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June 9-12, 1991

TABLE OF CONTENTS

ACKNOWLEDGMENTS

The ISF91 Committee would like to thank the following institutions that have made important contributions to the organization of the symposium and/or to the preparation of the program book:

International Business Machines Corporation

The Smeal College of Business at Penn State University

Leonard N. Stern School of Business at New York University

Also our special thanks to the

Sheraton Center Hotel and Towers for sponsoring the Monday breakfast,
The Leonard N. Stern School of Business at New York University
for sponsoring the Monday evening NYU Reception
and to
The New York Convention and Visitors Bureau
for assistance in planning the conference and the Lady Liberty photo on the front cover.

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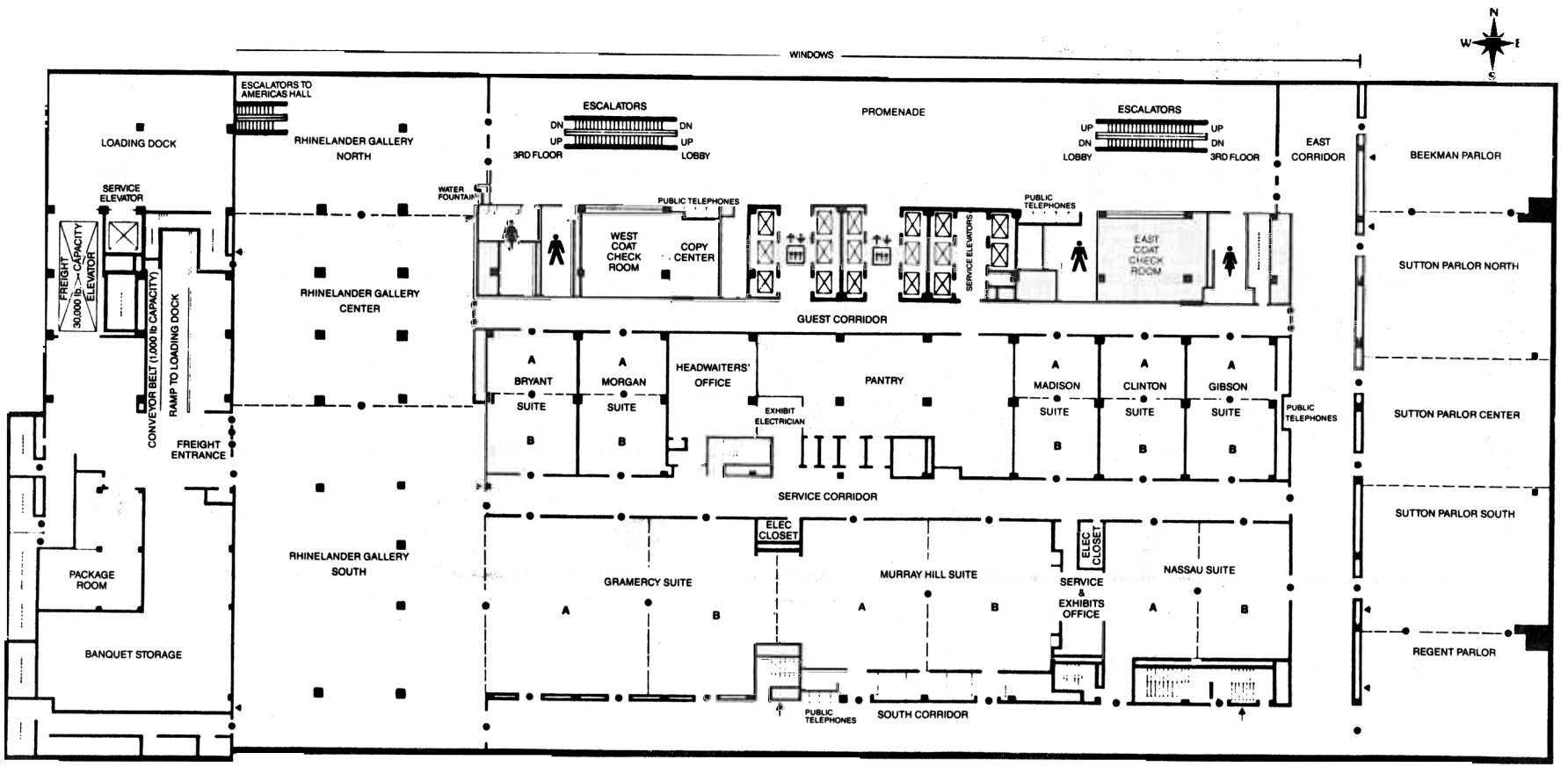

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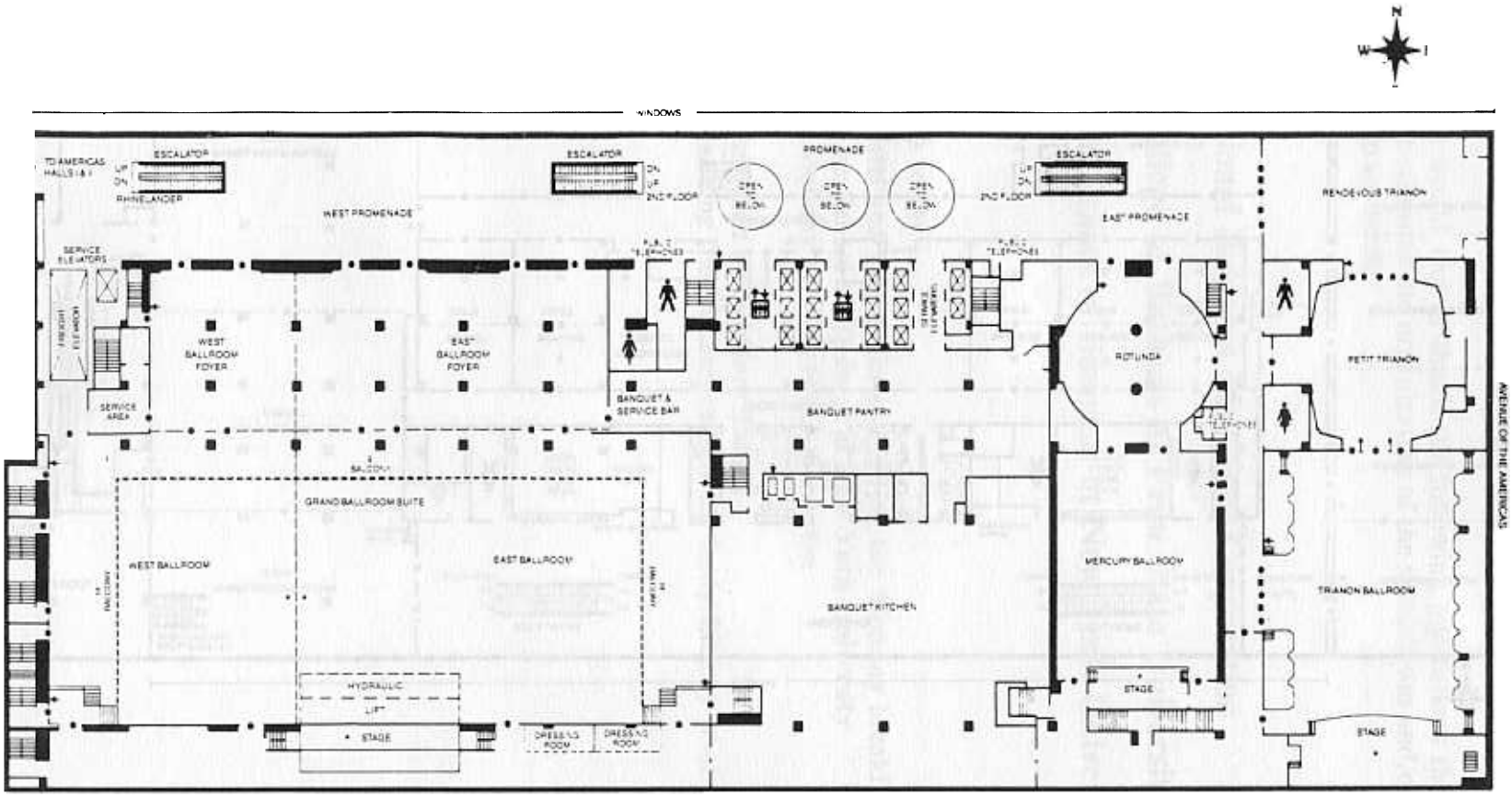
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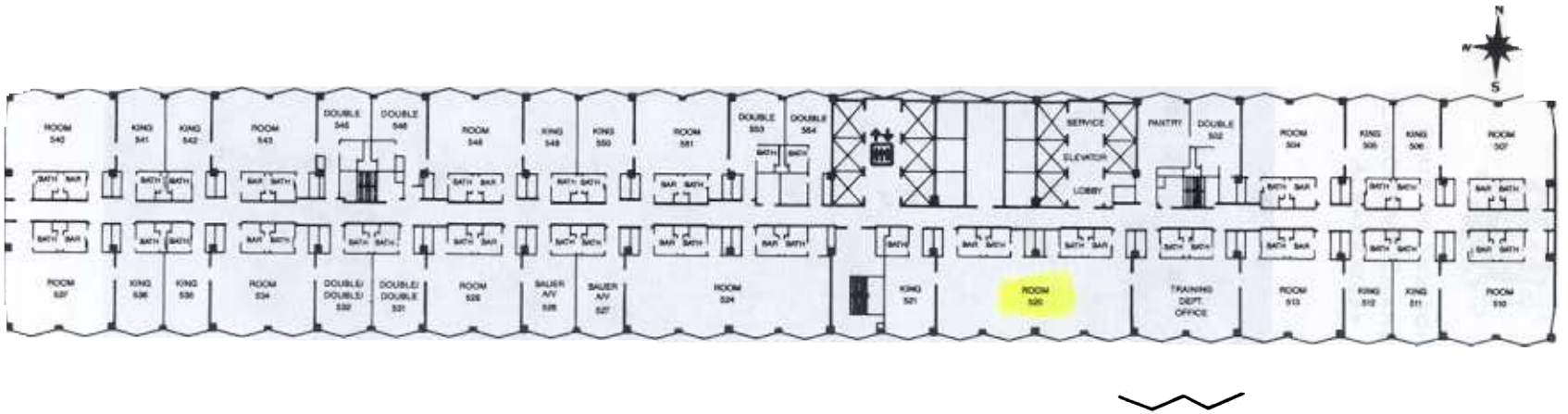

STATE OF NEW YORK
EXECUTIVE CHAMBER
ALBANY 12224

MARIO M. CUOMO
GOVERNOR

Dear Friends:

On behalf of the people of the State of New York, I am delighted to extend a most cordial welcome to the Eleventh International Symposium on Forecasting on the occasion of your meeting in New York City from June 9-12, 1991.

You may be assured of the interest of the State government in cooperating with your organization and of the friendly attention you will receive.

New York affords the tops in food and lodging as well as cultural events, sports, entertainment and tourist attractions. It is an exciting and beautiful State, and I hope that your members will find it possible to visit our many interesting historic sites and areas of natural beauty.

Sincerely,

Mario M. Cuomo

THE CITY OF NEW YORK
OFFICE OF THE MAYOR
NEW YORK, N.Y. 10007

April 26, 1991

To All in Attendance
International Symposium on Forecasting
The New York Hilton and Towers
New York, New York

Dear Friends:

Greetings! On behalf of the people of the City of New York, I am delighted to welcome you to our city as you participate in the Eleventh International Symposium on Forecasting.

New York is a powerful center of commerce and trade -- the city where more than one-third of our country's international long-distance calls originate. Our city is a mecca of culture as well -- from Broadway to be-bop, to revolutions in fashion and the arts. I believe that your international membership will feel right at home in our diverse, thriving metropolis.

This year's conference theme, "Practice and Potential," is highly relevant to our unique community of scholars and professionals in business, industry, and government. I trust that you will have a most productive conference, and that you will explore some of the crucial issues which face our business community, and the international business community as well.

I hope you will find time to sample some of the attractions which make our city a favorite destination for millions of tourists each year -- and I thank you for choosing New York as your conference site.

Sincerely,

David N. Dinkins
MAYOR

THE ELEVENTH INTERNATIONAL SYMPOSIUM ON FORECASTING

Theme: Practice and Potential

New York, USA
June 9 - 12, 1991

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Jon Hosking, IBM

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Australia/NZ/Asia
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Canada
Reinaldo Souza
Central/South America
Jan DeGooijer
Europe
Robert Fildes
United Kingdom

Message from the General Chairperson, Program Chairperson and Finance Chairperson

On behalf of the International Institute of Forecasters we welcome you to the 11th Annual International Symposium on Forecasting and to New York city, the Big Apple.

We chose the theme 'Practice and Potential' because both the practice and theory of forecasting are critical for the development of the subject. Practitioners often have forecasting problems and substantial experience of the application area, whereas theoreticians often have potential solutions. We have made an effort to produce a balanced program with opening and closing plenary speakers, keynote speakers and organized sessions ranging across the entire spectrum of forecasting activity, to encourage interaction among all varieties of forecaster; indeed, to provide a 'melting pot' of ideas and approaches.

In particular, to highlight the New York forecasting and planning scene, we have a 'Meeting within Our Meeting' that focuses upon forecasting issues in Finance.

Our institute prides itself on being a heterogeneous and interdisciplinary group which is the key to having an exciting and useful conference.

With your participation and support, we feel confident that this year's symposium will be a success.

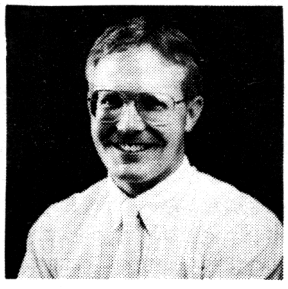
Lilian Wu Keith Ord Hans Levenbach

ORGANIZING COMMITTEE

Lilian Shiao-Yen Wu
General Chair

J. Keith Ord
Program Chair

Hans Levenbach
Financial Chair



John R. Snyder
Exhibits Chair

Richard De Roeck
Corporate Programs

Edward Melnick
University Programs

Peg Young
Publicity

Jon Hosking
At-large

NOTE: SHOULD YOU NEED HELP OR HAVE QUESTIONS - PLEASE LOOK FOR COMMITTEE PEOPLE WEARING RED OR GREEN BADGES.

Coffee Breaks: Coffee and tea will be available during the morning and afternoon breaks in the exhibit area, Beekman Suite and Sutton North.

Message Centre: A bulletin board for messages will be located at the registration area. Attendees are encouraged to check periodically for messages at this center. Announcement on changes in the program or scheduling will be posted here. To reach people staying at the New York Hilton, please call the hotel message operator directly at (212) 586-7000.

NOTE: It will not be possible to page attendees, to deliver messages or to post phone messages on the message board.

Additional Copies of Booklet: Additional copies of the program booklet may be purchased at the registration desk for $10. After the conference, copies may be purchased for $15 by writing to Professor J. Keith Ord, College of Business, Penn State University, University Park, PA 16802. Make checks payable to IIF.

Public Telephones and Washrooms: These are conveniently located on both the 2nd and 3rd floors of the conference center.

Copying Services: Available through the Hotel Copy Center located on the second floor.

SOCIAL EVENTS

The welcoming party will be held in the Sutton Complex of the Hilton Hotel on the second floor, June 9 from 8-10pm. Admission is by badge. Spouses and guests are welcome. All conferees, their spouses and guests are invited to the Monday evening NYU reception. Buses will be available at 6:00pm on the 54th street side of the Hilton. A luxury yacht has been charted to take ISF91 conferees and guests on a private cruise on Tuesday evening, June 11. Buses will be provided. Meet at 6:00pm on the 53rd street side of the Hilton. If you purchased cruise tickets when registering, your tickets should be included with the conference materials. If space is available on the cruise, tickets will be sold at the Registration Desk.

SPOUSES' PROGRAM

The Spouses' Program will be handled by *Into The ARTS*, (201-467-2368). Call them about Tour of New York, Gallery Visits, Artist's Studio Visits, Shopping at Woodbury Commons, Culinary Institute of American, Back Stage at Lincoln Center.

EXHIBITS

Exhibits will be located in the Beekman & Sutton North Rooms of the New York Hilton Hotel. A wide variety of educational materials and software will be on display. Exhibit hours are 8:00pm - 10:00pm Sunday, 8:00am - 5:00pm on Monday and Tuesday and 8:00am to 12:00 noon on Wednesday. Meeting ID badges will be required for admission.

NO SMOKING POLICY

There will be no smoking in any of the rooms in which technical sessions will be held, nor in the exhibit areas.

TRANSPORTATION TO THE AIRPORT

To LaGuardia Airport:
Taxi: approximately $20.00 from the Hotel
Carey Bus: $6.00, directly from the New York Hilton.

To JFK airport:
Taxi: approximately $28.00 from the Hotel
Carey Bus: $8.00, directly from the New York Hilton.

To Newark Airport:
Taxi: approximately $35.00 from the Hotel
Olympia Trails Bus: $7.00 from Grand Central Terminal

To Pennsylvania Station or Grand Central Terminal: a short taxi ride.

Shared Minibus Service: Provided by Giraldo Limousine (212-757-6840) and Abbey's Transportation (718-565-3213). Minibus service to the airport operates from about 7am to about 7pm, and until 11pm from the airport.

HOW THE BIG APPLE GOT ITS NAME

The term, the **BIG APPLE**, was used in the '20s and '30s by people in the entertainment and sports worlds, particularly by jazz musicians, to describe their view of New York. They bragged about getting a gig in New York - playing the "big time", the BIG APPLE.

In 1971, Charles Gillett, then President of the New York Convention and Visitors Bureau, chose the Big Apple as the central theme for a special new image campaign. The Big Apple symbolized the excitement, vitality and diversity of New York City. He encouraged every New York organization, every individual to use this now world-recognized symbol of New York City. It worked because it's true for residents and visitors alike - New York IS the BIG APPLE.

During the month of June, the average maximum temperature to 80°, average minimum temperature is 62.7°, and the average precipitation is 3.23".

NEW YORK ATTRACTIONS

NEW YORK, the largest city in the United States with a population of some 9,000,000, is made up of five counties or boroughs, as they are called here. The boroughs of Manhattan and Staten Island (formerly the borough of Richmond) are each an island. The boroughs of Brooklyn and Queens are both on the western end of Long Island. The Bronx is the only borough on the mainland. Tunnels, bridges and ferries link the five of them.

Furthermore, New York was found to have "the best food" and "the best arts, entertainment and nightlife". So rich is the Big Apple in places to go, things to do and activities and events to attend, that you could spend a lifetime in the city and only scratch the surface. For starters, however, here is a checklist of essential, only-in-New York sights and services. What are the only-in New York sights, attractions and services that attract more than 900 conventions and almost 20,000,000 people each year?

Statue of Liberty, Since 19886, Lady Liberty has lifted her lamp "beside the golden door," and now, after a multimillion dollar restoration in honor of her 100th birthday, she is welcoming visitors daily.

Empire State Building, The Mighty One (1,454 feet!) will be 60 years old this year. Each year millions of visitors enjoy the breathtaking views from observation decks on the 86th and 102nd floors, which have recently been completely renovated.

Rockefeller Center, A city within a city, this landmark will celebrate its 60th anniversay in 1992. The midtown complex offers a cornucopia of delights - among them: the famous Rainbow Room, you can ice skate in the winter and dine outdoors in the summer. Visit Radio City Music Hall, where you can get a backstage tour as well as a tour of the NBC-TV Studios in 30 Rockefeller Plaza.

World Trade Center, Twin towers each 110 stories tall, stand like soaring sentinels guarding New York City's harbor. Get a breath-taking view on the world's highest open-air observation deck - 1,377 feet up in the South Tower.

World Financial Center, A new $4 billion, 21st century "city built onto a city". A world complex designed for business and finance. It includes a dazzling crystal palace-the Winter Garden-where you can dine, listen to free entertainment and relax.

INFOQUEST, Get smart, free of charge. Take a mind trip into the world of computer games, robotics, fiber optic and fun at the AT&T Infoquest center, 56 and Madison Ave.

The Great Museums. Everyone has heard of the Met and the Modern, and they are essential experiences; but visitors should not overlook the new museums which include the Museum of American Folk Are, and the moving Lower East Side Tenement Museum at 97 Orchard St.

South Street Seaport, Consists of 12 blocks and three piers stretching along the East River Waterfront at Fulton Street. The entire area has been restored to its appearance when it was one of the world's great ports for sailing ships.

Times Square, Now undergoing a renaissance, "The Great White Way" is enjoying another "golden age." Marvel at the new theaters, movie houses, new hotels, billboards, neon lights, skyscrapers and shops. Even Nathan's of Coney Island (the world-famous hot dog heaven) has a Times Square Branch.

NEW YORK's RESTAURANTS

From the budget price delis and pizzerias to the posh "21" Club, Lutece and the Four Seasons, the city is guaranteed to please the palate and purse. But you must bring a hearty appetite: the puny eater will develop an inferiority complex!

Lower Manhattan

Admiral's Galley, 160 South St (at Dover Street) Galley's shipshape beneath the bridge Superb northern Italian cuisine, seafood, steak & chops. Re. Sug. $12 - $22.

Delmonico's, 56 Beaver Street. Continental cuisine, Norwegian salmon with sorrel sauce is a specialty. $15 - $30.

Tallships, (Vista International Hotel), 3 World Trade Center. Nautical atmosphere, hamburgers, steak sandwiches, grilled seafood. $7 - $20.

Village, Chinatown, Soho

Blue Note Jazz Club & Restaurant, 131 W. 3rd St. off Sixth Ave Top jazz artists perform nightly, 7pm-4pm. Continental cuisine, $8 - $23.

Grand Ticino, 228 Thompson St., bet. Bleecker and W. 3rd. Sts., italian cuisine, homemade gnocchi al pesto, saltimbocca alla romana. $6.25-$11.95.

Cadillac Bar, 15 W.21 St. casual atmosphere, Tex-Mex food, featuring mesquite fajitas, shrimp and frogs legs. $6 - $15.

Phoenix Garden, 46 Bowery Arcade (inside). Authentic Cantonese food, roast squab, pepper and salty shrimp, lemon chicken, $10-$22.

Taste of India, 181 Bleecker, Tandoori specialities, $8 - $21.

The Manhattan Brewing Co. 40-42 Thompson St. at Broome St., located in SoHo. Extensive menu including Texas BBQ, ribs, wings, chili, vegetarian foods. Homemade cornbread, and salads. $8 - $16

Singalong, 17 W. 19th St. Features continuous live entertainment with professional singers who sing the lyrics to original background music through the use of a Kaiaoke machine. $5.50 - $11.50.

42nd St. to 59th St.

Benihana, Japanese Steakhouse, 120 E. 56th St. Hibachi cuisine. Featuring shrimp, chicken, lobster and steak prepared at table by chefs trained in showmanship. $13 - $ 24.

Brasserie, 100 E. 53rd St. Open 24hrs a day.
Informal restaurant serving French, Alsatian and American food. $9.50 - $22.50

Cabana Carioca II, 123 W. 45th St. Brazilian food and atmosphere.

Darbar Indian Restaurant, 44 W. 56th St. One of the city's most exotic restaurants, Specialties; tandoori dishes, saag gosht, and crab malabar.
$7 - $19

Hard Rock Cafe, 221 W. 57th St. 40-foot guitar shaped bar, rock 'n' roll memorabilia. Burgers, steaks, ribs, and the "Pig" sandwich. $6.50 - $17.

Rusty Staub's, canopied entrance on E. 47 near fifth. Rusty Staub and other pro-athletes and celebrities are frequently present. Specialties include Shrimp le grand orange, and Canadian baby back ribs. $14 - $28.

EXHIBITORS AT ISF 91

Automatic Forecasting Systems, Inc.

Automatic Forecasting Systems, Inc., (ASF) is a software house specializing 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 facts, along the way.

Business Forecast Systems, Inc.

Business Forecast Systems, Inc. (BFS) specializes in providing forecasting services and software to business. BFS will be demonstrating three products at the conference: (1) Forecast Pro, a forecasting package designed for the business person (PC Magazine's "Editor's 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 "Editor's Choice" 1991, Lotus Magazine's "Best of Award," 1990). In addition to these packages, BFS offers custom software, seminars and consulting in the area of statistical forecasting.

The Center for International Business Cycle Research

The Center for International Business Cycle Research (CIBCR) at the Columbia Business School is concerned with innovations in economic measurement methodology as applied to business cycles, inflation and financial markets in the United States and other industrial nations. Our research goals are to improve the timeliness, scope, and forecasting capabilities of economic indicators and to expand our understanding of the fundamental economic relationships within and between the world's industrial nations.

The Center produces the weekly leading index which appears regularly in *Business Week* magazine. In addition, we produce the Long-Leading Index and Short-Leading Index of U.S. economic activity, the Leading Index of Inflation, the Daily Inflation Index, and the Leading Index of the Services Industries. We compile and analyze leading indicators for eleven countries published by the Conference Board in its International Economic Scoreboard. We also designed the Daily Industrial Materials Price Index that is published by the Journal of Commerce.

Dataplan GmbH

Elsevier Science Publishing Co.

Elsevier is known for its excellence as a publisher in Forecasting. Elsevier offers complimentary journal sample and perusal of its books on display.

John Wiley and Sons

John Wiley and Sons invites you to stop by our booth and see our wide range of publications for the forecaster.

Levenbach Associates, Inc.

Levenbach Associates, Inc. is exhibiting a complete and comprehensive set of PC software solutions to meet a wide range of forecasting needs. The SPREADSHEET FORECASTER is a toolkit containing 23 Lotus 1-2-3 templates for business forecasting. It is also available for business students and Executive Management Seminars. We will demonstrate AUTOCAST II an expert forecasting package with batch options for simultaneously forecasting large

numbers of end items and stock keeping units (SKU's). A new inventory model is being introduced for the first time at ISF91. In addition, we offer 4CAST/2 for demand analysis and forecast modeling, that includes a complete implementation of the census X-11 seasonal adjustment procedure on the PC. For sophisticated seasonal analyses, we market support Statistics Canada's new X11ARIMA/88 for the PC.

Promotional Materials Table

Colorado State University's video tape short course for business and industry decision makers, *Forecasting for Sales and Production*, Pergamon Press

Smart Software

Smart Software, Inc., founded in 1983, specializes in the development of sales and business forecasting software with expert system capabilities. The professional background of its principals includes software development and marketing, management consulting, and university teaching and research at Harvard, MIT, and RPI.

The company's lead product, SmartForecasts II (TM), is both a statistical and judgmental forecasting program designed for business professionals in marketing, sales, finance and manufacturing. It uses highly accurate "sliding simulation" techniques for AUTOMATIC statistical forecasting, as well as interactive graphics for judgmental adjustments, SmartForecasts II is the forecasting choice of many Fortune 1000 corporations, including GE, General Foods, Bristol Myers and Ameritech, in addition to a growing number of small- and medium sized companies.

At their booth Smart software will be demonstrating the new BATCH Processing Editions of SmartForecasts II with their ability to automatically forecast hundreds of thousands of sales and product items. Free SmartForecasts II Demo Packages will also be offered to interested ISF'91 attendees.

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FORECASTING WORKSHOP

Saturday, June 8, 1991
10:00-4:00

PRESENTER: Everette S. Gardner, Jr.

Department of Decision and Information Sciences, University of Houston, 4800 Calhoun Road, Houston, TX 77024, USA

This is a fast-paced workshop in practical methods for forecasting business data such as sales, expenses, and inventory usage. No background in forecasting or statistics is assumed. The workshop begins with a review of data analysis for forecasting, including identification of trends and seasonal patterns and removal of outliers or extreme data points. Next, alternative forecasting models commonly used in business are presented, using actual data from a variety of companies to illustrate applications. The models include alternative forms of exponential smoothing to handle different types of trends, regression analysis, and market diffusion approaches to forecasting. The workshop concludes with recommendations for managing the forecasting function such as monitoring accuracy, conducting periodic performance reviews, and gaining acceptance of the forecasts in marketing and production. Each participant in this workshop receives a copy of The Spreadsheet Forecaster, a collection of 23 ready-to-use worksheets for business forecasting.

BIOGRAPHY

Everette S. Gardner, Jr. is Professor and Chairman of Decision and Information Sciences at the University of Houston and President of the International Institute of Forecasters. He has published numerous research articles in journals such as *Management Science*, *Interfaces*, *Decision Sciences*, *Omega*, *Naval Research Logistics Quarterly*, and the *Journal of the Operational Research Society*. Currently he writes a column on forecasting and business decision-making for *Lotus Magazine*. Dr. Gardner is co-author of the textbook *Quantitative Approaches to Management*, now in its seventh edition and twenty-fifth year of publication from McGraw-Hill Book Company, New York. He has developed several popular computer programs, including Autocast II, an expert forecasting system, and the Spreadsheet Forecaster, both published by Levenbach Associates, Morristown, New Jersey. As a consultant, Dr. Gardner has served numerous corporations and government agencies. Some of his clients include the Burroughs Wellcome Company, Frito-Lay, Entre Computers, the Coastal Corporation, Chantal Cookware Corporation, Exxon Company USA, Centel Communications Systems, Compaq Computer Corporation, the NASA Johnson Space Center, Shell Oil Company, and Southwestern Bell.

Note: This event is not part of the regular ISF program. A separate registration fee of $150 is payable either in advance or at the registration desk.

COMMITTEE MEETINGS

Sunday, June 9, 1991

12 noon	Editors of *International Journal of Forecasting*	Clinton A
3:00 p.m.	Associate editors of *International Journal of Forecasting*	Clinton A

FEATURED SESSIONS

Day and Time	Location	Speakers
Monday		
8:45 – 10:15	West Ballroom	Wassily Leontief "Projections With A Dynamic Model"
		George C. Eads "The Use of Forecasting in Production Scheduling and Product Planning Decisions at General Motors"
10:45 – 12:15	Sutton South	Panel Discussion "Forecasting the Impact of AIDS" (Chair: Dennis Ahlburg)
1:00 – 1:45	East Grand Ballroom	Everette S. Gardner, Jr. "The State of The Institute" (Presidential Address)
3:30	Sutton South	Scott Armstrong and Fred Collopy "Rule-Based Forecasting: Foundations and Development"
5:15	Sutton South	Business Cycles, II Session Honoring Geoffrey H. Moore (Chair: Philip A. Klein)
5:15	Morgan B	"Practical Uses of Forecasting" Featured Speaker: David H. Mitchell (Chair: Robert G. Brown)
7:00	New York University	Allen E. Claxton "Forecasting and Planning for Higher Education in an Urban Environment"
Tuesday		
8:30 – 9:15	Trianon Ballroom	Arthur R. Taylor "The Chief Executive Officer as a Forecaster"
9:15 – 10:45	Trianon Ballroom	"Forecasting by Financial Analysts" (Chair: Lawrence D. Brown)
11:15 – 12:15	Petit Trianon	George F. Brown, Jr. "Forecasting the Implications of Defense Spending"
11:15 – 12:15	Madison A & B	Clive W. J. Granger "Forecasting the Stock Market Consideration of New Techniques"
1:00 – 1:45	Trianon Ballroom	Lyle E. Gramley "Prospects for the U.S. Economy"

Tuesday (Continued)

2:00 – 3:30	Rendezvous	"Modeling of Fixed Income Securities" (Chair: Betty J. Flehinger)
3:45 – 5:15	Rendezvous	"Portfolio Theory, with Remarks by Harry Markowitz" (Chair: Martin J. Gruber)

Wednesday

8:45 – 10:15	Sutton South/Center	Thomas M. Cook "Forecasting Applications at American Airlines" Spyros Makridakis "Towards the 21st Century: Major Trends and Their Implications for Planning and Strategy"

LIST OF SESSIONS BY TRACK

TRACK: APPLICATIONS

TRACK: ECONOMICS

TRACK: FINANCE

TRACK: FORECASTING METHODS

TRACK: PLENARY SESSIONS

SCHEDULE OF SESSIONS IN CHRONOLOGICAL ORDER

Monday, June 10, 1991
8:45 – 10:15 a.m.

SPECIAL FINANCE DAY MEETINGS

Tuesday, June 11, 1991

PL1
West Ballroom

OPENING PLENARY SESSION

Monday
8:45 – 10:15

CHAIR: *Lilian Shiao-Yen Wu*

IBM Research Division, T. J. Watson Research Center, Yorktown Heights, NY 10598, USA

[Introduction by Edward Melnick, New York University]

"PROJECTIONS WITH A DYNAMIC MODEL"

Wassily Leontief
Professor of Economics, New York University

Dr. Wassily Leontief studied at the University of Leningrad, from which he received the degree of Learned Economist in 1925. He continued his studies at the University of Berlin, which granted him the Ph.D. in economics in 1928.

Dr. Leontief first came to the United States in 1931 at the invitation of the National Bureau of Economic Research. He joined Harvard University, created the Harvard Economic Research Project in 1946, and served as its Director until 1972. In 1953 he was appointed Henry Lee Professor of Economics at Harvard, where he remained until 1975 when he joined New York University as Professor of Economics. He founded the Institute for Economic Analysis (IEA) at New York University in 1978 and served as its first director until 1985. He currently holds the rank of University Professor at New York University and is IEA's senior scholar. Dr. Leontief is an Officer of the French Legion d'Honneur (1968), a recipient of the Order of the Rising Sun (Japan, 1984) and of the French Order of Arts and Letters – Commandeur (1985). He was awarded the West German Bernard-Harms Prize in Economics (1970), and has received many other honorary awards. In 1973, the Royal Swedish Academy of Sciences awarded Dr. Leontief the Nobel Memorial Prize in Economic Science "for the development of the input-output method and for its application to important economic problems."

Dr. Leontief was commissioned two years ago by the United Nations to explore the developmental prospects of the world economy up to the year 2000, determining the possibility of narrowing the gap between developed and less developed countries. His research team has constructed a large, multi-regional input-output model of the world economy, and several even more detailed models of the U.S. economy.

He directed, under contract with the Italian Government, the preparation of a comprehensive "General Transportation Plan" for Italy.

Dr. Leontief is the author of eight books including *The Structure of the American Economy, 1919-1929* (1941, 1953), *Input-Output Economics* (1966, 1985), *The Future of the World Economy* (1977), and *The Future Impact of Automation on Workers* (with F. Duchin, 1986) as well as over 200 scholarly articles.

CHAIR: *Lilian Shiao-Yen Wu*
IBM Research Division, T. J. Watson Research Center, Yorktown Heights, NY 10598, USA

[Introduction by Richard De Roeck, General Motors]

THE USE OF FORECASTING IN PRODUCTION SCHEDULING AND PRODUCT PLANNING DECISIONS AT GENERAL MOTORS

George C. Eads
Vice President, New Product Planning and Economics Staff, General Motors, Detroit, MI 48202, USA

The recent merger of the GM Economics and Product Planning staffs underscores the close relationship that exists between forecasting and both production scheduling and product planning decisions at GM. The Corporation's short-run economic and industry vehicle forecasts are important inputs into production scheduling decisions. A change in forecast does not automatically initiate a change in production schedules. But it sets into motion a process that involves a reexamination of existing scheduling decisions. Similarly, the long-term economic forecast is a major building block in developing the product plan. In the past, care was taken to distinguish between the short-run forecast, which sought to capture the impact of the business cycle, from the long-term forecast, which focused on trend volumes. However, this led to difficulties in interpreting "jumps" between the short-term and the long-term, especially when, as now, industry sales are deviating significantly from trend. Therefore, it has been found useful to modify forecasting practices to permit a merging between the short- and long-run outlooks, hopefully without blurring the essential differences between each.

George C. Eads was named to head the new Product Planning and Economics Staff on August 7, 1990. Mr. Eads joined General Motors on May 23, 1986, when he was elected Vice President and Chief Economist on the former General Motors Economics Staff.

Prior to joining General Motors, Mr. Eads had a distinguished career in academic and government circles. In his previous position, he was Dean of the School of Public Affairs at the University of Maryland, where he had been a member of the faculty since 1981.

Between June 1979 and January 1981, Mr. Eads served as a member of President Carter's Council of Economic Advisers (CEA). Mr. Eads has written or co-authored more than 40 articles and books.

Born August 20, 1942, in Clarkesville, Texas, Mr. Eads received his bachelor's degree in economics from the University of Colorado and his M.A. and Ph.D. degrees in economics from Yale University.

Session A1
Sutton South

FORECASTING THE IMPACT OF AIDS

Monday
10:45 – 12:15

CHAIR: *Dennis A. Ahlburg*

Industrial Relations Center, 537 Management and Economics Building, 271 19th Avenue South, Minneapolis, MN 55455, USA

THE WORLD BANK PROJECTIONS OF WORLD POPULATION: THE NUMBERS, THE IMPLICATIONS, AND THE EFFECT OF AIDS

Rodolfo A. Bulatao
World Bank, Population, Health and Nutrition Division, 1818 H Street NW, Washington, DC 20433, USA

The paper discusses the recent World Bank Population Projections: 1985-2025. We will also discuss current work at the Bank to assess the impact of AIDS on the world population.

The paper will be followed by a panel discussion on advances in the methodology used in the projections and the implications of the population projections (economic, environmental and social).

Panel members:

Mark Montgomery
SUNY, Stonybrook, Economics Department, New York, NY 11794, USA

David Bloom
Columbia University, Economics Department, New York, NY 10027, USA

(One panelist to be announced)

CHAIR: *Pedro A. Morettin*
Department of Statistics, University of São Paulo, 01498, – São Paulo, Brazil

THE EFFECTS OF OVERLAPPING AGGREGATION ON TIME SERIES MODELS WITH AN APPLICATION TO UNEMPLOYMENT INDEX IN BRAZIL

Luiz K. Hotta
Department of Statistics, UNICAMP, Brazil
Pedro L. Valls Pereira
Department of Statistics, USP, Brazil

The unemployment index of SEADE/DIEESE, Brazil, is reported as a weight average of the index of the last three months. This problem is a special case of the overlapping aggregation or the use of moving-average filters in time series models, assuming that the original series could be characterized by an ARIMA process. It also studied the effect of this kind of aggregation on the seasonal component, the predictions, revisions and turning points of the time series.

USE FOR PRINCIPAL COMPONENTS IN TIME SERIES DECOMPOSITION AND FORECASTING: SIMULATIONS AND APPLICATIONS

Basílio de Bragança Pereira
COPPE/UFRJ, Brazil
Geraldo Sardinha Almeida
BB, Brazil

Principal components are applied in univariate and multivariate time series. In the univariate case it is used for decomposition of a time series. The performance of the method is studied through simulations and comparison with previous analysis of the air line, rainfall in Fortaleza and Canadian lynx data. In the multivariate case a forecasting method is applied to the Quenouille's data and compared with previous forecasts using reduced rank autoregressive and autoregressive index models.

ANALYSIS OF THE RELATIONSHIPS BETWEEN SOME NATURAL PHENOMENA AND FORECASTING CONSIDERATIONS

Pedro A. Morettin and Clélia M.C. Toloi
Department of Statistics, University of São Paulo, 01498 – São Paulo, Brazil

In the search for causes for the drought in the Brazilian North-East, we were led to investigate possible relationships between rainfalls in Fortaleza, Brazil, with mean sea level and sunspots. The main purpose was to establish eventual patterns of causality between pairs of variables. Transfer function models and vector ARMA models were used for the cases when causality and feedback were detected. These were compared with previous models used for the forecasting of periods of drought.

CHAIR: *Peg Young*
School of Business Administration, George Mason University, Fairfax, VA 22030, USA

USING CONSUMER CONFIDENCE SURVEYS IN FORECASTING LOCAL ECONOMIC EVENTS

Bernard Goitein
Center for Business and Economic Research, Bradley University, 1501 W. Bradley Avenue, Peoria, IL 61625, USA

Surveys of consumer confidence are frequently used for macroeconomic forecasting, and are part of the U.S. Composite Index of Leading Indicators. Analogous surveys of consumer confidence in the Peoria, Illinois area's local economy are found useful for forecasting year ahead changes in the area's number of households, sales and employment levels.

PREDICTING TURNING POINTS IN BUSINESS CYCLES BY DETECTION OF SLOPE CHANGES IN DYNAMIC LINEAR MODEL

Duk Bin Jun and Young Jin Joo
Department of Management Science, Korea Advanced Institute of Science and Technology, P.O. Box 150, Cheongryang, Seoul, Korea

For the purpose of detecting turning points in the business cycle, the underlying process of the leading composite index is described by the dynamic linear model with random level and slope, where the random slope distorted by random shocks at each turning point. The turning point is detected by observing a large value of the posterior probability that one of the previous slope components following a random walk process has been interrupted by the shock. The application result of this method to the U.S. leading composite index is comparable to the best result of the previous studies.

AMERICAN AND BRITISH POLITICAL BUSINESS CYCLES: A TIME SERIES APPROACH

Ronald S. Koot and J. Keith Ord
The Smeal College of Business Administration, The Pennsylvania State University, 303 Beam Business Administration Building, University Park, PA 16802, USA
Peg Young
School of Business Administration, George Mason University, Fairfax, VA 22030, USA

The Box-Tiao technique of intervention analysis is employed to determine the existence of political business cycles in the United States and the United Kingdom. The two economic variables of concern are unemployment and disposable personal income. The political intervention variables are designed to monitor the party in power, the timing of the elections, the incumbent running for re-election, and the existence of a state of war for that country. The technique proves successful at showing significant interventions as well as pinpointing the lead or lag of the political variables with the economic variables.

CHAIR: *Brian Henry*
Bank of England, Threadneedle Street, London, England EC2R 8AH, UK

EXCHANGE RATE FORECASTING FOR THE 1990s

James Burtle
Senior Adviser, Foreign Exchange Service, Wharton Econometric Forecasting Service, 401 City Line, Bala Cynwyd, PA 19004, USA

An important paper by Engle and Hamilton establishes that there are statistically significant long waves in movements of foreign exchange rates. However, the authors do not offer any reasons for these waves. This paper presents the hypothesis that the long waves arise because of indeterminacy in foreign exchange markets due to inelasticities of both supply and demand over wide ranges. Within these ranges, traders can actually push exchange rates up or down. This conclusion is contrary to the received view that traders are only intermediaries who will lose money if they try to force prices into other than a unique supply and demand equilibrium.

THE RANDOM AND DYNAMIC BEHAVIOR OF FORWARD AND SPOT EXCHANGE RATES: IMPLICATIONS FOR FORECASTING FUTURE SPOT RATES

Yueh H. Chen
National Sun Yat-sen University
Winston T. Lin
State University of New York at Buffalo, Jacobs Management Center, Buffalo, NY 14260, USA

The purpose of this paper is to investigate the implications of the dynamic and stochastic behavior of foreign exchange rates (spot and forward) for forecasting future spot rates, on the basis of the simple efficient market hypothesis (SEMH). The statistical methods involved include the ordinary least squares, the seemingly unrelated regressions, a four-step generalized least squares, and five special tests called T*, B, S', and W. The empirical results indicate that the SEMH is confirmed when the time horizon is short (one month), but it becomes unreliable when the time horizon is longer (three months and six months), and that the beta coefficient in the SEMH displays a mean shift and a variance shift through time. Thus, the forecasting of future spot rates based on forward rates is considerably affected by the stochastic and dynamic behavior of the beta coefficient. The forward and spot rates (expressed in terms of US dollars) of six currencies are used in empirical work.

NEWS EFFECTS IN A HIGH FREQUENCY MODEL OF THE STERLING-DOLLAR EXCHANGE RATE

Brian Henry, Bahram Pesaran, A. Goodhart, G. Hall
Bank of England, Threadneedle Street, London, England EC2R 8AH, UK

This paper uses an extremely high frequency data set on the Dollar-Sterling exchange rate to investigate news effects. The data set is some 130,000 observations over an eight week period. The paper investigates the time-series properties of the data using orthodox regression models, and then by making allowance for a time varying conditional variance. The conclusions vary significantly in moving to this more sophisticated model.

CHAIR: *Noel P. Greis*
University of North Carolina School of Business, Chapel Hill, NC 27599-3490, USA

USING NEURAL NETWORKS TO FORECAST COMMODITY PRICES

John Snyder, Doug Pattie, Jason Sweat, Michelle Richardson
Colorado State University, Fort Collins, CO 80523, USA

Neural networks and traditional time series techniques are used to forecast week end cash prices for live cattle and daily settlement prices for corn. The forecasts are made for 1, 4, 8, and 12 weeks ahead for live cattle. The daily corn price is predicted for 1 trading day ahead and for 10 trading days ahead. The paper discusses several configurations for the neural networks. Using MAPE and RMSE the neural networks forecast accuracies are compared against the time series forecast accuracies.

A NEURAL NETWORK MODEL FOR PREDICTION

Irene Poli
Department of Economics, University of Modena, Modena, Italy

This paper is concerned with the prediction problem for nonlinear time series. Complex aperiodic dependencies on time, resulting from high dimensional noise in the dynamics or from low dimensional chaos, are considered and a neural network approach is chosen to study the irregular behavior.

In this paper, a particular nonlinear neural network model is introduced, which uses a multilayer feed-forward architecture, with one input layer, one output layer and a single hidden or intermediate layer of processing units. The system's response function is formulated as a combination of spline smoothers and simple functionals for the connection weights. The model is assumed to operate in a stochastic environment and a state space representation for the nonlinear dynamics is derived. A recursive inferential methodology is developed from a Bayesian perspective and a particular formulation of the Kalman filter is obtained.

The resulting predictive algorithm, applied to chaotic time series, gives more accurate predictions with faster computation than conventional methods. The paper concludes with an application of the procedure to predict the level of the sea tide in Venice. The resulting predictions are compared with those obtained from standard linear statistical time series procedures.

BUSINESS FORECASTING USING NEURAL NETWORKS

Noel P. Greis
University of North Carolina School of Business, Chapel Hill, NC 27599-3490, USA

Artificial neural networks have been shown to be especially good at recognizing patterns and at generalizing essential weaknesses of many forecasting models. While there have been specialized applications of neural networks, few studies have systematically compared the forecast performance of neural networks with other methodologies. In this study we evaluate the forecast performance of artificial neural networks with traditional univariate techniques for a variety of data sets, including a subset of the M-competition and financial time series, and offer some guidelines to practicing forecasters who are interested in applying these methods.

CHAIR: *Roy Batchelor*
City University Business School, London, UK

THE RELEVANCE OF FORECAST-COMBINATION TO THEORIES OF INDIVIDUAL CHOICE

Robert F. Bordley
National Science Foundation, 1800 G. Street, NW, Washington, DC 20550, USA

When an individual is offered a lottery, that lottery can be interpreted as a noisy forecast of what the individual will get if he chooses the lottery. His own valuation of that lottery will be some average of his personal priors about lotteries and the lottery's face-value. When an individual is offered a choice among several forecasts, the fact that forecasts are generally correlated implies that his valuation of any one lottery will be affected by the other lotteries available. As we now show, this leads to a theory of choice which is consistent with many of the anomalies observed in actual choice behavior.

THE COMBINATION OF FORECASTS WITH DELAYED ERROR FEEDBACK AND TIME DEPENDENT GROUP BIAS

David N. Sessions and Lonnie K. Stevans
BCIS/QM Department, Hofstra University, Hempstead, NY 11542, USA

Two possible sources of time dependent forecast errors are those arising from delayed performance feedback and those resulting from unanticipated process structural change. In this paper we develop a combination method which explicitly models these two sources of error. Given a pool of k forecasters, the method can be used from the $k+2$ period on. The performance of the method will be compared to the mean forecast and an ad hoc method. Conditions will be derived for which the ad hoc method can be expected to beat the mean forecast, in mean squared error, for AR(1) and MA(1) error processes.

COMBINING THE FORECASTS OF DIVERSE FORECASTERS: EVIDENCE FROM A U.S. PANEL

Roy Batchelor
City University Business School, London, UK
Pami Dua
University of Connecticut at Stamford, Scofieldtown Road, Stamford, CT 06903, USA

Most empirical studies of forecast combination are artificial in that their raw materials are forecasts which have been generated ex post by applying textbook forecasting techniques to publish economic time series. This study starts instead from data on the ex ante forecasts of a panel of U.S. economic forecasters, and survey information on the techniques they actually use. For a number of variables and horizons, we examine the relation between accuracy and the number of forecasts combined, and assess whether it is especially advantageous to combine forecasts from forecasters who use very different economic theories and forecasting techniques.

CHAIR: *Mike Talbot*

Scottish Agricultural Statistics Service, University of Edinburgh, JCMB,The King's Buildings, Mayfield Road, Edinburgh, Scotland EH93JZ, UK

AN OBJECT ORIENTED REPRESENTATION OF RULE BASED FORECASTING

V. Assimakopoulos
National Technical University of Athens (NTUA), Management Systems Unit, Department of Electrical Engineering, 42, 28th October Str., GR 106 82, Athens, Greece

This paper introduces O.O.R., a method that builds upon the differentiation of knowledge into particular objects and their properties and the formation of different classes of objects. The inference relations which exist among objects are determined by rules.

By applying this object oriented approach on rule-based forecasting, the following components have been currently identified:

Classes:	Forecasting Methods, Time Series
Objects:	Specific instances of the classes
Properties:	Level, trend, smoothing factors, damping factors, functional form, cycles, outliers, etc.

This structured representation of the rule-base facilitates regular modifications and makes possible the development of an integrated forecasting environment supporting DBMS and high level reasoning facilities.

LINKING INFORMAL KNOWLEDGE TO MODEL-BASED FORECASTS

Mike Talbot
Scottish Agricultural Statistics Service, University of Edinburgh, JCMB, The King's Buildings, Mayfield Road, Edinburgh EH93JA, UK

This paper describes software tools which combine model-based quantitative forecasts with the judgments of domain experts in order to improve the effectiveness of forecasting procedures.

Cognitive mapping tools are used to capture and display the judgments of experts. Influence diagrams are employed to propagate the information supplied. Ways of linking these to time series analyses and econometric modelling procedures are outlined.

The work described is part of an EC program on the development of statistical expert systems for government forecasting.

CHAIR: *Arthur Schleifer, Jr.*
Harvard Business School, Boston, MA 02163, USA

FORECASTING SALES AT L. L. BEAN, INC.

Rol Fessenden
L. L. Bean, Inc., Freeport, MA 04033, USA

In the highly competitive retail business, the survivors are those companies that service their customers well while keeping their inventory investment under tight control. L. L. Bean sells 50,000 different sizes and colors to 6 million customers through 25 different catalogs. Forecasting in this complex, dynamic environment is critical to success and financial health. L. L. Bean uses a number of simple forecasting techniques, and is evaluating a number of new tools. The old stand-by "Newsboy Model" plays a key role, and will continue to do so.

FORECASTING DESIDERATA FOR THE MULTIVARIATE NEWSBOY PROBLEM

Patrick Noonan
Harvard University, Pierce Hall 120, Cambridge, MA 02138, USA

The textbook "Newsboy" stocking model does not address the complexities faced by many real-world decision makers with (possibly a large number of) substitutable products and/or purchase locations. For example, consumers decide among an array of available options and can substitute when facing stockouts. Data, when available at all, may be censored by stockouts and unobservable substitution behavior, so *demand* does not necessarily equal either *sales* or *orders*. Here we present a Bayesian approach to the problem, with its implications for forecasting practice.

UPDATING PROBABILISTIC DEMAND FORECASTS

Arthur Schleifer, Jr.
Harvard Business School, Boston, MA 02163, USA

"Newsboy Models" provide the optimal policy for ordering seasonal items when just one order can be placed for delivery prior to the start of the season, as is well known. What happens when it is possible to supplement an initial order with a replenishment order placed after the season has started, and therefore some information on demand has been acquired? In this paper a method of Bayesian updating will be presented.

Session RT1
Morgan A

ROUNDTABLE ON THEORY AND PRACTICE: BRIDGING THE GAP

Monday
10:45 – 12:15

CHAIRS: *Richard De Roeck and Essam Mahmoud*

Richard De Roeck
General Motors Corporation, Detroit, MI 48202, USA
Essam Mahmoud
American Graduate School of International Management (Thunderbird), Department of World Business, Glendale, AZ 85306, USA

Many members of the International Institute of Forecasters believe that there exists a communication gap between researchers and practitioners. Most members of the Institute work in universities while few members are associated with business and other organizations where, presumably, most of the forecasting activity takes place. Last summer, at the Delphi conference in Greece, much dialogue took place in a very informal atmosphere. A significant majority of those who attended at Delphi agree that we all derived considerable benefit from this dialogue. These roundtable discussions represent an attempt to reproduce some of that Delphi spirit.

A roundtable discussion will be held on each of the three days of the conference in the pre-lunch session. There will be no formal agenda. Forecasting in all of its aspects will be the only topic of conversation. Several Delphi participants will be on hand to help things move along if needed.

In order to maximize dialogue, attendance will be limited to 25 people.

PLEASE PREREGISTER AT THE MAIN DESK.

CHAIR: *Fred Joutz*

The George Washington University, Department of Economics, 2201 G Street NW, Washington, DC 20052, USA

CAUSALITY ANALYSIS, EFFECTS OF SHOCKS AND FORECASTING USING VECTOR AUTOREGRESSIONS IN FRENCH INDUSTRIAL PRODUCT SECTOR

J. P. Indjehagopian and M. Mourad
ESSEC and CERESSEC, Graduate School of Management, BP 105/95021 Cergy-Pontoise Cedex, France

In this paper vector autoregressive (VAR) models are considered to describe dynamic relationships between seven french industrial product index. The estimated VAR model is then converted to a moving-average representation with orthogonalized innovations. This technique is used to examine the impact of each variable on the other variables. Impulse responses of the macroeconomic system are computed to particular initial shocks. Then we use estimated vector autoregression to forecast the industrial index. This paper is organized as follows. First, we use Dickey-Fuller test to detect if some of the variables have unit roots, then we select the order of the VAR with the MFPE criterion and we estimate restricted and unrestricted VAR models to detect causality. In section 2 the moving average representation is used to generate the impulse responses.

FORECASTING THE SWEDISH UNEMPLOYMENT RATE: VAR VS. TRANSFER FUNCTION MODELING

Per-Olov Edlund and Sune Karlsson
Stockholm School of Economics, S-113 83, Stockholm, Sweden

Two competing methods for modelling multivariate time series are compared in terms of forecasting ability. The VAR model offers generality and allows for feedback between the variables, but requires estimation of a large number of parameters. The transfer function, on the other hand, usually can be modelled parsimoniously but does not allow for feedback. Since the transfer function is a special case of the VAR model, this gives a framework for assessing the relative merits of generality and simplicity.

COMBINING SHORT RUN AND LONG RUN FORECASTS: MODELING THE DEMAND FOR MOTOR GASOLINE USING SEASONAL COINTEGRATION TECHNIQUES TO PRODUCE CONSISTENT FORECASTS

Fred Joutz and Robert Trost
The George Washington University, Department of Economics, 2201 G Street NW, Washington, DC 20052, USA

Forecasters are asked to produce models for predicting the short run and longrun. Conventional practice involves the construction of separate models for the two horizons. The short run model explains demand as function of seasonal or rapidly changing variables. The long run model explains demand as a function of slowly changing variables like demographic characteristics and income. In general this results in conflicting forecasts at some horizon(s) with an ad hoc means of reconciling the difference(s). This paper will incorporate the information from a short run and a long run model for motor gasoline demand into a single model using the error correction framework. Recent developments in the cointegration and seasonal cointegration literature will be exploited in the model's construction and estimation. The forecast performance (from the merged model) can be compared against the separate models predictions.

CHAIR: *J. Scott Armstrong*
The Wharton School, University of Pennsylvania, Philadelphia, PA 19104, USA

THE STATE OF THE INSTITUTE

Everett S. Gardner, Jr.
University of Houston, Houston, TX 77204-6282, USA

Everett S. Gardner, Jr. is Professor and Chairman of Decision and Information Sciences at the University of Houston and President of the International Institute of Forecasters. He has published numerous research articles in journals such as *Management Science*, *Interfaces*, *Decision Sciences*, *Omega*, *Naval Research Logistics Quarterly*, and the *Journal of the Operational Research Society*. Currently he writes a column on forecasting and business decision-making for *Lotus Magazine*. Dr. Gardner is co-author of the textbook, *Quantitative Approaches to Management*, now in its seventh edition and twenty-fifth year of publication from McGraw-Hill Book Company, New York. He has developed several popular computer programs, including Autocast II, an expert forecasting system, and the Spreadsheet Forecaster, both published by Levenbach Associates, Morristown, New Jersey. As a consultant, Dr. Gardner has served numerous corporations and government agencies. Some of his clients include the Burroughs Wellcome Company, Frito-Lay, Entre Computers, the Coastal Corporation, Chantal Cookware Corporation, Exxon Company USA, Centel Communications Systems, Compaq Computer Corporation, the NASA Johnson Space Center, Shell Oil Company, and Southwestern Bell.

CHAIR: *H. O. Stekler*

Industrial College of The Armed Forces, National Defense University, Washington, DC 20319-6000, USA

INDUSTRY'S RESPONSE TO THE DEFENSE BUDGET CUTBACK

R. William Thomas
Congressional Budget Office, Washington, DC 20315, USA

The 1990 Budget Agreement led to far-reaching changes in the way Congress sets budget priorities. The fiscal year 1991 budget act specified ceilings for defense spending, which is now projected to decline by 8 percent in real terms in 1991 and by 4 percent a year in 1992 and 1993.

The impact of these cuts on the defense industrial base will be significant. Firms will seek to offset this impact through foreign military sales, diversification into civilian pursuits, or competing for a dwindling resource base. The ability of the various industrial sectors important to the Department of Defense to pursue these objectives will be reviewed.

THE DEFENSE BUDGET AND EVENTS IN THE PERSIAN GULF: EFFECTS ON U.S. INDUSTRY

Ralph Doggett
Interindustry Economic Research Fund, Inc., P.O. Box 451, College Park, MD 20740, USA

Based on the results of an integrated macroeconomic-interindustry forecasting model that incorporates detailed information on the distribution of expenditures for defense, this paper presents estimates of the likely impacts of current defense planning on individual industries in the 1990's. The effects of the conflict in the Persian Gulf on the industries that directly and indirectly supply goods and services to the Department of Defense are specifically addressed. The analysis is couched in terms of administration budget requests for the coming years, submitted to Congress in January 1991.

FORECASTING FOR FULLY EMPLOYED (WAR-TIME) ECONOMICS

Robert W. Beckstead and H. O. Stekler
Industrial College of the Armed Forces, National Defense University, Washington, DC 20319-6000, USA

Most econometric models excluded the years of World War II from their data bases because they are considered unrepresentative. However, it is still important to know what might happen if a fully employed wartime situation were to occur again. We make the basic assumption that the model reflects reality and that when the model breaks down it reflects a condition that would actually occur. With this assumption it is possible to predict and to determine stabilization measures that should be introduced.

CHAIR: *Andrew J. Hughes-Hallett*
University of Strathclyde and CEPR, Curran Building, 100 Cathedral Street, Glasgow, CR OLN, UK

BRAZIL'S EXTERNAL DEBT: FORECASTS AND IMPACT ANALYSES

A. M. Parhizgari and A. J. Prakash
Florida International University, Finance Department, DM-367A, Miami, FL 33199, USA

Controlled forecasts of Brazil's external debt up to 1989 are provided and the impact of a set of "as-if" policies on these forecasts is explored. A prototype financial econometric model designed to analyze, simulate and forecast debt and debt-related issues of the Latin American countries is employed. In this model, external debt is embedded in the overall structure of the economy. While international factors are considered, the domestic structure of the economy is made more accountable. The dynamics and the interplay of both sets of these factors are seen essential to realistic forecasts and analysis of Brazil's external debt.

An evaluation of the generated forecasts reveals a better medium-term prospect for Brazil than some recent technical reports had anticipated.

A COMPREHENSIVE APPROACH TO ANALYZING AND FORECASTING THE EFFECTS OF CHANGING TARIFF PROVISIONS ON DOMESTIC ECONOMIC ACTIVITY AND CONSUMER SPENDING

Ray Perryman and Frank J. Wyman, III
Baylor University, 700 South University Parks, Suite 500, P.O. Box 6028, Waco, TX 76706, USA

This paper sets forth a general equilibrium framework for measuring the effects of changes in specfiic tax provisions on all aspects of business activity and consumer's expenditures. The approach encompasses more than 500 industrial categories, 50 categories of consumer spending and six major income groups. It may be applied to trading patterns in any country, and impact may be localized to any county or multi-county region of the U.S. Illustrations are provided which relate to the impact of a free trade agreement with Mexico on the economy of Texas.

CAPITAL FLIGHT IN ECONOMIES WITH UNDERDEVELOPED FINANCIAL MARKETS: ANALYSIS AND PROJECTIONS

M. L. Anthony
University of Strathclyde, Glasgow
Andrew J. Hughes-Hallett
University of Strathclyde and CEPR, Curran Building, 100 Cathedral Street, Glasgow, GR OLN, UK

Casual estimates put the problem of capital flight from the less Developed Countries at anywhere between 20% and 85% of the increase of their external debt during the 1980s. That implies a very serious constraint on the development potential of those economies, and increasingly those in Eastern Europe. By its nature, capital flight is extremely difficult to measure. The existing "estimates" fluctuate between wide margins of the individual LDCs.

Since we are dealing with an unreported phenomenon, we propose using the same type of estimation techniques that have been used to examine the extent of the "hidden" or "underground" economic activity in the centrally planned economies. These techniques can be set up to estimate the extent of unobserved activity together with its main determinants. In this paper we set out these techniques for the capital flight case, and make projections of the capital flight for 12 countries in the 1980s. That allows us to make inferences about policy implications and provides a forecasting model for analyzing capital flight from countries with underdeveloped financial markets.

CHAIR: *Laurence Copeland*
School of Management, University of Stirling, Stirling FK94LA, Scotland, UK

EXCHANGE RATES, COUNTRY PREFERENCES AND GOLD

Michael Dooley, Peter Isard and Mark P. Taylor
International Monetary Fund, Washington, D.C. 20431, USA

This paper develops the argument that exchange rate movements may be largely coterminus with changes in the market's perception of political risk factors. It is argued that changes in perceptions of political risk may be reflected in movements in the local currency price of gold and hence that gold price movements may yield explanatory power with respect to exchange rate movements over and above effects operating through domestic financial markets. The paper applies multivariate vector autoregression and cointegration modeling techniques to test for the short and long run influence of gold prices on exchange rates conditional on other monetary and real macroeconomic variables and applies the resulting error correction exchange rate equation to out of sample forecasting exercises.

DISAGGREGATED FOREIGN EXCHANGE RATE EXPECTATIONS: SOME RESULTS FOR G7

Ronald MacDonald
Department of Economics and Management, University of Dundee, Dundee DD14HN, Scotland, UK

Recently a number of researchers have started to use foreign exchange rate survey data as a measure of agents' exchange rate expectations. This work has given a number of important insights into the behavior of risk premia and the extent to which agents fully exploit available information. One of the main drawbacks of much of this work is its reliance on the survey median response; the use of the median masks the potential diversity of opinions which underpin exchange rate surveys. In this paper we examine a new survey data base which consists of the disaggregated survey responses of leading forecasters in the G7 countries on three key exchange rates.

ANOMALIES IN FOREIGN CURRENCY RETURNS

Laurence Copeland
University of Stirling, Stirling FK94LA, Scotland, UK

There is by now a substantial literature documenting the fact that stock returns vary with the day of the week and month of the year. As yet, however, there have been relatively few investigations looking at whether the same effects exist in currency markets. This paper examines the question with respect to returns on the five major currencies (Deutschemark, Pounds, Yen, Swiss Franc, French Franc) and finds some evidence of excess returns on different days of the week and months of the year.

CHAIR: *Sevket I. Gunter*

School of Business and Management, Temple University, Speakman Hall (006-00),
Philadelphia, PA 19122, USA

THE FLEXIBILITY AND EFFICIENCY OF A MULTI-OBJECTIVE APPROACH TO GENERATE COMBINED FORECASTS

J. P. Ancot, H. Stijnen, and Caroline Wilbers
Economic Information Systems, Netherlands Economic Institute, 3062 PA Rotterdam, Burg. Oudlaan 50,
The Netherlands

Recent forecasting literature has demonstrated the practical relevance of combining individual forecasts. However, most approaches solve the optimization problem with respect to a single criterion. Also most papers address the strictly statistical properties of the combining methods considered. This paper presents a multicriteria approach to the problem, explicitly recognizing that most forecasting situations face multiple (partly conflicting) objectives, e.g., risk aversion, preference for short term accuracy, etc. Advantages are flexibility (e.g., w.r.t. relative contribution of individual objectives) and efficiency (e.g., w.r.t. the use of available information, the method including the treatment of "qualitative" information). The comparative performance of the approach is demonstrated through a number of applications.

PERFORMANCE OF EXACT VERSUS HEURISTIC N(E)RLS ALGORITHMS IN COMBINING FORECASTS

Sevket I. Gunter
School of Business and Management, Temple University, Speakman Hall (006-00),
Philadelphia, PA 19122, USA

There exists various exact and heuristic algorithms for estimating nonnegativity restricted OLS and ERLS combination models. First, simple extensions of the exact algorithms are presented to reduce the computational time requirements. Second, ex-ante prediction accuracies of combined forecasts from the exact versus heuristic algorithms are empirically compared using forty firm-specific earnings series. The effects of fit, sample size, forecast error correlations, and series stability on the relative accuracy of the exact versus heuristic algorithms are analyzed.

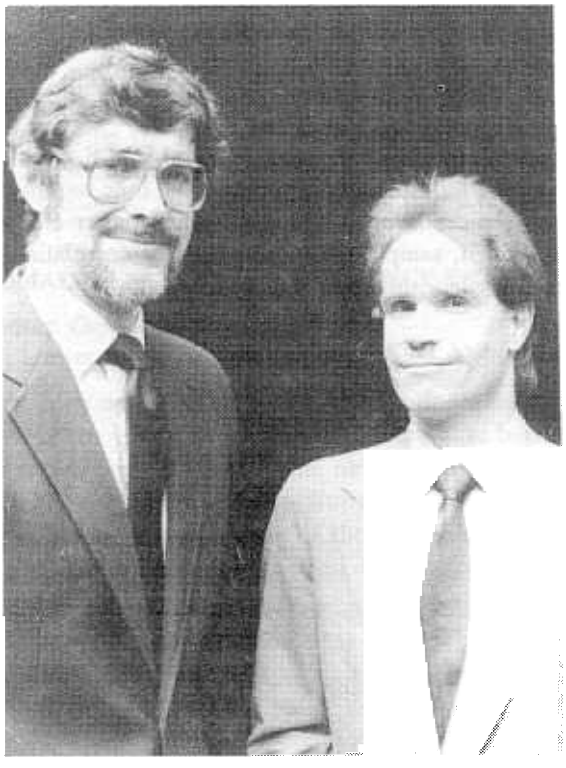
CHAIR: *Hans Levenbach*

Levenbach Associates Inc., 103 Washington Street, Morristown, NJ 07960, USA

RULE-BASED FORECASTING: FOUNDATIONS AND DEVELOPMENTS

Fred Collopy
The Weatherhead School, Case Western Reserve, Cleveland, OH 44106, USA
J. Scott Armstrong
The Wharton School, University of Pennsylvania, Philadelphia, PA 19104, USA

Is it possible to select the "best" extrapolation method for a given time series? This goal has been elusive. However, rules can aid in the selection and combining of forecasting methods. Drawing upon both literature and knowledge of forecasting experts, we present rules that specify actions tailored to the characteristics of the series. For example, if a forecaster identifies a trend as unstable, more conservative methods are used than if the trend is stable. The rules are described in terms that are understood by practicing forecasters. Decision support systems enable the economical application of rules. We demonstrate the effects of some rules. Rule-based forecasting was tested on a variety of time series. It provided more accurate ex ante forecasts than other methods (including the use of equally weighted combined forecasts). We report briefly on recent efforts in rule-based forecasting: (1) neural nets for rule selection, (2) causal forces as a feature of series, (3) ex ante simulation for calibration of rules, and (4) rules for modifying seasonal factors.



J. Scott Armstrong and Fred Collopy

J. Scott Armstrong, Ph.D.-M.I.T., has been a Professor at the Wharton School since 1968. He has taught at the Stockholm School of Economics, University of Hawaii, IMEDE (Switzerland), University of Canterbury (New Zealand), University of Capetown, Chulalongkorn University (Bangkok), University of Auckland, and IDEA (Buenos Aires). In addition to his work on forecasting, he has published papers on survey research, educational methods, social responsibility, scientific methodology, applied statistics, and strategic planning. He is the author of *Long-Range Forecasting*, published by John Wiley (2nd ed., 1985). Prior to Wharton, he was an industrial engineer for Eastman Kodak, a systems analyst for Xerox, and a marketing researcher for Polaroid.

Fred Collopy, Ph.D.-Wharton, is on the faculty in the Department of Management Information and Decision Systems at the Weatherhead School of Case Western Reserve University. His thesis was on rule-based forecasting. He has also done forecasting research dealing with error measures, the use of causal forces in extrapolation, modification of seasonal factors, and expert beliefs about forecasting. He has worked extensively in the area of information systems for over twenty years, and has conducted research related to the organizational impacts of information systems, decision support systems, and user-interface design. He was the founder and President of Conceptual Instruments, a software development firm, and has lectured and consulted extensively in the areas of forecasting and information systems.

CHAIR: ***Essam Mahmoud***

American Graduate School of International Management (Thunderbird), Department of World Business, Glendale, AZ 85306, USA

FORECASTING FOR EUROPE AND 1992

Richard De ***Roeck***
General Motors Corporation, Detroit, MI 48202, USA

A general discussion of the forecasting problems that arise in trying to assess the impact of recent developments in the European Economic Community.

FORECASTING QUALITY USING REGRESSION ANALYSIS: THE CASE OF INDIA

Jaideep ***Motwani***
Grand Valley State University, 1 Campus Drive, Allendale, MI 49410, USA
Essam Mahmoud and ***Gillian Rice***
American Graduate School of International Management (Thunderbird), Department of World Business, Glendale, AZ 85306, USA

Forecasting quality by means of econometric models can help policy makers to identify the most important variables and the relationships between variables, thus enabling managers to plan more appropriately. Multiple regression analysis is used to generate models that could be used by organizations to predict the level of quality. These models represent a formal attempt to account for the effects of critical factors on the perceived level of quality forecasting. Seventy-two Indian manufacturing organizations are the subjects of the study.

FORECASTING EXPORTS FOR PUBLIC POLICY MAKERS

Essam Mahmoud ***and Michael Goldman***
American Graduate School of International Management (Thunderbird), Department of World Business, Glendale, AZ 85306, USA

Forecasts of exports are valuable for public policy making in the trade arena. This presentation illustrates the use of selected time series models in predicting exports. The results show promise for the usage of time series models versus selected econometric models. The difficulties of dealing with international data sources are also shown.

INTERNATIONAL FORECASTING PRACTICES OF U.S. CORPORATIONS

Gillian ***Rice, Elizabeth Hentze and Essam Mahmoud***
American Graduate School of International Management (Thunderbird), Department of World Business, Glendale, AZ 85306, USA

Organizations need to anticipate many events in the economic, political and legal environments which might affect their international sales. While a number of studies have examined the sales forecasting practices of corporations, relatively little attention has been paid to the forecasting activities done to support the international operations of these firms. This study reports the preliminary results of an investigation of the international forecasting practices of the largest U.S. multinational corporations.

CHAIR: *Robert G. Brown*
Materials Management Systems Inc., P.O. Box 239, Thetford Center, VT 05075-0239, USA

WINEGLASS: A PROGRAM FOR ASSESSING BUSINESS VOLUMES

Lilian Shiao-Yen Wu and Mat Baskin
IBM Research Division, T. J. Watson Research Center, Yorktown Heights, NY 10598, USA

In business, planning often starts with an annual financial goal for the company. This goal is then partitioned into targets for sales, expenses, costs and profits for individual products, marketing organizations or customer sets. Business planners take these annual targets and further apportion them into monthly targets.

In this talk we will quantify the uncertainty present in this planning and assessment process and demonstrate a PC program called WINEGLASS that can be used to generate monthly targets, track business volumes, make forecasts and assess whether annual targets are achievable.

ASSURING THE QUALITY OF FORECASTS

Robert G. Brown
Materials Management Systems Inc., P.O. Box 239, Thetford Center, VT 05075-0239, USA

The environment is one where several thousand, to several million, forecasts must be revised periodically as for production and inventory control. Naive statistical models work well enough for most of the series most of the time. Automatic methods of finding a good forecast model, and of revising it with new information, work well.

There are some aberrations in the data which present problems for finding the right model or for revising it: outliers, changes in the underlying process, inadequate initial models (especially for new products), shift in the seasonal pattern (for promotions or movable holidays), linear or exponential rate of growth, and so on.

One set of issues centers on finding when a significant aberration has occurred. When do you monitor an individual series versus monitoring an aggregate over several series? What is the basis for aggregation? In either case what is the standard for comparison to detect that there is an exception? How does one set the thresholds to focus on the critical few?

Another set of issues centers in finding the assignable cause, and taking action to make the correction that is appropriate for each cause. Usually that requires a Person In Charge who can apply uniquely human talents to seeing patterns and thinking of alternative hypotheses to test. A person has a wealth of background information that applies to finding the assignable cause.

CHAIR: *Soumyo D. Moitra*
Bellecore, 290 West Mt. Pleasant Avenue, 3D-241, Livingston, NJ 07039-2729, USA

CONSUMER ATTITUDES, BUYING INTENTIONS AND CONSUMPTION EXPENDITURES: AN ANALYSIS OF THE SWEDISH HOUSEHOLD SURVEY DATA

Anders Ågren and Bo Jonsson
Uppsala University, Department of Statistics, P.O. Box 513, S-751 20 Uppsala, Sweden

Surveys collecting data on consumer attitudes and buying intentions have been performed in Sweden since 1973. This paper examines the predictive ability of such data in models for total private consumption and expenditures on durables. The study shows that this type of data has a predictive value in addition to other economic variables. In particular, we have found that intention variables perform very well in the model for durables considering both contribution to explanatory power and improvement of the ex post forecasts.

QUANTIFYING THE SALES EFFECTS OF ADVERTISING—THE BOOTS APPROACH

N. J. Theobald
Economics Unit, Boots the Chemists, Nottingham, NG2 3AA, UK

The current UK economic climate is intensifying pressure on retailers to justify their television advertising expenditure. Attempts to quantify the sales impact often prove difficult, however, Boots has developed an econometric approach that overcomes most problems.

The model uses the relationship between television ratings and coverage. It identifies short and long term sales impacts, the number of messages required to stimulate sales and the amount of advertising recall. These criteria are then used to forecast sales of future campaigns and optimize timing and regional allocation. The model provides significant resource savings and is invaluable as a planning tool.

SENSITIVITY OF DEMAND FORECASTS TO DISTRIBUTION AND ADOPTION PARAMETERS

Soumyo D. Moitra
Bellecore, 290 West Mt. Pleasant Avenue, 3D-241, Livingston, NJ 07039-2729, USA

This paper presents a forecasting model for telecommunication services where the demand is affected by the service deployment or distribution plans as well as by the adoption process. The assumptions that go into such models and the reasons why different models yield different results are discussed. In particular, the sensitivity of the demand forecasts to the deployment and customer adoption parameters are examined. The model is a general one, and could be applied to many other services or products.

CHAIR: *John F. Elder, IV*
Delta Financial, Inc., 1006 Wildmese Place, Charlottesville, VA 22901, USA

IDENTIFICATION OF TRANSFER FUNCTIONS MODELS

Daniel Muller and António Costa
Instituto Superior de Economia e Gestão, Universidade Técnica de Lisboa, R. Miguel Lupi, 20, 1200 Lisboa, Portugal
Francisco Tomé
Telefones de Lisboa e Porto, Departamento de Planeamento Estratégico, Av. Afonso Costa, 4-3º, 1900 Lisboa, Portugal

The developments concerning the identification of the parameters (r,s,b) of the transfer function models, have been supported comparing the empirical cross-correlation function with the corresponding theoretical behavior for different kinds of models. This procedure allows an easy identification of b. However, r and s remain in practice not well defined because the time lags corresponding to the parameters r and s are not obvious due to the structure of the cross-correlation function.

The purpose of this paper is to present a new theoretical approach for the identification of the parameters (r,s,b) of the transfer function models applied to time series. The procedure considered is evaluated on several simulated time series and some conclusions for model selection are assessed.

ROBUSTNESS OF CROSTON'S METHOD OF FORECASTING INTERMITTENT DEMAND

P. DeSautels, J. Shockcor and T. Willemain
Rensselaer Polytechnic Institute, Department of Decision Sciences & Engineering Systems, Troy, NY 12180-3590, USA
C. Smart
Smart Software, Inc., Belmont, MA 02178, USA

Croston (1972) developed the most prominent procedure for forecasting intermittent demand. Croston made simplifying assumptions about the joint distribution of the interval between demands and the size of demands. We investigate empirically the performance of Croston's method using artificial datasets that violate the simplifying assumptions.

ELIMINATING VARIABLES THROUGH "HIGH-ORDER CORRELATION"

John F. Elder, IV
Delta Financial, Inc., 1006 Wildmese Place, Charlottesville, VA 22901, USA

A major challenge in constructing an empirical forecast model is selecting the "stimulus" variables to employ from the vast pool of variables (and their transformations) having potential explanatory power. Too many candidates (especially similiar ones) can severely complicate the search for the best model and make optimal techniques impossible to use. "Greedy" step-wise selection techniques can result in inferior models, and "robust" principle component methods do not identify useless variables. However, by extending the concept of linear correlation to higher powers, redundant variables can be discovered and removed, leading to simpler, more accurate forecast models.

CHAIR: *John F. Elder, IV*
Delta Financial, Inc., 1006 Wildmese Place, Charlottesville, VA 22901, USA

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CHAIR: *Ralph D. Snyder*
Department of Econometrics, Monash University, Clayton, Victoria 3168, Australia

ARIMA FORECASTS WITH RESTRICTIONS DERIVED FROM A STRUCTURAL CHANGE

Victor M. Guerrero
Institute Tecnologico Autonomo de Mexico, 01000, Mexico DF

Some time series models which account for a structural change either in the deterministic or in the stochastic part of an ARIMA model are presented. The structural change is assumed to occur during the forecast horizon of the series and the only available information about this change, besides the time point of its occurrence, is provided by one or two linear restrictions imposed on the forecasts. Formulas for calculating the variance of the restricted forecasts as well as some other statistics are derived. The methods suggested here are illustrated by means of empirical examples

STRUCTURAL MODELS FORECASTING: A REVIEW

R. C. Souza
DEE, PUC/RJ, Rua Marques Sao Vincente 225, Gavea 22453, Rio de Janeiro, RJ Brazil

The analysis of a times series in terms of its non-observable components of trend, seasonal, cyclical and noise is not new. One of the possible approaches, known in the literature as structural model, uses the state space to formulate the model whose state vector, which accommodates these unobserved components, is sequentially updated through the Kalman Filter. In this paper we review the three most used structural model formulations, namely the Harrison & Stevens approach on the bayesian side, and the "classical" approaches of Harvey and Young. The corresponding softwares BATS, STAMP and MICRO-CAPTAIN are also compared.

FORECASTING INFLATION RATE VIA STRUCTURAL MODELS

G. H. Brasil
Department of Statistics, UFES, Brazil
R. C. Souza
Department of Electrical Engineering, PUC/RJ, Brazil

In this paper we use the structural model framework to detect the unobserved components of trend, seasonal and noise present in some of the monthly indices used to measure the Brazilian inflation. The noise component in particular is used to study the peculiarities of the indices, such as: period of data collection, geographical region used, date of publication of the results, etc. Concerning the structural model itself, we opted for the Bayesian approach of West and Harrison, as this particular formulation is very helpful to model data subject to sudden structural changes, quite common in the Brazilian economy.

FROM EXPONENTIAL SMOOTHING TO KALMAN FILTER

Ralph D. Snyder
Department of Econometrics, Monash University, Clayton, Victoria 3168, Australia

In this paper the exponential smoothing methods of forecasting are rationalized in terms of a statistical state space model with only one primary source of randomness. Their link, *in general terms*, with the ARMA class of models (both stationary and nonstationary cases) is also explored.

CHAIR: *Seppo Pitkänen*

Lappeenranta University of Technology, Department of Industrial Engineering & Management,
P.O. Box 20, SF-53851, Lappeenranta, Finland

FORECASTING AND PLANNING PROBLEMS AFTER GERMAN UNIFICATION

Heinz G. Schild
Hopmannstr, 6, D-5300 Bonn 2, Germany

The entry of those states which once made up the GDR into the Federal Republic of Germany changed the domain and inherent dynamics of business forecasts and plans. This is a serious problem especially for companies which take over ex-GDR organizations (e.g., Post and Telecom) or will be merged with them (e.g., Railways).

Forecasts based on extrapolations or regressions over the new domain will not work. Under the assumption that the situation in the new eastern states will approximate that of the western states over the next years, we restrict our forecasts to the domain of the western states and model the expected behavior in the domain of the eastern states with converging curves. Problems arise from incompatibilities in data definitions; assumptions have to be made and possibly proved about the form and slope of the converging curves, their final levels compared to that of the western states and the years when such levels will be reached. Finally, the magnitude and timing of the effects of the development in the eastern domain on the forecasts for the western domain have to be considered.

WAS THE SOVIET ECONOMIC COLLAPSE UNPREDICTABLE (OR HOW TO CLOSE ONE'S EYES FROM UNPLEASANT FORECASTS)?

Seppo Pitkänen
Lappeenranta University of Technology, Department of Industrial Engineering & Management,
P.O. Box 20, SF-53851, Lappeenranta, Finland

A Finnish politician, a well-known expert on East-West relations, has noted that "only a person with no real information about the matter could have predicted what happened in the Soviet economy in the late 1980's." For politicians and businessmen in the West the breakdown seems to have been an almost total surprise.

The author starts with several forecasts presented at the end of the 1970s and the beginning of the 1980s, which show that the chaos was very manifest beforehand. The main emphasis is devoted to an analysis of the psychological reasons that made the Western economic and political decision-makers ignore the forecasts that were available. The analysis leads to a discussion about the difficult ties involved in the professional role of a "neutral" forecaster.

CZECHOSLOVAKIA: DRAWING CONSEQUENCES FROM AN EDUCATION IN AN OPENING ECONOMY [Presented by Title Only]

Lubomir Kostroň
Masarykova Universita, Department of Psychology, Arne Nováka 1, 660 88 Brno, Czechoslovakia

(1) Breaking cognitive barriers—determining present possibilities under conditions of economical, legislative and market uncertainties (use of Egon Brunswik's Lens Model for decision-making)—ways to visualize long-range goals—broadening cognitive fields. (2) Seeking for a new image of a successful manager—Changing patterns of behavior from unresponsible child behavior as a model of a successful manager in central planned economy, to responsible adult behavior as a model of a successful manager in an open market economy. (3) Tools for an immediate change—The role of psychology in helping to change one's mind. Universities as an agent of social change. (4) Building a sum of positive knowledge vs. inserting a proper amount of doubts—Learning democracy as a principle of thinking. Breaking language barriers, learning interdisciplinarily from other cultures, identifying specific national image and contribution. (5) Psychology in service of the Club of Rome efforts.

CHAIR: *Philip A. Klein*

Department of Economics, The Pennsylvania State University, 516 Kern Graduate Building, University Park, PA 16802, USA

MONITORING VS. FORECASTING THE BUSINESS CYCLE: A SECOND LOOK

John P. Cullity
Rutgers University-Newark, Hill Hall, 360 Martin Luther King, Jr. Boulevard, Newark, NJ 07102, USA

In 1981, Geoffrey Moore delivered a keynote address to the First International Symposium on monitoring vs. forecasting approaches to the business cycle. This paper reexamines this matter. Moore's original contributions to the development of leading indicators of recessions and revivals are widely recognized. However, the development of these indicators led to other important findings. This paper focuses on a few of them. Specifically, the paper examines: (1) Systematic differences between mild and severe contractions; (2) The use of leading indicators to forecast magnitudes; (3) The development of signal systems using leading indicators; and (4) International forecasting accuracy.

WEATHER, SEASONS AND THE RELATIONSHIP WITH GROWTH AND BUSINESS CYCLE TURNING POINTS

Michael P. Niemira
Mitsubishi Bank, 2 World Finance Center, 40th Floor, New York, NY 10281, USA

In a series of papers by Miron, et al., they established that the seasonal cycle has similar dynamics to the business cycle. Hence, the question that this paper addresses is whether there is a tendency for business cycle turning point dates to be influenced by seasonal weakness or strength? A second question addressed is: how significant are "weather shocks" on the business cycle? Although forecasters have long ignored seasonal patterns, they may be significant for the business cycle forecaster to account for separately when: (1) the assumed deterministic seasonal cycle is more stochastic, and (2) when they act as a potential shock to the business cycle.

LESSONS FROM A SURVEY OF MACROECONOMIC FORECASTS, 1986-1990

Victor Zarnowitz
Department of Economics, University of Chicago, 5752 S. Blackstone Avenue, Chicago, IL 60637, USA

[Abstract not available.]

GEOFFREY H. MOORE'S CONTRIBUTIONS TO BUSINESS CYCLE ANALYSIS

Philip A. Klein
Department of Economics, The Pennsylvania State University, 516 Kern Graduate Building, University Park, PA 16802, USA

This paper will be the major exception to the focus on indicators. It will sketch some of Moore's major contributions to our understanding of business cycles today, but will focus primarily on showing how Moore's work typifies the approach to statistical methods which continuing productive research must take in dynamic fields such as economic instability and forecasting. It will attempt to summarize some of Moore's major statistical innovations including some recent ones in an attempt to show that statistical presentation in a field such as this can never be regarded as a shrine to established statistical techniques. Rather, as economic conditions change and economic interrelations develop, the expert analyst and forecaster must constantly adapt and refine statistical methods and techniques so as to be able to answer—on an ongoing basis—the critical question, Am I revealing in an optimal way the critical interrelationships necessary to understand how instability develops and is transmitted in the current economy? As such, Moore has been an exemplary analyst of time series critical in understanding unfolding instability.

Session F3 Room 510	FINANCIAL REPORTING AND FORECASTING	Monday 3:45 – 5:15

CHAIR: *Jay D. Forsyth*
Central Washington University, 6000 16th Avenue, S.W., Seattle, WA 98106-1499, USA

THE REPORTING OF OIL PRODUCT PRICES

Nigel Meade
The Management School, Imperial College, London, SW7 2PG, UK
Joe Roeber
Joe Roeber Associates, London, UK

Oil products are traded on a number of geographical markets, examples are NW Europe and New York. These markets are based on networks of traders and price reports are provided by various services. The number of services is such that there is generally more than one price report available for the same oil product.

Three aspects of the reporting of oil product prices will be addressed:

- means of comparing price reports from different services
- modelling a price report
- examination of the changes in oil product price reporting over the period 1986 to 1990

During this period many changes have occurred, both in the markets and communications.

USING MODEL INSETS TO MONITOR REVENUE FORECASTS

Henry Thomassen
Economic Advisor to the Governor, Atlanta, GA 30334, USA

A State's revenues are forecast for various budget periods. For assurances or forewarning, interim checks on forecasts may also be required. When new observations on determining variables are not available, tracking can benefit from "model insets." Insets rest upon stages set by longer-term models. They incorporate interactions that distort in interim spans but are trusted to wash out over time. Seasonal models can be insets. Models of mutually-offsetting influences, like advance payments and refunds, are more informative varieties. Georgia's revenue behavior since 1950 suggests that several classes of model insets can be developed to aid monitoring.

REAL AND PERCEIVED OBSTACLES TO THE PUBLICATION OF FORECASTED FINANCIAL STATEMENTS BY SEC REGISTRANTS

Jay D. Forsyth
Central Washington University, 6000 16th Avenue, S.W., Seattle, WA 98106-1499, USA
Grant D. Forsyth
The Central Building–Suite 404, 810 Third Avenue, Seattle, WA 98104, USA

An examination of the legal, economic and institutional issues surrounding the failure of publicly traded companies to include prospective financial statements as part of the annual report. The preliminary results from a test survey concerning current management attitudes on the publication of financial statement forecasts will be reviewed.

CHAIR: *Celal Aksu*
School of Business and Management, Temple University, Philadelphia, PA 19122, USA

COMPOSITE FORECASTING OF EARNINGS: THE EVIDENCE FROM JAPAN

J. B. Guerard, M. Takano, P. Todd, Y. Yamene
Daiwa Securities Trust Company, Global Portfolio Research Department, One Evertrust Plaza, Jersey City, New Jersey 07302, USA

We present evidence to support composite modeling of Japanese earnings using analyst, company, and time series forecasts. Earnings forecasts are used in an equity selection model. The application of a mean-variance optimization analysis produces statistically significant excess returns.

EFFECTS OF ANALYST DISAGREEMENT ON THE ACCURACY OF ANALYSTS', TIME SERIES AND COMBINED FORECASTS OF ANNUAL EARNINGS

Gerald J. Lobo
School of Management, Syracuse University, Syracuse, NY 13244, USA

This paper examines the effects of disagreement in analysts' earnings forecasts on the accuracy of analysts', time series and combined forecasts made at four different forecast horizons. The empirical analysis indicates that while analysts' forecasts outperform forecasts from each of three time series models studied, simple combinations of analysts' and time series forecasts are superior to forecasts from either source at every horizon. The accuracy of individual and combined forecasts is inversely related to the dispersion of analysts' forecasts and the improvement from combination is greatest when analysts' forecast dispersion is greatest and the forecast horizon longest.

MODELING AND FORECASTING QUARTERLY ACCOUNTING EARNINGS IN THE PRESENCE OF OUTLIERS AND VARIANCE CHANGES

Celal Aksu
School of Business and Management, Temple University, Philadelphia, PA 19122, USA
David Reilly
Automatic Forecasting Systems, Inc., P.O. Box 563, Hatboro, PA 19040, USA

Presence of structural changes such as strikes, plant closings, changes in regulations/competition, etc. affect modeling and forecasting of accounting earnings adversely. Empirical studies indicate that "single" models identified under the assumption of an identical process generating all firms' earnings are more robust to structural changes and thus outpredict "firm-specific" models. In this paper, we use the outlier and variance change detection and adjustment procedures to identify firm-specific ARIMA models of earnings to explicitly account for the effects of structural changes. The forecasting performance of our models are compared to that of other models used in previous studies.

CHAIR: *Edna White*
Florida Atlantic University, Boca Raton, FL 33432, USA

WEIGHTED AVERAGE OF COMBINED FORECASTS

Bahram Emamizadeh
Amirkabir University of Technology, Tehran, Iran
Ali Reza Lari
University of Maryland, Towson State, Towson, MD 21204, USA

Job shop systems face the task of forecasting the demands for various parts. Generating forecasts from several methods is proposed by Makriadolkis. However, it seems that each forecasting method may have more effect than others.

In this study, by using a statistical package and eight forecasting methods with several data series and regression analysis, weights for each forecasting method are found and a final forecast is made. The results are compared for MAPE against the individual results and simple average. Our study shows that weighted forecasts are in most cases better than the simple average forecasts.

AN EMPIRICAL EVALUATION OF COMBINING FORECASTS IN AIR BOOKING CONTROL

Ginés Alarcón
Universidad Politcnica de Madrid, Escuela Universitaria de Ingenieria Ténica Aeronáutica,
Plaza Cardenal Cisneros, s/n, 28040 Madrid

Aiming to improve the results obtained by the application of the Box-Jenkins method to the time series corresponding to the booking period of one flight. In those points whose values have presented high deviation from their real values, a study has been carried out by means of forecasting combinations so as to achieve not only better results than those previously obtained but also to determine those structures which allow to detect those specific cases and, as a consequence to apply the suitable corrections.

COMBINING VECTOR FORECASTS TO PREDICT COMPETITIVE EVENTS

Edna M. White and Ronald Dattero
Florida Atlantic University, Boca Raton, FL 33432, USA
Benito E. Flores
Texas A&M University, College of Business Administration, 1811 Leona Drive,
College Station, TX 77840, USA

Most previous work on the combination of forecasts has been confined to time series forecasting. The present research extends the utilization of the technique into the domain of predicting one-time, competitive events. Preliminary results and conclusions on the accuracy and effectiveness of the combination approach will be reported and discussed.

CHAIR: *Bent Sorensen*
COWIconsult, Parallevej 15, DK-2800, Lynby, Denmark

COMBINING FORECASTS BY NEUROCOMPUTING

José M. Otero
University of Malaga (Spain), C/Raimundo Lulio, 1, 29018, Malaga, Spain

Neural networks have been used in forecasting as an alternative to time series modelling. In this paper neural computing is used to explore some of its possibilities as an easy and natural procedure for combining forecasts. For this purpose some forecasts from the famous "M-Competition" have been selected and combined in three different ways: the simple average (corresponding to the best performance yielded in the "M-Competition") and two neural networks (one corresponding to a linear combination).

STATISTICAL DATA PATTERN RECOGNITION

Ibrahim M. Al-Jabri and Nacer Boundaoui
Stuart School of Business Administration, Illinois Institute of Technology, Chicago, IL 60616, USA

One of the key steps in the selection of an appropriate forecasting model is data pattern identification. This paper develops an alternative approach designed to identify the pattern of given time series. The major patterns studied in this research are horizontal, trend, and seasonal since they tend to be the most widely encountered in practice. This method is evaluated over a variety of conditions using simulated time series.

USING AI TOOLS TO FORECAST THE CONSEQUENCES OF A BID DECISION

Bent Sorensen
COWIconsult, Parallelvej 15, DK-2800, Lynby, Denmark

Many enterprises in the knowledge-based business regularly bid on projects (e.g,. feasibility studies, program management, design and construction) in competition with each other. A methodology is required for deciding when to bid, in order to avoid costly bidding if the chance of winning is small, or if the risk associated with the job is high.

This study compares two AI tools, an expert system and a neural network, in order to investigate the extent to which the bid decision process is rule based, and to which extent it is dominated by complex, non-linear assessment. The input is material used in actual bid situations along with the final bid decisions, evaluated before and after a winning bid.

CHAIR: *Graham Hall*

Manchester Business School, Manchester University, Booth Street West, Manchester M15 6PB, UK

CAN FORECASTING BE MADE A CENTRAL ACTIVITY IN MANUFACTURING ORGANIZATIONS?

Robert Raeside and Moira Watson
Napier Polytechnic, Department of Mathematics, Edinburgh, Scotland

Recent research has clearly indicated that forecasting activity is far from central in many organizations, despite the potential for increased business efficiency. Indeed, if forecasting is carried out at all, it is often perceived as a peripheral activity in the organization's structure and functioning.

Drawing on results of a survey of Scottish electronics firms and two in depth case studies, this paper confirms the above view and outlines some steps that can be taken to give forecasting a greater role in such firms. In particular, it is argued that pressures to improve quality and adopt production scheduling policies like JIT and MRP will result in forecasting activity moving to a more central role in manufacturing organizations.

STRATEGIC VISION: CLARITY OF PURPOSE IN A TURBULENT ERA

Michael D. Ryall
President, Decision Strategies International, 89 Headquarters Plaza, North Tower, 14th Floor, Morristown, NJ 07960, USA

This paper presents a new, integrated approach to developing strategic vision. The need for qualitative thinking tools in the early phases of strategic planning, particularly in situations of high environmental complexity and uncertainty, is discussed. The benefits of scenario analysis, including uncertainty bounding, enhanced organizational communication and improved calibration to environmental dynamics are highlighted. A method for building strategic vision is presented with new insights on integrating environmental driving forces, industry structure and firm-specific competencies. Although grounded in recent academic advances, the process described is geared toward the practitioner. Finally, methods for linking this qualitative analysis to existing quantitative operational and financial planning systems are discussed.

THE USEFULNESS OF COMPANY SPECIFIC VARIABLES FOR FORECASTING SMALL FIRM PERFORMANCE

Graham Hall
Manchaster Business School, Manchester University, Booth Street West, Manchester M15 6PB, UK

Little is known about the influences on the performance of small firms facing similar market conditions. This paper:

(a) considers the effects of the education levels found within small firms operating in instrumentation on profitability, change in profitability and total growth of sales

(b) similarly, in order to identify the best practice the influence of key aspects of financial management, strategy, marketing, the management of innovation, and operations management

(c) the effects of market specific values

(d) the relative importance of sets of variables specified on (a), (b), and (c), in order to establish the major influence on performance.

The results underline the importance of strategic and financial variables and the irrelevence of operations management

PRACTICAL USES OF FORECASTS

CHAIR: *Robert G. Brown*
Materials Management Systems, Inc., Thetford Center, VT 05075-0239, USA

David Mitchell—**FEATURED SPEAKER**
IBM White Plains

David H. Mitchell was appointed to his current position in January 1985. In this capacity, Mr. Mitchell determines U.S. product demand and negotiates supply with the product divisions for the complete IBM product line. He schedules all U.S. customer orders and directs/controls the field finished goods inventory. He is responsible for IBM U.S. distribution and logistics programs. He initiates marketing actions to improve product sales and develops new demand planning and inventory management tools.

Mr. Mitchell began his IBM career in 1959, and held a number of management positions in engineering and manufacturing, including Site General manager of Boulder. He was the Director of Manufacturing and Component Planning for General Business Group where he had worldwide responsibility for their manufacturing activities.

PROBLEMS OF PEOPLE KNOWING HOW TO USE FANCY TOOLS

Richard Dunnet
Federal Mogul, Detroit, MI 48202, USA

Fancy forecasts aren't much use in an organization where the people don't know how to use them, or how they relate to lead times and inventories.

FORECASTING THE FAILURE OF COMPONENT PARTS IN COMPUTER SYSTEMS

Everette S. Gardner, Jr.
University of Houston, Houston, TX 77204-6282, USA

This paper is an applied study in forecasting the failure of component parts in computer systems to aid in production planning and inventory control. Monthly failures of these components are shown to be related to cumulative shipments from the factory after a time lag of several months. The relationship is modeled using discounted least-squares regression. Forecast accuracy is then compared to exponential smoothing as well as a combination of the regression and smoothing forecasts. The major research finding is that, contrary to expectations, combining the forecasts did not improve forecast accuracy.

OPERATIONAL FORECASTING FOR PRODUCTION AND DISTRIBUTION

A. Dale Flowers
Case Western Reserve University, Cleveland, OH 44106, USA

We will discuss the results of implementing an operational forecasting system in a medium sized company. The company distributes about 7000 parts to the residential planning industry through approximately 3000 distributors. The company makes roughly 2000 of the parts and purchases the others for resale. Many of the purchased items come from overseas suppliers, and have lead times up to six months to acquire. The investment in inventory and the level of customer service were the primary criteria driving this implementation.

CASE'S FORECASTING PRACTICES

Irene Lam
J I Case SPC, Racine, WI 53404, USA

The paper will describe the current forecasting methods, with statistics of the number of parts using each method. We will discuss current problems in maintaining the forecast, how we measure forecast error, and the impact on safety stock investments.

FORECASTS IN THE SERVICE PARTS BUSINESS

Roger Miller
John Deere Parts Distribution, Milan, IL 61264, USA

Good forecasts are achieved through a combination of formal calculations on the computer and judgement of experienced analysts. Poor forecasts result in inventory that is much higher than planned or service to customers much worse than was planned.

CHAIR: *Panos Kontzalis*
Marketing Research & Planning, Sandoz Pharma AG, CH-4002 Basel, Switzerland

SALES FORECASTING MODELS IN UNSTABLE ECONOMIES

S. E. Baratojo
Nielsen Marketing Research, Av. Bernardino de Campos, 98, 04004, São Paulo, SP, Brazil

Sales forecasting in countries subject to unstable economies becomes impractical with traditional univariate methods. Often, besides the difficulty in identifying the real competitors of a given brand, it is necessary to find ways to explain sudden changes in level, growth, and even the various transients present in the sales data. In this paper an attempt is made to build a model for a personal use product, making use of the marketing mix variables as well as explanatory variables for the main competitors. The final model also includes intervention variables to explain the effects of the various shocks in the economy which have affected the Brazilian economy ever since 1984.

IDENTIFICATION OF KEY ATTRIBUTES GAP ANALYSIS AND SIMULATION TECHNIQUES IN FORECASTING MARKET POTENTIAL OF ETHICAL PHARMACEUTICAL PRODUCTS (CASE STUDY)

Panos Kontzalis
Marketing Research & Planning, Sandoz Pharma AG, CH-4002 Basel, Switzerland

Product X is an ethical pharmaceutical product which is currently under R + D for the treatment of various autoimmune diseases. In order to evaluate its market potential, a market model has been built-up based on physicians prescribing attitudes and current scientific profile of product X.

Model creation consisted of the following steps (two case studies will be prescribed in detail)

1. Identification of key attributes physicians consider as important in selecting products for the treatment of the condition.
2. Measurement of the relative importance of each attribute vs. all other (trade off utility score).
3. Association of major existing therapies with key attributes (gap-analysis).
4. Product usage simulation based on the utility scores and current scientific knowledge on product X.

The model predicts the overall market share likely to be attained by product X and its impact on each of the major competitors.

With certain modifications the model could be also used in forecasting market potential of non-pharmaceutical products.

CHAIR: *R. C. Souza*
DEE, PUC/RJ, Rua Marques Sao Vincente 225, Gavea 22453, Rio de Janeiro, RJ Brazil

WHY KALMAN FILTER?

Ralph D. Snyder
Department of Econometrics, Monash University, Clayton, Victoria 3168, Australia

In this paper the Kalman filter and regression approaches for estimating linear state space models are compared. It is argued that the Kalman filter is no more efficient from a computational point of view, is relatively more complex and hence more obtuse, and that as a consequence its central role in the smoothing, estimation and prediction of time series is questionable.

DYNAMIC ERROR COMPONENT MODELS

Pablo Marshall
Departmento de Probabilidades y Estadística, Pontificia Universidad Católica de Chile, Santiago, Chile

This paper considers a new approach to the dynamic extension of the classical error components models. Based on the ideas of Structural Time Series Models, a class of models where the time specific and time unit specific effects are decomposed as trends and irregular components is defined. This structural specification allows the modelling of stochastic trends as is known to be the case in many economic time series, and permits a more direct analysis and interpretation of the relationships between the trend components across units. The class of models presented can be used to form forecasts. The minimum mean square error estimation of common and specific trends by the Kalman filter is studied, and the maximum likelihood principle for the estimation of parameters is employed. Classical test procedures for the hypothesis of error components are developed and the results of some applications are presented.

A DYNAMIC MODEL TO FORECAST ELECTIONS RESULTS

L. E. Segadas and P. A. R. da Roza
CGI, REDE Globo, Rio de Janeiro, Brazil
R. C. Souza, T. K. Filho and A. L. V. Filho
DEE, PUC/RJ, Rua Marques Sao Vincente 225, Gavea 22453, Rio de Janeiro, RJ Brazil

This paper describes the main aspects concerning a dynamic model to forecast the final results of an election, based on actually counted votes. Previous elections data bases are used to create homogeneous clusters of voters within the electoral universe considered. Such dynamic formulation has been successfully used by the Brazilian Globo TV network in the 1989 presidential election and adapted for the 1990 state governors elections.

CHAIR: *R. C. Souza*
DEE, PUC/RJ, Rua Marques Sao Vincente 225, Gavea 22453, Rio de Janeiro, RJ Brazil

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Session S2 New York University	FORECASTING AND PLANNING AT AN URBAN UNIVERSITY	Monday 6:30 – 7:00

CHAIR: ***Edward Melnick***

New York University, Statistics & Operations Research Department, Leonard N. Stern School of Business, 40 W. 4th Street, Room 519, New York, NY 10003, USA

Allen E. Claxton

Allen E. Claxton is Senior Vice President for Finance at New York University, with responsibility for the traditional financial functions plus insurance and administrative computing. (New York University is a private, not-for-profit educational corporation with 12,000 full-time employees and an annual operating budget in excess of $1.1 billion.) Mr. Claxton has a Bachelor's degree from Princeton and a Masters degree (public administration) from Syracuse. Before joining NYU, he was employed in a variety of public finance and budget positions in the federal government (Bureau of the Budget and the Agency for International Development) and in the City of New York (City Budget Bureau and City University of New York).

[Professor Aaron Tenenbein, Chairman of the Department of Statistics/Operations Research, Stern School of Business, New York University, will be host at this session and will open the proceedings with some welcoming remarks.]

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CHAIR: *Everette S. Gardner, Jr.*

Department of Decision and Information Sciences, University of Houston, 4800 Calhoun Road, Houston, TX 77024, USA

THE CHIEF EXECUTIVE OFFICER AS A FORECASTER

Arthur R. Taylor
Dean of the Fordham Graduate School of Business Administration

Chief Executive Officers represent many styles, and their strengths are often emphasized in carrying out their responsibilities, as is expected. All of them, however, are expected to forecast. They forecast to Boards of Directors. They forecast to analysts, and now, to institutional investors. In some cases they have legal responsibility for their forecasts. They are also required to forecast for their employees. All strategic plans require assumptions. Even in those strategic plans which emanate from the bottom to the top, the assumptions have to be agreed upon, and they are almost always agreed upon by the Chief Executive Officer and they require an ability to look forward into the future.

It is rare that the chief executive officer is a forecaster by virtue of his experience. He relies on others, either in a consulting capacity, or in an employee capacity. It is largely a matter of trial and error. This talk will examine the chief executive officer's dilemma, what he can and can't do about it, and describe what is increasingly a weakness in the American industrial system.

Arthur R. Taylor became the Dean of the Fordham Graduate School of Business Administration in October 1985. Since that time, both the school and faculty have doubled in size, an increase that Dean Taylor attributes to the conscientious integration of quality management principles into the curriculum and administration of the school.

Prior to 1985, Dean Taylor was a Director of the First Boston Corporation, Executive Vice President and Director of the International Paper Company, and President of CBS, Inc. He founded cable television's Entertainment Channel (now the Arts and Entertainment Network), and conceived and developed the New York City partnership for which he served as President. He currently serves on several Fortune 500 company board of directors, chairs the Academy for Corporate Governance, and is Chairman of his own investment company, Arthur Taylor & Co.

CHAIR: *Antoni Espasa*

Universidad Carlos III de Madrid, Departmento de Economia, Calle Madrid 126, 28903 Getafe, Madrid, Spain

COMPARISONS OF NAIVE AND MULTIVARIATE PROBABILISTIC FORECASTS OF DAILY ELECTRICITY PEAK LOADS

Gail Adams
New England Power Pool, Holyoke, MA 01041, USA
P. Geoffrey Allen and Bernard J. Morzuch
University of Massachusetts, Amherst, MA 01003, USA

Electric utilities strive to have sufficient generating capacity to meet demand. Typically the probability of failure is that demand exceeds capacity no more than one day in ten years. The critical capacity value can be calculated directly or indirectly. This paper compares weekly peak load distributions estimated directly with weekly data and indirectly from the underlying daily peak load population, using both naive and multivariate models.

HOURLY ELECTRICITY DEMAND FORECASTING

Clive Granger
Department of Economics, University of California, San Diego, La Jolla, CA 92093, USA

As part of a real-time forecasting competition organized by an electric utility, two models were produced, each capable of modeling forecasts at 8 am for each hourly demand of the next day. A separate model was estimated for each hour, using available data at 8 am, including temperature forecasts and previous demand values. One model included an adaptive term, to pick up any possible long-run change in the level of demand. The models were compared to several other forecasting techniques and were found to provide the lowest absolute mean deviation forecast errors for most weekday hours.

FORECASTING DAILY ELECTRICITY CONSUMPTION USING METEREOLOGICAL VARIABLES WITH DYNAMIC NON-LINEAR RESPONSE FUNCTIONS WHICH CHANGE WITH TIME

J. R. Cancelo and Antoni Espasa
Universidad Carlos III de Madrid, Departmento de Economia, Calle Madrid 126, 28903 Getafe, Madrid, Spain

We present an ARMAX model with intervention analysis for forecasting the daily demand for electricity in Spain. The model contains about one hundred and fifty parameters, which are estimated with seven years of daily data. Changes in the working conditions, like holidays, are modelled using dummy variables; metereological variables entered as inputs with non-linear dynamic response functions that change according to the season of the year and the type of day. Both kinds of effects explain the short-term oscillations and the main part of the annual cycles in the data: trend growth and the rest of the seasonal pattern are captured by an ARIMA model on the residuals.

CHAIR: *Stuart Bretschneider*
The Maxwell School, Syracuse University, Syracuse, NY 13244, USA

FORECAST EVALUATION IN THE U.S. DEPARTMENT OF AGRICULTURE

David R. Solenberger
U.S. General Accounting Office, Suite 600, Broadmoor Building, 5700 Broadmoor, Mission, KS 66202-2400, USA

This paper describes GAOs evaluation of USDA short term meat and long term commodity forecasts. Forecasts have many private and governmental uses. For example, the commodity forecasts are used directly in budget estimates. Our evaluation involves two components. First, we measure error rates. Second, we compare those forecasts to benchmarks. The accuracy measures used identify bias and total error. We use as simple a measure as possible, mean percent error and mean absolute percent error. Forecast errors can affect decision making; such as through inefficient allocation of resources or poor budget estimates. Recent General Accounting Office reports recommended that USDA improve its forecasts in a number of ways. New legislation suggesting that USDA implement some of these recommendations is discussed, as well as the status of USDA's actions to implement the recommendations.

FORECAST EVALUATION AND USDA

Ken Nelson
Economic Research Service, Livestock Dairy and Poultry Branch, 1301 New York Avenue NW, Washington, DC 20005-4788, USA

Price and production forecast for livestock have been assessed for accuracy by analysts both inside and outside the forecasting agencies. Some results of these assessments will be presented along with a discussion of the increased difficulty of making judgments about the merit of forecasts owing to: (1) particular constraints on the forecasting process, and (2) diffuse forecasting objectives because of the widely varying needs of users.

FORECASTING PRACTICES IN THE U.S. FEDERAL GOVERNMENT

Stuart Bretschneider
The Maxwell School, Syracuse University, Syracuse, NY 13244, USA
Wilpen Gorr
Carnegie Mellon University, Pittsburgh, PA 15213, USA

This paper reports on the results of a survey sent to members of "Federal Forecasters," a profession affiliation designed to identify individuals within the federal government responsible for forecasting to each other. The paper describes the objectives, procedures and uses of forecasting by different federal agencies with particular attention on the different approaches to evaluation of forecasting. Exploratory analysis on factors related to why specific evaluation criteria are employed are also presented.

CHAIR: *Kajal Lahiri*
State University of New York, Albany, NY 12222, USA

FORECASTING RESEARCH IN CHINA FOR 1980's

Chen Yuxiang and Li Feng
Institute of Forecasting and Development, Hefei University of Technology, Hefei, Anhui, 230009, P.R. China

By statistic analysis for more than 3000 papers submitted or published on the journal "*Forecasting*" since 1982, this paper systematically describes the present situation of research in forecasting theories, forecasting methods, forecasting systems and their applications in China, as well as the views from various departments of government, universities and enterprises on forecasting. The environments of forecasting research and the characteristics of economic forecasting in nations of planning systems are also discussed. Based on them, the author puts forward some notable problems and their solutions in forecasting research.

USE OF N.A.P.M. SURVEY DATA IN BUSINESS CYCLE FORECASTING

Susmita Dasgupta and Kajal Lahiri
State University of New York, Albany, NY 12222, USA

Three-category qualitative (up, down and stay same) survey data on actual changes in buying prices, employment, production, new orders inventories and supplier deliveries during prior month is analyzed over 1948:06-1989:08 using certain probability methods developed by Carlson and Parkin (*Economica*, 1975) and Fishe and Lahiri (*J. Econometrics*, 1981). Apart from generating estimates of underlying rates of change in the variable, the procedure also gives estimates of variability across firms. We show that both these measures have independent power to explain industrial production, composite leading indicator, employment, etc. The performance of relative variability measure on inventories is particularly impressive in predicting NBER turning points. Using the variability measures, we also tested the so-called "moderation hypothesis" on the severity of post-war business cycles (i.e., progress towards economic stability) in the U.S.

TESTING FOR RATIONALITY IN BLUE-CHIP FORECASTS: A PANEL DATA ANALYSIS

Kajal Lahiri, Anthony Davies, and Sanjay Shah
State University of New York, Albany, NY 12222, USA

We use Blue-Chip economic indicators on GNP deflator, real GNP, industrial production, housing starts, non-residential fixed investment, and unemployment over 1978:1-1990:12. Starting 18 months before the end of the target year, the panel forecasts monthly until May of the year. Special attention is paid to contemporaneous correlation due to aggregate shocks, heteroskedasticity and autocorrelation in forecast errors which result from a three-dimensional nested error structure. We obtain generalized method of moments estimates to test for forecast rationality and efficiency.

THE M2 COMPETITION: PRELIMINARY RESULTS

CHAIRS: ***Spyros Makridakis and Michèle Hibon***

(INSEAD) European Institute of Business Administration, Boulevard de Constance,
77305 Fontainebleau Cedex, France

In November 1987 actual data was obtained from four companies about the sales of some of their products. In addition several macroeconomic series was gathered. This data was distributed to several forecasters who made predictions for the 1988 calender year. Consequently, updated data was collected in November 1988 and again distributed to the forecasters who made predictions for the entire 1989 calender year.

In this talk the various predictions are analyzed and the results compared to the actual values of 1988 and 1989. Various combinations and judgmental forecasts are also presented and evaluated in comparison to those of quantitative methods.

This paper will be followed by a discussion.

Discussants:

(to be announced)

CHAIR: *Randall L. Schultz*
University of Iowa, Iowa City, IA 52242, USA

A MANAGERIAL PERSPECTIVE ON THE PARAMETERIZATION OF FORECASTING METHODS

James E. Cox, Jr.
Department of Marketing, Illinois State University, Normal, IL 61761, USA

Many times the accuracy measures used to parameterize forecasting methods is the mean squared error (MSE). Most forecasting computer packages use this as a default measure. However, the proper accuracy measure to use depends on the managerial objectives set for the forecasting situation. The MSE may not be the appropriate accuracy measure to use. This paper surveys the forecasting process and the primary accuracy measures used to parameterize forecasting methods. Also discussed will be the factors that should be considered by the manager in choosing an appropriate accuracy measure.

A MODEL FOR MANAGEMENT'S USE OF MULTIPLE FORECASTING INPUTS

Mark M. Moriarty
Krannert Graduate School of Management, Purdue University, West Lafayette, IN 47907, USA

Forecasters charged with the responsibility of developing sales (or market share) forecasts for use by managers have access to predictive data from a variety of sources. Typical sources would be data from the sales force, from models developed by corporate economic forecasting groups, and from product management's quantitative forecasting models. Such information is usually aggregated informally to give a weighted predictive estimate of sales (or market share) for the next planning period. While such a process works for many situations, models for the integration of the component information inputs typically are absent. This paper develops a management model for the combination of information for forecasting purposes derived from data sources available to the firm. Two empirical examples show the value of the model.

MODEL-BASED PLANNING AND FORECASTING

Randall L. Schultz
University of Iowa, Iowa City, IA 52242, USA

An approach to forecasting is presented that recognizes the natural precedence relation between planning and forecasting: marketing plans should precede sales forecasts. The approach is implemented using market response models which are developed using the ETS method, an appropriate combination of econometric and time series analysis for market analysis. The presentation summarizes the modeling logic of *Market Response Models: Econometric and Time Series Analysis* (Kluwer Academic Publishers, 1990).

THE USE OF QUALITY CONTROL TECHNIQUES TO MONITOR FORECAST ACCURACY

CHAIR: *Barbara A. Price*
School of Business Administration, Winthrop College, Rock Hill, SC 29733, USA

ON THE USE OF CONTROL CHART CONCEPTS FOR TRACKING SMOOTHED FORECASTS

Arnold L. Sweet
Purdue University, West Lafayette, IN 47905, USA

Simple models for the control of inventories use estimates of the mean and standard deviation of the demand in their computations. It is also useful to generate a warning signal to indicate when the model may require some major adjustments. In the practice of statistical quality control, the behavior of a process is monitored by means of Shewhart control charts. The application of control chart concepts to the monitoring of the mean and standard deviation of demand when they are estimated by means of coupled exponentially smoothed forecasts will be discussed. Suggestions are made as to how to use the warning signals to reset the smoothing procedures.

THE USE OF SHEWHART AND CUSUM CHARTS IN BUDGET MANAGEMENT

Robert D. Russell
Hoechst-Celanese, Rock Hill, SC 29730, USA

Forecasters smooth and filter process variations to develop useful expectations of the future from historical process data. Shewhart used process variations to identify and correct unnatural events that make a process unpredictable. One approach tries to forecast the future process while the other attempts to make the current one more predictable. Both have the same purpose—to better manage future decisions. This report considers that application of Shewhart techniques to budget management, and describes a management procedure that appears to offer improved forecasts and control of budgets.

MONITORING FORECAST ACCURACY

Robert G. Brown
Materials Management Systems, Inc., Thetford Center, VT 05075, USA

Forecasts for production and distribution planning for tens of thousands of products in dozens of locations are revised usually every month. It is vital to have programmable rules for monitoring the quality of these forecasts so that people can focus on the critical few to intervene when necessary. There are two broad categories of monitors. The Demand Filter is an exception report to monitor current data before it is used to revise values of the coefficients in the statistical model. The Tracking Signal reports significant bias in the forecasts.

The analyst must review these exception reports, anticipate scenarios and use the reports to confirm diagnosis, look for patterns and fix the root cause of a set of symptoms. The major point of the presentation is the procedure for using exception reports.

MONITORING FORECASTS—THE PAST AND THE FUTURE

H. C. Haynsworth and Barbara Price
Winthrop College, Rock Hill, SC 29733, USA

After a survey of traditional tracking signal methods for forecast monitoring has been presented, a set of standards for the evaluation of monitoring systems designed for use with short-term forecasts will be proposed. Since tracking signals have generally failed to live up to expectations in actual applications, some ways to use statistical quality control concepts to monitor forecasts will be suggested.

CHAIR: *J. Thomas Yokum*

Department of Business Administration, Angelo State University, 1112 Algerita,
San Angelo, TX 76909, USA

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

Peter J. Danaher and Roderick J. Brodie
University of Auckland, Auckland, New Zealand

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. In the discussion of the paper, Hagerty (1987) showed theoretically that these results were not surprising. This paper extends the analysis of Hagerty (1986, 1987) by deriving conditions under which naive econometric models are expected to do better than complex models when predicting market share.

DISAGGREGATION METHODS TO EXPEDITE PRODUCT LINE FORECASTING: FURTHER INVESTIGATIONS

Charles W. Gross and Jeffrey E. Sohl
University of New Hampshire, McConnell Hall, Durham, NH 03824, USA

This paper extends the methodologies presented in previously reported research for generating sales forecasts for individual products within various product lines through the use of disaggregation procedures to the problem of generating disaggregated forecasts within geographical areas. Monthly sales data for two major products were examined for each of the seven geographic areas served by a computer company. Twenty-one different disaggregation schemes were evaluated. Results here confirm our previous findings that disaggregation methods appear useful in certain situations because of workload efficiency at the expense of only modest increases in error.

INTERACTIVE MARKET RESPONSE MODELS: IMPLICATIONS FOR FORECASTING

J. Thomas Yokum
Department of Business Administration, Angelo State University, 1112 Algerita,
San Angelo, TX 76909, USA
Albert R. Wildt
University of Missouri-Columbia, Columbia, MO 65201, USA
Paul Prabhaker
DePaul University, Chicago, IL 60604, USA

Marketing mix interactions are predictor variable combinations influencing market response directly and indirectly. Potential modeling problems include omitted interactions and collinearity.

The research purpose is to compare the forecast accuracy of correctly specified and misspecified interactive market response models. A Monte Carlo analyses is used to focus on the comparison of different variable specifications applied to a true interaction structure, and whether a simpler specified model (i.e., lagged sales) can accurately predict market response. MSE and MAPE are assessed for manipulations in explained variance, price and advertising variance, interaction contribution, sample size, and forecast horizons.

CHAIR: *Robert H. Shumway*
Division of Statistics, University of California, Davis, CA 95616, USA

AUTOMATED PREDICTION, CAUSALITY AND FEEDBACK ANALYSIS FOR MULTIVARIATE TIME SERIES

Wallace E. Larimore
Adaptics, Inc., 40 Fairchild Drive, Redding, MA 01867, USA

Recent results in real-time system identification and adaptive control demonstrate the dramatic achievement of completely automated operation for complex dynamical systems. This paper describes and extends these results to automated time series analysis and forecasting including the determination of "causality," feedback and optimal state space prediction of the future. The approach involves the canonical variate analysis (CVA) method that determines the optimal state space model including the selection of state order for modeling and prediction of a multivariate time series. CVA determines the optimal choice of inputs from a candidate set of input variables for optimal prediction of the outputs. Fast and numerically stable computational methods using the ADAPTx software package give reliable results in minutes on workstations and high end PC computers.

MONITORING FOR OUTLIERS AND LEVEL SHIFTS IN KALMAN FILTER IMPLEMENTATIONS OF EXPONENTIAL SMOOTHING

Nancy J. Kirkendall
Energy Information Administration, EI-70, 1000 Independence Ave., SW, Washington, DC 20585, USA

This paper presents a new application of the Kalman filter implementation of exponential smoothing with monitoring for outliers and level shifts. The assumption is that each observation comes from one of three models: the steady model, the outlier model or the level shift model. This concept was introduced as a multi-process model by Harrison and Stevens (1976). In this paper, four different model selection criteria are introduced and compared by applying them to energy data. The new features of the application include the four model selection criteria and the estimation of the required parameters by maximum likelihood.

FORECASTING WITH INCOMPLETE AND PROVISIONAL DATA

Robert H. Shumway
Division of Statistics, University of California, Davis, CA 95616, USA

We consider the problem of forecasting using incomplete and provisional data collected from both the past and the forecast horizon of a time series. Using a bivariate structural model with correlated measurement errors, we derive minimum mean square error forecasts for provisional and final series containing common trend, seasonal components and correlated measurement errors. We illustrate the technique by using provisional data to forecast ischemic heart disease mortality. This work is joint with M. J. Katzoff of the National Center for Health Statistics.

CHAIR: *Lawrence D. Brown*

Department of Accounting and Law, State University of New York at Buffalo, Buffalo, NY 14260, USA

EARNINGS VARIANCE, PREDICTABILITY, AND CONSENSUS ANALYST FORECAST DISPERSION

Jeffrey S. Abarbanell and William N. Lanen
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This paper examines definitions of earnings predictability and the empirical proxies that have been used to operationalize the concept. The measurement of ex ante earnings predictability is an important issue in the analyst forecast and earnings response coefficient literature. We present a simple model of individual analysts who acquire signals about firm earnings. These signals are comprised of analyst-specific information and information common to all analysts. Consensus forecasts are obtained by aggregating individual analysts' forecasts. The results of our model indicate that the ability of consensus forecasts to reflect ex ante earnings predictability is affected by the composition of earnings signals acquired by analysts. Evidence based on I/B/E/S consensus forecast data indicates that the relation between the standard deviation of analysts' forecasts and other measures of earnings predictability varies cross-sectionally. The results have implications for how empirical measurement based on analysts' forecasts should be used as a proxy for earnings predictability and security risk.

THE ASSOCIATION BETWEEN THE DISPERSION OF ANALYST FORECASTS AND MARKET MEASURES OF UNCERTAINTY

Brad Cornell, John Gould, and Wayne Landsman
Anderson Graduate School of Management, University of California at Los Angeles, Los Angeles, CA 90024, USA

Theoretical measures of risk in asset pricing models are based on agents' ex ante beliefs regarding the probability distribution of future asset returns. Because estimates of ex ante beliefs have been unavailable, empirical measures of risk have been based on the ex post distribution of security returns. Recently, however, the Institutional Broker Estimates System (I/B/E/S) of Lynch, Jones and Ryan has begun to make available data on the forecasts of individual security analysts. These data make it possible to derive estimates of security risk more closely related to ex ante beliefs. This study calculates one such ex ante measure of risk based on the dispersion of analyst forecasts and relates it to both ex post risk measures and security returns. The relation between the ex ante and ex post risk measures is a critical issue for asset pricing theory because if they diverge in general, or in specific periods, then empirical implementations of the models will be misleading.

ACCURACY IMPROVEMENTS FROM A CONSENSUS OF UPDATED INDIVIDUAL ANALYST EARNINGS FORECAST

Scott E. Stickel
The Wharton School, University of Pennsylvania, Philadelphia, PA 19104, USA

This study compares the bias and accuracy of mean consensus earnings forecasts comprised of updated individual analyst forecasts to the bias and accuracy of other frequently cited forecast measures. It is well known that analyst forecast accuracy improves as the forecast horizon shortens. I use a model that updates individual analyst forecasts for information revealed after the forecast date, in effect, shortening the forecast horizon. Any resulting accuracy improvement is of interest to investors, who rely on analysts for earnings forecasts and is relevant to studies that compare the accuracy of analysts forecasts with time series based forecasts and management forecasts. My study adds to the literature on combining forecasts by demonstrating that a mean consensus of updated, chronologically synchronized, individual analysts' forecasts is a less biased and more accurate forecast of actual earnings than other frequently cited forecast measures, including a simple average of chronologically different forecasts.

CHAIR: *Bruce Abramson*

Department of Computer Science, University of Southern California, Los Angeles, CA 90089-0782, USA

MARKET DYNAMICS AND FORECASTING IN ENERGY RESOURCE APPRAISALS

Richard Newcomb
Department of Mining and Geological Engineering, College of Engineering and Mines,
University of Arizona, Tuscon, AZ 85721, USA

The paper examines bias in applications of option pricing to energy resource appraisals. Bias arises when the resource/reserves distinction derived from corporate engineering and geologic information fails to relate the present worth of reserves to variations in economic information, typically marketability data on transportation, other asset prices, market shocks and inefficiencies. Costly errors frequently result in merger and acquisition decisions. Market dynamics are formalized in a spatial-temporal setting made compatible with conventional measures of cyclical and secular trends, then applied in forecasts of regional coal values.

CONCEPTS, METHODS, AND SOFTWARE TOOLS FOR ENERGY ANALYSIS

Robert Hoffman and Bert McInnis
ROBBERT Associates, 34 Hereford Place, Ottawa, Ontario K1Y3S5, Canada

This paper describes an approach to modeling energy systems in terms of concepts, methods, and software tools. The approach was developed in the context of building a large scale simulation model for Canada, the Socio-Economic Resource Framework (SERF). SERF has been used for a variety of energy related analyses including energy conservation and green house gas emissions. The concepts and methods are embodied in a set of software tools developed by ROBBERT Associates for the Macintosh A/UX platform. These tools will be demonstrated using a model that represents energy use in the stock of household appliances in Canada.

THE INABILITY TO FORECAST OIL PRICES

John C. Tobin
2528 Medinah Drive, Evergreen, CO 80439, USA

The auther builds on the analyses and observations of Mr. Ed Capen of Atlantic Richfield and Mr. Charles Bishop of Marathon Oil to develop a probabilistic approach to long-term price forecasting. The author believes that not only is such a form of forecasting sufficient but that it will also lead to more informed, well reasoned investment decisions. The paper covers the following areas that forecasters should consider: (i) Time history of prices over the past 100 years; (ii) A discussion of forecasting since the early 70's; (iii) Technical Commodity analysis; (iv) Fundamentals of supply and demand for energy, and where oil and OPEC fit into this equation; (v) Today's realities of price volatility and the need to use probabilistic forecasts for decision making in the current investment environment. It is with this recognition of uncertainty in any forecast, including prices, that the Decision Maker can best fulfill his fiduciary responsibility to his shareholders, customers, employees, etc.

A BELIEF NETWORK-BASED SYSTEM THAT FORECASTS OIL PRICES

Bruce Abramson

Belief networks are knowledge-based models that combine the rigor of decision analytic elicitation, the mathematical precision of probability theory, and the simulation capabilities of artificial intelligence systems. ARCO1 models the crude oil market as a belief network and uses scenario generation and Monte Carlo analysis to forecast oil prices. Its joint development at ARCO and USC reflects a balance of basic and applied research concerns. This talk will outline the theory underlying a belief network-based system, describe the modeling effort that went into ARCO1, and discuss its protypical implementation as a forecasting tool for the 1990 oil market (both before and during the Gulf crisis).

CHAIR: *David J. Smyth*

Louisiana State University, Department of Economics/2107 CEBA, College of Business Administration, Baton Rouge, LA 70803-6306, USA

THE FORECASTING PERFORMANCE OF A RATIONAL EXPECTATIONS MACROECONOMIC MODEL WITH PARTIAL CURRENT INFORMATION

Kent Matthews
University of Wales, Cardiff Business School, Economics Section, Colum Drive, Cardiff CF1 3EU, Wales
S. Blackman
University of Liverpool, Liverpool, England

All forecasters that employ macroeconomic models face the "ragged edge" problem of having information on endogenous variables that vary according to date. Some endogenous variables are currently observed, such as interest rates, whereas others are observed with a lag. Usually the information on current observables is employed informally or with aid of type 2 residuals. In this paper we describe an algorithm which formally distributes the innovation in the current observable (the difference between a model forecast and currently observed variable), across the behavioral equations in a rational expectations macroeconomic model and assesses its forecast performance.

GOOD BUSINESS CYCLE FORECASTS – A MUST FOR STABILIZATION POLICIES

Lars-Erik Öller
Apollogatan 3C 19, SF-00100 Helsingfors, Finland

Macroeconomic stabilization policies imply expansionary government budgets in recessions and contractive fiscal policy when the economy gets overheated. This strategy has been criticized both from a theoretical and a practical point of view, the latter being that macroeconomic forecasts are too inaccurate. Data from Sweden and Finland compare accuracy of government forecasts with fiscal policy.

MEASUREMENT ERRORS IN SURVEY FORECASTS OF EXPECTED INFLATION AND THE RATIONALITY OF INFLATION EXPECTATIONS

David J. Smyth
Louisiana State University, Department of Economics/2107 CEBA, College of Business Administration, Baton Rouge, LA 70803-6306, USA

Studies that use survey data to test the rationality of inflationary expectations usually test for unbiasedness by regressing actual inflation on expected inflation and testing the joint hypothesis that the intercept is zero and the slope coefficient is one. Such studies are fatally flawed because they incorrectly assume that expected inflation is measured without error. A procedure that allows for the influence of observation errors in expected inflation is developed and applied to the Michigan Survey Research Center data. Contrary to some recent studies, rationality is rejected.

CHAIR: *J. Scott Armstrong*
The Wharton School, University of Pennsylvania, Philadelphia, PA 19104, USA

SPONSORING FORECASTING RESEARCH
[Presented by title only]

Robert Fildes
Department of Operational Research and Operations Management, School of Management, University of Lancaster, Lancaster, England LAI 4YX, UK

Most of the research related to forecasting comes from disciplines of econometrics and statistics. It is published in journals whose primary interest is in developing new techniques rather than producing effective forecasts. In contrast, most of the public interest in forecasting derives from the forecasts themselves. Many journals such as *Futures* concentrate on the results of a primarily judgemental forecasting process. Between these two extremes there is a large chasm into which many an important forecasting problem falls without trace. In this panel discussion a number of distinguished editors representing the spectrum of forecasting journals comment on what they believe to be the important research problems in forecasting and how journals and authors might contribute to their solution.

Other panelists include:

Derek Bunn

The London Business School, Sussex Place, Regent's Park, London NW1 4SA, UK

Harold Linstone

Portland State University, P.O. Box 751, Portland, OR 92707, USA

CHAIR: *Neal C. Stolleman*
Bellecore, Room 3D 206, 290 West Mt. Pleasant Avenue, Livingston, NJ 07039, USA

FORECASTING THE OPTIMUM PRICE FOR CAPITAL EQUIPMENT PRODUCTS

Thomas R. Calkins
Forecasting & Pricing Associates, 108 Mayapple Road, Stamford, CT 06903, USA

To provide the maximum benefit for a business, the forecasting function must not only predict unit sales, it must estimate the combination of price and resulting unit sales that will optimize the financial contribution of a product. A number of parameters are used to describe the marketing environment and represent judgments on eight factors that affect the price sensitivity of a product. These parameters are input to a reverse Weibull distribution model that calculates, prints and/or graphically displays unit sales by price, price sensitivities and an optimum price based on judgments provided. A short introduction to price sensitivity analysis is presented to facilitate an understanding of how the model works.

THE MYSTERIOUS MIX EFFECT

Sigfrido Lichtenthal
11 Westminster Road, Scarsdale, NY 10583-2423, USA

Is it possible to project a gain of market share in every one of ten geographical areas, and still lose in the aggregate? The answer is a resounding YES. This and other unexpected results may occur as a consequence of hard-to-visualize changes in the relative weight (mix) of components.

The paper describes RATIAN (Ratio Analyst), a computer tool which relates composite ratios of growth rates, and separates intrinsic variances from those due to mix change. Typical RATIAN analyses examine market share, sales productivity, E/R, unit cost, etc.; comparisons may match plan to actual, period-to-period, etc.

INTERTEMPORAL PRICING FOR A NEW SERVICE

Neal C. Stolleman
Bellecore, Room 3D 206, 290 West Mt. Pleasant Avenue, Livingston, NJ 07039, USA

This paper discusses some theoretical issues associated with pricing a new service characterized by externalities. In this model, consumers must pay both a monthly recurring charge (P) for the service as well as a one time non-recurring charge (NRC) for installation, thus introducing friction into the consumer decision process. First order conditions for profit maximizing price trajectories for both continuous and discrete model frameworks are derived. Results depend in part on how the rate of accumulation of the customer stock is retarded by P and NRC, and how such deceleration is moderated by externality effects, i.e., whether externality effects are skewed with respect to price elements. A quantitative simulation model is developed which uses hypothetical demand and cost data to illustrate the effects of length of consumer planning horizons, expectations and externalities on the time path of prices, profitability and market size.

CHAIRS: *Richard De Roeck and Essam Mahmoud*

Richard De Roeck
General Motors Corporation, Detroit, MI 48202, USA
Essam Mahmoud
American Graduate School of International Management (Thunderbird), Department of World Business, Glendale, AZ 85306, USA

Many members of the International Institute of Forecasters believe that there exists a communication gap between researchers and practitioners. Most members of the Institute work in universities while few members are associated with business and other organizations where, presumably, most of the forecasting activity takes place. Last summer, at the Delphi conference in Greece, much dialogue took place in a very informal atmosphere. A significant majority of those who attended at Delphi agree that we all derived considerable benefit from this dialogue. These roundtable discussions represent an attempt to reproduce some of that Delphi spirit.

A roundtable discussion will be held on each of the three days of the conference in the pre-lunch session. There will be no formal agenda. Forecasting in all of its aspects will be the only topic of conversation. Several Delphi participants will be on hand to help things move along if needed.

In order to maximize dialogue, attendance will be limited to 25 people.

PLEASE PREREGISTER AT THE MAIN DESK.

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

FORECASTING PRISON POPULATION WHEN CAPACITY IS LIMITED

Pamela K. Lattimore
U.S. Department of Justice, 633 Indiana Avenue, NW, Washington, D.C. 20531, USA
Joanna R. Baker
Virginia Polytechnic Institute & State University, Blacksburg, VA 24061, USA

Currently, most U.S. prison systems are operating above capacity. The short-run solution to this problem has been the early release of prisoners, often accompanied by large-scale prison construction and the development of a variety of prison-diversion programs. In the long-run, the development of accurate forecasts of demand for prison beds is needed to assure that adequate prison capacity is available. This paper presents a prison population projection model that extends previous efforts by explicitly considering the effects of capacity and recidivism – the propensity of individuals to return to prison following release – on time served and future commitments.

FORECASTING CRIMINAL SENTENCING DECISIONS: AN ECONOMETRIC APPROACH

Duncan I. Simester
Massachusetts Institute of Technology, MIT, USA
Roderick J. Brodie
University of Auckland, Private Bag, Auckland, New Zealand

Forecasting outcomes of criminal sentence decisions has traditionally relied on subjective judgment. This paper demonstrates how a quantitative approach can be used to successfully forecast the length of criminal sentences and the success of appealing against criminal sentences. Data was collected from decisions of the New Zealand Court of Appeal for a set of cases related to sexual offenses. A regression model was fitted which the dependent variable was the length of sentence, and the explanatory variables were measures of the nature of the offense and offender. The estimated model was plausible and out performed equal weights and naive models when it was used to forecast over a hold out sample. A probit model using the disparity between actual and forecast sentence length was used to forecast the success of appealing against sentences.

MODELING AND FORECASTING U.S. MORTALITY: DIFFERENTIALS IN LIFE EXPECTANCIES BY SEX

Lawrence R. Carter
Department of Sociology, University of Oregon, Eugene, OR 97403, USA
Ronald D. Lee
Graduate Group in Demography, University of California at Berkeley, Berkeley, CA 94720, USA

This paper examines forecasted differentials in age-sex-specific mortality in the United States, 1990 to 2065. A nonlinear model, $m(x,t) = a(x)b(x)k(t)$, for each sex is fitted to a matrix of age-specific U.S. 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 to 2065. Preliminary results show male and female e(0)s of 82 and 89.2 respectively by 2065, a difference of 7.2 years. These forecasts are substantially higher with narrower confidence intervals than those prepared regularly by the Actuary of the Social Security Administration.

CHAIR: *Richard A. Highfield*
Cornell University, Johnson Graduate School of Management, Ithaca, NY 14850, USA

FORECASTING EXCHANGE RATES: AN EVALUATION OF MULTIVARIATE TIME SERIES MODELS

Mary E. Gerlow, Scott Irwin and Te-Ru Liu
Department of Ag Economics, Ohio State University, 2120 Fyffe Road, Columbus, OH 43210, USA

Full, mixed, naive Bayesian, and general Bayesian VAR models are developed and used to forecast the dollar/yen, dollar/Canadian dollar, and dollar/German mark exchange rates. Based on criteria of rationality, statistical accuracy, and market timing ability, out-of-sample forecasts are evaluated. The results indicate that all of the VAR models provide rational forecasts across one and three month forecasting horizons. Further, the naive Bayesian VAR model significantly outperforms the random walk model in forecasting the dollar/yen rate and has market timing ability in forecasting the dollar/Canadian dollar rate.

MULTIVARIATE FORECASTING WITH BAYESIAN AND SYSTEM-THEORETIC MODELS

Richard A. Highfield
Cornell University, Johnson Graduate School of Management, Ithaca, NY 14850, USA

Many methods exist for the implementation of multivariate forecasting models for economic time series, but the specification of these models is difficult in the absence of an explicit theory relating the variables. Bayesian vector autoregression and minimal realization state space models represent two approaches to the trade-off between "letting the data do the talking" and the imposition of a parsimonious structure to allow for efficient parameter estimation. This paper examines the relationship between these two approaches and presents a method that combines elements of both. The proposed method is illustrated in an example using macroeconomic data.

CHAIR: *H. O. Stekler*
Industrial College of The Armed Forces, National Defense University, Washington, DC 20319-6000, USA

FORECASTING THE IMPLICATIONS OF DEFENSE SPENDING

George F. Brown, Jr.
DRI/McGraw-Hill, 24 Hartwell Avenue, Lexington, MA 02173, USA

The rapid growth of defense spending during the 1980s and the accompanying shift in its composition spotlighted the importance of understanding the impacts of defense on the economy and industrial performance. DoD needed to understand production capacity, technology relationships, and cost pressures in order to define and implement a cost-effective acquisition plan. Government and private sector executives needed to understand the opportunities and problems implied for various industrial sectors, occupational groups, and regions of the country. And all parties faced ongoing questions about the implications of defense spending on the Federal deficit, on international competitiveness, and on long-term economic progress.

The forecasting technologies developed during the 1980s have provided a clear and consistent ability to study defense and the economy. New models and data bases have been developed to provide accurate assessments of the implications of proposed shifts in the level or composition of defense spending along very detailed dimensions. Assessments can be made, as well, of the implications of external events on the defense sectors. The ability to make well-founded decisions, by government and business executives alike, has been significantly strengthened.

With defense decisions entering a new, and highly different, era in the 1990s, the forecasting capabilities developed during the 1980s retain considerable importance. The lessons learned over the past decade, about both the process of defense forecasting and the linkages of defense to components of the economy, will be examined in this presentation. The particular emphasis will be on those implications expected to be of greatest importance in the 1990s.

George F. Brown, Jr. is a nationally recognized expert in the field of defense economics, and has served as an advisor and consultant to numerous Department of Defense and defense industry organizations. He has spoken and published frequently on topics related to defense economics and on the related areas of government fiscal policy and industry profitability. Dr. Brown's efforts have included assessments of the implications of major national policy developments such as the Reagan Administration's defense plans and the Gramm-Rudman amendment, as well as detailed examinations of various weapons programs and industrial sectors.

He assumed his present position as Chief Executive at DRI/McGraw-Hill in 1985, having previously headed its Government and Health Practices. Prior to joining DRI, Dr. Brown held the Roosevelt Chair in Economics at the U.S. Naval War College from 1973 to 1979 and served as a Study Director at the Center for Naval Analyses from 1969 to 1973. He has a B.S. in Administration and Management Science, an M.S. in Industrial Administration, and a Ph.D. in Economics from Carnegie-Mellon University.

CHAIR: *Sergio G. Koreisha*
University of Oregon, Eugene, OR 97403, USA

FORECASTING THE STOCK MARKET CONSIDERATION OF NEW TECHNIQUES

Clive W. J. Granger
Center for Econometric Analysis, Department of Economics, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0508, USA

The venerable efficient market theory has recently been under attack as a variety of new approaches and techniques have produced promising results for forecasting the means and variances of returns. Although cointegration and chaos models do not seem to be helpful, disaggregation, the use of causal variables over the long-run and threshold autoregressive models with switching based on volatility all appear to provide relevant forecasts. The use of neural network models in conjunction with the present value theory will also be discussed.

Clive Granger obtained his Ph.D. in Statistics from the University of Nottingham in 1959 and spent the following year on a Harkness Fellowship at Princeton University working on spectral analysis. He subsequently became Professor of Applied Statistics and Econometrics at Nottingham, and in 1974 moved to the University of California at San Diego to become Professor of Economics. He has published several books and over a hundred articles on forecasting, speculative markets, econometrics, time series analysis and pricing. His best known work is on a definition of causality and on cointegration. He is a fellow of the Econometric Society and has held a Guggenheim Fellowship.

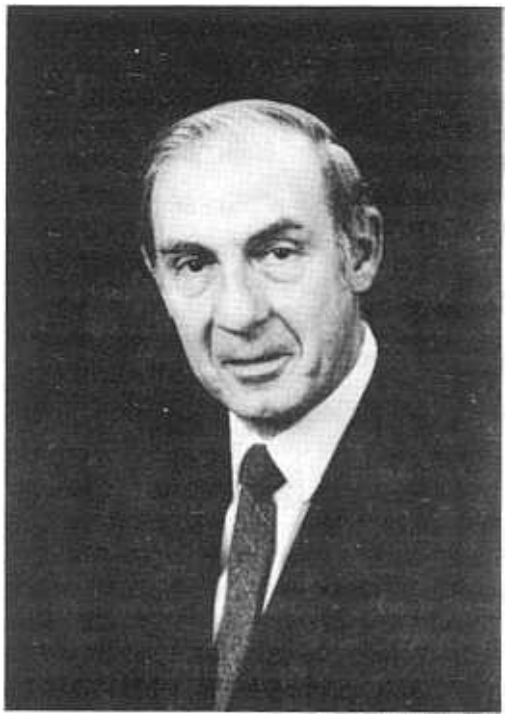
CHAIR: ***Estela Bee Dagum***

Statistics Canada, Seasonal Adjustment, 13-K, R. H. Coats Building, Ottawa, Ontario, Canada, K1A 0T6

PROSPECTS FOR THE U.S. ECONOMY

Dr. Lyle E. Gramley

Mortgage Bankers Association of America, 1125 15th Street NW, Washington, D.C. 20005-2766, USA



Lyle E. Gramley is the Senior Staff Vice President and Chief Economist of the Mortgage Bankers Association of America (MBA). His responsibilities include supervising a staff of economists and directing economic analyses, surveys, forecasts, and reports in the areas of real estate finance, new mortgage instruments, legislative and regulatory proposals, and industry trends. He joined MBA in September 1985.

Previously, Gramley was one of the seven Governors of the Federal Reserve Board. Prior to that, he was a member of the President's Council of Economic Advisers.

Born in Aurora, Illinois, Gramley was educated at Aurora University and Beloit College, where he received a B.A. in 1951. He performed his graduate work at Indiana University, where he received an M.A. in 1952 and a Ph.D. in Economics in 1956. He was awarded the distinguished Alumni Service Award from Indiana University, the Outstanding Alumni Award from Aurora University, and received honorary doctor of law degrees from Indiana University and Beloit College.

CHAIR: *Russell P. Robins*

A. B. Freeman School of Business, Tulane University, New Orleans, LA 70118, USA

FORECASTING QUARTERLY DATA USING MONTHLY INFORMATION

Peter Rathjens
Economics Department, Brandeis university, Waltham, MA 02254, USA
Russell P. Robins
A. B. Freeman School of Business, Tulane University, New Orleans, LA 70118, USA

There are occasions when researchers are interested in quarterly forecasts of variables that are released at higher frequencies. In these situations, it is common for researchers to convert from the higher frequency to the lower frequency by some method, such as averaging or stock-end, and then to model the low frequency data. This paper shows how to improve quarterly forecasts by using within quarter variations of monthly data. We compare the one-step-ahead forecasts for real GNP generated using our approach with those of Fair and Shiller (1990). Our model is extremely simple and yet produces a lower RMSE than any model in Fair and Shiller (1990).

IMPROVED CURRENT QUARTER FORECASTS

Peter Rathjens
Economics Department, Brandeis University, Waltham, MA 02254, USA
Russell P. Robins
A. B. Freeman School of Business, Tulane University, New Orleans, LA 70118, USA

The systematic use of monthly information in a simple time-series model for forecasting quarterly GNP can lead to dramatic improvements over the forecasts from time-series models which employ only quarterly data. Moreover, the use of these monthly data allows the time-series model to dominate the forecasts from most of the large scale macroeconomic models for mid-quarter forecasts.

FORECASTING REGIONAL EMPLOYMENT BY SECTOR: A BOTTOM-UP TRANSFER FUNCTION MODELING APPROACH

Barry R. Weller and James A. Kurre
Penn State-Erie, Behrend School of Business, Station Road, Erie, PA 16563-1400, USA

This paper demonstrates the usefulness of a multi-equation transfer function modeling approach in generating regional employment forecasts by sector. The modeling approach is bottom-up, with transfer function models being developed to generate employment forecasts for various sub-sectors of the regional economy while accounting identities provide the forecasts for major sectoral aggregates, the latter including total regional employment, manufacturing employment, durable manufacturing employment, non-durable manufacturing employment, non-manufacturing employment. Ex-post forecast accuracy of the model is extensively evaluated. Forecast horizons range from one month to twelve months ahead while the ex-post forecast intervals span periods of widely varying degress of instability.

CHAIR: **Betty J. Flehinger**
Department of Mathematical Sciences, IBM Research Division, Yorktown Heights, NY 10598, USA

A CASE STUDY OF PRACTICAL APPLICATION OF FORECASTING AND QUANTITATIVE TECHNIQUES IN FIXED INCOME PORTFOLIO MANAGEMENT

Jae Park
IBM Credit Corporation, Stamford, CT 06903, USA

Asset/Liability management, where assets are mortgages; liabilities are bonds and bonds with call options.

- Prepayment risk management
- Interest rate risk management
- Maximizing profit, measurement of profit
- Minimizing market value fluctuations
- Investment criteria

MORTGAGE PREPAYMENT MODELING

John E. Kolassa
IBM Research Division, Yorktown Heights, NY 10598, USA

Fixed-income securities are securities giving the owner the right to an income stream fixed in advance. When these securities are issued or insured by an institution with a negligible risk of default, they appear to be entirely safe investments. This, however, is not the case, Many fixed income securities allow the issuer to buy back the security if such a policy becomes advisable in the future. This may take the form of a call option on a bond, or the refinancing option on a mortgage.

This talk will describe efforts to model mortgage prepayment behavior for a certain class of home mortgages, when the underlying data are the prepayment histories of the individual mortgages.

VALUATION OF MORTGAGE BACKED SECURITIES

Scott F. Richard
Goldman, Sachs & Co., New York, NY 10004, USA

Mortgage-backed securities are claims to the cash flows from large pools of single-family mortgages. Homeowners retain the option to prepay their mortgages at any time. Hence the owner of a mortgage-backed security cannot be certain of either the timing or amount of future cash flows. In order to value these securities we must simulate the path of future interest rates and conditional on this path, the future cash flows. We forecast the future path of interest rates using the market's forecasts implicit in the current term-structure of interest rates and we forecast the mortgage cash flows using an economic model of household prepayment behavior.

CHAIR: *Leonard J. Tashman*
University of Vermont, Burlington, VT 05401, USA

AUTOMATIC PROCEDURE FOR THE CONSTRUCTION AND USE OF ARIMA MODELS WITH INTERVENTION ANALYSIS

Antoni Espasa
Universidad Carlos III, Madrid 126, 28903 Getafe (Madrid), España

This paper presents an automatic procedure to determine univariate ARIMA models with intervention analysis for sets of series. The method developed fits into the Box-Jenkins iterative modelling strategy for initial specification, estimation, and validation. The selection between a model with an autoregressive component and a model with only moving averages factors is made by means of a non-parametric test based on the correlogram median. The procedure has been applied in the construction of models for 350 Spanish economic series about production, prices, wages, etc., and the paper summarizes the main features of the models obtained.

AUTOMATIC TIME SERIES FORECASTING THE DEVELOPMENT OF FUTURETECH SOFTWARE

Manfred Krautschneider
Monash University, Mathematics Department, P.O. Box 197, Caulfield East, Victoria 3145, Australia

We report on development of a new automatic business forecasting system for personal computers. It was the aim of this project to make SARIMA modelling available for commercial decision making by non-expert users. It includes both time and frequency domain analysis and pattern recognition elements. Integration of these into an expert system for automatic forecasting proved valuable. Data and rules as well as prior forecasting decisions and results are automatically maintainted. FUTURETECH is IBM SAA compliant, and takes advantage of multi-tasking and graphical user interface features of OS/2.

AUTOMATIC FORECASTING OF INPUT VARIABLES IN AN EXPLANATORY MODEL: SOME ISSUES AND LESSONS

Leonard J. Tashman
University of Vermont, Burlington, VT 05401, USA

Recent studies by Richard Ashley and others have made us wonder all the more about the efficacy of explanatory forecasting models, due to the imprecision with which the inputs (explanatory variables) themselves can be forecast. One study, for example, found evidence that *unconditional forecasts* via a single-input transfer function model had higher post-sample MAPES than could be produced from a univariate ARIMA model. Our research further explores the consequences for explanatory models of errors in forecasting input variables. Specifically, we analyze situations in which input variables are forecast by automatic forecasting algorithms.

CHAIR: *Roman Krzysztofowicz*
University of Virgina, Charlottesville, VA 22901, USA

MULTIPLE PREDICTION INTERVALS FOR TIME SERIES: COMPARISON OF SIMULTANEOUS AND MARGINAL INTERVALS

N. Ravishanker
University of Connecticut, Department of Liberal Arts, Department of Statistics, U-120, MSB 428, 196 Auditorium Road, Storrs, CT 06269-3120, USA
Lilian Shiao-Yen Wu
IBM Research Division, T. J. Watson Research Center, Yorktown Heights, NY 10598, USA

Simultaneous prediction intervals for forecasts from time series models that contain L (L = 1) unknown future observations with a specified probability will be discussed and compared with the L marginal intervals. These intervals are based on two types of probability inequalities, viz., the Bonferroni-type and the product-type inequalities. They differ from the marginal intervals in that they take into account the correlation structure between the forecast errors. We discuss the construction of these simultaneous intervals for commonly used forecasting methods based on model based and empirical correlations. For both methods, the simultaneous intervals are accurate, whereas the marginal intervals are far too short.

THE N-STATISTICAL TABLES

N.N.N. Nsowah-Nuamah
University of Ghana, Department of Statistics, P.O. Box 115, Legon, Ghana

The N-Statistical Tables have been prepared to form the basis for our conclusions about the forecast value as a whole namely, the construction of interval forecasts. Twenty-one trend models have been considered. However, they have been regrouped into eight in accordance with the form in which a particular trend function, μ (t), is assumed in the time series. Interval forecasts for transformed models have also been considered.

A COMPARISON OF ADAPTIVE METHODS OF EXPONENTIAL SMOOTHING

Jochen Schwarze
Universität Hannover, Wirtschaftsinformatik, Wunstorfor Strabe 14, D-3000 Hannover 91, Germany

The paper presents the results of a comparison of 6 methods of exponential smoothing with automatic adaption of the smoothing parameter: SMITH, TRIGG & LEACH, D'AMICO, VAN DOBBEN DE BRUYN, CHOW, WHYBARK. Different types of time series (generated by simulation) have been used. The results (forecasting accuracy with respect to parameters of the forecasting models) have been analyzed by the use of different errors.

BAYESIAN CORRELATION SCORE: A UTILITARIAN MEASURE OF FORECAST SKILL

Roman Krzysztofowicz
University of Virgina, Charlottesville, VA 22901, USA

From the theory of sufficient comparison of experiments, a measure of skill is derived for categorical forecasts of continuous predictands. Called Bayesian correlation score (BCS), the measure combines information from two sources: a prior record of the predictand and a verification record of forecasts. Three properties characterize the BCS: (1) it is meaningful for comparing forecasts of the same as well as different predictands, (2) it is interpretable as correlation between the forecast and the predictand, and, most significantly, (3) it orders alternative forecast systems consistently with their *ex ante* economic values to rational decision makers (those who maximize the expected utility).

CHAIR: *Dennis J. Mazur*

Department of Veterans Affairs Medical Center; Department of Medicine, Biomedical Information Communication Center, Oregon Health Sciences University, Portland, OR 97207, USA

INFORMATION AND THE ACCURACY OF JUDGMENTAL FORECASTS

Thomas Stewart
Center for Policy Research, State University of New York, Albany, NY 12222, USA
William R. Moninger
National Oceanic and Atmospheric Administration, Boulder, CO 80303, USA
Kenneth F. Heideman
Geophysics Laboratory Hanscom AFB, MA 01731, USA
Patricia Reagan-Cirincione
State University of New York, Albany, New York, 12222, USA

This study investigated the relation between the amount and type of information available to forecasters and their accuracy in a situation characterized by a high degree of complexity and uncertainty. Meteorologists, including both experienced forecasters and students made forecasts of severe weather under different information conditions. In one condition, forecasts were based on an extensive amount of data similar to that available to operational forecasters. Under another condition, meteorologists saw only maps of storm contours and numerical reports of a small class of weather conditions. Components of forecasting skill are compared among information conditions and implications for judgmental forecasting are discussed.

PROFESSIONAL AND CLIENT INTERPRETATIONS OF PROBABILITY TERMS IN FORECASTING MEDICAL EVENTS

Dennis J. Mazur and David H. Hickam
Department of Veterans Affairs Medical Center; Department of Medicine, Biomedical Information Communication Center, Oregon Health Sciences University, Portland, OR 97207, USA

How professionals and clients interpret terms connoting chance or likelihood of risky outcome occurrence is key to optimal communication about risk and benefit in verbal dialogues and written contracts involving forecasting of future events. This study analyzes variation in patient and physician interpretations of numerical meanings of verbal expressions of probability used in advance directives, informed consent, and human subjects research protocols. This study further suggests ways to optimize patient-physician communication about chance in forecasting medical events.

CONDITIONS FAVORING THE DECOMPOSITION OF JUDGMENT IN SITUATIONS WITH NO DATA

J. Scott Armstrong
The Wharton School, University of Pennsylvania, Philadelphia, PA 19104, USA
Donald MacGregor
Decision Research, 1201 Oak Street, Eugene, OR 97401, USA

Decomposition produced large improvement in accuracy over global estimates when the numbers were large and where uncertainty was high. When neither of these conditions held, decomposition produced less accurate results than the global assessment.

CHAIR: *Paul J. Fields*

Department of Management Science, The Smeal College of Business Administration,
The Pennsylvania State University, University Park, PA 16802, USA

A FORECASTING PROCEDURE FOR INVENTORY ITEMS WITH AN ERRATIC BEHAVIOR

Michel Vachon
Department of Administrative Sciences, Collège militaire royal de Saint-Jean, Richelain,
Quebéc JOJ 1RO, Canada

A sample of 4461 series of the Canadian Forces Supply Services data bank are analyzed to develop a recognition pattern and forecasting technique selection algorithm based on volume of consumption on the last year of data and minimum cumulative forecasting error on that year. Several forecasting techniques that perform well in the environment are tried to result in a final set of 7 techniques. They are all based either on a naive forecast or exponential smoothing principle. The concept of combination of forecast was also looked at and proved successful on series with a minimum yearly volume of 12 units. Aggregation was tried and proved successful only when the 4461 series were aggregated to 197.

FORECASTING APPLICATIONS USING ADVANCE ORDERS

Martin Selzer
AT&T Network Systems, 15th Floor, Two Gateway Center, Newark, NJ 07102, USA

In many industries, the number of orders placed in advance provides information to predict total final orders. Three models which use known hard orders for a future period are derived. The first model estimates regression weights to give a point forecast and confidence intervals for total final orders from advance orders. The second model estimates Binomial and Beta distribution parameters to evaluate if sales targets will be reached based on advance orders. The third model combines the first two to give a recovery plan if forecasts suggest actual orders will fall below targets. Data from AT&T Network Systems is evaluated to analyze results.

FORECASTING DEMAND FOR PERISHABLE GOODS

Paul J. Fields and J. Keith Ord
Department of Management Science, The Smeal College of Business Administration,
The Pennsylvania State University, University Park, PA 16802, USA

For a sales forecast to be useful in managing a business the standard deviation of forecast errors must be small relative to the firm's profit margin. This is especially true in a business involving perishable goods.

This paper presents a comparison of various techniques for forecasting demand in a bakery. A two-stage method is introduced which combines the demand forecast for an entire day with the intra-day sales pattern. The standard deviation of forecast errors using the two-stage method is shown to be within the realm of usefulness for business decisions.

CHAIR: *Charles W. Chase, Jr.*
Director, Forecasting, Johnson & Johnson CPI, Grandview Road, Skillman NJ 08558-9418, USA

HOW TO TURN FRUSTRATIONS INTO A CHALLENGE IN THE FORECASTING PROFESSION

Chaman L. Jain
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As in any other profession forecasters have their share of frustrations. New product managers do not want realistic forecasts, but ones that meet their expectations. Forecasts, the forecaster tries so hard to improve, are not used. Managers (users of forecasts) often remember the cases of bad forecasts and not the good ones. If they do appreciate good forecasts, it takes them a long time to show it. One cannot move too far up the corporate ladder in this profession. Managers don't understand that forecasts are often wrong because of their own doing. They change the assumptions in the middle of the forecasting period. These changes are some of the things which frustrate the forecaster. The objective of this paper is to discuss what frustrations the forecasters have and what can be done about them.

POLITICS OF FORECASTING IN THE TELECOMMUNICATION INDUSTRY

Charles S. Frary, III
Managing Director—Marketing Services, New England Telephone Company, 265 Franklin Street, 3rd Floor, Boston, MA 02110, USA

Forecasts for telecommunications services today depend in part on marketing and sales plans, initiatives of competitors, and changing perceptions of customers as to their own needs. These factors add to traditional demand drivers of the former monopoly world and necessarily involve the interests of departmental groups within the telephone company in actual market performance compared to the forecast. Competitive pressures also make financial results ever more dependent on accurately anticipating business growth in a cost reduction environment. Forecasters today must possess a high degree of political savvy in building *credibility* in the forecast and the forecaster as perceived by forecast clients who themselves live in a more politically-charged environment than ever before.

THE AFFECTS OF CORPORATE POLITICS ON BUSINESS FORECASTING

Charles W. Chase, Jr.
Johnson & Johnson, CPI, Grandview Road, Skillman NJ 08558-9418, USA

Politically speaking, the main purpose of thie paper is to highlight the corporate misunderstanding of the methodologies employed by business forecasters. In many cases the forecasts we take great care to develop become numbers that are manipulated for purposes of self enhancement. Forecasting is a quest for truth, and a forecast should not be arbitrarily altered in order to serve the needs of a manager's expectations. As business forecasters we must arm ourselves with the statistical findings, and take a position that will allow the company's resources to be used effectively. In such cases, we must accelerate our resolve, and let the results of our labors speak for themselves.

CHAIR: *Janet A. Sniezek*
University of Illinois at Urbana-Champaign, Department of Psychology, 603 East Daniel, Champaign, IL 61820, USA

ECONOMIC EFFECTS OF INFORMATION TECHNOLOGIES HOUSEHOLD WORK IN THE YEAR 2000

Gisela Frerk
GMD (German National Research Center for Computer Sciences), Schoenhauser Str. 64, 5000 Cologne 51, Germany

The new forms of information technologies household work appears to be particularly feasible in the fields of electronic self-service, electronic information supply, teletalk and house-automatization. They affect the organization and content of domestic work and yield a variety of saving effects.

The use of new information technologies as a labor saving device involves reductions in transaction costs by saving in time and money as well as greater flexibilization in and improvements in certain household activities.

Under economic aspects we have to examine the value added, fiscal and allocative effects of using IT in private households.

CULTURALLY BASED DIFFERENCES IN DELPHI METHOD RESPONSE PATTERNS

Amitabh Chandra
Seton Hall University, Department of Computing & Decision Sciences, USA
George Heitmann
Department of Management Science, The Smeal College of Business Administration, The Pennsylvania State University, University Park, PA 16802, USA

This paper reports on results noted in several illustrative uses of the Delphi method with participants having different cultural/experiential backgrounds. In particular, the influence of cultural differences in second round convergence patterns and the assessment of uncertainty is examined.

EFFECTS OF SOCIAL AND INDIVIDUAL VARIABLES ON FORECAST ACCURACY AND CONFIDENCE

Timothy Buckley
Janet A. Sniezek
University of Illinois at Urbana-Champaign, Department of Psychology, 603 East Daniel, Champaign, IL 61820, USA

This paper reports a field experiment in which the format for producing forecasts was manipulated. Volunteers were recruited just prior to a Big Ten football game and given a brief form requesting forecasts of various aspects of the game's outcome (e.g., team point totals). Forecasts were made with three formats: independent individuals, and two forms of groups of size three (Consensus – all discuss until reach agreement and Judge-Adviser – advisers independently complete forms and given them to the Judge for final answers). Forecast accuracy and confidence are explained as a function of decision format, and social and motivational processes.

CHAIR: *Sergio G. Koreisha*
University of Oregon, Eugene, OR 97403, USA

USING PRINCIPAL COMPONENTS IN TIME SERIES FORECASTING OF DEMOGRAPHIC RATES

William R. Bell and Brian C. Monsell
Statistical Research Division, U.S. Bureau of the Census, Federal Office Building 3, Washington, D.C. 20233, USA

Population projections typically involve forecasting age-specific fertility and mortality rates, thus creating forecasting problems of high dimension. Bozik and Bell (1987) developed an approach to forecasting age-specific fertility rates using principal components. This approach reduces the dimension of the forecasting problem by producing a small number of principal component time series that can be modeled and forecast to produce forecasts of age-specific fertility. The present paper reviews this work and extends it to time series modeling and forecasting age-specific mortality rates. We apply this methodology to time series of U.S. white fertility rates by single years of age and to white male and female mortality rates by (mostly) 5-year age groups. We examine the quality of the principal components approximation for varying numbers of components, and develop a multivariate time series model for the full set of principal component time series. We then use this model to produce point and interval forecasts of age-specific fertility and mortality.

FORECAST CONFIDENCE INTERVALS FROM VAR MODELS

Richard G. Sheehan
University of Notre Dame, College of Business Administration, Notre Dame, IN 46556, USA

Relatively few macroeconomic forecasting efforts present the confidence intervals associated with those forecasts. The Federal Reserve Bank of Minneapolis, however, has adopted the policy of presenting the confidence intervals of their forecasts. Their forecasts are based on vector autoregressive (VAR) models and their confidence intervals are simulated rather than derived analytically. Unfortunately, their confidence intervals frequently are so wide that no significance can be attached to their forecasts. The issue discussed in this paper is whether VAR forecasts necessarily have wide confidence intervals. This paper asks whether different lag length selection procedures also yield different width confidence intervals. My results are based on two types of experiments. First, I undertake an extensive set of Monte Carlo experiments. The second experiment uses actual macro data for real GNP, inflation money growth and an interest rate. The results using the Monte Carlo generated data as well as actual macro data indicate that the answer to the above question do different lag length selection procedures yield different width confidence intervals, is unambiguously yes. While somewhat narrower macro forecast confidence intervals can be obtained than have been published previously, macro confidence intervals remain distressingly wide.

DETERMINING THE ORDER OF A VECTOR AUTOREGRESSION WHEN THE NUMBER OF COMPONENT SERIES IS LARGE

Sergio G. Koreisha
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Tarmo Pukkila
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In this article we contrast the performance of several methods used for identifying the order of vector autoregressive (VAR) processes when the number of component series K is large. Through simulation experiments we show that their performance is dependent on K, the number of nonzero elements in the polynomial matrices of the VAR parameters, and on the permitted upper limit of the order used in testing the autoregressive structure. In addition we also introduce a new quite powerful order determination criterion.

CHAIR: *Bonnie Ray*
IBM Watson Research Center, Yorktown Heights, NY 10598, USA

FORECASTING WITH LONG-MEMORY MODELS

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

Fractional differenced ARMA models (FARMA) were introduced by Granger and Joyeux (1980) and Hoskings (1981). They provide a discrete time approach to the analysis of time series that present long-range dependence. Applications of FARMA models to the analysis of macroeconomic time series provide some indication that these models could also be useful in long-range forecasting. We present some empirical results and review previous applications, questioning the applications, questioning the applicability of FARMA for practical forecasting purposes.

FRACTIONAL MODELING AND FORECASTING OF SODA ASH SALES

N. Singh
Monash University, Clayton, Melbourne Victoria, 3168, Australia
Harry J. Gielewski
Shell Company, Melbourne, Australia
Manmohan Singh
Swinburne Institute of Technology, Melbourne, Australia

The purpose of this study was to fit representative autoregressive integrated moving average (ARIMA) models to the bulk sales quantity (TNE) of soda ash in various States of Australia so as to make reliable forecasts. Interestingly enough, the fractional ARIMA models were found to be better representative models to the sale values for more than fifty percent of the States.

Various existing methods for estimating d are summarized with a view to comparing their merits and demerits. In view of the limitations of the existing methods, a heuristic approach for estimating d is suggested. Absolute forecast error percentages are obtained for each State.

LONG-RANGE FORECASTING OF IBM PRODUCT REVENUES USING FRACTIONALLY DIFFERENCED SEASONAL ARMA MODELS

Bonnie Ray
IBM Watson Research Center, Yorktown Heights, NY 10598, USA

We use a series of IBM product revenues to illustrate the usefulness of fractionally differenced seasonal ARMA models for business forecasting. By allowing two seasonal fractional differencing parameters in the model, one at lag three and the other at lag twelve, we obtain a stationary series without losing information about the quarterly and annual process behavior through over-differencing. We apply modified identification and estimation techniques to the IBM revenue data and compare the resulting model to a specific non-fractional seasonal ARMA model by looking at each model's forecasts. The fractionally differenced seasonal model gives more accurate next-quarter, next-half-year, and next-year forecasts than the non-fractional seasonal model based on criteria which are specifically constructed to reflect the accuracy of long-range periodic forecasts.

CHAIR: *Nasser Ordoukhani*
East Carolina University, Greenville, NC 27858, USA

PADE APPROXIMATIONS AND ITS APPLICATION IN TIME SERIES ANALYSIS

Kuldeep Kumar
National University of Singapore, Department of Economics and Statistics, 10, Kent Ridge Crescent, Singapore 0511

Since the appearance in 1970 of the book by Box and Jenkins, the use of Autoregressive-Moving Average (ARMA) model has become widespread in many fields for the analysis and prediction of time series data. However, one of the main criticisms of these ARMA models is that they are difficult to specify. In this paper we have proposed a new method based on the theory of Pade approximations for the estimation of parameters and specification of the order of ARMA (p,q) models. Simulation results and results obtained after applying this method to real data sets substantiate our claim for using this method.

FORECASTING OF TRANSFORMED SERIES

Nasser Ordoukhani
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D. K. Nassiuma
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A variance stabilizing transformation technique is proposed to compute forecasts for a nonstationary process $\{Z_t\ t = 1, 2, ...\}$. It can be viewed in a general sense as a linearizing transformation for nonlinear systems. Its performance for forecasting is compared to forecasts from retransformed series such as naive forecasts and forecasts based on Hermite polynomial transformations as suggested by Granger and Newbold (1976). The delta retransformation approach for computing forecasts is also proposed and its performance is compared to other techniques. An example on forecasting demand for repair parts shows that forecasts based on the proposed variance stabilizing transformation technique can outperform other transformation techniques.

CHAIR: *Neal C. Stolleman*
Bellcore, 290 West Mt. Pleasant Avenue, 3D 206, Livingston, NJ 07039, USA

INCENTIVE REGULATION AND THE DIFFUSION OF NEW TECHNOLOGY IN TELECOMMUNICATIONS

William E. Taylor
National Economic Research Associates, Inc., One Main Street, Cambridge, MA 02142, USA

Proponents of regulatory reform in telecommunications argue that traditional rate of return regulation reduces the incentive to innovate and retards the diffusion of new technology in the network, compared with various forms of incentive regulation. We examine the determinants of the rate of diffusion of new technology in various industries and identify mechanisms by which price and quantity regulation influence the rate of adoption of new technology. These ideas are tested in a cross-sectional analysis of the relationship between adoption of specific technologies among local operating companies and the form of regulation in the states in which they operate.

THE DEMAND FOR INTERNATIONAL TELECOMMUNICATIONS SERVICE

James W. Alleman
International Center for Telecommunications Management, University of Nebraska at Omaha, Omaha, NE 68182, USA
Paul N. Rappoport
Temple University, Philadelphia, PA 19122, USA

The United States has a large and growing balance of payments deficit in international telecommunications services, reaching over $2.5 billion in 1989. New technology has allowed the cost of international transport to decline significantly; although the price of the service has not fallen concomitantly. Without reductions in accounting rates or prices in non-United States countries and in the presence of the diffusion of the lower cost technology, the majority of the deficit represents a pure transfer of income to the recipient country. This paper describes a model which estimates demand for international voice services between the U.S. and other countries and employs the estimates in a policy simulation framework which explores policy alternatives to reduce the deficit in light of new technologies.

THE IMPACT OF THE U.S. LOCAL EXCHANGE CARRIER INDUSTRY STRUCTURE ON TECHNOLOGY DEPLOYMENT

Leland W. Schmidt
GTE Service Corporation, 5205 North Oconner Boulevard, Irving, TX 75039, USA

The paper develops a proposition that only through collective action by all U.S. local exchange carriers is it rational to expect the evolution of an economically efficient feature-rich intelligent public network throughout the nation.

CHAIR: *Roy Batchelor*
City University, Business School, Trobisner Crescent, Barbican Cent, London, EC2Y 8HB, UK

FORECASTING CURRENT QUARTER GNP: A COMPARISON OF ALTERNATIVE METHODS

K. S. Sarma
IBM Corporation, Armonk, NY 10504, USA

The need for forecasting current quarter GNP arises because the U.S. Department of Commerce does not issue its first estimate (also known as the advance estimate) of real GNP for a given quarter until late in the first month of the next quarter. For example, Commerce Department's estimate of GNP for the first quarter is not available until the last week of April. Yet, within each quarter we get a variety of daily, weekly and monthly reports on employment, industrial production, interest rates, etc.

This paper evaluates alternative methods of making use of the incoming data to predict the current quarter GNP. The analysis is focused on two methods. The first method consists of forecasting GNP directly from the indicators released early in the quarter. This method makes use of the Vector Auto Regression Technique and is based on five key indicator variables released early in the quarter. This method provides timely and accurate forecasts of Commerce Department's first estimate of GNP. However, because of it's limited size it cannot utilize the information released later in the quarter. As a result, the VAR model is not suitable for predicting revisions in GNP. In order to overcome this deficiency a second method is used to predict GNP from its components. In this method ARIMA and Transfer Function Techniques are used. Since the second method can make use of additional data released later in the quarter, it contains information not captured by the first method.

The paper consists of an analysis of simulation results from the above two methods. Encompassing tests are carried out and the source of forecast errors is investigated. The gain in accuracy due to the combination of forecasts from these two methods is also assessed.

VARIANCE RATIONALITY: DEFINITION AND TESTS ON ECONOMIC FORECASTERS

Roy Batchelor
City University, Business School, Trobisner Crescent, Barbican Cent, London, EC2Y 8HB, UK

A forecast is defined as "variance-rational" if the forecaster's subjective variance for the forecast variable is equal to its true conditional variance, with conditioning done on the forecaster's information set. The variance rationality of participants in the ASA-NBER surveys of U.S. economic forecasters is then tested by comparing their subjective variances for future inflation and GNP growth with the squared errors in their mean forecasts. Although mean forecasts are rational, the variance estimates are not. Forecasters are typically overconfident at long forecast horizons, and give too much weight to the size of recent forecast errors.

CHAIR: *Martin J. Gruber*

Department of Finance, Stern School of Business, New York University, 90 Trinity Place, New York, NY 10006, USA

HOT HANDS: THE PREDICTABILITY OF PERFORMANCE

Stephen J. Brown
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William N. Goetzman
Columbia University, New York, NY 10027, USA

Recent evidence appears to show that there is persistence in the performance results of mutual fund money managers. Measuring performance on a risk adjusted basis, money managers with performance above the median in any recent two year period experience above median performance in the second two year period. Managers with below median performance have below median performance in the next two years. This result appears to be at variance with the efficient market hypothesis which grew out of the work of Markowitz, Sharpe and others. In this paper we show that this result is at least in part due to the fact that we only observe the performance of managers that survive at least four years. We show that if as few as five percent of the worst performing managers are excluded from the sample each year, we would observe this "hot hands" phenomenon at least half of the time. We further show that the effect is exacerbated in periods when the market is up. There is a higher probability of observing the apparent persistence of performance when the return on the market is above its long term average. Such periods characterize the time span of the empirical studies that appear to validate the "hot hands" result.

IMPLEMENTING FORECASTING METHODS AND PORTFOLIO THEORY

James L. Farrell, Jr.
Farrell-Wako Global Investment Management Inc., New York, NY 10048, USA

The Markowitz model is the paradigm of portfolio theory. It offers the notion of efficient portfolios or ones that offer the highest return at a given level of risk. Markowitz further provides the algorithm for determining such portfolios, given inputs of return and risk estimates for component securities in the analysis. One of the prime difficulties in applying this technique is developing suitable inputs for the model. While widespread availabilities of computer power and data bases make the generation of historic input data relatively easy, this approach has been shown by many researchers to be deficient. Using forecast data is the necessary alternative, but is more difficult to implement. This presentation describes techniques for developing forecast data and illustrates the merits of this approach.

Session F11 Room 510	NEW METHODS: CHAOS THEORY AND GENETIC ALGORITHMS IN FINANCE	Tuesday 3:45 – 5:15

CHAIRS: *Richard J. Bauer and Richard J. Priesmeyer*

School of Business and Administration, St. Mary's University, San Antonio, TX 78228-8607, USA

GENETIC ALGORITHMS: A TUTORIAL

Gunar E. Liepins'

Martin Marietta, Oak Ridge National Laboratory, MS6360 Building 6025, Oak Ridge, TN 37831, USA

Genetic algorithms are a class of software algorithms based on biological principles. The operations in a genetic algorithm include: selection, evaluation, crossover, and mutation. The tutorial will explain these operations and the general theory underlying genetic algorithms. The session will also include a brief review of the major categories of genetic algorithm applications.

GENETIC ALGORITHMS AND STOCK MARKET TIMING TRADING RULES

Richard J. Bauer, Jr., CFA

Finance Department, St. Mary's University, San Antonio, TX 78228-8607, USA

One of the major hurdles in the application of genetic algorithms is problem representation. This session will examine the use of genetic algorithms in the evaluation of stock market timing trading rules using macroeconomic data. A trading rule expressed in a general form might have trillions, or more, of possible parameter combinations. Searching enumeratively through this number of combinations is beyond the capability of even the fastest computers. By using genetic algorithms, near-optimal combinations can be determined in an efficient manner. This paper will discuss the problem representation and results from applying genetic algorithms to the search for attractive market timing trading rules.

CHAOS THEORY: TUTORIAL AND FINANCIAL APPLICATIONS

Richard Priesmeyer

Management Department, St. Mary's University, San Antonio, TX 78228-8607, USA

Chaos theory is a relatively new branch of mathematics which focuses on patterns of change in a system's performance; it is sometimes called non-linear system theory. Within the past 15 years many natural and biological systems such as weather and the human heart have been found to adhere to chaos theory. Recent research provides evidence that organizational performance (i.e., sales, profit, growth, etc.) also adheres to chaos theory. The finding has major implications for corporate planning since the technique can reveal structural limits to organizational growth and can aid in planning recoveries from mergers, divestitures, and environmental shocks which disrupt performance.

This session will introduce chaos theory concepts and describe a specific methodology which can be used for corporate analysis. It will then present the result of such analysis displaying chaotic "limit cycles" for several major corporations and industries. The session will conclude with a discussion of implications for management and a list of practical applications.

CHAIR: *Mahmoud A. Kaboudan*
The Pennsylvania State University, Allentown Campus, Fogelsville, PA 18051, USA

EVIDENCE ON CHAOS IN STOCK PRICES

Jonathan D. Jones
Office of Economic Analysis, 9-1, Securities and Exchange Commission, 450 5th Street, NW, Washington, DC 20549, USA

This paper tests for nonlinear dynamics, or deterministic chaos, in daily stock prices on the New York Stock Exchange. The Dow Jones Industrial Average index is used. The tests include Brock's residual test, Scheinkman and LeBaron's bootstrapping approach, and Brock, Dechert, and Scheinkman's W statistic. The sample periods include 1929-1940, 1970-1981, and 1982-1989. These periods correspond to a period of historically high stock volatility, as well as periods before and after the introduction of stock index futures and index options. Additionally, the paper tests for nonlinear dynamics in intraday observations on S&P 500 and non-S&P 500 portfolios for the market disturbances of October 1987 and 1989.

THE CORRELATION EXPONENT: A MEASURE OF CHAOTIC DYNAMICS AND ITS ROLE IN FORECASTING

Mahmoud A. Kaboudan
The Pennsylvania State University, Allentown Campus, Fogelsville, PA 18051, USA

Dynamical chaotic behavior in economic and business data is an old problem that has received recent attention from theoretical and practical forecasters. This study is divided into two parts. The first reviews one of three measures of chaos, the correlation exponent. The second part suggests a new test that uses the exponent to identify data behavior. The proposed test complements two already existing ones that apply to nonlinear data series. Together, these tests can identify whether a series is random, independent and identically distributed (iid), and/or chaotic. The implications of these tests on forecasting efforts are examined by employing time series data of a small electric utility.

CHAIR: *Pamela Texter Geriner*

Department of Decision Sciences & MIS, George Mason University, 4400 University Drive, Fairfax, VA 22030, USA

MEASURES OF FORECASTING ACCURACY FOR INVENTORY AND PRODUCTION PLANNING AND CONTROL PROBLEMS

Sevket I. Gunter
Temple University, School of Business and Management, Speakman Hall (006-00), Philadelphia, PA 19122, USA

Traditional measures of accuracy such as MSE are misleading proxies for the true cost of forecast errors in many applications. This paper develops decision-theoretic efficiency measures for demand forecasts, and demonstrates that the true cost of forecast errors may lack the symmetry and smoothness properties of such generic measures. Methods for combining forecasts that minimize the true cost of errors are developed. Numerical examples are provided to compare the true costs of selecting among or combining forecasts based on decision-theoretic versus generic measures of accuracy and their variations that approximate the asymmetries in the true loss functions.

THE LINK BETWEEN FORECASTING ACCURACY, TIME SERIES TYPE AND FORECASTING MODEL MATCHING – A CLUSTER ANALYSIS APPROACH

Tilin Yi and Robert Fildes
Department of Operational Research and Operations Management, University of Lancaster, Lancaster LA1 4YX, UK

Forecasting model selection is an important problem in forecasting science. In the Makridakis et al. (1982) study, 24 forecasting methods and 1001 time series were analyzed from which empirical conclusions were derived aimed at offering guidance on selection. In this paper, first we cluster analysis to segment a population of time series into sub-populations using various summary statistics. Individual forecasting methods are then matched to the sub-population under some criteria.

Finally, the relationship between the relative accuracies of various forecasting methods and the summary statistics has been investigated and some provisional results established.

THE VALUE OF KNOWING THE POPULATION MODEL FORM FOR IMPROVING FORECASTING ACCURACY

Pamela Texter Geriner and Peg Young
Department of Decision Sciences & MIS, George Mason University, 4400 University Drive, Fairfax, VA 22030, USA

It is a widely held belief that if the correct form of a population model can be identified, the estimated model will provide the most accurate forecasts. The purpose of this study is to investigate the validity of this hypothesis. Data series are simulated using various forecasting methods. Each of these forecasting methods are used to estimate models for all of the simulated time series data. The relationship between the estimated population model and the most accurate forecasting model is then examined. In addition, the correlation between the best fitting model and most accurate forecasting model will be explored.

Session FM12 Madison B	AUTOMATIC FORECASTING: PRESENT AND FUTURE	Tuesday 3:45 – 5:15

CHAIR – Moderator: *Anne B. Koehler*
Miami University, Oxford, OH 45056, USA

Panel Members:

Stuart Bretschneider – Syracuse University, Syracuse, NY 13244, USA

Hans Levenbach – Levenbach Associates Inc., Morristown, NJ 07960, USA

Leonard J. Tashman – University of Vermont, Burlington, VT 05405, USA

The panel members will discuss the role that automatic forecasting software can and should play in forecasting. Both the potential for automatic forecasting and its limits will be examined. Participation by the audience will be encouraged.

CHAIR: *M. J. Lawrence*
School of Information Systems, University of New South Wales, Kensington, NSW 2033, Australia

BUILDING SMARTER FORECASTING APPLICATIONS WITH EXPERT SYSTEMS

Hans Levenbach
Levenbach Associates, Inc., 103 Washington St., Suite 348, Morristown, NJ 07960, USA

Forecasting applications in the real business world have lacked adequate means of combining the judgmental qualitative knowledge of the manager with formalized quantitative modeling approaches. Expert systems are beginning to contribute to the selection of appropriate forecasting models to a given situation. Judgmental aspects of the decision processes are usually handled as "add-factors" to models. We offer a new framework for improving business forecasting applications that blend both the qualitative and quantitative aspects of the forecasting process into a single, cohesive system. We discuss its implementation for the PC environment.

EXPERT SYSTEMS IN FORECASTING AND DATA ANALYSIS

Timothy A. Davidson
Temple, Barker & Sloane, Inc., 99 Hayden Avenue, Lexington, MA 02173, USA

For the past several years expert systems have been employed by marketing and sales professionals of consumer goods manufacturers to assist them in reducing their workload without jeopardizing quality. Expert systems technology shows up in two important areas, short-range sales demand forecasting and in gleaning key information from masses of market research data.

The presenter will discuss the key elements of automatic forecast modeling systems from direct experience with the design and development of these expert systems. Further, the presenter will report on the results of a recent survey of consumer goods manufacturers regarding the extent to which automatic analysis systems have been embraced. TBS survey's revealed both the overall satisfaction and the shortcomings of today's expert systems in marketing.

EXPLORING JUDGMENTAL FORECASTING

M. J. Lawrence and M. J. O'Connor
School of Information Systems, University of New South Wales, Kensington, NSW 2033, Australia

Most of our knowledge of the accuracy or goodness of human judgment has been gained from studies carried out in a setting of multivariate non-serially correlated cues. This is not representative of the task of time series forecasting where there is typically a single series of serially correlated cues. As judgment is widely used in this setting, this study seeks to investigate the extent to which some of the widely documented judgmental biases and heuristics apply to time series forecasting. The research design varied the series presentation, series length and the type of series to investigate the influences of presentation scale, length of series, recency and anchoring and adjustment in estimating a judgmental forecast. The time series used were modelled from stationary ARMA processes. The study found that while scale did not influence accuracy it was influenced by the series length and the most recent segment slope. Subject's forecasts could be modelled as exponential smoothing or anchoring and adjustment, where the anchor point corresponded to the long term average of the stationary series. The implications of the results for training practical forecasters are discussed.

Session MP10 Morgan B	THE ROAD TOWARD EXCELLENCE IN OPERATIONAL FORECASTING	Tuesday 3:45 – 5:15

CHAIR: *A. Dale Flowers*

Head, Operations Management Division, Weatherhead School of Management,
Case Western Reserve University, Cleveland, OH 44106, USA

The road to excellence in operational forecasting begins with the realization that *all business planning starts with a forecast*. A high quality forecast can have a very significant impact on the corporation. The potential benefits include:

- Lower inventories
  - Purchased
  - Work in process
  - Finished goods
- Better production scheduling
- Greater organizational stability
- Lower costs
- Better cash management
- Freed up capital funds
- Proactive posture in the marketplace

Most forecasting systems *evolve* over time rather than result from a careful design. The purpose of this session is to help general managers, forecast managers, forecast analysts, MIS personnel and other stakeholders in the forecasting process design excellent systems with one try; i.e., *do it right the first time*. The need for it is obvious—you will not get a second chance.

The session will be conducted in a workshop format. If you participated in the design of your company's forecasting system, you can use the scorecard provided to evaluate the design process. If you did not participate in the design, you may use the scorecard to evaluate the results of your design team's effort. We will invite persons in the audience to share their reviews with each other at various times during the session.

The design process we will propose uses the *structured systems approach*. We have "fleshed these out" with specific forecasting concepts. The major steps through which we will "travel" in the session include: Develop functional specifications

- Identify software/hardware products
- Define historical data for testing
- Design the forecasting data base
- Functional specification review
- Statistical tests
- Evaluation and selection
- Modifications document
- Education and training
- Interface requirements
- Implementation plan

The completion of this project plan typically requies six to nine months. A cross functional design team consisting of 6 to 12 people will typically be required. They may work a total of 1.5 to 2 man years to complete the design for a large division or company requiring a fairly complex system.

CHAIR: *Gillian Rice*

American Graduate School of International Management (Thunderbird), Department of World Business, Glendale, AZ 85306, USA

THE FUTURE OF FOREIGN DIRECT INVESTMENT IN EASTERN EUROPE

Thomas L. Brewer
Georgetown University, School of Business, Washington, D.C. 20057, USA

This presentation analyzes the future of foreign direct investment in Eastern Europe, with special attention given to the motor vehicle industry. A comprehensive political risk assessment of this topic requires that several different levels of analysis be included in both the analysis of the political environment and the analysis of the industry. Thus, the political environment entails not only East European and West European regional analyses, but also national level analyses of each of the individual countries of Eastern Europe and sub-national level analyses of developments within countries as well. Similarly, the analysis of the industry requires an analysis of patterns and trends in the motor vehicle industry at the global level, in addition to the strategies of individual firms within the industry and the market prospects for individual products.

EVALUATING POLITICAL RISK IN SOUTHEAST ASIA AND THE MIDDLE EAST...A CASE OF PETROLEUM MULTINATIONAL CORPORATIONS

Albert Celoza and Stuart Mattson
American Graduate School of International Management (Thunderbird), Department of International Studies, Glendale, AZ 85306, USA

Political risk is an ever-present problem for petroleum multinational corporations (MNCs) in several parts of the world. This paper will analyze and illustrate how the petroleum MNCs relate to the petroleum producing countries of southeast Asia and the Middle East. This involves evaluating present and future levels of political risk in these two regions, and discussing the quantitative and other methods used by MNCs to predict and counteract the risk.

POLITICAL RISK FORECASTING: A RISK MANAGEMENT PERSPECTIVE

Candace Clark
Apple Computer, Inc., 2025 Mariani Avenue, MS: 28G, Cupertino, CA 95014, USA

Many U.S. businesses have purchased political risk insurance to protect their investments abroad against financial losses resulting from U.S. or foreign government political action. This is an area of insurance which must be responsive to the constantly changing global political landscape. This presentation will take a practical approach to identify and analyze political risks for XYZ company, assess policy structure guidelines, and evaluate the viability of political risk insurance and alternatives.

PRAGMATIC APPLICATIONS OF COUNTRY RISK FORECASTING WITHIN THE CORPORATION

Barbara Samuels II
Country Risk Policy Group, The Chase Manhattan Bank, N.A., 1, Chase Manhattan Plaza, 15th Floor, New York, NY 10081, USA

Country risk is not simply encountered by multinational corporations (MNCs) but created as a function of the specific relationship of the MNC with the host country. Country risk as such presents a special challenge for each corporate "forecaster," namely how to identify "macro" risks (and opportunities), and the specific "micro" implications for the corporation in question. In a world of escalating economic and political interdependence, this challenge has become more awesome, yet both MNC managers and national policymakers need pragmatic tools to enhance global competitiveness and national comparative advantage.

CHAIR: *Edward Melnick*

New York University, Statistics & Operations Research Department, Leonard N. Stern School of Business, 40 W. 4th Street, Room 519, New York, NY 10003, USA

PROPERTIES OF SEASONAL ADJUSTMENT–PROCEDURES IN THE FREQUENCY DOMAIN

W. Stier
University of St. Gallen, Varnbüelstr 19, CH-9000 St. Gallen, Switzerland

There exist quite a lot of seasonal adjustment procedures. Even within the same country we can observe that different agencies use different procedures with the result that published adjusted series differ, especially for current data points which is a disagreeable state of affairs. For most of the practically important procedures it is not possible to derive their filter-characteristics analytically due to non-linearities and/or iterations. This is especially true for current values. In this paper it is shown how amplitude- and phase-characteristics can be derived empirically thus providing a possibility to evaluate the above mentioned differences.

THE USE OF HARMONIC ANALYSIS AND CYCLE REGRESSION ANALYSIS TO DECOMPOSE AND FORECAST

LeRoy F. Simmons
Loyola College, 4501 North Charles Street, Baltimore, MD 21210, USA

Cycle Regression Analysis (CRA) uses harmonic analysis to simultaneously estimate trend, seasonality and cycles. With cycles one can forecast both the timing and level of turning points. A cycle's beginning and end along with its systematic change in pattern may now be precisely studied.

This tutorial will show how one can use the principles of harmonic analysis and the CRA's fit of "real" data to estimate non-linear trends, turning points, systematic changes in seasonal and cyclic patterns, the lengths of a cycle, and the beginning and ending of cycles.

A TEST FOR WEAK BANDWIDTH STATIONARITY

Edward Melnick and James Ramsey
New York University, Statistics & Operations Research Department, Leonard N. Stern School of Business, 40 W. 4th Street, Room 519, New York, NY 10003, USA

Most forecasting models assume that observations are generated by either a weakly stationary process or a process with unit roots. Rarely is this assumption tested other than to examine time plots of the data (or differenced data) to look for a trend in the mean and/or monotonically increasing variance of the data. In this talk a family of processes with bounded variation is introduced (harmonizable processes) and tests are proposed for the weakly stationary assumption. More specifically, the methodology requires that the modeller specify the time horizon of interest (e.g., short or long term forecast) and test the variance/covariance structure of the process for the indicated frequency band. The methodology will be illustrated with simulated and live data.

CHAIR: *J. Keith Ord*

Department of Management Science, The Pennsylvania State University, 303 Beam Business Administration Building, University Park, PA 16802, USA

FORECASTING APPLICATIONS AT AMERICAN AIRLINES

Thomas M. Cook
American Airlines Decision Technologies, P.O. Box 619616, Dallas-Fort Worth Airport, TX 75261, USA

This presentation describes many of the forecasting applications at American Airlines. Applications include yield management, route profitability forecasting, spare part demand forecasting, and dependability forecasting. Forecasting techniques applied include time series, multiple regression, simulation and logit choice modeling.

Thomas Cook is President of American Airlines Decision Technologies. Dr. Cook holds an AB in mathematics from Grinnell College, an MBA from Southern Methodist University and a Ph.D. in Operations Research from the University of Texas at Austin. He manages both the internal and external consulting activities of Decision Technologies. Decision Technologies is composed of approximately 220 consultants that specialize in modeling, industrial engineering, and model-based system development.

Prior to joining American eight years ago, Dr. Cook spent three years consulting for a large international consulting firm, seven years developing large-scale computer based systems for an aerospace corporation and six years teaching and researching at the graduate and undergraduate level. He has co-authored two text books published by Prentice-Hall and has published papers in journals such as *Management Science*, *Decision Sciences*, *Operations Research Quarterly*, *Transportation Research*, *IEEE Transactions* and *Interfaces*.

Dr. Cook is currently President of The Institute of Management Science, a member of Operations Research Society of America, special editor of *Interfaces*, associate editor for *Operations Research*, and President of the Airline Group of the International Federation of Operation Research Societies.

CHAIR: *J. Keith Ord*

Department of Management Science, The Pennsylvania State University, 303 Beam Business Administration Building, University Park, PA 16802, USA

TOWARDS THE 21ST CENTURY: MAJOR TRENDS AND THEIR IMPLICATIONS FOR PLANNING AND STRATEGY

Spyros Makridakis
(INSEAD) European Institute of Business Administration, Boulevard de Constance, 77305 Fontainebleau Cedex, France

Technologies such as *robotics*, *computerized integrated manufacturing*, *expert systems*, *personal* (mobile) *telephones and faxes*, *IDSN* (Integrated Digital System Networks), and *super personal* (as small as notebook size) *computers* are a reality, whose widespread diffusion, between now and the beginning of next century, is an almost certainty bound to fundamentally change our societies, profoundly affect the way people work, as well as their personal and professional lives, and paramountly influence the way firms are organized, managed and compete. The purpose of this talk is to identify major scientific, technological and other trends and the changes that such trends are bound to bring, discuss their implications as far as business organizations are concerned and express my views as to what can be done by management in order to anticipate, rationally assess and effectively deal with the consequences of these changes.

Following the attainment of a place in the Greek Sailing Team in the Olympics of 1960, Spyros Makridakis set sail for New York University from where he obtained a Ph.D. in 1969. Since then he has advised numerous international organizations and government agencies and consulted worldwide with companies such as AT&T, General Motors, Motorola, Aussedat-Rey, ICI, American Express, ICME and L'Air Liquide. Spyros has held teaching and research positions with several European and American institutions; as a research fellow with IIM in Berlin, an ICAME fellow at Stanford University and a visiting scholar at MIT and Harvard. Makridakis is now Research Professor at INSEAD in France where his present research is concerned with the impact of technological change on society, work and management and their implications for business organizations.

In addition to teaching and consulting expertise, Makiridakis has also authored or co-authored eighteen books including *Forecasting Methods for Management* (Wiley) which is now in its 5th edition and has sold more than 90,000 copies in nine different languages. Professor Makridakis has written around 100 articles and papers in various journals and was also the founding chief editor of the *Journal of Forecasting* and the *International Journal of Forecasting.* His latest book, *Forecasting, Planning and Strategy for the 21st Century* was published in 1990 by the Free Press.

CHAIR: *G. Kent Webb*

San Jose State University, 391 College Avenue, Apartment A, Palo Alto, CA 94306, USA

FORECASTING CRUDE OIL PRODUCTION IN CHINA AND THE UNITED KINGDOM

Shaoping Zhao and George Heitmann

The Pennsylvania State University, The Smeal College of Business Administration, Department of Management Science, 303 Beam Business Administration Building, University Park, PA 16802, USA

During the past decade, average crude oil production levels in the Peoples Republic of China and the United Kingdom have been at approximately the same level. Growth patterns have, however, been quite different. Chinese production continues to grow whereas production may have peaked in the United Kingdom in 1986. And, obviously, the political/economic environment in the two countries is markedly different.

The paper reports on a comparative ARIMA modelling of output patterns in the two countries.

FORECASTING THE ANTWERP MARITIME TRAFFIC FLOWS USING TRANSFORMATIONS AND INTERVENTION MODELS

André Klein

Department of Economic Statistics, University of Amsterdam, 1011 NH Amsterdam, The Netherlands

This article uses univariate time series models with data transformations and intervention models to forecast the volumes of twenty-two maritime traffic flows in the port of Antwerp which are expressed in tonnes. The models obtained produce forecasts which are a substantial improvement over those obtained with unadjusted data. The models also provide useful insight into the behavior of the maritime traffic flows during the period 1971-1982.

ELECTRONICS INDUSTRY MARKET FORECASTING

G. Kent Webb

San Jose State University, 391 College Avenue, Apartment A, Palo Alto, CA 94306, USA

A recursive model is developed that has been used for long-term forecasting in major equipment and component markets in the U.S. Electronics Industry. Evolution of the model through the 1980s is discussed with respect to structure, data limitations, and implementation of the model in Lotus 1-2-3. The implications of these findings are discussed in terms of the outlook for the electronics industry in the 1990s.

CHAIR: *Delisle Worrell*

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

A METHOD OF FORECASTING ECONOMIC CONDITIONS IN DEVELOPING COUNTRIES USING PROJECTIONS FOR REGIONS AND OTHER MULTI-NATION GROUPS

Randall J. Jones, Jr.
Central State University, Edmond, OK 73034, USA

For many developing countries few forecasts of national economic conditions are available. This paper demonstrates a technique for generating such forecasts by regressing time series data for the developing country on comparable time series for the region or other multi-nation group (e.g., oil exporters) within which the country is included. National forecasts are derived by substituting into the resultant equation forecasts for the "explanatory" region or group produced by such agencies as the International Monetary Fund.

POLICY FORECASTING IN DEVELOPING COUNTRIES: THE CARIBBEAN

Delisle Worrell
Central Bank of Barbados, P.O. Box 1016, Bridgetown, Barbados

The Caribbean is rather better provided for than the average developing country with respect to economic and forecasting skills as well as data; but by industrial country standards there are major deficiencies. A large number of empirical models have been tried in the Caribbean and some of them have offered forecasts. However, the models have not been maintained over time and they are often incompatible with each other in respect to theory, definitions of variables, estimation techniques and data requirements. Our paper examines how Caribbean countries have tried to cope, and makes suggestions for improvement.

CHAIR: *Martin R. Morman*
Morehouse College, 5960 Canaan Woods Drive, Atlanta, GA 30331, USA

THE FORECASTING OF CHINESE IMPORT AND EXPORT STRUCTURE

Xiang-Ying Du and You-Rui Yu, G. L. Zang
Research Center for System Analysis RIMST, Ministry of Machine Building & Electronic Industry, No. 2 Shou-Ti South Road, Beijing, 100044, China
G. L. Ahang
Beijing Institute of Printing, Da Xing 102600, Beijing China

After investigating and researching a vast amount of import and export data in China, Japan, Europe, USA and NICs, the authors describe the present status and development of Chinese import and export structure with scenario writing. The forecasting of Chinese import and export structure in the next 10 years is made by both qualitative and quantitative methods. With Fuzzing mathematical analysis, the selection proposal of main imports and exports in China is put forward.

THE DEMAND FOR DURABLE GOODS

Niels Kaergård
Institute of Economics, University of Copenhagen, Studiestraede 6, DK-1455, Copenhagen K., Denmark

Econometric models are estimated with data from the past and used to forecast the future. Consequently, the main question is for how long such models could be expected to have a constant structure. This question is analyzed with the Danish growth-model CLEO. Some summary results for the whole model were presented at the Forecast Symposium in 1989.

This paper presents a thorough analysis of a single relation – the demand for durable goods. It is shown that the relation is rather stable and that although the model shows systematically biased forecasts since the oil-crisis, the main cycles are forecasted correctly.

AN ECONOMETRIC MODEL OF THE URANIUM INDUSTRY

Martin R. Morman
Morehouse College, 5960 Canaan Woods Drive, Atlanta, GA 30331, USA

The purpose of this study is to develop and empirically estimate an econometric model of the uranium industry which is based on the concept of economic exhaustion. The supply model incorporates the notion the decision criteria used by uranium owners to select the extraction rate which maximizes the net present value of their extraction receipts. An input demand function is used to explain those factors which influence the demand for uranium. No attempt is made to model those factors which influence new discoveries or exploratory activities. The demand and supply equations are estimated using: ordinary least squares (OLS), two-staged least squares (2SLS), and three-staged least squares (3SLS). The model is used to evaluate policy alternatives in the uranium industry.

CHAIR: *Mary E. Gerlow*

Department of Ag Economics, Ohio State University, 2120 Fyffe Road, Columbus, OH 43210, USA

CAN ECONOMISTS ACCURATELY PREDICT COMMODITY PRICES?

Mary E. Gerlow and Scott Irwin
Department of Ag Economics, Ohio State University, 2120 Fyffe Road, Columbus, OH 43210, USA

Economists expend considerable effort in forecasting commodity prices. However, there is little direct evidence regarding economists' success or failure in predicting commodity prices. In this study, economists' forecasts of hog and cattle prices over the period 1974-1989 are examined. Four different sets of forecasts for each commodity are included in the data set: one issued by the U.S. Department of Agriculture and three issued by U.S. land-grant universities. In all cases, a naive random walk model produces lower root mean squared errors than the economists. However, market timing tests indicate that the economists do have a significant ability to forecast large price changes.

A PERFORMANCE COMPARISON OF A TECHNICAL TRADING SYSTEM WITH AN ARIMA AND VAR MODEL FOR SOYBEAN COMPLEX PRICES

Mary E. Gerlow, Scott Irwin, and Carl Zulauf
Department of Ag Economics, Ohio State University, 2120 Fyffe Road, Columbus, OH 43210, USA

Both technical trading systems and economic time series models are based upon the assumption that current market prices are not independent of past market behavior. This study examines the relative economic performance of a Channel (CHL) technical trading system with ARIMA and VAR models in forecasting soybean, soybean meal, soybean oil prices over the period January 1984-June 1988. The CHL system exhibits consistent trading returns across the soybean complex. Furthermore, the CHL system is robust across the two subperiods of the out-of-sample period, one of which is characterized by rising commodity prices, and the other by declining prices.

CHAIR: *Jeffrey Jarrett*

Department of Management Science, University of Rhode Island, Kingston, RI 02881-0802, USA

TEACHING FORECASTING

John Hanke
Management Information Systems Department, Eastern Washington University at Cheney, MS-44, 316, Kingston Hall, Cheney, WA 99004, USA

This presentation will investigate how forecasting has been taught in the 1980's and suggest how a good class in forecasting for management students should be taught in the 1990's.

INTEGRATING THE COMPUTER INTO THE FORECASTING COURSE

Jeffrey Jarrett
Department of Management Science, University of Rhode Island, Kingston, RI 02881-0802, USA

The teaching of forecasting can utilize the computer (both PC and larger models) in a variety of ways. The purpose of this presentation is to give examples of the following:

1. Criteria for choosing software for the forecasting course.
2. Variety of software for both PC and larger computer environments.
3. Integrating software into the course through computerized forecasting projects.
4. Using the methods of computer assisted instruction (CAI).
5. The importance of PC Networking in the course.

CHAIR: *Annele Eerola*

Swedish School of Economics and Business Administration, Research Institute, Arkadiagatan 22, SF-00100 Helsinki, Finland

ORGANIZATIONAL ROLE AND PERCEPTION OF FORECASTING PRACTICES

Janet A. Sniezek and Timothy Buckley
University of Illinois at Urbana-Champaign, Department of Psychology, 603 East Daniel, Champaign, IL 61820, USA
Scott Seibert
Cornell University, Ithaca, NY 14853, USA

Selected members of a multi-national organization were surveyed with respect to their forecasting practices and attitudes toward these practices. Consistent with previous claims, most forecasting was a direct result of human judgement (Armstrong, 1986; Dalrymple, 1987). As such, forecast accuracy can be highly susceptible to variations in perceptions of the forecasting function over the array of organizational members participating in the forecasting process. Differences in these perceptions, as well as differential attitudes toward forecast error, are explained as a function of organizational role using a "Cognitive-Motivational" model of forecasting.

STRATEGY FORMATION: FORECASTS AS SHARED MEANINGS

Annele Eerola
Swedish School of Economics and Business Administration, Research Institute, Arkadiagatan 22, SF-00100 Helsinki, Finland

Empirical data suggest that companies acquire market forecasts from various external sources in order to monitor their environment in meaningful terms. Forecasts prepared by external experts are considered useful because they can provide a shared reference frame for those participating in the companies' strategy processes. This paper discusses the behavioral groundings of the practice of using external forecasting services. The linkages between the forecasts and the companies' strategy formation are illustrated, resulting in re-examination of the criteria for producing useful forecasts. The paper is based on an in-depth study among forecast users in eight Scandinavian companies.

THE ORGANIZATION OF FORECASTING
[Presented by title only]

Robert Fildes
Department of Operational Research and Operations Management, School of Management, University of Lancaster, Lancaster, England LA1 4YX, UK

Quantitative forecasting techniques are not much used in business. Instead organizations rely on the judgement of managers working close to the product market. Increasingly, however, developments in the production planning area require more accurate forecasting. This presentation describes how companies produce their market forecasts, and the perceptions of managers as to the inadequacies in the procedures. It concludes with a discussion of the reasons why organizations mismanage their forecasting activity and how these activities might be improved.

CHAIR: *Marsha Katz*
Governors State University, University Park, IL 60466, USA

AN ASSESSMENT OF THE EFFECT OF INCREASED FUNDING FOR PUBLIC SCHOOLS ON EDUCATIONAL ACHIEVEMENT: A CASE STUDY OF NEW JERSEY

Kusum Ketkar
Department of Economics, Seton Hall University, W. Paul Stillman School of Business, South Orange, NJ 07079, USA

Various alternative criteria are considered including educational tests and drop-out rate to measure educational achievement of students in a school district. A simultaneous equation model is developed to assess the effect of public and private spending on schooling, various economic, socio-demographic, racial and other environmental factors influencing family life on educational achievement of children. The model is tested using cross-section data at municipality level from the State of New Jersey. A recent court ruling requires the state government of New Jersey to bring per pupil spending in the 30 poorest school districts to the level of the states wealthier districts.

FORECASTING CLASS ENROLLMENTS IN A UNIVERSITY

Marsha Katz
Governors State University, University Park, IL 60466, USA

This paper represents an attempt to increase the accuracy of scheduling courses in the business school by forecasting enrollments per class. Currently, class scheduling is performed by the division head by a judgmental forecast. This study suggests different techniques such as a naive forecast, a seasonally adjusted naive model and a regression model are appropriate for different types of courses based on size of enrollment and frequency of offering. University enrollment, business school enrollment and employment rate were significant variables. Regression models reduced error over naive forecasts up to 50% especially for courses with frequent offerings.

CHAIR: *Paul S. Horn*

Department of Mathematical Sciences, University of Cincinnati, ML#25,
Cincinnati, OH 45221-0025

THE ESTIMATION OF THE STOCHASTIC COEFFICIENT MODELS VIA E-M ALGORITHM

A. Lima Velga
PUC/RJ-DEE, Rua Marques de Sao Vicente, 225, 22453, Rio de Janeiro, RJ, Brazil

One way of handling the problem of the non-stationarity in the analysis of time-series is to allow the coefficients of the model to be stochastic. Despite the literature on the subject, the estimation of the parameters of the vector stochastic process generating the coefficients remains a problem.

This paper presents a new method for the estimation of these parameters based on the E-M (Estimation-Maximization) algorithm where the estimation step is carried out by a Kalman smoother and the maximization is applied to the expected value of the likelihood of the unobserved components of the model.

A SEMI-NONPARAMETRIC TOLERANCE REGION BASED ON THE BOOTSTRAP

Paul S. Horn
Department of Mathematical Sciences, University of Cincinnati, ML#25,
Cincinnati, OH 45221-0025

In this paper a new one-sided tolerance limit will be investigated. The proposed tolerance limit takes the form of a multiplicative factor times a quantile estimate. The multiplicative factor is simple in form and based on bootstrapped quantiles of order statistics. The quantile estimate itself could be of form; for example it could be nonparametric, and therefore, based on order statistics as well.

The proposed tolerance limit has the desirable property of allowing for the possibility of exceeding the sample maximum, and thus capturing more probability content. This is not possible with a traditional nonparametric tolerance limit. On the other hand, the proposed limit avoids, in general, using the extreme order statistics themselves, thus avoiding possible breakdown with heavy-tailed data. If the extreme order statistics are outliers, the traditional nonparametric tolerance limits will be badly influenced.

LIST OF CHAIRPERSONS AND SPEAKERS

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To obtain information concerning **ISF 92**, please contact:

Professor Allan Catt
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