTH AMERICAN CONTACT

**Reinaldo Souza**
Department of Electrical Engineering, PUC/RJ, Brazil

EUROPEAN CONTACT

**Jan de Gooijer**
University of Amsterdam

BRITISH CONTACT

**Robert Fildes**
Lancaster University

AUSTRALIAN CONTACT

**Mike Lawrence**
University of New South Wales

AMERICAN CONTACT

**Wilpen Gorr**
Carnegie Mellon University

# Acknowledgements

The International Institute of Forecasters and BERL wish to thank the following **Institutions** who made important contributions to the organisation of the symposium as sponsors and in other important ways.

Earthquake and War Damage Commission
Labour Department
NZ Association of Economists
NZ Institute of Management
NZ Institute of Economic Research
Reserve Bank of New Zealand
Statistics Department
The Treasury
Victoria University of Wellington

In addition the following **firms** also made invaluable contributions as sponsors and in other ways:

ANZ Bank
George Jeffery Ltd
SAS Institute
Westpac Bank

Finally there have been many individuals who have played a part. Some who deserve special mention are:

Esmé Burt, BERL
Jeff Beaumont, George Jeffery Ltd
David Chapman, NZ Institute of Management
Brian Bee, SAS Institute
Mike Hannah, Reserve Bank of New Zealand
Chris Moore, Westpac
David Vere-Jones, Victoria University of Wellington
David Ward, ANZ Bank

To all the above, the promoters express their grateful thanks which also go, of course to the Organising Committee and to Norma Goodman the Organising Secretary.

# General Information and Administrative Details

## Registration

The registration desk will be located on the 6th Floor of the Plaza International Hotel outside the Ballroom Suite. It will be open to accommodate pre-registered and non-registered attendees at the following times:

| | |
|---|---|
| Friday, August 7, 1992: | 3.30 pm to 8.00 pm |
| Saturday, August 8, 1992: | 8.30 am to 5.00 pm |
| Sunday, August 9, 1992: | 8.30 am to 5.00 pm |
| Monday, August 10, 1992: | 8.30 am to 2.00 pm |

Your ISF 92 badge serves as a pass for all programme sessions, exhibits and special events. Please wear your badge at all times.

It is permitted for attendees to move from session to session in order to hear papers in which they are particularly interested provided that disruption of sessions does not occur nor offence be created to other participants and presenters.

At ISF 92, luncheons are intended to be working occasions where discussion on papers at previous sessions can continue. Luncheon tables will be designated according to the location and time of session and, while not wishing to impose too much regimentation on attendees, it is requested that presenters will take lunch at the tables which are designated for the session at which they have participated and that other participants do likewise.

Please note that there will be no smoking in any of the technical sessions.

For information on all matters relating to the conference, contact either the registration desk personnel or persons wearing an official badge, designated by a blue spot.

## Accommodation

The Plaza International Hotel is the main accommodation centre. Satellite hotels are the West Plaza and Museum Hotel both within 400 metres of the Plaza International. Conference meals such as continental breakfasts and working luncheons will be served only at the Plaza International and persons staying at the satellite hotels must pay for all meals taken at those hotels.

# General Information and Administrative Details

## Registration

The registration desk will be located on the 6th Floor of the Plaza International Hotel outside the Ballroom Suite. It will be open to accommodate pre-registered and non-registered attendees at the following times:

| | |
|---|---|
| Friday, August 7, 1992: | 3.30 pm to 8.00 pm |
| Saturday, August 8, 1992: | 8.30 am to 5.00 pm |
| Sunday, August 9, 1992: | 8.30 am to 5.00 pm |
| Monday, August 10, 1992: | 8.30 am to 2.00 pm |

Your ISF 92 badge serves as a pass for all programme sessions, exhibits and special events. Please wear your badge at all times.

It is permitted for attendees to move from session to session in order to hear papers in which they are particularly interested provided that disruption of sessions does not occur nor offence be created to other participants and presenters.

At ISF 92, luncheons are intended to be working occasions where discussion on papers at previous sessions can continue. Luncheon tables will be designated according to the location and time of session and, while not wishing to impose too much regimentation on attendees, it is requested that presenters will take lunch at the tables which are designated for the session at which they have participated and that other participants do likewise.

Please note that there will be no smoking in any of the technical sessions.

For information on all matters relating to the conference, contact either the registration desk personnel or persons wearing an official badge, designated by a blue spot.

## Accommodation

The Plaza International Hotel is the main accommodation centre. Satellite hotels are the West Plaza and Museum Hotel both within 400 metres of the Plaza International. Conference meals such as continental breakfasts and working luncheons will be served only at the Plaza International and persons staying at the satellite hotels must pay for all meals taken at those hotels.

## Checkout Regulations

All attendees must pay their hotel bills personally on checking out. Those who have already paid their room rates will find that their accounts have been credited for the amounts paid. They should check with the hotel early in the conference that credit has been allowed and if not should confer with staff on the registration desk.

## Meals

Included in the registration fee are the following meals and refreshments:

**The Welcoming Party** on Friday night will include a light snack and drinks in the Ballroom Suite area.

**Continental breakfasts** will be served at the Plaza International Hotel in the Ballroom Suite area on Saturday, Sunday and Monday.

**Luncheons** will be served in the Banquet Suite area on the ground floor on Saturday and Sunday.

**Coffee/Tea** will be served at the morning and afternoon tea breaks on Friday, Saturday, Sunday and Monday.

All other meals and expenses must be paid for personally by participants.

## Services

A **bulletin board** will be located near the Registration Desk.

**Public telephones** are located in all the main foyers of the hotels.

**Copying facilities** will be located near the Registration Desk.

**Audio and video cassettes** are not presently intended to be supplied.

*(However, if there is a demand for these services to be supplied at any or all sessions, the organising committee will make every endeavour to do so.)*

**Proceedings** of ISF 92 will not be prepared but the editors of the *International Journal of Forecasting* will welcome papers to be submitted for publication.

**Additional Copies of this Programme** may be purchased for $30 per copy by applying to the Registration desk or writing to Allan Catt, BERL, PO Box 10-277, Wellington, New Zealand.

## Social Events

The principal social event for participants will be the **ISF 92 Dinner** to be held in the Banquet Suite on the First Floor on Sunday Evening at 8.00 pm. In addition a block booking has been made for Dinner at the **ROCKS RESTAURANT** for Saturday night at 8.00 pm. For both events tickets may be purchased from the Registration Desk. Please obtain your tickets to these events as soon as possible to ensure admission which will be limited to available capacity at the time of final notice to the restaurants concerned.

Information on other restaurants will be provided in the information kit and at the registration desk.

## Entertainment

The hotels are located near the theatre, cinema and musical centres and full information on "what's on" will be provided in the information kits and at the registration desk.

## Guest Programme

Due to lack of numbers only a limited guest programme has been organised. Instead tentative arrangements have been made and on Friday evening, after the Welcome Party, guests will be asked to meet with the social committee to decide their choice of activities during the conference.

## Transportation to the Airport

Transport to the airport is relatively cheap (taxis $12 and shuttles $8) and easy to arrange from the hotel. Plan to leave the hotel 40 minutes before departure time and you will have time to get there and check in for domestic flights - add one hour if departing for Australia.

# Exhibitors

The Exhibits area is located in and around the foyer outside the Ballroom Suite where morning and afternoon coffee breaks will be taken. In alphabetical order, the following are the exhibitors:

**AUTOMATIC FORECASTING SYSTEMS INC (AFS)**
P O Box 563, Hatboro, Pennsylvania 19040, USA

A software house specialising in forecasting and time series analysis. Its latest product AUTOBOX 3.0 is an advanced statistical forecasting and data management expert system. The program uses artificial intelligence to perform complex modeling and forecasting operations and to make decisions based on fact along the way. AFS is participating in Workshop Number 6 on Monday afternoon.

**BERL (Business and Economic Research Ltd)**
P O Box 10 277, Wellington, New Zealand

New Zealand's longest established private forecasting organisation. The Company provides professional and independent consulting services from a wide range of disciplines across the broad spectrum of economic and business activity. It is adviser to the NZ Manufacturers' Federation and to a number of Government Departments and State Owned Enterprises. BERL publishes a quarterly forecast of the New Zealand economy, *Berl Forecasts* and for a limited client group produces monthly interest rate forecasts. BERL is conducting Workshop Number 3 at which its interest rate forecasting and its use of General Equilibrium models will be discussed.

**BUSINESS FORECAST SYSTEMS INC**
681 Conard Street, Belmont, Massachusetts 02178, USA

Specialists in the provision of forecasting services and software to business. The following are three BFS products: (1) *Forecast Pro*, a forecasting package designed for the business person (PC Magazines "Editors Choice" 1989), (2) *Forecast Master Plus*, an advanced forecasting package designed for an analyst, and (3) *ForeCalc*, an ADD-In for Lotus 1-2-3 and Symphony that provides quick and easy forecasting (PC Magazine's "Editors Choice" 1991, Lotus Magazine's "Best Award" 1990). In addition to these packages, BFS offers custom software and consulting services in the area of statistical forecasting. Robert Goodrich and Eric Stellwagen from BFS will participate in Workshop Number 6 on Monday Afternoon.

**CONSENSUS ECONOMICS INC**
49 Berkely Square, Lonndon WIX 5DB, UK

Publishers of monthly consensus forecasts of all major countries. In a single volume it possibly provides the single most up-to-date and reliable view of the world economy available. Copies are available and interested participants should apply to the person manning the desk.

The firm of Hans Levenbach who is responsible for Friday's Workshop Number 2 dealing with spreadsheet forecasting. The SPREADSHEET FORECASTER is a toolkit of PC solutions to meet a wide range of forecasting needs. It contains 23 Lotus 1-2-3 templates and is available for business, student, and executive management seminars. Also available is AUTOCAST II an expert forecasting package with batch options for simultaneously forecasting large numbers of end items and stock keeping units (SKU's).

This Company's books on forecasting are on display. An order list will be kept by the person manning the desk.

**The MIERS (Market Information and Economic Researched Solutions) GROUP LTD**
P O Box 12 253, Wellington, New Zealand

An international publishing business with its headquarters in Wellington. It publishes the monthly *Market Forecaster* and produces weekly faxes for the financial markets. A complimentary copy of the August edition of the *Market Forecaster* is available at the desk.

**The NZ INSTITUTE OF ECONOMIC RESEARCH**
8 Halswell Street, Wellington, New Zealand

The Institute produces New Zealand's most complete economic forecasts. The Institute also engages in much contract and basic research. It is funded partly by its members comprising most of New Zealand's largest firms and also by a large amount of contract research. A feature of the Institute's display will be the PHILLIPS HYDRAULIC MODEL OF THE ECONOMY which was designed and constructed by New Zealander Bill Phillips (discoverer of the Phillips Curve) when a student at the London School of Economics. The Institute will conduct Workshop Number 4 at which its PC version of the Reserve Bank of New Zealand Model of the New Zealand economy will be demonstrated.

**SAS INSTITUTE (NZ) LTD**
39 The Terrace, Wellington, New Zealand

A subsidiary of the US-based software development company, SAS Institute Inc. It licenses and supports the world's leading Information Delivery System, the SAS System. As one integrated, open solution, the SAS System can meet all the applications needs within an enterprise, and is designed for all levels of users.

SAS/ETS Software is the SAS System's forecasting module. It provides an entire library of practical, proven econometric and time series tools for analysing data, manipulating time units and intervals, reporting financial trends and building econometric models of unlimited size. Since it is part of the SAS System you can add other modules to help you manage your data, update files, perform advanced statistical analyses and display your forecasts in full colour graphics.. The Company will have its well-known forecasting packages on display. SAS will participate in Workshop Number 6 on Monday afternoon.

## Profile of Plenary Speakers

***J Scott Armstrong***

Professor at the Wharton School, University of Pennsylvania, and known internationally for his work on rule based forecasting, and his book Long Range Forecasting. He has published papers on survey research, educational methods, social responsibility, scientific methodology, applied statistics and strategic planning. He was one of the founders of the International Institute of Forecasting.

***Robert Fildes***

Professor at the University of Lancaster, and is editor of the International Journal of Forecasting. He has written numerous articles and books on forecasting and has previously been academic dean at the University of Manchester, with visiting professorships at Berkeley and the University of British Columbia . He, also, was one of the founders of the Institute of Forecasting.

***Andrew Harvey***

Professor of Econometrics at the London School of Economics, author of Forecasting, Structural Time Series Models and the Kalman Filter (CUP 1989) and of many articles on econometrics, in leading journals. He is one of the world's most eminent econometricians.

***V. I. Keilis-Borok***

Distinguished seismologist and geophysicist who is Professor and Director at the International Institute of Earthquake Prediction Theory in Moscow. He has been Chairman of the International Geophysical Union, and has specialised in pattern recognition, computational algorithms for forecasting. He is an entertaining and controversial speaker.

***Lillian Wu***

From IBM Research Division, T J Watson Research Centre, Yorktown Heights, New York. A specialist in technological forecasting and operational research, Dr Wu has unparalleled experience in the use of the highest quality statistical techniques in the world of business. Incidentally, Dr Wu had her early education in Wellington where her father was in the Diplomatic Service.

## Profile of Plenary Speakers

***J Scott Armstrong***

Professor at the Wharton School, University of Pennsylvania, and known internationally for his work on rule based forecasting, and his book Long Range Forecasting. He has published papers on survey research, educational methods, social responsibility, scientific methodology, applied statistics and strategic planning. He was one of the founders of the International Institute of Forecasting.

***Robert Fildes***

Professor at the University of Lancaster, and is editor of the International Journal of Forecasting. He has written numerous articles and books on forecasting and has previously been academic dean at the University of Manchester, with visiting professorships at Berkeley and the University of British Columbia . He, also, was one of the founders of the Institute of Forecasting.

***Andrew Harvey***

Professor of Econometrics at the London School of Economics, author of Forecasting, Structural Time Series Models and the Kalman Filter (CUP 1989) and of many articles on econometrics, in leading journals. He is one of the world's most eminent econometricians.

***V. I. Keilis-Borok***

Distinguished seismologist and geophysicist who is Professor and Director at the International Institute of Earthquake Prediction Theory in Moscow. He has been Chairman of the International Geophysical Union, and has specialised in pattern recognition, computational algorithms for forecasting. He is an entertaining and controversial speaker.

***Lillian Wu***

From IBM Research Division, T J Watson Research Centre, Yorktown Heights, New York. A specialist in technological forecasting and operational research, Dr Wu has unparalleled experience in the use of the highest quality statistical techniques in the world of business. Incidentally, Dr Wu had her early education in Wellington where her father was in the Diplomatic Service.

# FORECASTING WORKSHOPS

## FRIDAY, 7 AUGUST 1992

WORKSHOP 1 9.00 am - 12.30 pm

### Structural analysis of time series

The principal structural series models are regression models in which the explanatory variables include functions of time, and the parameters are time varying. The programme STAMP (Structural Time Series Analyser, Modeller and Predictor) is a menu-driven programme which enables the user to fit univariate structural time series models, and models with intervention and explanatory variables. Estimation can be carried out in either the time domain or the frequency domain and a full set of diagnostics is provided. The Kalman filter is used to make predictions and construct optimal estimates of trend, seasonal and cyclical components. The short course will outline the structural approach to time series modelling and show how to generate estimates, diagnostics and forecasters for these models using the STAMP software.

Presenter Professor Andrew Harvey, London School of Economics and Political Science

WORKSHOP 2 30 5.30 pm

### Forecasting with PC's - A spreadsheet approach

Hands-on, fast paced seminar dealing with the main statistical and computer tools for achieving productivity and accuracy improvement with forecasting on microcomputers. The seminar is intended for beginning and seasoned business forecasters alike. Spreadsheet compatible forecasting software for Lotus 1-2-3, Symphony, Quattro Pro and Excel is introduced to help solve a wide variety of practical forecasting problems in marketing, inventory and production applications. Models are explained for dealing with historical data from sales demand, budgeting, product shipments, school enrollments etc.

Topics include: trend analysis, seasonal decomposition, business cycles, outlier treatment, and graphical methods for analyzing and presenting data. Participants will receive a complimentary copy of THE SPREADSHEET FORECASTER, a comprehensive set of 23 Lotus templates for business forecasters designed by Dr Everette S Gardner, Jr.

Presenter: Hans Levenbach, Levenbach Associates Inc, Morristown, NJ, USA
Author of THE MODERN FORECASTER

WORKSHOP 3 Saturday, 8 August 1992 7.30 am - 8.45 am

**Interest rate and medium term forecasting at BERL**

The methods of forecasting used at BERL will be described in the context of two specific services, namely *interest rate forecasting* and *general equilibrium modelling.*

Presenters: Allan Catt, Bryan Philpott, Dennis Rose and Adolf Stroombergen, BERL

WORKSHOP 4 Sunday, 9 August 1992 7.30 am - 8.45 am

**Use of the Reserve Bank model in forecasting at NZIER**

The methods of forecasting used at the New Zealand Institute of Economic Research with special emphasis on the use of the Institute's *PC version of the Reserve Bank model 12* which is now available, at a fee, for general use.

Presenters: Stan Vandersyp, Phil Briggs and Brendon O'Donovan, New Zealand Institute of Economic Research

WORKSHOP 5 Monday, 10 August 1992 7.30 am - 8.45 am

**The use of "Scenario" methods in forecasting**

*Scenario forecasting* will be discussed in the context of a model being developed to forecast under conditions of uncertainty.

Presenter: Petrus Simons, Integrated Economic Services

WORKSHOP 6 Monday, 10 August 1992 2.30 pm - 4.00 pm

**Readily available quantitative forecasting methods**

Discussion of computer based packages for business.

Presenters: Robert Goodrich/Eric Stellwagen, Business Forecasting Systems, Belmont, USA and David Riley, Automatic Forecasting Systems, Penn., USA

WORKSHOP 7 Tuesday, 11 August 1992 9.00 am - 5.00 pm

**Modelling earthquake probabilities and characteristic earthquakes**

Venue: Victoria University, Earth Science Seminar Room

## SCHEDULE OF SESSIONS IN CHRONOLOGICAL ORDER

**Saturday, 8 August 1992**
**9.00 - 10 am**

| Page | Session Title | Location |
|---|---|---|
| 1 | Opening Plenary Session | Ballroom C |
| | Multivariate Stochastic Variance Models | |
| **10.00 - 11.00 am** | | |
| 4 | Judgemental Forecasting I | Ballroom C |
| 5 | Transport Application | Ballroom A |
| 6 | Contributed Papers | Ballroom B |
| 8 | Forecasting for Public Sector | Ballroom D |
| **11.30 - 1.00 pm** | | |
| 9 | Finance I | Ballroom C |
| 10 | Forecasting for Management I | Ballroom A |
| 12 | Seismology I | Ballroom B |
| 14 | Socio Economic Forecasting | Ballroom D |
| 15 | Neural Networks I | Ambassador Room |
| **2.15 - 3.45 pm** | | |
| 16 | Forecasting price change | Ballroom C |
| 18 | Environmental Forecasting | Ballroom A |
| 19 | Contributed Papers | Ballroom B |
| 21 | Time Series Methods I | Ballroom D |
| 22 | Neural Networks II | Ambassador Room |
| 1 | Plenary Session<br>Conditional Forecasting: Under what condtions should a method be used | Ballroom C |

**Sunday, 9 August 1992**

**Monday, 10 August 1992**

## SATURDAY, 8 AUGUST 1992

## PLENARY SESSIONS

### 9.00 AM

**CHAIR** **Hans Levenbach**, Levenbach Associates Inc, Morristown, NJ, USA

### MULTIVARIATE STOCHASTIC VARIANCE MODELS

**Andrew Harvey, Esther Ruiz and Neil Shephard**
Department of Statistical and Methematical Sciences, London School of Economics, England

Changes in variance, or volatility, over time can be modelled using the approach based on autoregressive conditional heteroscedasticity (ARCH). However, the generalisations to multivariate series typically involve a large number of parameters, and can be difficult to estimate and interpret. Another approach is to model variance as an unobserved stochastic process. Although it is not easy to obtain the exact likelihood function for such stochastic volatility models, they tie in closely with finance theory and have certain statistical attractions. This paper sets up a multivariate model, discusses its statistical treatment and shows how it can be modified to capture common movements in volatility in a very natural way. The model is then fitted to daily observations on exchange rates.

### 4.15 PM

**CHAIR** **Stuart Bretschneider**, The Maxwell School, Syracuse University, USA

### CONDITIONAL FORECASTING: UNDER WHAT CONDITIONS SHOULD A METHOD BE USED

**J Scott Armstrong**
The Wharton School, University of Pennsylvania, Philadelphia, PA 1904, USA

Research on forecasting has evolved from a theoretical to an empirical basis. Originally, empirical researchers in forecasting used the advocacy procedure: this tended to reinforce the theoretical conclusions. Forecasting researchers adopted the method of multiple hypotheses in the 1970s; this led to the conclusion some theoretically elegant methods were of no demonstrable practical value. Conditional forecasting is a complementary approach to multiple hypotheses. It tries to identify the conditions under which a given method is most useful. Recent research shows some widely accepted extrapolation methods are inappropriate in some situations, and some previously discarded methods might be relevant in other situations. Conditional forecasting offers an opportunity to improve extrapolation procedures.

## PLENARY SESSIONS

## SUNDAY, 9 AUGUST 1992

### 9.00 AM

**CHAIR** **Frank Evison**, Professor Emeritus, Research School of Earth Sciences, Victoria University of Wellington, New Zealand

### FORECASTING OF CRITICAL PHENOMENA IN HIERARCHICAL CHAOTIC SYSTEMS OF INTERACTING ELEMENTS IN THE ABSENCE OF FUNDAMENTAL EQUATIONS

**V Keilis-Borok**, Professor and Director, International Institute of Earthquake Prediction and Theory, Moscow

This paper discusses experience in forecasting elections and earthquakes and highlights the possibilities of an integrated approach (from the whole to details). This approach allows an enhanced predictability and the establishment of global similarity in critical transitions.

Rather universal symptoms of instability are encountered: the permanent background activity ("static") becomes more intensive, irregular, clustered and synergetic. Statistical significance is established for some predictions bsed on this approach.

### 4.15 PM

**CHAIR** **Fraser Jackson**, Victoria University of Wellington, New Zealand

### THE IMPACT OF FORECASTING COMPETITIONS

**Robert Fildes**
Department of OR and OM, Managament School, Lancaster University, England
**Spyros Makridakis**
INSEAD, Blvd de Constance, Fountainebleau, France

Comparative forecasting accuracy, evaluated through forecasting competitions has been a popular research topic for more than twenty years. These competitions have a direct analogue in organisations that need to choose the 'best' forecasting method for their particular situation. This presentation will first examine what has been learned within the forecasting community from such competitions. In particular it is concluded that conventional ARIMA modelling has proved inadequate, compared with simpler, more robust approaches. It will then be demonstrated that these results, taken from a variety of forecasting competitions, have been neglected by academic statisticians who have preferred to focus on extending the ARIMA modelling framework. The presentation concludes with a challenge to research statisticians: can they develop a class of model that is better fitted to business and economic data, or alternatively, can they refute the conclusions we forecasters have drawn from twenty years of research on comparative forecasting accuracy ?

**PLENARY SESSION**

**MONDAY, 10 AUGUST 1992 AT 9 AM**

**CHAIR** **David Vere-Jones**, Institute of Statistics and Operations Research, Victoria University of Wellington, New Zealand

## FORECASTING IN IBM: HISTORY, PRACTICE AND POTENTIAL

**Lilian Shiao-Yen Wu**
T J Watson Research Centre, Yorktown Heights, New York, USA

Forecasting in IBM has always been closely linked to characteristics of its marketplace. During the 60's and 70's, IBM did little formal statistical forecasting. Forecasting largely meant planning, ie starting with financial targets then generating goals for financial controls and sales of individual countries and products. During the year, planners tracked the attainability of these goals. With the introduction of the personal computer in the 80's, we started to use statistical methods both to forecast sales and to monitor the attainability of annual targets.

In this talk I will include two of my own contributions to IBM forecasting, WINEGLASS and work on quantifying components of forecast error. WINEGLASS is a PC programme, based on the "WINEGLASS chart", which can be used to track business volumes against goals. It is widely used in IBM. Our approach to understanding the structure of forecast error is based on separating error into two components, and quantifying one of the components called residual variability. Residual variability is a limit to forecast accuracy and can often be reduced by changing the way a company sells its products. I will illustrate these points with IBM's personal computer sales.

**CHAIR** **Michael Lawrence**
School of Information Systems, University of New South Wales
P O Box 1, Kensington, NSW 2033, Australia

## MODELLING AND EXTRAPOLATING TREND IN JUDGEMENTAL TIME SERIES FORECASTING

**R H Edmundson**
Business Information Technology Program, University of New South Wales,
P O Box 1, Kensington, Australia

This paper considers judgemental modelling and extrapolation of the trend component of a time series. The study extends the prior study Lawrence and Makridakis (1986) which revealed that judges appeared to be subject to bias in extrapolating trend in annual series. In particular it was shown that a declining trend was more apt to be damped than a rising trend. The present study considers monthly data and separates the fitting of an historical model from the extrapolation. There is an indication that the bias shown by Lawrence and Makridakis is not exhibited in the model fitting activity. It is also indicated that the extent of dampening may be related to the stability of the judgementally fitted trend model.

## A VAR MODEL INCORPORATING LEADING INDICATOR AND JUDGMENTAL ELEMENTS FOR FORECASTING MACROECONOMIC VARIABLES IN NEW ZEALAND

**llan Catt and Adolph Stroombergen**
Business & Economic Research Ltd, Wellington New Zealand

Bayesian VAR model is enhanced by the addition of a synthetic variable, abling elements of judgmental and leading indicator methods to be included. model includes typical VAR variables (GDP, Prices etc) and the synthetic iable is derived from 50 series redated to synchonise peaks and troughs. s variable enables turning points to be induced in two ways. Firstly the l leading indicator effect, and secondly, the imposition of judgmental casts of the individual components. The coefficients of this variable st that the effect of the judgment/leading indicator contribution is g relative to the autoregressive elements which are negative in sign and to damp the effect of the synthetic variable.

Based
Brazi
From t

The fr
and cas
as resu
operati
would be
either.

**CHAIR** **Dennis Alburg**
Industrial Relations Centre, University of Minnesota,
271 19th Avenue S, Minneapolis, MN 55455, USA

**GOMPERTZ CURVES WITH SEASONALITY**

**Philip hans Franses**
Econometric Institute, Erasmus University Rotterdam, P O Box 1738,
NL-300 DR Rotterdam, The Netherlands

This paper considers an extension of the usual Gompertz curve by allowing the parameters to vary over the seasons. This means that, for time series that are measured per season, the saturation levels can be different over the year. An estimation and testing method is proposed and applied in two practical occasions.

**SIMULTANEOUS USE OF DATA WITH DIFFERENT TIME AGGREGATION IN CONSTRUCTING A QUARTERLY MACROECONOMIC MODEL OF THE GREEK ECONOMY**

**D F Tserkezos**
Faculty of Social Sciences, Department of Economics,
University of Crete, 74100 Rethymno, Greece

In recent years the construction of temporally disaggregated models has gained favour [eg Brewer (1973), Liu (1969), Liu and Hwa (1974)] It is known that the use of temporally aggregated data may confuse the causal direction of a Wold recursive structure on the one hand [Liu (1969)], while on the other hand, it may induce (a) lower precision of estimation and prediction [Amemiya and Wu (1972)], and (b) lower power of tests in a linear regression model. If the data are measured in temporal frequencies economists wish them to be, standard estimation methods can be applied. If the data are subject to different temporal aggregation, say annual, quarterly and monthly observations, as are frequently encountered by economists, complicated estimation of missing, observations and unknown parameters are valued for to make best use of existing information.

This is the case in Greece where quarterly data for only some basic macroeconomic variables are available after the first quarter of 1975. So, very interesting applied works using quarterly data before the year 1975 are impossible to be done, at least at quarterly basis.

In this paper following a related series "missing" data approach we attempt to construct a Quarterly Macroeconomic Model of the Greek Economy. The suggested approach is a "missing data" technique similar to Sargan - Drettakis (1974), Gilbert (1977) and Tserkezos (1984), following an approach suggested by Anderson (1957). We treat the "missing" quarterly observations as unknown parameters which have to be estimated simultaneously with the other parameters of a Quarterly (Dynamic) model in which some of the under disaggregation variables are the dependents, taking into account the available annual observations and the appropriate functional and stochastic specification between the dependent and the independent variables.

Cont'd

## THE FORECAST OF CHINA'S ECONOMIC POLICY

**Zhong Hongsheng, Yang Zhaoya**
Liaoning Institute of Economic Management Cadre
**Yan Guoqing**
Shengyang Polytechnic University

Many people in the world consider confusing and unstable, and unable to forecast the economic policy in People's Republic of China in the past 43 years after foundation, thus it can never be forecasted.

The writers of this paper have made a systematic study of China's economic policy (CEP) for many years and have found it regular and foreseeable. The writers have summarised the basic law and other major laws of the CEP movement (1949-91) putting forward the main factors which affect the CEP, describing the tracks of the CEP both in the past 43 years and in the future, clarifying many confusing points of view. Some forecasts the writers made before the latest changes of the CEP have been proved correct. To give a typical example, this paper forecasts the next change of the CEP before the year 2000.

**CHAIR** **Dennis Rose**
BERL, P O Box 10 277, Wellington, New Zealand

**ECONOMIC AND MANAGERIAL RATIONALITY IN GOVERNMENT REVENUE FORECASTING**

**Stuart Bretschneider**
The Maxwell School, 329 Link Hall, Syracuse University, NY 13244
**Wilpen Gorr, Mark Kemlet, Younghee Lee**
Carnegie Mellon University, USA

This paper examines school districts' revenue forecasts to determine whether they are 'economically rational' in the weak or strong senses. They apparently are neither. We thus provide a simple theory of 'managerial rationality' to explain biases in revenue forecasts, focusing on political and organisational influences. Further investigation and testing indicate substantial support for key components of the theory.

**WHY AGRICULTURAL FORECASTING IS THE WAY IT IS AND WHAT MIGHT BE DONE ABOUT IT**

**P Geoffrey Allen**
Department of Resource Economics, University of Massachusetts, Amherst MA 01003, USA

In the United States, the first agricultural forecasts were from farmer crop reporters whose judgemental estimates were summarised and later subject to technical adjustment by government statisticians. Agricultural economists rapidly came to dominate all areas of agricultural forecasting, in other developed nations as well as the United States. A division arose between short-term outlook forecasters and economists concerned with policy analysis. Outlook forecasts were produced to a deadline with the best practical techniques. They aided decision making by farmers and others and also influenced both cash and futures prices of commodities. Meanwhile, policy analysts were constructing ever more complex structural econometric models, whose success was gauged more by conformity with economic theory and use of latest techniques than on predictive power. They failed dismally to predict or even account for the world-wide commodity price upheavals of the early 1970's. More recently, a small group of agricultural economists have demonstrated the array of time series methods, with more attention to comparative testing of forecasting performance. To make the total effort useful more emphasis must be placed on comparative testing, out of sample, of the available range of models.

**CHAIR** **Paul Frater**
BERL, P O Box 10 277, Wellington, New Zealand

## REDUCING RISK IN STOCK MARKET INVESTMENTS

**Geoffrey H Moore and Anirvan Banerji**
Center for International Business Cycle Research, Columbia University Business School, New York, NY 10027, USA.
**Ernst A Boehm**
Westpac-Melbourne Institute Centre for Business Cycle Analysis, University of Melbourne, Parkville, Victoria 3052,Australia

This paper will show how the risk of price declines in stock market investments can be reduced by using a sequential signal system to determine when to buy or sell. The signals are based on growth rates in long leading indexes and in broad stock price indexes. Tests of the method during the past twenty years or more will be shown for the United States, Australia, United Kingdom, France, West Germany and Japan. In some instances the reduction in risk (measured in terms of volatility of rates of return) will be achieved at the cost of a lower average rate of return, but in other cases the average rate of return may be significantly higher than that obtained by a simple buy-and-hold strategy.

## ADVANCE WARNINGS FROM BOND YIELD RISK DIFFERENTIALS

**Geoffrey H Moore and John P Cullity**
Department of Economics, Rutgers University,
360 Dr Martin Luther King Jr Blvd, Newark, NJ 07102

The difference between the yields of corporate bonds of different risk quality is a good leading indicator of USA business cycles, according to recent research conducted by the Center for International Business Cycle Research at Columbia University. The Center takes the yield spread between corporate bonds of different rating and compares the turning points in this series with turning points in the US business cycle. Research of a similar character has been reported in a recent National Bureau of Economic Research study by Benjamin Friedman and Kenneth Kuttner. Their study employs the difference between the interest rates on commercial paper and Treasury bills as a leading indicator of future economic activity. One of the explanations for the leading properties of both of these indicators relates to changing perceptions of default risk, as reflected in profits and profit margins. This paper provides details on the leading properties of the CIBCR indicator, compares its performance in recent decades with that of the NBER series, and explores its relationship to profit variables and their implications for investment decisions.

**CHAIR** **Hans Levenbach**
Levenbach Associates Inc, Morristown, NJ, USA

## THE ROLE OF EXPLORATORY DATA ANALYSIS IN SOLVING NEW ZEALAND MANAGERS' FORECASTING PROBLEMS

**Kathy Boardman**
Department of Management Science and Information Systems,
University of Auckland, Auckland, New Zealand

The role of exploratory data analysis in understanding the business processes and improving forecasting ability is examined, with a sample of 80 middle and senior managers.

## APPLICATION OF FORECASTING AND QUANTITATIVE FORECAST TECHNIQUES IN EUROPEAN BUSINESS ORGANISATIONS

**Henning Madsen, Kai Kristensen, Peder Ostergaard**
Department of Information Science, The Aarhus School of Business,
Fuglesangs Alle 4, DK-8210 Aarhus V, Denmark

**Chris Jones**
Leeds Business School, England,

**Mik Wisniewski**
University of Sterling, Scotland

The awareness and use of forecasting and forecast techniques in business organisations have been surveyed several times in the past. But cross country comparisons have not been reported. As part of a large European survey concerning the extent and nature of use of quantitative management science techniques in business organisations, applications of forecasting and forecast techniques have been surveyed again in Denmark, Scotland and the UK. The survey is based on a postal questionnaire and the received information characterises the business organisations and their use (or non-use) of quantitative management science techniques in general. Thus, the respondents were asked: (i) whether internal staff members themselves apply the techniques in question or it is left to external consultants; (ii) for which purpose the techniques are applied; (iii) which techniques are known and which are actually applied; (iv) the kind of computer support. This report concentrates on the survey results related to quantitative forecast techniques represented by: (i) moving average and smoothing methods; (ii) regression and econometric models; (iii) the Box-Jenkins method; (iv) simulation models.

General results and cross country comparisons will be demonstrated as well as relations to the application of quantitative management science methods in general and the results of the previous surveys.

Cont'd ...

## DEMAND FORECASTING AND PRODUCTION PLANNING

**Susan J Byrne**
Department of Management Science and Information Systems,
University of Auckland, New Zealand
**Nathanial de Lautour**
Department of Engineering Science, University of Auckland, New Zealand

Production planners for a manufacturing company required satisfactory demand forecasts for up to six weeks ahead, in order to efficiently plan the production schedules. An investigation was made of simple methods for this forecasting, using as the test system demand figures for 85 weeks for 36 products sold in three distinct markets. Exponential smoothing methods of various types, Box-Jenkins methods, and composite approaches are examined. It was concluded that a combination of total demand forecasts, followed by forecasting of proportion of demand for each product market was the most useful. The paper concludes by examining the lessons learned from this process and some suggestions for improvement.

**CHAIR** **David Vere-Jones**
Institute of Statistics and Operations Research,
Victoria University of Wellington, P O Box 600,
Wellington, New Zealand

**FORECASTING EARTHQUAKES WITHIN THE SAN ANDREAS FAULT SYSTEM**

**W L Ellsworth**
US Geological Survey, MS-977, 345 Middlefield Road, Menlo Park,
CA 94025, USA

Practical earthquake prediction may be defined as the narrowing of the space-time bounds on future damaging earthquakes into a sufficiently small region to warrant an appropriate public response. Although the goal of reliable short-term warnings remains elusive, long-term forecasts of major earthquakes $M \geq 7$, are beginning to gain acceptance in California as a tool for planning and response.

Probabilistic assessments of fault rupture for specific segments of the San Andreas fault and its principal branches have identified regions of both high and low hazard during the next three decades. These forecasts are based on straightforward physical models of the strain accumulation cycle, and knowledge of the prior earthquake history of a specific fault segment. They tightly circumscribe the location and expected magnitude of future events, but have inherently poor time resolution, and are usually expressed as a conditional probability for a 20- to 30- year interval. Some segments of the fault, such as the part of the fault north of San Francisco that ruptured in the great 1906 earthquake, have low assigned probabilities because they have recovered only a fraction of the strain released in the intervening 86 years. In contrast, the southern end of the fault, in the Coachella Valley, last broke in 1680($\pm$-40) and is generally thought to be due if not overdue.

Both the data and the models used to make such forecasts leave much to be desired, a fact stressed by those who have authored or reviewed such studies. Because we are likely to be data-limited for the foreseeable future, due to both the short length of the historic record of earthquakes and limitations in our ability to read and decipher the longer geologic record, a better understanding of the process could significantly leverage the available information.

**FORECASTING EARTHQUAKES USING MULTIPLE PRECURSORS**

**David A Rhoades**
Applied Mathematics, New Zealand Institute for Industrial Research
and Development, P O Box 1335, Wellington, New Zealand

The hope that forecasting of earthquakes may someday become routine is founded on the possibility that the information from a number of different types of precursor, which are individually unreliable and capable of producing only small refinements of earthquake hazard, can be combined to produce large refinements of the hazard - of several orders of magnitude or more. The extent to which information can be combined depends on the degree of independence which exists between precursors of different types.

Cont'd

An outline is presented of an approach to the multiple precursor problem which allows for the unreliability of each precursor type (quantified by its false alarm and failure rates) and assumes a kind of independence that is reasonable for precursors which have quite different time-scales. The information provided by an individual precursor is assumed to include the probability distributions for the location, magnitude and time of occurrence of a related earthquake, if it should occur. The basis of the theory is that the existence of precursory information affects not only the expectation of future earthquake occurrences but also the expectation of future occurrences of other precursors. If short term precursors occur in the domain of time and space indicated by earlier long term precursors then the forecast based on the earlier information is reinforced: otherwise it is weakened.

**EARTHQUAKE PREDICTION RESEARCH IN JIANGSU PROVINCE AND THE SOUTH YELLOW SEA**

**Men Kepei**
Nanjing Fuel Corporation, Nanjing, China 210018

Jiangsu province and its seaboard - the South Yellow Sea ($31^{O}$-$35^{O}$N, $118^{O}$-$124^{O}$ E), is one of the most active mid-seismic regions in the east of China mainland. On the basis of grey system theory and the theory of commensurability, using the seismic data in 1910-1991, the combinatorial models have been established to research the moderate earthquake prediction in this region, and the results are most encouraging.

This paper firstly gives three examples of test prediction for the South Yellow Sea Ms 6.2 earthquake of May 21, 1984, the Ms 5.1 Sheyang earthquake of February 17, 1987 and the February 10, 1990 Changshu earthquake with magnitude 5.1. And then, by comparing and analysing the products sets of multi-group models, a preliminary prediction opinion has been presented: the next $Ms \geq 5.0$ earthquake would occur during the period of July 11, 1992 - May 10, 1993, and the period (December 1 1992 - February 25 1993) will be more risky. The commensurable value of $Ms \geq 5.0$ earthquake in this region is about three years.

**CHAIR** **Ernst A Boehm**
Westpac-Melbourne Institute Centre for Business Cycle Analysis,
University of Melbourne, Parkville, Victoria 3052, Australia

## FORECASTING THE DEPENDENCY BURDEN' FOR THE UNITED STATES

**Dennis A Ahlburg**
Industrial RElations Centre, University of Minnesota,
271 19th Avenue S, Minneapolis, MN 55455, USA
**James W Vaupel**
Odense University, Denmark

## THE ROLE OF TRANS-TASMAN MIGRATION IN FORECASTING THE NEW ZEALAND POPULATION

**Jacques Poot**
Senior Lecturer in Economics, Quantitative Studies Group,
Faculty of Commerce and Administration, Victoria University
of Wellington, New Zealand.

By international standards, population growth in New Zealand is rather volatile. International migration is the main cause of this. However, official population projections use exogenously-set fixed levels of net migration. This paper argues that, for the short to medium-term, such projections can be improved upon by considering structural econometric models for certain components of international migration. Specifically, the paper discusses a model of trans-Tasman migration and the relationship between this migration and overall net migration. The performance of the model is assessed by focussing on migration during the sharp restructuring of the New Zealand economy in the late 1980s.

## MODELING AND FORECASTING US MORTALITY: DIFFERENTIALS BY RACE AND SEX

**Lawrence R Carter**
Associate Professor, Department of Sociology,
University of Oregon, Eugene, OR 97403-1291, USA

This paper examines differentials in observed and forecasted age-sex-race-specific mortality in the United States, 1900 to 2065. A non-linear model, $m(x,t) = \exp(a(x)+b(x)k(t)+e(t))$, for each race (white and nonwhite) and sex is fitted to a matrix of age-specific US death rates, 1933 to 1988, using SVD to derive a single time varying index of mortality, $k(t)$. Box-Jenkins techniques are used to estimate and forecast $k(t)$. These forecasts are used to generate age-specific mortality rates and life expectancies by race and sex from 1990 to 2065. Of particular interest is an examination of the dynamics of the so called nonwhite/white mortality crossover. Preliminary results show white female, nonwhite female, white male and nonwhite male $e(0)$s in 2065 of 90.9, 85.6, 82.6 and 77.6 respectively. There is a gradual increase over time in the age of crossover for both sexes, disappearing by the year 2030. Other life table functions are also examined. The overall curvilinear patterns in life expectancy are of very slow movementtowards race divergence by sex and either sex convergence or stability by race. In no instance is closure expected by 2065. Some policy implications of these results are discussed.

**CHAIR** **Marcus O'Connor**
University of New South Wales, P O Box 1, Kensington 2033, Australia

**FORECASTING VOTING BEHAVIOUR WITH NEURAL NETWORK MODELS**

**William Remus**
College of Business Administration, Department of Decision Sciences, 2404 Maile Way, Honolulu, Hawaii 96822, USA

**THE APPLICATION OF NEURAL NETWORKS AND OTHER TRADITIONAL TECHNIQUES TO SHORT-TERM LOAD FORECASTING**

**Darwish M K Al-Gobaisi, A Kurdali and A Woldai**
Water & Electricity Department, Abu Dhabi, United Arab Emirates

Load demand forecasting over different time horizons plays a significant role in planning, maintenance, and efficient economical operation of a power utility. Short-term demand forecast being one of the important inputs to the economic dispatch model of the system requires accurate prediction to meet increased economic constraints.

Sampled data of hourly demand, temperature, and humidity are selected from the Abu Dhabi data set for preliminary investigation.

Neural network approach is proposed as a tool for producing short-term load forecasts. This is an alternative to the classical statistical and adaptive models. It is a promising quality forecasting tool, in the area of Artificial Intelligence. It identifies the appropriate historical patterns of Load and weather data to be used for network weights estimation, in reality, performs a pattern-recognition function.

The paper concludes with an illustrative comparison with other well-known forecasting techniques.

**NEURAL NETWORK: AN IDEAL FORECASTER IN FUZZY ENVIRONMENT**

**Ashutosh Saxena**
Research Fellow in School of Computer Science, DAVV, Indore, India

This paper emphasizes a wide and efficient use of Artifical Neural Network to forecast in the fuzzy environment, where the parameter of the system does not have sharp boundaries. The decision making in the fuzzy environment is a decision process in which the constraints and/or goals are fuzzy in nature. A fuzzy decision can be viewed as an intersection of the given constraints and goals. Artificial neural networks are supposed to be powerful computational devices, of which the operation is not well understood. Several training algorithms are discussed to train the net and are allowed to forecast. The obtained results are appreciable when compared with the real world data. The paper also contains general topics related to Artificial Neural Network and fuzzy logic.

**CHAIR** **Jacques Poot**
Senior Lecturer in Economics, Faculty of Commerce and Administration, Victoria University of Wellington, New Zealand

**THE CHALLENGE OF FORECASTING IN UNSTABLE ENVIRONMENTS**

**R C Souza**
DEE, PUC/RJ, Rio de Janeiro, RJ, Brazil
**J E Bacellar**
New Product Development Manager, Nielsen Marketing Research, Sao Paulo, SP, Brazil

Brazilian monthly inflation rate has recently dropped from 80% to 2% and moved upwards to 20%, economic hell or heaven can materialise every other month. This paper describes how accurate forecasts and actionable scenarios of marketing variables can be produced in such environment through a combined use of Bayesian and conventional forecasting approaches.

**A VECTOR ERROR CORRECTION MODEL OF THE RESERVE BANK PRICE SYSTEM**

**Dean Hyslop**
Research Section, Economic Department, Reserve Bank of New Zealand Wellington, New Zealand

The Reserve Bank's Model XII is estimated using Engle and Granger's (1987) two-step single equation approach in the presence of cointegration. This paper uses the Maximum Likelihood estimation procedure developed by Johansen (1988) to reestimate the Model's price system. This procedure provides a coherent method for estimation in the presence of multiple cointegrating relationships between the variables, and also overcomes the standard efficiency problems of single equation estimation. The cointegrating vectors obtained, when unrestricted, imply implausible long run elasticities for the model. Hypotheses concerning the cointegrating vectors are generally easily rejected, although more plausible relationships result when restrictions are imposed. The dynamics implied by the models are generally acceptable but not obviously better than those of simple VAR models which ignore possible cointegration. The statistical shortcomings of the model highlight possible problems with the model specification.

**COMMON TREND ANALYSIS FOR CONSUMER PRICES WITHIN AND ACROSS SOUTH-EUROPEAN ECONOMIES**

**J R Cancello and A Espasa**
Universidad Carlos III, 28903 Getafe-Madrid, Spain

In a recent paper by Patel and Zeckhauser (1990) the existence of common trends for different price indexes is investigated. In this paper we apply their methodology with some modifications related mainly to the cointegration tests, to different consumer price indexes for Spain, France and Italy. For each country a vector of four consumer price indexes: food, rent, services and (other) goods are considered.

Our findings show a similar behaviour for prices across countries. In the three cases food, rent and services prices are I(1), while goods prices are I(2). Only in the Spanish case stochastic long run dimensionality has been

Cont'd

reduced from four to three; so it can be concluded that in none of the countries analyzed a single price index will summarise satisfactorily the long run behaviour of individual prices.

The results across countries show the general absence of common trends for food and rent. Services prices seem to share a single stochastic trend, and so can be said for goods prices. This seems to indicate a high degree of interrelationship among the three economies, as their relative prices of these categories of products seem to keep a long run relationship. Such a result may modify the expected results of certain price control policies, and any essay of reducing inflation rates must bear in mind this relationship.

**CHAIR** **Geoffrey Allen**
Department of Economics and Marketing, Lincoln University, Canterbury, New Zealand

**SHOOTOUTS AT NOAA: COMPARING KNOWLEDGE BASED FORECASTING SYSTEMS FOR STORMS**

**Bruce Abramson**
Department of Computer Science and Social Science Research Institute, University of Southern California, Los Angeles Ca, USA

**FORECASTING CHLOROBENZENE AND CRESOL IN THE OUTPUT OF A HAZARDOUS INCINERATION PROCESS**

**Barbara Price and Toby Haynsworth**
School of Business Administration, Winthrop University, Rock Hill, SC 29733, USA

The purpose of the study is to develop a mathematical model that can be used to predict, within some range of values, the amount of chlorobenzene and cresol in the ash output of the inceration process used by a hazardous waste disposal company. The study will be based upon an analysis of historical data concerning the content of the material being incinerated, the incineration process operating characteristics, and ash output composition. It is hoped that this data analysis will determine whether or not predictors can be found that will provide tools for closer control of the company's processes, which in turn, will lower the risk of processing ash with excessive quantities of chlorobenzene and cresol. Such improved control may very well result in a reduction of the toxic emissions generated by the process and of the costs associated with the reprocessing of already incinerated materials.

**SEEKING ORDER IN CHAOS, THE CHALLENGE OF SEASONAL WEATHER FORECASTING**

**Neil Cherry**
Department of Natural Resources Engineering, Lincoln University New Zealand

It is hard enough to forecast New Zealand weather 24 hours in advance, so how can a forecaster hope to give a reasonable estimate of the likely weather for a season or two in advance ? Chaos theory, particularly, the 'Butterfly Effect' gives a theoretical basis for limiting short-range weather forecasts to 5 to 10 days before the computational errors have compounded to unacceptable levels. On the other hand, there is growing understanding of the larger scale structure and circulation of the atmosphere, and its relationships to periodic influences such as the 11 year sunspot cycle and the 2-3 year Quasi Biennial Oscillation, as well as erratic but persistent effects associated with the Southern Oscillation (El Nino/La Nina) and volcanic eruptions. This understanding gives an increasing ability to forecast probable deviations of the seasonal weather from the climatological mean.

Analysis of historical climatological time series and the related climatic indices has led to the development of a hybrid seasonal forecasting method which incorporated time series analysis techniques and an analogue method. Using a conceptual regional circulation model as an interpretive tool, the hybrid forecasting method has been developed and used since 1986 to produce seasonal forecasts for Canterbury. Recently they have been used to forecast hydro river and lake inflows for Electricorp.

CHAIR **Lilian Shiao-Yen Wu**
T J Watson Research Centre, Yorktown Heights, New York, USA

## AN EVALUATION OF EXPONENTIAL GROWTH AND DIFFUSION MODELS FOR INFORMATION SYSTEMS SPENDING FORECASTS

**Fred Collopy**
The Weatherhead School, Case Western Reserve University,
Cleveland, Ohio, 44106, USA

Prior literature on information systems spending forecasts suggested that they be based on an exponential or an S-shaped pattern of growth. We evaluated the usefulness of these models for forecasting aggregate spending on information systems in the US. Models based upon such growth assumptions produced larger *ex ante* forecast errors than those from models that assumed simple linear growth. Using successive updating, we obtained a total of 85 *ex ante* forecasts across horizons of one to ten years. Simple extrapolations such as linear exponential smoothing and linear trend were substantially more accurate than the random walk: their Median Relative Absolute Errors (MdRAE) were .26 and .20 respectively. Three basic diffusion models had an average MdRAE of 1.11, which is 11% larger than that from the random walk. A model assuming exponential growth had a MdRAE of 7.61, which is seven times that of the random walk and about 30 times that of the simple linear trend models. One recently proposed extension to a basic diffusion model produced accuracy comparable to that of the linear trend model.

## FORECASTING TIME-DEPENDENT FAILURE RATES OF SYSTEMS OPERATING IN SERIES AND/OR PARALLEL

**N Singh**
Department of Mathematics, Monash University, Australia 3168

This paper discusses an unconventional but powerful approach to analysing the observed failure rates of complex systems that operate in series under changing operational and environmental conditions. This approach construes that such failure rates are time-dependent and hence can be treated as time series. Since the time series thus generated are complex in the sense that they are either aggregates, products or both of two or more time series, especial time series techniques are required for their analyses. Fortunately, some results recently developed by the author and others have been found useful for the analyses of such time series. Forecasting procedures are discussed and illustrative examples are given.

The methods and techniques used in this paper can also be used for the analysis of reliability-decay processes (see Singh, 1991), actual failure times, times between failures and interactions between failure times and maintenance times of complex systems.

Cont'd

## AN ANALYSIS ON ECONOMIC FORECASTING ACCURACY WITH A DISCUSSION ON THE ROLE OF ECONOMIC MATHEMATICAL MODELS

**Guo Ming**
United Nations Fellow, Economic Information Centre of Yunnan
156 East Dongfeng Road, Kunming, 650041, PRC

This paper mainly discusses the accuracy of economic forecasting and the role of economic mathematical models in economic forecasting and analysis, on the basis of epistemology and systems theory.

Forecasting process is just that of cognition from an epistemology standpoint, and it is natural that there are errors in the forecasting. Natural system is very different from social system in cognition. The former is a close cognition and the latter is a tracking cognition. System in general may be divided into two kinds, that is "White System" and "Grey System". A white system is transparent, and a grey system is dim. The former may be quantified accurately, but the latter may only be quantified by statistical law. Since econometric models are white and economic systems are grey, the two systems are not the same in structure. Therefore economic system cannot be quantified by econometric models. As the samples used for the estimation of the econometric models may be obtained from different populations, the samples cannot ensure the validity, consistency and unbiasedness of the population parameters. The accuracy in economic forecasting is limited, for psychological factors exist all along in economic activities. In addition, other factors, such as data errors, imperfect forecasting technology, also affect the accuracy.

**CHAIR** **Anne B Koehler**
Department of Decision Sciences, Miami University Oxford
OH 45066, USA

**A BOOTSTRAP SIMULATION STUDY IN TIME SERIES**

**R C Souza**
DEE, PUC/RJ, Rio de Janeiro RJ Brazil
**A C Neto**
D Estatist UFPR, Curitiba PR Braz

In 1979 Effron proposed a new computer intensive procedure known as Bootstrap. The procedure is particularly important in statistical problems where finite sample theory is impossible or difficult to derive, or when only asymptotic theory is available. The Bootstrap technique has been used ever since in various applied statistical problems, but its use in time series is still in its infancy. In this paper we show an application of Bootstrap to time series. A simulation study was carried out, where synthetic series corresponding to usual ARMA (p.q) structures were generated and submitted to both; the conventional parametric parameters estimation and the non-parametric Bootstrap estimation. A comparison of the performance of both approaches is presented.

**UNIT ROOTS AND FORECASTING**

**Philip Hans Franses**
Econometric Institute, Erasmus University P O Box 1738
NL-3000, DR Rotterdam, The Netherlands

Testing for unit roots in time series is now standard practice in empirical research. Since many economic time series appear to be nonstationary, a common procedure is to use the differencing filter to obtain stationary series. But, given that many currently applied test procedures for unit roots have low power, it is readily recognised that overdifferencing, ie using the differencing filter when it is not necessary, may not be an exceptional phenomenon.

This paper investigates the effects on the forecasting performance of univariate time series models of misspecifying the number of times a differencing filter should be used. The evaluation of the possible effects is based on Monte Carlo simulations, as well as on two empirical examples. One of the results is that the assumption of too many unit roots, ie overdifferencing, can have a deteriorating effect on the forecasting performance. This outcome is contrary to a wide-spread belief.

**CHAIR** **William Remus**
University of Hawaii, 2404 Maile Way, Honolulu, HI, USA 96822

## NEURAL NETWORK MODELS FOR TIME SERIES FORECASTS

**Marcus O'Connor**
University of New South Wales, P O Box 1, Kensington 2033, Australia
**William Remus and Tim Hill**
University of Hawaii, 204 Maile Way, Honolulu, HI USA 96822

Neural networks have been advocated as a competitor for statistical forecasting methods. In the present experiment, time series forecasts based on neural networks are compared with forecasts from six statistical time series methods (including exponential smoothing and Box-Jenkins) and a judgment-based methods. The experiment used the 111 times series from the M-competition (Makridakis et al., 1982). The classical methods were all estimated by experts in a particular technique as part of the M-competition. The neural networks were estimated by the first author using the same ground rules as the M-competition. Three different functional forms for neural networks were developed. Across all 111 series, the best of three neural networks did significantly better or as good as statistical and human judgment methods.

## USING NEURAL NETWORKS TO EXTRAPOLATE AND CHARACTERISE CHAOTIC TIME SERIES

**Russell Robinson**
Institute of Geological and Nuclear Sciences Ltd,
P O Box 1320, Wellington, New Zealand.

It is well known that common feed-forward, multi-layered neural networks, trained by the back-propagation algorithm, can be used as powerful non-parametric function approximators.

When applied to the problem of short-term auto-extrapolation of a chaotic time series, they outperform linear techniques and require no prior assumptions as to the mathematical form of the underlying dynamics. If the initial extrapolations are sufficiently good, the inevitable growth of prediction error with time can be used to estimate the most positive Lyapunov exponent. The number of inputs (time lagged values of the series) required gives a rough idea of the dimension. It is also relatively easy to extend the inputs to include information from sources other than the series itself. Disappointing results (in this and other applications such as classification) from uncritical application of inexpensive PC software can be often be traced to four causes: 1) an insufficiently long series from which to draw training examples; 2) over-training (memorization) resulting in poor generalisation (this is easily avoided); 3) a lack of reasonably stationary dynamics; and 4) inappropriate transfer functions for the input and output layers of neurons. Long training times remain a problem although this can often be reduced considerably by suitable preprocessing of inputs and/or using techniques other than back-propagation (eg genetic algorithms) to derive a first estimate of the network's internal weights. Once training is complete, the actual forecasting is very rapid compared to some other non-linear methods.

**CHAIR** **Chris Moore**
Westpac Banking Corporation, P O Box 691, Wellington, New Zealand

## FORECASTING INTEREST RATES FOR FINANCIAL FUTURES MARKETS

**Ken Holden**
University of Liverpool, United Kingdom
**J L Thompson**
Liverpool John Moores University, United Kingdom

The prices of financial future contracts traded at LIFFE can be interpreted as forecasts of the three-month interest rate which will apply at the delivery rate. Since the contracts are traded daily up to two years prior to the delivery date there are up to 8 contracts available at any time.

The paper outlines the institutional framework of the contracts and examines, for 12 contracts, how the prices change. The series are tested individually for the presence of unit roots, for unbiasedness and changing volatility. Variation across series is also examined. Finally the interest rate forecasts are compared with forecasts from the UK National Institute macroeconomic model.

**CHAIR** **Roderick J Brodie**
Department of Marketing and International Business
University of Auckland, New Zealand

## FORECASTING RETAIL SALES DEMAND FOR STOCK ORDERING

**Harvey A Lockie**
Lockie Computing, Auckland, New Zealand
**Andrew Jardine**
Department of Marketing & International Business,
University of Auckland, Auckland, New Zealand

This paper describes a rule-based system which has been developed over the last five years. The accuracy of the rule-based system is compared with conventional time series forecasting methods.

## THE DEVELOPMENT OF DOMAIN-SPECIFIC RULES FOR RULE BASED FORECASTING: AN APPLICATION TO NAVAL FORECASTING

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

**CHAIR** **Ray Dibble,**
Victoria University of Wellington, New Zealand

## THE PROBLEM OF DETECTING SEISMICITY PATTERNS THAT MAY BE PRECURSORS TO MAIN SHOCKS

**Max Wyss**
Geophysical Institute, University of Alaska, Fairbanks, Alaska

A seismicity pattern is a change in rate of occurrence of earthquakes as a function of time, space and magnitude band. For testing the hypothesis that such a pattern many be related to the preparation process of mainshocks one needs to show that the pattern is real and significant, and that it is plausible to link it to the mainshock. The greatest obstacle for detecting precursory seismicity patterns is the heterogeneous reporting of earthquake occurrences in the catalogs that furnish the data. As a function of time the reporting rates change artificially (due to changes in analysis procedure) for events of all magnitude bands, and these changes are different as a function of space covered by a catalog. The artificial rate changes can be dramatic (30% to 80%) and the amount of change can be a function of the magnitude. Therefore all claims of precursory seismicity patterns (quiescence, increased rate, b-value changes and combinations of seismicity parameters) should be rejected, unless a thorough analysis has shown that it is not likely the pattern was artifically introduced in the catalog.

Testing the hypothesis that quiescence of the background seismicity in the source volume may precede mainshocks, we have scrutinised all rate changes contained in some catalogs as functions of time, magnitude band and space. The numerous rate changes that are restricted to small magnitude events, and those that can be explained by simple transformations of magnitude scale are interpreted as artificial. This leaves a few seismic quiescences that can be interpreted as precursors. The characteristics of these anomalies are that they are confined to the source volume and its vicinity, that they occur during months and years before the mainshock, and that the rate decrease (in the 40% to 80% range) affects events of all magnitudes. The statistical significance as estimated by the standard deviate z test is usually above 99%.

## SYNOPTIC EARTHQUAKE FORECASTING: HYPOTHESIS TESTS OF THE PRECURSORY SWARM MODEL IN NEW ZEALAND

**Frank Evison**
Institute of Geophysics, Research School of Earth Sciences,
Victoria University of Wellington, New Zealand

Tests have been carried out on the simple precursory swarm hypothesis beginning in 1977, and on the generalised hypothesis beginning in 1991.

The database was substantially changed during the tests through a major review of the catalogue by the New Zealand Seismological Observatory. This resulted in the appearance of swarm clusters in the catalogue as far back as 1968-72, and in two of the mainshock events becoming associated with precursory swarms.

Cont'd

In the earlier tests the performance of the simple hypothesis, relative to the Poisson model, deteriorated to the proposed rejection level with the occurrence of the Doubtful Sound earthquake of 1989, May 31, M6.1 and the tests were duly abandoned. The tests on the generalised hypothesis, which allows for clustering, and has been under test in Japan since 1983, are expected to require a decade or so to reach conclusion.

This research illustrates the advantage of synoptic models, the need for rigorous testing and the value of an independent database.

## TIME SERIES METHODS II

**CHAIR** **Nuno Crato**
Technical University of Lisbon/University of Delaware,
501 Ewing Hall, Newark, ED 19716, USA

### NUMERICAL ASPECTS OF BAYESIAN VAR-MODELLING

**K Rao Kadiyala**
Krannert Graduate School of Management, Purdue University,
W Lafayette, IN 47907, USA
**Sune Karlsson**
Department of Economic Statistics, Stockholm School of Economics
Box 6501, 113 83 Stockholm, Sweden

This paper studies the numerical aspects of the implementation of prior distributions for a Bayesian analysis of vector autoregressive models. This is done in the context of a vector autoregressive forecasting model for the US economy due to Litterman [1980, 1986]. The forecasting performance of the different prior-posterior pairs is also reported on.

### MULTIPLICATIVE DISTURBANCES FOR SMOOTHING MODELS

**Anne B Koehler**
Department of Decision Sciences, Miami University, Oxford, OH 45056, USA
**J Keith Ord**
Department of Management Science, 303 Beam Business Administration
Building, Pennsylvania State University, University Park, PA 16802, USA
**Ralph D Snyder**
Department of Econometrics, Monash University, Clayton,
Vic 3168, Australia

Statistical models for smoothing methods in forecasting, such as simple smoothing and additive or multiplicative Winters' Method, have used additive disturbances. Models with multiplicative disturbances (ie multiplicative error terms), give rise to the same point forecasts, but have different forecast error variances than those for models with additive disturbances. These new models lie outside the class of ARIMA models even for simple smoothing, and the forecast error variances depend on the level of the series. Furthermore, the existence of these new models gives theoretical evidence for why smoothing methods seem to do well in empirical studies.

**CHAIR** **Robin Segal**
Social Science Research Institute
University of Southern California, Los Angeles, CA 90089-1111, USA

## WEIGHTED ANALYSIS OF CORRELATIVE FACTORS

**Hua Bing and Wang Shou Dian**
Editoral Department, Science and Economy, 219 Yimeng Road,
Linyi City, Shandong, People's Republic of China

The developments and changes in objective measures occur in relation to, and restricted by correlated factors. They are not dependent on subjective views of them. Whether we pay attention to them or not the correlated factors always restrict the observed change. Can we therefore predict the future by means of mathematical analysis of correlated factors ? The answer is affirmative, because the quantitative constraints on change are given by the interactions of the correlated factors. From our observations we can find out these relations between them.

In our forecasting work, we find that changes in objective measures always follow simple rules, just as the attraction rules in motion of the universe follows a simple law. We use a rule of the form

$$X\ (\text{Future value or Future state}) = Z\ (\text{Present value or Present state}) \circ \frac{Y\ (\text{the weight value of the changeable correlative factors})^{1+Y^{2}\ldots Y^{n}}}{N\ (\text{the total of the weight})}$$

## SIMULATION OF URBAN BUS TRANSPORT BASED ON THE CATASTROPHE THEORY

**D N Cossenza, M P S Santos, C Correa**
PET / COPPE / UFRJ, Caixa Postal 68 512, 21945,, Rio de Janeiro-RJ,
Brazil

The prediction of the future behaviour of systems, physical or deterministic, are believed to be accurate if their governing equations and initial conditions are well known. However, the study of non-linear dynamic systems has shown that when they are subjected to small changes, their future behaviour might become, in the long run, either periodic or 'unpredictable'. That is, it becomes chaotic and discontinuous.

Public transport in the city of Rio de Janeiro is composed mainly by bus transport, which responds for more than 70% of the total trips made from home to work and vice-versa. Frequently, the bus system collapses due to strikes of the bus workers - drivers and conductors - and due to severe floods in the Rio de Janeiro urban region. By considering four control variables : strikes, floods, fuel availability and the number of buses, the risk of not having bus transport to go to work is analysed through a simulation model based upon the catastrophe theory.

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

## FORECASTING MARKET SHARES FOR A MONOPOLY-DUOPOLY DIFFUSION PROCESS UNDER DIFFERENT PRICING AND ADVERTISING STRATEGIES

**Amitabh Chandra**
Department of Computing & Decision Sciences, W Paul Stillman School of Business, Seton Hall University, South Orange, NJ 07079
**George Heitmann**
Department of Management Science & Information Systems, Smeal College of Business Administration, Penn State University, University Park, PA 16802
**David Rosenthal**
Department of Computing and Decision Sciences, W Paul Stillman School of Business, Seton Hall University, South Orange, NJ 07079, USA

Diffusion [for an extensive literature review on diffusion, refer, for example, to Mahajan, Muller and Bass, 1990] is the "process by which an innovation is communicated through certain channels, over time, among the members of a social system." Growth curves (eg exponential and logistic) have been used to model such diffusion processes. This paper deals specifically with the modeling and forecasting of diffusion of innovation of a durable new product (non-repeat purchase). The *N* people in this social system are in one of following three states: (1) unaware of the product (2) aware and potential buyers (adopters) of the product, and, (3) adopters of the product. Potential adopters may be influenced in their purchase by word-of-mouth effect from early adopters. A manager seeking to launch such a new product has a limited set of variables (eg, pricing and advertising strategies) to control this diffusion process (ie the progression of individuals from state 1 to state 3.) The impact of competitive entry into such a monopolistic market [Eliashberg and Jeuland, 1986] - where a new entrant (imitator) has a cost function that is expected to be very different from the first entrant's (innovator's) cost function (due to smaller R & D expenses, learning curve effect, etc.) - changes the dynamics of this diffusion process. This paper analyses the dynamics of this monopoly-duopoly diffusion process under various pricing policies (eg constant pricing, skim-penetration pricing, stay-out pricing), and different advertising strategies (eg level, pulse); makes forecasts of the cumulative market share of the two firms; and presents normative implications for the manager.

## PREDICTIVE ACCURACY OF SIMPLE VERSUS COMPLEX ECONOMETRIC MARKET SHARE MODELS: THEORETICAL AND EMPIRICAL RESULTS

**Peter Danaher**
Department of Mathematics and Statistics,
University of Auckland, New Zealand
**Roderick J Brodie**
Department of Marketing and International Business,
University of Auckland, New Zealand

While econometric market share models have been shown to be useful to managers as descriptive tools, controversy exists over their use in forecasting. For

Cont'd

instance, Brodie and de Kluyver (1987) showed, using data for 15 brands in three markets, that naive forecasting will often do better than econometric models when predicting market share.

**A COMPARATIVE STUDY OF THE PREDICTIVE ACCURACY OF MARKET SHARE MODELS USING DISAGGREGATE DATA**

**Andre Bonfrer and Roderick J Brodie**
Department of Marketing and International Business,
University of Auckland, New Zealand

This paper replicates and extends the recent study by Kumar and Heath 1990), which compares the predictive accuracy of market share models using disaggregate weekly scanner data.

Attention is paid to issues regarding both estimation and specification of market response models, as well as the time series nature of such data.

**CHAIR** **Bob Edmundson**
Business Information Technology Program,
University of New South Wales, Australia

## DSS DESIGN TO SUPPORT TIME SERIES FORECASTING

**Geoff Dick, Bob Edmundson and Marcus O'Connor**
University of New South Wales, P O Box 1, Kensington, Australia

This paper applies theory and practices from systems and DSS design to the forecasting process. Using Simon's decision making framework of intelligence, design and choice, the paper examines the components of the process of forecasting and suggests ways in which a DSS might support each stage. The model suggests the different circumstances in which human judgement in the forecasting task needs to be assisted by database and model support. The interface between the use of database and model support and human judgement is emphasised.

## JUDGEMENTAL FORECASTING IN TIMES OF CHANGE

**Marcus O'Connor**
University of New South Wales, P O Box 1, Kensington 2033, Australia
**William Remus and Ken Griggs**
University of Hawaii, 2404 Maile Way, Honolulu, HI USA 96822

This paper reports a study which examines the ability of people and statistical models to forecast time series which contain major discontinuities. It has often been suggested that human judgement will be superior when circumstances change dramatically and statistical models are no longer relevant. Using ten time series that contained five different discontinuities and two levels of randomness, the results indicate that people performed significantly worse than parsimonious statistical models. This occurred for the segments of the time series where the discontinuity occurred and for the subsequent segment where the series was stable. People seemed to change their forecasts in response to random fluctuations in the time series, identifying signal where it did not exist. This was especially true for the series with high variability.

## GROUP INTERACTIONS AND THE OUTCOMES OF STRATEGIC FORECASTS IN A DECISION SUPPORT LABORATORY

**Pak Yoong**
Faculty of Commerce and Administration, Victoria University of Wellington, New Zealand

The identification of strategic options, conducted on a periodic basis, is a critically important aspect of today's modern organisational life. Many business leaders learned that the accuracy and validity of these strategic issues may directly impact on the successful operation of their firms. The use of various economic forecasts is prevalent during such environmental scanning and analysis exercises. The turbulent business environment and limited accuracy of economic forecasts make long range planning difficult. Although researchers have explored the issues of how Computer-Supported Collaborative Work (CSCW) may aid the overall strategic planning process, there has been little attention paid to the links between the processes used during environmental scanning. It will also examine how the tools of CSCW may aid the identification of strategic issues in turbulent economic conditions.

**CHAIR** **Max Wyss**
Geophysical Institute, University of Alaska, Fairbanks, Alaska

## POINT PROCESS PROCEDURES FOR DETECTING ANOMALOUS EARTHQUAKE ACTIVITY

**Y Ogata**
Institute of Statistical Mathematics, Tokyo, Japan

For the purpose of long-term prediction of a large earthquake, the anomalous precursors such as seismic quiescence and related seismic gaps have been studied in seismology. The statistical techniques relate to testing a stationary Poisson process for seismic activity with data from which the effect of aftershocks is removed. Aftershocks, however, constitute the greatest proportion of shocks in an earthquake catalogue and rigorous discrimination is very difficult especially for smaller or swarm type events. Therefore, in principle, they should not be removed from original occurrence data. Since the pioneering work by Omori in the last century, aftershock statistics has been a unique research subject in Japan and its various aspects have been extensively investigated. These results are effectively considered in the present modelling.

To identify the ordinary sequential pattern of occurrence times and magnitudes of earthquakes in a focal area or sufficiently side region, I have proposed fitting the Epidemic Type Aftershock-Sequences (ETAS) model to the occurrence data by the maximum likelihood estimation procedure. The ETAS model is a point process model defined by the superposition of the modified Omori decaying functions of *any* shocks $i$ which occurred at times $t_i<t_o$ A crucial point of the model here is that the decay factors depend on the magnitude $M_i$ of the shock.

By the identification of an ordinary temporal seismicity pattern using the ETAS model, we can predict the expected occurrence rate of earthquakes in normal sequences. Comparing the expected rate with occurrence data, we define *relative quiescence* as a significant decrease from the expected rate. The significance and size of such a relative quiescence is graphically shown by using time-changed occurrence data $T_1$, ..., $T_n$, or the *residual point process*, into which ordinary origin times of earthquakes $t_1$, ..., $t_n$ are transformed by the estimated ETAS model.

This procedure is very crucial for the effective residual analysis and detection of the relative quiescence. According to the present modelling, some reported naive quiescence can be a mere effect of the decaying activity of aftershocks from the last major earthquake. On the other hand, the relative quiescence, or a decrease from the expected level, is found to take place even in an active stage of seismicity.

A number of reported naive quiescences before great earthquakes in Japan and elsewhere in the world were examined by this method and clearly confirmed to be relative quiescences too. These relative quiescences affect far wider areas than the reported focal areas. In many cases, these quiescences range over a number of years. Further some relative quiescences, which are not clear in ordinary occurrence data, can be found by the present method.

Cont'd

## MODELS FOR HISTORICAL EARTHQUAKES AND THEIR IMPLICATIONS FOR FORECASTING

**David Vere-Jones**
Institute of Statistics and Operations Research,
Victoria University of Wellington, New Zealand

One of the major difficulties in developing statistical forecasting procedures for earthquakes is the lack of direct data on major earthquakes. Historical data provide one of the few opportunities for looking at occurrence patterns on times scales longer than the half-century or so which is typical for instrumental catalogues. The compensating difficulty is the lack of reliability and uniformity of coverage for historical events. This paper describes attempts that have been made to model large events from regions with some of the longest and most reliable records: China, Japan and Persia.

The simplest model available is the Poisson model which needs for its specification only an average reoccurrence rate (or return time). The time to the next event is then exponentially distributed and independent of the elapsed time since the last event.

A more elaborate stress release model has been fitted to the same data sets in a recent series of papers by Xiaogu Zheng and the author. In this model the risk of the next event is taken as an increasing function of a regional stress level, which increases steadily between events and drops when a major earthquake occurs. It is found that the model fits some regions much better than others.

Where it can be used appropriately, this model allows projection forward of the hazard rate into the future, and hence the calculation of the distribution of the time to the next event. However, the probability gains that can be achieved by such models are quite modest - corresponding to an increase over the Poisson risk by factors of around 1 to 4 but not much larger. While such knowledge might be useful from a strategic planning point of view, it does not give sufficiently precise forecasts of future events times to be of direct use in producing earthquake warnings.

## FRACTAL GEOMETRY AND EARTHQUAKE PREDICTION

**Y Y Kagan**
Institute of Geophysics and Planetary Physics, UCLA,
Los Angeles, CA 90024-1567, USA

An earthquake occurrence exhibits scale-invariant properties: the frequency of an aftershock occurrence decays in time as a power-law and earthquake size distribution is also a power-law. Recently it has been determined that several statistical features of earthquakes, ie spatial distribution of earthquakes and rotation of their focal mechanisms, are also self-similar, We present evidence that the power-law exponents might have universal values: for earthquake size distribution beta = 1/2, for shallow earthquakes time distribution between events theta = 1/2.

We review experimental evidence for earthquake scale-invariance, and offer a model of random defect interaction in a critical stress environment which,

Cont'd

without additional assumption, seems to explain most available empirica results.

The fractal pattern of earthquake occurrence suggests to us the form of functions for the extrapolation seismic activity as well as providing us with the values of parameters. Using catalogs of earthquake focal mechanisms we extrapolate recent seismicity to predict world-wide earthquake probabilities.

The prediction is expressed as a map of earthquake probabilities, where both spatial coordinates of centroid position and the probability density of focal mechanism orientation for future earthquakes are shown.

For long-term prediction we use the Poisson hypothesis of earthquake tempora behaviour.

The proposed short-term prediction uses an algorithm by Kagan and Knopoff (Science, **236**, 1563-1567), which allows, in principle, a real time automatic calculation of earthquake probabilities.

In both cases the technique used is completely formal and does not require human operator intervention, hence the prediction results can be objectively tested.

## TIME SERIES METHODS II

**CHAIR** **Philip Hans Franses**
Econometric Institute, Erasmus University, P OBox 1738
NL-3000, Dr Rotterdam, The Netherlands

### IDENTIFYING TRANSFER FUNCTION RELATIONSHIPS BETWEEN NON-STATIONARY TIME SERIES USING SAS/ETS SOFTWARE

**John C Brocklebank**
SAS Institute Inc, Cary, NC, USA
**David A Dickey**
North Carolina State University, Raleigh, NC, USA

This paper discusses some of the complexities associated with modelling transfer function relationships between non-stationary time series using SAS procedures ARIMA and STATESPACE. An example is considered with two uncorrelated input series and one output time series, where the inputs and output time series require different orders of differencing to achieve stationarity.

PROC ARIMA provides flexibility and many diagnostics for the user when modelling the individual series and establishing the transfer function relationship between the output and input series. PROC STATESPACE, on the other hand, automatically identifies and models the transfer function relationship between stationary time series.



### DIVERGENCE IN THE FORECASTING ERROR WITH MISSPECIFIED LONG-MEMORY MODELS

**Nuno Crato**
Technical University of Lisbon/University of Delaware
501 Ewing Hall, Newark, DE 19716 USA

Stationary long-memory models as the fractionally differenced ARMA can generate finite sample realisations that are virtually indistinguishable from typical observations of nonstationary ARIMA processes. The forecasting error variance caused by this misspecification will increase proportionally to the square of the number of steps ahead. Thus, these misspecification errors are much more serious than those due to the choice of a wrong stationary model to forecast a given stationary process. A test for stationarity and some applications are presented.

### CHOICE OF TIME-SERIES FORECASTING METHOD USING DISCRIMINANT SCORES

**C Shah and M L King**
Department of Econometrics, Monash University, Wellington Road
Clayton, Vic 3168, Australia

A lot of research has been done on comparing the forecasting accuracy of different univariate time series forecasting methods. The biggest such study, using empirical data, was undertaken by Makridakis et al (1982). The evidence from such comparative studies indicate that there is not one 'best' method for all kinds of data. Furthermore, there also seems to be evidence to suggest that the simpler methods, such as exponential smoothing, often perform as well

Cont'd

as or even better than the more complex methods. This is particularly true for short term forecasting. Unfortunately, there has been limited success in identifying the factors that contribute to the relative advantage of one method over another. Consequently, a practitioner is still faced with the problem of objectively choosing one out of several methods available to use in forecasting a given time series. In this paper we address this problem by considering certain characteristics of a time series in order to calculate its discriminant score. This score is then used to calculate the probability of a particular method being 'best' in forecasting that series. Three forecasting methods, simple exponential smoothing, Holt-Winters method and basic structural time-series model using the STAMP package, are considered. Quarterly time series from Makridakis et al (1982) 'M-Competition' are used.

**CHAIR** **Kathy Boardman**
Department of Mangaement Science and Information Systems,
University of Auckland, Auckland, New Zealand

## FORECASTING THE FOREIGN DIVESTMENT DECISION OUTCOME: A POSITIVIST MODEL

**Nicholas T van der Walt**
Department of Marketing and International Business,
University of Auckland, New Zealand

Focused on decision structures negating centrally desired outcomes of politically or ethically motivated international divestment decisions, the author develops a predictive model to identify which factors impact most significantly on the implementation of such decisions at the local level.

## FORECASTING MANAGEMENT PRACTICE AND PERFORMANCE: RECIPROCAL EFFECTS OF CONSULTING METHODOLOGY DEVELOPMENT AND CLIENT CHANGE MANAGEMENT

**Nicholas T van der Walt and Don Scott**
Department of Marketing and International Business,
University of Auckland, New Zealand

Postulating a model of the interaction between international consulting methodology development and the change management process in local client firms, the author argues that international accounting companies impact significantly on changes in local management practice and performance.

The interaction between consultant and client is examined to identify whether it has value in determining the nature and direction of change in local management practice and performance in the light of political and economic discontinuity.

## BACK-CASTING AND STRATEGIC DECISIONS

**Alan E Singer**
Department of Management University of Canterbury, Christchurch,
New Zealand

The conceptual framework of 'strategy as rationality' (Singer 1992) is applied to the strategic mystery of managerial investment decisions with *sunk costs*. The set of backward-looking-rationalities, $R^{BAK}$, is considered in relation to the decision-function-rationalities, D (.), of the available models of investment-with-sunk-costs. The framework is operationised, yielding *"SCIO-3"* a simple qualitative decision-aid for rationally reviewing projects that have already started.

## THE RELATIONSHIP BETWEEN MANUFACTURING AND VARIOUS SWEDISH BUSINESS TENDENCY SURVEYS SERIES ILLUMINATED BY FREQUENCY AND COMPLEX DEMODULATE METHODS

**Anders Christoffersson**
Department of Statistics, University of Uppsala, Box 513,
751 20, Uppasala, Sweden

**Roland Roberts**
Department of Geophysics, University of Uppsala, Box 556,
751 22, Uppsala, Sweden

Analysis of time series data is usually performed in the time domain or in the frequency domain. The information available in both domains is fully equivalent but some structural models can be most easily expressed (and therefore analysed) in one of the two domains. Many time series show properties which are both time-and frequency-dependent. One way to analyse such data is to use complex demodulation which provides a representation of the data that is a hybrid between the frequency and time domains, and has some of the advantages of both.

We use frequency and complex demodulate domain analyses to elucidate the relationship between Swedish manufacturing production and various business tendency survey data series. The results are compared with those of a more conventional analysis performed in the time domain.

We find that most of the significant relationship between the series lies in a clearly defined frequency band from 0.1 to 0.5 cycles per year, and that this relationship is essentially stable over time. Other frequencies primarily represent "noise" and are therefore undesirable in the sense that they obscure both the business cycle in the individual time series, and also the relationships between the various series.

**CHAIR** **Alan Singer**
Department of Management, University of Canterbury, New Zealand

**COMBINING SUBJECTIVE FORECASTS**

**Edward Melnick and Aaron Tenenbein**
Department of Statistics and Operations Research, New York University
40 West 4the Street, Room 519, New York, NY 10003

Weights are developed for the development of a consensus forecast using a logistic function based upon the voting record of the forecasters. The methodology is extended to reflect a strategy that minimizes the cost of producing an incorrect forecast.

**THE DELPHI TECHNIQUE: EFFECTS OF FEEDBACK TYPE, CONFIDENCE, DESIRABILITY OF FORECAST OUTCOME AND SELF-RATED EXPERTISE, ON OPINION CHANGE AND ACCURACY OF FORECASTS**

**Gene Rowe**
Bristol Business School, Bristol Polytechnic, Coldharbour Lane
Frenchay, Bristol, BS16 1QY, England

**George Wright**
Strathclyde Graduate Business School, Scotland

The Delphi technique was developed to structure the information exchange between a group of non-interacting experts in order to attain reliable consensus and increased forecast accuracy. However, we question the theoretical underpinnings of the typical Delphi design (referring to research in social psychology), and suggest that the limiting nature of prescribed feedback (largely of statistics) is as likely to lead to 'process loss' as 'process gain', with adverse effects on achieved forecast accuracy.

To examine this hypothesis, an experiment involving the forecasting of political and economic changes was conducted using Delphi-like procedures which differed in terms of the feedback given (either 'statistical', 'reasons' or 'none'). Results indicated that each feedback condition showed an increase in prediction accuracy from first to second rounds. However, the force for opinion change was no greater for our information-rich feedback than for the typical statistical feedback, or even for no feedback at all. Analysis of the factors which led to the opinion changes of subjects (and the appropriateness of those exchanges) are reported, including analysis of the effects of the variables 'confidence', 'self-rated expertise' and 'desirability of forecast outcomes'. Issues concerning the composition of Delphi groups, the selection of panelists, and the format of the procedure, are discussed.

**HEADS OR MODELS ?**
**DECISION MAKING WHERE THE CUES ARE NOT WELL SPECIFIED**

**Michael Lawrence and Marcus O'Connor**
School of Information Systems, University of New South Wales,
P O Box 1, Kensington, NSW 2033, Australia

Over twenty years research on cognitive biases and limitations has built a strong case for managers not to use their heads (ie judgement) if a suitable

Cont'd

**CHAIR** **V Keilis-Borok**
International Institute of Earthquake Prediction and Theory, Moscow

## FORECASTING EARTHQUAKE INSURANCE LOSSES IN NEW ZEALAND: A USER'S PERSPECTIVE

**I McLean**
Earthquake and War Damage Commission Wellington, New Zealand

Major losses by catastrophe insurers and reinsurers worldwide in the years 1988-1991 have focused attention on the forecasting of catastrophes, even including those like earthquake which have not contributed much to recent high losses. Forecasting earthquake insurance losses involves estimating five distinct distributions which model factors contributing to the final insurance loss. The accuracy with which each of these distributions can be specified for New Zealand conditions appears to vary considerably from one distribution to another. Ideally, users require confidence limits, both for estimates of expected annual loss due to earthquake throughout New Zealand, and of probable maximum loss for the most damaging earthquake event within the insurance time horizon.

## A REVIEW OF NATURAL HAZARD RISK MANAGEMENT

**L A Roberts and C A Rollo**

A review is undertaken of the methods available for managing risks arising from natural hazards, and the extent to which these methods are used in practice. Particular attention is paid to modelling the risk process, and the setting of reinsurance premiums. There is some consideration of natural hazards in New Zealand, and the cover provided by local insurance companies.

**CHAIR** **Adolph Stroombergen**
BERL, P O Box 10 277, Wellington

## COMBINING HISTORICAL AND PRELIMINARY INFORMATION TO OBTAIN TIMELY TIME SERIES DATA

**Victor M Guerrero**
Instituto Tecnologico Autonomo de Mexico, Mexico

A method is presented to improve the precision of timely data, which are published when final data are not yet available. Explicit statistical formulas, equivalent to Kalman filtering, are derived to combine historical with preliminary information. The application of these formulas is validated by the data, through a statistical test of compatibility between sources of information. Also derived is a measure of the share of each source of information, to the precision of the timely data obtained by way of the combination. An empirical example with Mexican economic data serves to illustrate the procedure.

## GENERAL EQUILIBRIUM MODELLING FOR ECONOMIC PLANNING

**Bryan Philpott**
Victoria University of Wellington, New Zealand

This paper describes the use of general equilibrium models in the process of medium term economic planning, especially in so far as such planning is related to structural change, to its implications, and to the design of current policy optimal adjustment and growth.

## A SYSTEM DYNAMICS MODEL FOR ECONOMIC DEVELOPMENT FORECASTING

**Yashovardhan Platak and P RamBabu**
School of Futures Studies and Planning, Devi Ahilya University,
Khandwa Road, Indore 452 001, India

In a present day situation almost all of the developing countries are facir serious problems with their economy. On one hand, the in-house problems c unemployment, population explosion, exhaustion of resources, poverty etc a causing serious concern. Whereas on the other hand increase in extern debts, shrinking exports, day by day worsening of balance of payme situation, increase in pressures from IMF, World Bank and other moneta organisations, have really helped the developing countries to place themselv in tight corners. The rate of inflation is increasing every day.

In this paper we employ the methodology of System Dynamics to see t interdependencies of various economic factors associated with inflation ra On the basis of this we forecast a future scenario and suggest appropri policy measures to control the trends.

**CHAIR** **Allan Catt**
BERL P O Box 10 277 Wellington, New Zealand

**FORECASTING CONFERENCE TOURISM DEMAND**

**Stephen F Witt, Alan M Sykes, Mireille Dartus**
European Business Management School, University of Wales, Swansea, Wales

Although there are a number of studies which are concerned with tourism forecasting, these are generally concerned with holiday tourism or total tourism. Published research on conference tourism forecasting is virtually non-existent.

An econometric model which explains international conference tourism demand by origin country is constructed and estimated. The explanatory variables include income, transport costs, registration fees and hotel costs, together with various dummy and/or time trend variables to represent origin and destination effects. As the dependent variable is specified in probabilistic form, a logistic model is used, and it is estimated by the method of maximum likelihood.

Good empirical results are obtained. The explanatory variables reduce the deviance significantly, 'correct' coefficients signs are obtained and many of the coefficients are statistically significant.

The forecasting ability of the econometric model is compared with that of the 'no change' naive model for one-year-ahead forecasts. It is demonstrated that the naive model outperforms the causal model, which supports previous empirical results where, in the case of vacation/total tourism, the naive model generates more accurate forecasts of international tourism demand than econometric models.

**APPLICATION OF COINTEGRATION METHODOLOGY TO AUSTRALIAN INTERNATIONAL SHORT TERM TOURISM DEMAND (NEW ZEALAND CASE)**

**N Kulendran**
Department of Econometrics, Monash University, Clayton
Victoria 3168, Australia

There appears to be a belief in studies of tourism demand that if the country of destination is close to the country of origin, then movements of tourists are highly responsive to the exchange rate. This belief is examined using cointegration methodology, considering New Zealand as the origin and Australia as the destination. Time series for short term tourist arrivals from New Zealand and the real exchange rate are examined. Once the long-run equilibrium is identified, Engle and Granger (1987) error correction models are estimated and the direction of causality investigated. To evaluate the forecasting performance of these models, the forecasts are compared with those from univariate ARIMA models.

**FORECASTING RECREATIONAL EXPENDITURES IN THE UNITED STATES**

**Abdur R Chowdhury**
Department of Economics, Marquette University, Milwaukee, WI 53233
**Golam Mohammad**
Department of Maritime Administration, Texas A&M University, USA

**CHAIR** **Ken Holden**
University of Liverpool, United Kingdom

## THE INTERDEPENDENCE OF THE VOLATILITY OF STOCK MARKETS: A FIVE VARIABLE VECTOR AUTOREGRESSIVE ANALYSIS

**Gokce Soydemir**
Research Directorate, The Central Bank of the Republic of Turkey
060100 Ulus Ankara, Turkey

The transmission of shocks from national securities markets to international securities markets and to international financial system may lead to world-wide systemic crisis. The purpose of this paper is to detect such risks arising from structural changes in world securities markets. Changes such as the abolition of exchange controls, and technological advances in communication have made capital markets freer and more competitive. This extent of integration between national markets has increased the likelihood that markets around the world will move in similar directions.

Several studies like, Kelleher (1988)[1] report that stock price movements in the world became increasingly similar in the 1980s, compared to the 1970s and before. King and Wadhwani (1990)[2] provide evidence in support of the interdependence of national securities markets. These results appear consistent with the ongoing strengthening of crossborder trading, listing, and investment activities as a consequence financial deregulation and innovation.

This study provides evidence of this inter-market volatility transmission briefly outlined above, by a five variable vector autoregressive (VAR) method using impulse response functions and variance decompositions. A similar study had been done by Eun and Shim (1989)[3] and found that innovations in the US are rapidly transmitted to other markets in a clearly recognizable fashion, whereas no single market explained the US market movements. Daily data of five major markets (New York, London, Tokyo, Hong Kong, Australia) are obtained from Bloomberg, and ranges from January 1989 to December 1991.

The results of the study imply that a large price decline in one major market could trigger a serious disruption in another market, and eventually, in the global financial system through the volatility transmission of national markets.

## ACCOUNTING DATA AND SYSTEMATIC RISK PREDICTION

**Florence Kirk, Badr E Ismail and Moon K Kim**
Department of Accounting, School of Management, Syracuse University,
900 S Crouse Avenue, Syracuse, NY 13244-2130, USA

This paper considers the usefulness of accounting data in security risk prediction. The method relies on two sets of models. In the first, acconting information identified as being contemporaneously related to security risk is used to predict future risk. In the second, the estimation process is extended to also capture the intertemporal relationship between successive periods' risk estimates. The results indicate that models incorporating both accounting data and market beta provide superior risk predictions relative to the market model whereas models incorporating only accounting data do not. Strong evidence is found that the relative predictive advantage of accounting data, used alone or in combination with market beta, lies in high risk securities.

**CHAIR** **David Rhoades**
Applied Mathematics, New Zealand Institute for Industrial Research and Development, P O Box 1335, Wellington, New Zealand

## PROBABILITY OF ERUPTIONS AND RELATED RISK AT SOME NEW ZEALAND VOLCANOES

***J H Latter***
*Institute of Geological and Nuclear Sciences Ltd P O Box 1320,* Wellington, New Zealand

This paper examines the mean frequency of eruptions, in order of magnitude volume steps, at selected New Zealand volcanoes. Data are adequate to estimate mean frequency and standard deviation for 14 volume classes of eruption, and three of sector collapse, at seven volcanoes. Eruption histories at other New Zealand volcanoes are too poorly known for reliable estimates to be made. Five of these 17 estimates are random, since the standard deviation exceeds the mean, and an additional nine yield standard deviations of more than about 70% of the mean. Only three remaining have standard deviations low enough (less than 50% of the mean) to warrant the suggestion of a non-random periodicity in their occurrence. However, three quarters of the estimates (including these three) are based on small samples of 10 intervals or less. Hence Poisson (random) distribution fits the data better than a periodic distribution, and has been used to estimate the probability of occurrence of each class of event during a 100-year period.

## ERUPTION FORECASTING IN NEW ZEALAND

**R R Dibble**
Victoria University of Wellington, New Zealand

Only at White Island and Ruapehu volcanoes, have enough eruptions been monitored instrumentally for a study of forecasting to be made. This paper describes the data, the forecasts, and their success rate, in terms of Synthetic Hit Rate. SHR is defined as the square of the number of successful forecasts (hits), divided by the number of forecast judgements, and by the total number of eruptions or other phenomena forecast.

At White Island rapid uplift of the crater floor, and decreases in the magnetic field and fumarole temperatures usually preceded eruptions, and tentative forecasts were made by scientists of Victoria University and DSIR. 1967 and 1983 there were 11 eruptions, and 4 of the 8 forecasts of -ssful, giving an SHR of 18%. Counting other 13 judgements, and 8 hits,

At Ruapehu between 1964 and 1968, sequences of eruptions were usually forewarned by continuing tremor of seismic power 1 kW or more, with earthquakes of 20 kW (M=2.5) or more. Forecasting based on this would have made 13 forecasts for 8 hits on about 35 eruptions, giving an SHR of 14%. However, the eruptions occurred in only 11 sequences, each of 7 days duration or less, and the SHR for sequences was 46%.

In 1981, computerised forecasts by "committee" were made using three linear prediction equations linking eruptions with lake temperature, thermal power

Cont'd

**CHAIR** **Hugh Barr**
DSIR, Physical Sciences, Applied Maths Division,
P O Box 1335, Wellington, New Zealand

**FORECASTING SHORT TERM NEWSPRINT DEMAND IN FOUR EC COUNTRIES**

**Seppo Pitkanen and Markku Rommi**
Lappeenranta University of Technology, Department of Industrial Engineering and Management, P O Box 20, SF-53851, Lappeenranta, Finland

The monthly forecasting models for 12 periods onwards for France, Italy, the UK and quarterly for Spain, are constructed in two phases. First the turning point analysis of trends is carried out by multiple regression analysis on leading indicator basis. The R's of the econometrically correct but - from the point of view of causal modelling - unorthodox models vary from .973 to .986. Second the actual forecasts are obtained by classical time series decomposition where the previous trend estimates are taken as given. The approach applied appeared to be superior to the Box-Jenkins and Winter-Holzman ones in the enlightening of all traditional indicators of goodness of fit, as well as with respect to the real development of demand since the models were constructed.

**FORECASTING THE PRODUCT LIFE OF THOUSANDS OF SKU'S - A CASE STUDY**

**LeRoy Simmons and Laurette P Simmons**
Loyola College, 4501 North Charles Street, Baltimore MD 21210-2699, USA

**PREDICTING FUTURE DEMAND VIA BAYESIAN UPDATING AND INVENTORY CONTROL**

**Amresh Das**
Xavier University of Lousiana, New Orleans, LA 70125

The paper discusses the inventory problem with uncertain demand and a non-symmetric loss function. Here the random demand follows a certain normal distribution. The future demand for the N-th period is related to the previous (N-1) demands via the parameters. Thus the future demand is predicted (via Bayesian theory) by using the data on previous demands. An intertemporal loss function is minimized by choosing "new" orders.

**CHAIR** **Ashley Lienart**
Reserve Bank of New Zealand, P O Box 2498, Wellington

## SOME ASPECTS OF FORECASTING WITH VECTOR ARMA PROCESSES

**M Shelton Peiris**
School of Mathematics and Statistics,
The University of Sydney, Australia

Suppose that $\{\underline{X}_t\}$ and $\{\underline{Y}_t\}$ are two independent m-variate zero mean stationary ARMA processes. Very often in practice we need the $l$ -step-ahead forecast of $X_{it} + Y_{it}$, ie the total forecast of the $i^{th}$ component. This note discusses the three disjoint methods of obtaining such forecasts, namely:

A Use of component models
B Use of joint vector models
C Use of combined joint vector model

The efficiencies of such forecasts are compared and, it is shown that the method B gives better forecasts than the others. Some examples are added to illustrate the situation.

## A NEW APPROACH TO IDENTIFICATION AND FORECASTING FOR ARMA PROCESSES WITH NONSTATIONARY WHITE-NOISE

**N Singh**
Department of Mathematics, Monash University, Melbourne, Australia

This paper considers the problem of identification of an autoregressive-moving average (ARMA) process when the white-noise is nonstationary in variance. Series realised from such a process are obviously nonstationary and are often encountered in practice. Examples are given in the main paper. The problem of identification of both (i) the ARMA process and (ii) the covariance structure of the white-noise has not been given due attention in the literature, not to say of forecasting. It is this problem which is discussed in this paper and a solution is suggested. Illustrative examples are discussed.

# THE THIRTEENTH INTERNATIONAL SYMPOSIUM ON FORECASTING

*Sponsored by*

**The International Institute of Forecasters**

*in collaboration with*

**H. John Heinz III School of Public Policy and Management**

**Carnegie Mellon University**

*and*

**Richard T. Farmer School of Business Administration**

**Miami University (Ohio)**

**9 - 12 June 1993**

**Pittsburgh Hilton & Towers, Gateway Centre, USA**

To obtain information concerning **ISF 93**, please contact:


Wilpen Gorr
School of Urban and Public Affairs
Carnegie Mellon University
Pittsburgh, PA 15213-3890
Telephone: 412-268-8471