

## Journal of Computational Intelligence in Finance (formerly NeuroVest Journal)

A list of the table of contents for back issues of the Journal of Computational Intelligence in Finance (formerly NeuroVest Journal) is provided, covering Vol.1, No.1 (September/October 1993) to the present.

See "<http://ourworld.compuserve.com/homepages/ftpub/order.htm>" for details on ordering back issue volumes (Vols. 1 and 2 are out of print, Vols. 3, 4, 5, 6 and 7 currently available).

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September/October 1993  
Vol.1, No.1

A Primer on Market Forecasting with Neural Networks (Part1) Mark Jurik The first part of this primer presents a basic neural network example, covers backpropagation, back-percolation, a market forecasting overview, and preprocessing data.	6
A Fuzzy Expert System and Market Psychology: A Primer (Part 1) James F. Derry The first part of this primer describes a market psychology example, and looks at fuzzifying the data, making decisions, and evaluating and/or connectives.	10
Fuzzy Systems and Trading (the editors) A brief overview of fuzzy logic and variables, investing and trading, and neural networks.	13
Predicting Stock Price Performance: A Neural Network Approach Youngohc Yoon and George Swales This study looks at neural network (NN) learning in a comparison of NN techniques with multiple discriminant analysis (MDA) methods with regard to the predictability of stock price performance. Evidence indicates that the network can improve an investor's decision-making capability.	14
Selecting the Right Neural Network Tool (the editors) The pros, cons, user type and cost for various forms of neural network tools: from programming languages to development shells.	19
Product Review: Brainmaker Professional, version 2.53 Mark R. Thomason The journal begins the first of its highly-acclaimed product reviews, beginning with an early commercial neural network development program.	20
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Guest Editorial: Performance Evaluation of Automated Investment Systems Yuval Lirov The author addresses the issue of quantitative systems performance evaluation.	3
Performance Evaluation Overview (the editors)	4
A Primer on Market Forecasting with Neural Networks (Part2) Mark Jurik The second part of this primer covers data preprocessing and brings all of	7

the components together for a financial forecasting example.

A Fuzzy Expert System and Market Psychology: A Primer (Part 2) 12

James F. Derry

The second part of this primer describes several decision-making methods using an example of market psychology based on bullish and bearish market sentiment indicators.

Selecting Indicators for Improved Financial Prediction 16

Manoel Tenorio and William Hsu

This paper deals with the problem of parameter significance estimation, and its application to predicting next-day returns for the DM-US currency exchange rate. The authors propose a novel neural architecture called SupNet for estimating the significance of various parameters.

Selecting the Right Neural Network Tool (expanded) 21

(the editors)

A comprehensive list of neural network products, from programming language libraries to complete development systems.

Product Review: NeuroShell 2 25

Robert D. Flori

An early look at this popular neural network development system, with support for multiple network architectures and training algorithms.

FROM THE EDITOR 2

NEXT-GENERATION TOOLS product announcements and news 28

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January/February 1994

Vol.2, No.1

Title: Chaos in the Markets

Guest Editorial: Distributed Intelligence Systems 5

James Bowen

Addresses some of the issues relevant to hybrid approaches to capital market decision support systems.

Designing Back Propagation Neural Networks:

A Financial Predictor Example 8

Jeannette Lawrence

This paper first answers some of the fundamental design questions regarding neural network design, focusing on back propagation networks. Rules are proposed for a five-step design process, illustrated by a simple example of a neural network design for a financial predictor.

Estimating Optimal Distance using Chaos Analysis 14

Mark Jurik

This article considers the application of chaotic analysis toward estimating the optimal forecast distance of futures closing prices in models that process only closing prices.

Sidebar on Chaos Theory and the Financial Markets 19

(the editors) [included in above article]

A Fuzzy Expert System and Market Psychology (Part 3) 20

James Derry

In the third and final part of this introductory level article, the author discusses an application using four market indicators, and discusses rule separation, perturbations affecting rule validity, and other relational operators.

Book Review: Neural Networks in Finance and Investing 23

Randall Caldwell

A review of a recent title edited by Robert Trippi and Efraim Turban.

Product Review: Genetic Training Option 25  
Mark Thomason  
Review of a product that works with BrainMaker Professional.

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March/April 1994  
Vol.2, No.2  
Title: A Framework

IJCNN '93 8  
Francis Wong  
A review of the International Joint Conference on Neural Networks recently held in Nagoya, Japan on matters of interest to our readers.

Guest Editorial: A Framework of Issues: Tools, Tasks and Topics 9  
Mark Thomason  
Issues relevant to the subject of the journal are extensive. Our guest editorial proposes a means of classifying and organizing them for the purpose of gaining perspective.

Lexicon and Beyond: A Definition of Terms 12  
Randall Caldwell  
To assist readers new to certain technologies and theories, we present a collection of definitions for certain technologies and theories that have become a part of the language of investors and traders.

A Method for Determining Optimal Performance Error in Neural Networks 15  
Mark Jurik  
The popular approach to optimizing neural network performance solely on its ability to generalize on new data is challenged. A new method is proposed.

Feedforward Neural Network and Canonical Correlation Models as Approximators with an Application to One-Year Ahead Forecasting 18  
Petier Otter  
How do neural networks compare with two classical forecasting techniques based on time-series modeling and canonical correlation? Structure and forecasting results are presented from a statistical perspective.

A Fuzzy Expert System and Market Psychology: (Listings for Part 3) 23  
James Derry  
Source code for the last part of the author's primer is provided.

Book Review: State-of-the-Art Portfolio Selection 25  
Randall Caldwell  
A review of a new book by Robert Trippi and Jae Lee that addresses "using knowledge-based systems to enhance investment performance," which includes neural networks, fuzzy logic, expert systems, and machine learning technologies.

Product Review: Braincel version 2.0 28  
John Payne  
A new version of a low-cost neural network product is reviewed with an eye on applying it in the financial arena.

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May/June 1994

Vol.2, No.3

Title: Special Topic: Neural and Fuzzy Systems

Guest Editorial: Neurofuzzy Computing Technology 8

Francis Wong

The author presents an example neural network and fuzzy logic hybrid system, and explains how integrating these two technologies can help overcome the drawbacks of the other.

Neurofuzzy Hybrid Systems 11

James Derry

A large number of systems have been developed using the combination of neural network and fuzzy logic technologies. Here is an overview on several such systems.

Interpretation of Neural Network Outputs using Fuzzy Logic 15

Randall Caldwell

Using basic spreadsheet formulas, a fuzzy expert system is applied to the task of interpreting multiple outputs from a neural network designed to generate signals for trading the S&P 500 index.

Thoughts on Desirable Features for a Neural Network-based  
Financial Trading System 19

Howard Bandy

The authors covers some of the fundamental issues faced by those planning to develop a neural network-based financial trading system, and offers a list of features that you might want to look for when purchasing a neural network product.

Selecting the Right Fuzzy Logic Tool 23  
(the editors)

Adding to our earlier selection guide on neural networks, we provide a list of fuzzy logic products along with a few hints on which ones might most interest you.

A Suggested Reference List: Recent Books of Interest 25  
(the editors)

In response to readers' requests, we present a list of books, some of which you will want to have for reference.

Product Review: CubiCalc Professional 2.0 28

Mark Thomason

A popular, fuzzy logic tool is reviewed. Is the product ready for investors and traders? The answer may be somewhat fuzzy itself.

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OPEN EXCHANGE letters, comments, questions 6

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July/August 1994

Vol.2, No.4

Title: Special Topic: Neural and Genetic Systems

Guest Editorial: Neurogenetics and its use in Trading System Development 8

Jeffrey Katz and Donna McCormick

The authors discuss some of the differences between standard neural technology and neurogenetics, and present a basic example of how an S&P trading system might be developed using neurogenetics.

Neurogenetic Computing Technology 12

Francis Wong

Genetic algorithms can be usefully applied to the optimization of neural networks for forecasting and classification problems. The author discusses

this general application area along with a specific financial application.

An Introduction to Genetic Algorithms: A Mutual Fund Screening Example 16

Richard J. Bauer, Jr.

The basic mechanics of genetic algorithms are covered. A mutual fund screening example is used to illustrate the process and to suggest ways in which the technology might be used to explore various trading strategies.

Selecting the Right Genetic Algorithm Tool 20

(the editors)

Adding to our earlier selection guides on neural networks and fuzzy logic products, we provide a list of genetic algorithm products along with a few hints on which ones might most interest you.

Nonlinear Trading System Costs: Dollars and Time 22

Mark Thomason

The Neurophyte Column: Elements of Interest to the Novice

Book Reviews: Three Books on Time Series Forecasting 26

M. Edward Borasky

A look at three books dedicated to the task of forecasting, with discussion on the important but often-overlooked matter of statistical significance. "The Forecasting Accuracy of Major Time Series Methods", Spyros Makridakis, et al., "Nonlinear Modeling and Forecasting", Martin Casdagli and Stephen Eubank (editors), and "Time Series Prediction", Andreas Weigend and Neil Gershenfeld (editors).

Product Review: MicroGA 30

Steven Swernofsky

A genetic algorithm product for developing applications in C++ is reviewed. It runs on the PC and the Mac, and includes an interesting C++ code generator.

FROM THE EDITOR 5

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September/October 1994

Vol.2, No.5

Title: Special Topic: Neural Network Design

Guest Editorial: A Neural Network Project Roadmap 7

James E. Bowen

An overview of relevant issues and considerations of neural network development projects at a systems level.

Design of Neural Network-based Financial Forecasting Systems:

Data Selection and Data Processing 12

Randall Caldwell

An in-depth review of two tasks critical to neural network design are presented, including metrics, parameters, and concerns of interest to investors and traders.

Design Issues in Neural Network Development 21

Peter C. Davies

The author addresses several fundamental considerations to be made, during the design phase of a project, when developing a neural network application.

Neural Network-based Trading System Design:

Prediction and Measurement Tasks 26

Howard B. Bandy

A discussion of four closely-related tasks fundamental to the design of a neural network-based trading system is provided, along with a spreadsheet implementation of a profitability tester.

Applying Nonlinear Financial Tools: Getting Started	33
Mark R. Thomason	
The Neurophyte Column: Elements of Interest to the Novice	
Book Review: Trading on the Edge	35
Sandy Warrick	
The reviewer looks at a new, ambitious book, edited by Guido Deboeck, that describes a wide variety of new technologies and techniques currently being applied to the world's markets.	
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November/December 1994  
Vol.2, No.6  
Title: Neural Network Implementation

Implementation Issues in Neural Network Development	7
Peter C. Davies	
This article addresses several fundamental considerations to be made, during the implementation phase of a project, when developing a neural network application.	

Discriminant Analysis Versus Neural Networks in Credit Scoring	11
R.J. van Eyden and J.J.L. Cronje	
The authors implementation of a neural network for comparison with multiple discriminant analysis, using a financial application.	

Selecting the Right Neural Network Tool	16
(the editors)	
In support of the task of implementation, we provide an update to our popular guide to neural network products, along with comment on how readers might select the one most appropriate for them.	

A Basic Neural Network-based Trading System Development Project #1	23
Mark Thomason	
The Neurophyte Column: Elements of Interest to the Novice	

Product Review: AIM for Windows	28
Howard B. Bandy	
The Reviewer looks at a modeling product that often compares itself with neural networks, and provides an analysis of its performance using a financial time series.	

Book Reviews: Two recent book on finance and advanced technologies	32
Mark R. Thomason	
Two recent single-author titles of particular interest to most readers are reviewed, one on neural networks and one on genetic algorithm. "Neural Network Time Series Forecasting of Financial Markets" by E. Michael Azoff, and "Genetic Algorithms and Investment Strategies" by Richard J. Bauer, Jr.	

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January/February 1995

Vol.3, No.1

Title: A Competitive Task

Extracting Meaning from a Neural Network 7

E. Michael Azoff

A method for performing weight perturbation differential analysis as a more accurate approach than simple weight magnitude analysis is provided. This supports the claim that the black box tag often attached to neural networks by newcomers to the field is not an inherent property of the technology.

Induction: Learning Rules From Data (Part 1) 11

James F. Derry

The author embarks on the task of extracting expertise from databases for the purpose of market analysis and forecasting, offering insight into a useful tool that may have been overlooked by many investors.

Secondary Pre-processing 17

John Payne

A method for performing a second stage of neural network pre-processing is suggested, using a group of standard functions (squares, square roots and logarithms). The results are tested for empirical evidence of the usefulness of the method.

A Basic Neural Network-based Trading System Development Project #2 23

Mark Thomason

The Neurophyte Column: Elements of Interest to the Novice

An Index to NEUROVEST JOURNAL: September 1993 to December 1994 16

Indexed by general topics is the material published in the Journal to date.

Product Review: Propagator for Windows 28

Howard B. Bandy

An inexpensive, stand alone, neural network development system based on the backpropagation algorithm is reviewed. What are the high and low points of this addition to the commercial neural network product base?

Book Review: An Introduction to the Bootstrap 32

Mark R. Thomason

A book by the inventor of a method for estimating distributions, parameters and error rates is reviewed, including suggestions as to why the method is relevant to investors and traders.

FROM THE EDITOR a competitive task 4

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March/April 1995

Vol.3, No.2

Title: Special Focus: Performance Metrics

NNCM-94 7

Ypke Hiemstra

A review of the Neural Networks in the Capital Markets workshop held last year in Pasadena, California on matters of interest to our readers.

Monitoring Forecast Performance Using the Breakeven Locus 8

E. Michael Azoff

A method for visual, qualitative analysis of trading system performance is

presented, including a practical example of its application.

Performance Metrics for Neural Network-based  
Trading System Development 13  
Randall B. Caldwell

An overview of prediction, neural network, and financial forecasting performance metrics and methods is presented, along with strategies for their application to neural network-based trading system development.

A Basic Neural Network-based Trading System Development Project #3 25  
Mark R. Thomason  
The Neurophyte Column: Elements of Interest to the Novice

The Stochastics Indicator: A New Perspective Using Neural Networks 31  
Randall B. Caldwell  
Technical Analytica: Technical Market Analysis and Insight

Product Review: Neuralyst for Windows 36  
Howard B. Bandy  
The latest version of this popular neural network development system, which functions as an Excel add-in, is reviewed. New features include genetic algorithms and trading system tools.

Book Review: Design, Testing, and Optimization of Trading Systems 39  
Randall B. Caldwell  
One of the few books to focus exclusively on the design and testing of trading systems is reviewed in light of this issue's special focus on the subject of performance metrics.

FROM THE EDITOR performance metrics 4  
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May/June 1995  
Vol.3, No.3  
Title: Special Topic: Chaos in the Markets

Meeting of the Society for Nonlinear Dynamics and Econometrics 7  
Robert McClelland  
A review of the 1995 SNDE meeting in New York on matters of interest to our readers.

A Direct Approach to Forecasting Stock Equities  
using Nonlinear Dynamics Modeling 8  
Bernard V. Kessler  
The first part of an introductory overview of the application of nonlinear dynamics (NLD) and chaos theory to the prediction of stock market equity prices is presented.

A Neural Network Supports the Chaotic Paradigm  
for the S&P 500 Index 16  
Mary E. Malliaris  
Challenging the efficient market hypothesis and supporting those who claim that they have found statistical evidence that a chaotic dynamics structure underlies the market, this paper constructs a neural network which lends support to the deterministic paradigm.

Chaos and Prediction Horizons in Silver Futures Trading 22  
Ted W. Frison  
The dynamical structure of a silver futures contract is determined. The system has chaotic like behavior, the evidence coming from the Lyapunov exponents.



Mark R. Thomason

The Neurophyte Column: Elements of Interest to the Novice

Product Reviews: Three Products on Chaos from the  
Academic Software Library 35

Mark R. Thomason

Three introductory-level software tools on chaos analysis and demonstrations are reviewed from a supplier of educational physics-related software. Chaos Data Analyzer, Dynamics Workbench, and Chaos Demonstrations

Book Review: Fractal Market Analysis 38

Sandy Warrick

The follow-up to the popular title Chaos and Order in the Capital Markets is reviewed in light of its author's continuing study of chaotic financial market behavior.

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July/August 1995

Vol.3, No.4

Title: Going on Three

Supervised Evolution of the Neural Trader Component  
of a Stock Portfolio Trading System (Part 1) 7

David L. March

A method is described for adjusting neural network weights in situations where there is no advance knowledge about the correspondence between the network input and output, and where the target objective or profit function is stepwise instead of continuous.

Induction: Learning Rules From Data (Part 2) 13

James F. Derry

The author completes his report on extracting expertise from databases for the purpose of market analysis and forecasting, offering insight into a potentially useful tool that may have been overlooked by many investors.

The Adaptive Moving Average 18

Howard B. Bandy

In this issue of Technical Analytica the details of constructing and applying adaptive moving averages to trading are described, along with explicit mathematical and spreadsheet formulas.

A Basic Neural Network-based Trading System Development  
Project #5 26

Mark R. Thomason

The Neurophyte column continues with details on training and selecting best networks, this time completing the prediction component of the system.

User Survey '95: Results 30

A summary of the results to our first survey of readers regarding commercial neural network products for financial applications is presented.

Product Review: Pattern Recognition Workbench 32

Howard B. Bandy

A new high-end neural network development system for the professional is reviewed with an eye towards its application to finance.

Book Reviews: Two Books on Neural Networks and C++	35
Mark R. Thomason and Sandy Warrick	
Two recent titles on neural networks, both of which include C++ software on disk, are separately reviewed. "Advanced Algorithms for Neural Networks" by Timothy Masters, and "Neural Network and Fuzzy Logic Applications in C/C++" by Stephen Welstead.	
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September/October 1995

Vol.3, No.5

Title: Special Topic: Anything but Backpropagation

Neural Networks in Finance : Design and Applications,  
Louvain-la-Neuve, Belgium

7

Eric de Bodt

An overview of a recent seminar on neural networks in finance is presented.

Backpropagation versus Conjugate Gradient Training Methods

8

Paul A. Billings

An alternative to backpropagation, with less critical "user-tunable" parameters, is discussed. Benchmarks are generated to compare these two algorithms for training multilayer perceptrons.

The General Regression Neural Network

13

Timothy Masters

An objective and intuitive look at the details of a neural network, as a modification to probabilistic networks to allow for function mapping. Both its strengths and weaknesses are discussed.

Supervised Evolution of the Neural Trader Component  
of a Stock Portfolio Trading System (Part 2)

18

David L. March

The author completes his 2-part report on neural network traders with detailed examples on applying the methods presented earlier to stock portfolio trading.

Improved Prediction Performance Metrics for  
Neural Network-based Financial Forecasting Systems

22

Randall B. Caldwell

This paper presents a study of traditional and new measures for comparing the prediction performance of neural network-based trading systems. Results reported will be of significant interest to trading system developers using neural networks.

Generating Principal Components using TimeStat

27

James Hampton

In this issue of Technical Analytica, the details for using a new freeware product to generate principal components are described.

A Basic Neural Network-based Trading System Development  
Project #6

29

Mark R. Thomason

The Neurophyte column continues with details on training and selecting best networks, this time completing the prediction component of the system.

Product Review: Neural Network Tutor

36

Randall B. Caldwell

A new, unique product on learning neural networks is reviewed, including a

look at its built-in neural network simulator.

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November/December 1995

Vol.3, No.6

Title: Special Topic: Data Selection and Preprocessing

A Resource List:

Software, Books and Articles on Principal Components Analysis 7  
(the editors)

In response to reader requests, we provide a resource on the subject.

Input Variable Set Diversity and a Neural Network's  
Financial Forecasting Ability 8  
Andrew A. Kramer

This paper explores the ability of three different sets of input variables to predict a biotechnology stock index, and compares the results using both multilayer feedforward and generalized regression neural networks.

An Explicit Feature Selection Strategy for  
Predictive Models of the S&P 500 Index 14  
Tim Chenoweth and Zoran Obradovic

This paper focuses on the selection of an appropriate set of features for a feedforward neural network model used to predict both future market direction and future returns for the S&P 500 Index. Daily and monthly predictions of returns and market direction are analyzed.

Three Methods of Neural Network Sensitivity Analysis for  
Input Variable Reduction: A Case Study in Forecasting the  
S&P 500 Index (Part 1) 22  
Randall B. Caldwell

This paper examines three commonly-applied sensitivity analysis methods using a financial forecasting problem for the S&P 500 index as an example. Preliminary results indicate that financial practitioners and researchers should consider the use of alternative sensitivity metrics to those commonly employed.

The Fast Fourier Transform for Analyzing  
Financial Time Series 26  
James Hampton

In this issue of Technical Analytica, the author addresses the processing steps necessary to apply FFTs to time series analysis by financial practitioners. Issues regarding the stationarity and persistence of market cycles are addressed. An approach to using FFTs and cyclic market information as part of a data selection strategy for neural networks applied to forecasting the Dow Jones 20-Bond Average index is presented.

Product Review: GeneHunter 34  
Howard B. Bandy

A new, genetic algorithm add-in product for Excel is reviewed with the financial practitioner in mind.

Book Reviews: Bayesian Forecasting and Artificial Life 38  
James Hampton

Two books on entirely different subjects are reviewed for their relevance to trading and investing. "Applied Bayesian Forecasting and Time Series Analysis" by Andy Pole et al., and "Artificial Life: An Overview" by Christopher Langton.

FROM THE EDITOR	data selection and preprocessing	4
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January/February 1996

Vol.4, No.1

Title: Addressing a Framework of Issues

INFFC Update 7  
A summary of preliminary results of the first International Nonlinear Financial Forecasting Competition is presented.

Forecasting the 30-year U.S. Treasury Bond with a System of Neural Networks 10  
Wei Cheng, Lorry Wagner, and Chien-Hua Lin  
A forecasting model based on a system of artificial neural networks is used to predict the direction of the 30-Year U.S. Treasury Bond on a weekly basis. This paper describes the methods used for data selection, training and testing, the basic system architecture, and how the decision model improved the total system accuracy as compared to individual networks.

Three Methods of Neural Network Sensitivity Analysis for Input Variable Reduction: A Case Study in Forecasting the S&P 500 Index (Part 2) 16  
Randall B. Caldwell  
This paper concludes an examination of three commonly-applied sensitivity analysis methods using a financial forecasting problem for the S&P 500 index as an example. Preliminary results indicate that financial practitioners should consider the use of alternative sensitivity metrics to those commonly employed.

Rescaled Range Analysis:  
Approaches for the Financial Practitioner (Part 1) 23  
James Hampton  
Technical Analytica: This paper begins an investigation of the application of rescaled range (R/S) analysis techniques to analyzing financial time series. An example using the S&P 500 daily index is utilized to illustrate the material presented.

Principal Components Analysis for Neural Network Input Variable Reduction and Financial Forecasting (Part 1) 29  
Mark R. Thomason  
The Neurophyte: Principal components analysis (PCA) has been successfully applied to neural network-based systems in finance, particularly in the area of dimension reduction and input variable selection. This paper presents an objective analysis of PCA accessible to the financial practitioner and to the applied researcher interested in exploring financial applications, providing a foundation for future work on the subject.

Book Review: The Fuzzy Systems Handbook 33  
James F. Derry  
A popular and very readable tutorial on the subject of fuzzy systems, complete with practical examples and C++ code, is reviewed.

An Index to the NEUROVEST JOURNAL:  
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An index for locating past articles and reviews in volumes 1, 2 and 3.

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March/April 1996

Vol.4, No.2

Title: Special Topic: Visualization Tools for Complexity and Finance

#### Visualization Tools for Complexity and Finance

(or Looking Before We Leap)

7

James Hampton and Randall Caldwell

Before embarking on the development of new visualization tools for implementation on advanced visualization platforms, it is important to briefly review some of the tools and techniques currently available to us, as practitioners and applied researchers in finance.

#### An Overview of Data Dimensions and Visualization

14

Brand Fortner

An introductory overview of data dimensions and visualization is presented. The purpose is to illustrate the following: for all kinds of data, even financial data, being fully aware of its dimensionality can be very helpful to visualization and analysis tasks.

#### Visualization and Neural Network Tools under Linux

21

Kenneth Lin

Hundreds of powerful and useful software programs are available which run under Linux, a public-domain version of Unix for the Intel x86 platform. This introductory paper presents information on a few of those programs which support visualization applications and neural network development.

#### A Visualization Technique for Selecting

Neural Network Trading Thresholds

25

James Hampton

Trading systems which use neural networks trained to predict future price variances are often based upon a single pair of crossover thresholds as part of a trading strategy. This paper proposes a visualization method that can be used to greatly simplify the task of selecting the most robust yet profitable trading thresholds based on common risk and reward measures.

#### Principal Components Analysis for Neural Network Input

Variable Reduction and Financial Forecasting (Part 2)

30

Mark R. Thomason

The Neurophyte: Principal components analysis (PCA) has been successfully applied to neural network-based systems in finance, particularly in the area of dimension reduction and input variable selection. This paper presents an objective analysis of PCA accessible to the financial practitioner and to the applied researcher interested in exploring financial applications, providing a foundation for future work on the subject.

#### Product Review: MatLab and Neural Network Toolbox

35

Mark Thomason

The latest version of a popular program which integrates matrix computation, numerical analysis, signal processing, data analysis, and graphics into a common interactive environment is reviewed along with its neural network add-on toolbox.

#### FROM THE EDITOR visualization tools for complexity and finance

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#### OPEN EXCHANGE letters, comments and questions

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the elements of graphing data

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May/June 1996  
Vol.4, No.3  
Title: Back to Basics

Conference Report: CIFEr '96	7
Mario Bortoli	
A report on the second conference on "Computational Intelligence in Financial Engineering.	

Applying Neural Networks and Genetic Algorithms to Tactical Asset Allocation	8
Ypke Hiemstra	
Tactical Asset Allocation (TAA) involves the prediction of asset class returns and adjustment of the strategic portfolio. The paper claims that by its very nature the return generating process is nonlinear, and presents a neural network that applies a fundamental approach to predict the S&P500. An optimization model using genetic algorithms exploits the predictions to adjust the strategic portfolio.	

Using a Fuzzy Logic Model for Portfolio Insurance of Japanese Stocks	16
Kay-Hwang and Woon-Seng Gan	
In this paper a portfolio insurance strategy based on Nikkei Stock Index Futures is used to insure a portfolio of Japanese Stocks which has the same component stocks as in the Nikkei 225 Stock Index. A new approach using fuzzy logic is developed to decide when to rebalance the replicating portfolio, and is compared with the conventional method which rebalances the portfolio daily.	

Rescaled Range Analysis: Approaches for the Financial Practitioner (Part 2)	23
James Hampton	
Technical Analytica: The second part of a paper which investigates the application of rescaled range (R/S) analysis techniques to analyzing financial time series. An example using the S&P 500 daily index is utilized to illustrate the material presented.	

Neural Network Input Variable Selection (Revisited)	30
Mark R. Thomason	
The Neurophyte: Methods for selecting variables as inputs to neural networks for financial forecasting purposes represent a subject of considerable interest. This paper briefly elaborates on the topic and discusses the related topics of multicollinearity, degrees of freedom and performance metrics.	

Product Review: NeuroGenetic Optimizer	35
Mark Thomason	
The latest version of a neural network development system which uses genetic algorithms to optimize network architectures and input variables is reviewed. The software includes special features for time series prediction.	

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July/August 1996  
Vol.4, No.4

INFFC Update

7

Manoel F. Tenorio and Randall B. Caldwell

The latest on the first International Nonlinear Financial Forecasting Competition, along with final results for the Prediction Strategy entries.

Nonstationary Time-Series Forecasting within a  
Neural Network Framework

9

Sara M. Abecasis and Evangelina S. Lapenta

Modeling and forecasting the behavior of univariate time series with the back-propagation learning algorithm is presented in this paper.

Nonstationary time series were mapped to stationary ones by the use of the power transformation. Some success was achieved regarding predictions based on the validation data samples.

Nonstationary State Space Models for  
Multivariate Financial Time Series: An Introduction

17

Mario Bortoli

A simple class of State Space Models is presented, as black-box, parametric, stochastic and dynamic models that can be effectively used to describe the dynamics of nonstationary multivariate time series. A brief comparison between State Space Models and other techniques (Auto Regressive Integrated Moving Average, Error Correction Models and Neural Networks) is proposed. An example for predicting financial time series is presented.

Rescaled Range Analysis:

Approaches for the Financial Practitioner (Part 3)

27

James Hampton

Technical Analytica: The third part of a paper which investigates the application of rescaled range (R/S) analysis techniques to analyzing financial time series. An example using the S&P 500 daily index is utilized to illustrate the material presented.

An Introduction to Nonstationary Analysis and  
Financial Time Series Preprocessing

31

Mark R. Thomason

The Neurophyte: Reviewed is the procedure of price differencing for financial time series, its use in conjunction with other preprocessing techniques, its association with data stationarity in the context of the time-frequency relationship, along with the autocorrelation function for analysis. Discussion addresses practical considerations to be made when applying filtered data as inputs to neural network predictors.

Product Review: Market Skill-BUILDER

37

James Hampton

A new tool for developing trading skills within a familiar spreadsheet environment is reviewed.

FROM THE EDITOR nonstationary analysis and finance

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September/October 1996

Vol.4, No.5

Title: On Non-Traditional Tools

Regime Signaling Techniques for  
Non-Stationary Time-Series Forecasting

7

Radu Drossu and Zoran Obradovic

An accuracy-based signaling technique as an alternative to statistics-based

signaling for detecting changes in a time series distribution is proposed. The validity of the proposed technique is evaluated in the context of either low-noise or high-noise, non-stationary time series.

#### Comparing Conventional and Artificial Neural Network Models for the Pricing of Options on Futures 16

Paul Lajbcygier, Christopher Boek, Andrew Flitman and Marimuthu Palaniswami

Pricing of American-style options on futures is compared using conventional models and artificial neural networks. The conventional models used in the evaluation are the Black-Scholes, the modified Black and the Barone-Adesi/Whaley models, while the alternative considered are feedforward artificial neural networks.

#### Rescaled Range Analysis:

Approaches for the Financial Practitioner (Part 4) 24  
James Hampton

Technical Analytica: The final part of a paper which investigates the application of rescaled range (R/S) analysis techniques to analyzing financial time series. The series concludes with a discussion on applying local Hurst estimates as inputs to neural network-based financial forecasters.

#### Selecting the Right Neural Network Tool — Third Edition 33 (the editors)

Our first update on commercial neural network products in almost two years is presented. Results from our survey of vendors indicate that, though there are a few new players, the overall number has substantially decreased.

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November/December 1996

Vol.4, No.6

Title: Predictors Anonymous

#### Neural Network Model Development and Optimization 7 Costas Siriopoulos and Raphael N. Markellos

This paper is concerned with applying artificial neural network (ANN) models in forecasting financial time series. The methodology includes a model development and optimization stage and the translation of forecasts into investment timing decisions. Performance is evaluated in terms of both statistical and economic significance. The use of BDS and R/S analysis results for ANN modelling is explored.

#### Qualitative Information in Finance:

Natural Language Processing and Information Extraction 14  
Marco Costantino, Russell J. Collingham and Richard G. Morgan

This article describes the importance of qualitative information in the financial operators' investment decision-making process and how natural language processing can be successfully used for processing and analyzing such information. Natural language processing is briefly compared to other artificial intelligence techniques which are widely employed in finance: neural networks and expert systems.

#### Rough Sets Help Time the OEX 20 Chris Skalkos

Technical Analytica: This paper describes an application of rough sets



analysis to trading the OEX. Using rough sets techniques, a set of rules for short-term trading the OEX based on the Hines indicator is extracted. A system is then developed, encompassing all of the derived rules, in order to evaluate trading system performance.

Application of Wavelet Filters to Non-Stationary Financial Time Series	29
Mark R. Thomason	

The Neurophyte: This paper proposes an application of the discrete wavelet transform to the processing of nonstationary data within the context of financial time series analysis and prediction. Shortcomings, limitations and advantages of wavelets, with respect to filtering financial time series for prediction applications, are discussed.

Product Review: ThinksPro	38
Mark R. Thomason	

A new comprehensive neural network development system, with features for time series analysis and an abundance of network options and parameters, is reviewed.

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January/February 1997

Vol.5, No.1

Title: Special Topic: Hybrid Neural Networks for Financial Forecasting

Guest Editorial: Hybrid Intelligence for Financial Forecasting	4
Zoran Obradovic	

A look at the papers and the topic of this special issue by our guest editor.

A Neural-Fuzzy System for Financial Forecasting	7
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Zuohong Pan, Xiaodi Liu and Olugbenga Mejabi

This paper introduces a hybrid Neural-Fuzzy system for financial modeling and forecasting. The model's performance is compared with a random walk model, an ARIMA model, a regression model corrected for autocorrelation, a regression corrected for autoregressive conditional heteroskedasticity, and a regression model corrected for both autocorrelation and ARCH. The power and predictive ability of the models are evaluated on the basis of mean absolute error, root mean squared error, turning point prediction, pattern recognition, correlation between output pattern and actual pattern, and conditional efficiency.

A New Neural Network for Nonlinear Time-Series Modeling	16
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Amir Hussain, John J. Soraghan and Tariq S. Durrani

This paper describes a new two-layer linear-in-the-parameters feedforward network termed the Functionally Expanded Neural Network (FENN). The new structure can be considered to be a hybrid neural network incorporating to a variable extent the combined modeling capabilities of the conventional Multi-Layered Perceptron (MLP), Radial Basis Function (RBF) and Volterra Neural Networks (VNN) structures. Simulated chaotic Mackey-Glass time series and real-world noisy, highly non-stationary sunspot and actual stock market time series data are used to illustrate the superior modeling and prediction performance of the FENN compared with other recently reported, more complex feedforward and recurrent neural network based predictor models.

The Pricing and Trading of Options using a  
Hybrid Neural Network Model with Historical Volatility 27  
Paul Lajbcygier, Andrew Flitman, Anthony Swan and Rob Hyndman  
The residuals between conventional option pricing models and market prices have persistent patterns or biases. The "hybrid" method models the residuals using an artificial neural network. The pricing accuracy of the hybrid method is demonstrated on real data using the Australian All Ordinaries Share Price Index options on futures and is compared with all major competing conventional models. The hybrid method is found to be both statistically and economically superior to the conventional models alone.

A First Multi-Network Hybrid for Financial Forecasting 41  
Mark R. Thomason  
The Neurophyte: A basic approach to designing and analyzing multi-network hybrids for financial forecasting is presented. The hybrid consists of the combination of three MLP neural networks using simple linear combining techniques. Several market indicators are used as network input variables to forecast weekly S&P 500 prices at different horizons. The prediction and trading performance of the hybrid network is compared with that of the individual networks and a buy-and-hold trading strategy.

Product Review: The Financial Toolbox 45  
Mark R. Thomason  
A new toolbox from the maker of MatLab is reviewed with the interests of practitioners and applied researchers in finance in mind.

FROM THE EDITOR hybrid neural networks for financial forecasting 5  
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March/April 1997  
Vol.5, No.2  
Title: In Search of a Discipline

Forecasting the CHF-USD Exchange Rates  
using Neural Networks 7  
Jingtao Yao, Yili Li and Chew Lim Tan  
A study of using neural networks to predict the exchange rates between Swiss Francs and American Dollars. Results show that a simple backpropagation-trained network with efficient learning and a simple set of technical indicators as inputs serves well as a predictive model. Issues on the frequency of sampling, choice of network architecture, forecasting periods, and measures for evaluating the model's predictive power are discussed.

Improving Decision-Making in the Financial Markets  
with the Probabilistic Neural Network Paradigm 14  
Mike P. Foscolos and Sujinda Nilchan  
This paper demonstrates the probabilistic neural network to be theoretically and practically the most suitable neural network algorithm for financial decision-making. The authors compare the decision-making ability of the probabilistic algorithm with the commonly-applied standard backpropagation algorithm and decisions formulated by fundamental financial analysts.

Time Synchronization of Technical Indicators  
as Model Inputs 22  
James Hampton  
Technical Analytica: Published reports on techniques applied in support of cycle analysis, technical analysis, and leading/lagging indicators often rely on the frequently subjective interpretation of charts and charting methods, and the existence of persistent, periodic market characteristics. Here, several issues are reviewed regarding phase and the time

synchronization of variables applied to data-driven financial systems.

Financial Forecasting with Wavelet Filters  
and Neural Networks

27

Mark R. Thomason

The Neurophyte: Band-pass filters based on wavelets for pre-processing inputs to neural network-based financial forecasters are studied. Results are compared with simple high-pass and low-pass filters. Results indicate that, for the dataset and test period studied, the wavelet filters provide improvement over the benchmark filters when used with neural networks for forecasting the S&P 500 Index.

Product Review: WAVEWI\$E Market Spreadsheet and Data Server 36  
Edward Weiss

The new version of this spreadsheet application, with features specifically designed for data manipulation, market analysis and testing trading systems, is considered.

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May/June 1997

Vol.5, No.3

Title: Special Topic: Data Mining for Financial Applications

Database Mining/Knowledge Discovery in  
Financial Databases: An Overview

5

James F. Derry

An overview of database mining methods and implementations is presented. Of interest are financial applications in the areas of investing, trading, stock selection and portfolio optimization. The use of software agents for searching financial information on the Internet are addressed.

Sidebar: Rough Sets, Rough Neurons, Induction and  
Data Mining #2

10

Edward Weiss

Self-Organizing Data Mining for a Portfolio Trading System 12

Frank Lemke and Johann-Adolf Mueller

This paper describes the application of data mining algorithms for a portfolio trading system. Parametric models are adaptively created from data by the Group Method of Data Handling (GMDH) in the form of networks of optimized transfer functions. Nonparametric models are selected from a given variable set by analog complexing, representing one or more patterns of a trajectory of past behavior which are analogous to a chosen reference pattern. The trading system simulates trading a portfolio of diverse stocks using daily out-of-sample price data.

A Qualitative Approach to Pattern Identification for  
Financial Data Mining

27

Mirko Dohnal

This paper considers Interest Rate (IR) and Purchasing Rate (PR) models as two methods for forecasting exchange rates. An integrated model is created by merging IR and PR models using qualitatively-degraded conventional equations. Lists of all possible qualitative scenarios are generated as part of the case study presented in this paper. Qualitative scenarios result in the development of transition graphs, which capture all possible transitions between the scenarios. Since transition graphs provide insight into possible future market behavior, qualitative modelling can provide a tool for financial forecasting.

Data Mining with the ADX Indicator using Neural Networks James Hampton Technical Analytica	37
Data Mining and Financial Forecasting with a Probabilistic Neural Network Mark R. Thomason The Neurophyte	39
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July/August 1997

Vol.5, No.4

Title: Practice versus Research

Company Viability Prediction using Neural Networks  
with Sparse Data 5

Jeroen van Bussel and Leo P.J. Veelenturf

In research related to neural networks, the quantity of data is often restricted with respect to its dimension. This shortage of data occurs in problems such as the forecasting of the financial condition of a company. This paper describes the prediction of company viability using neural networks. Because of the large dimensional input space and limited datasets, three methods were examined for reducing the dimension of the input.

Predicting Deterministic Chaotic Time Series 14

Tim S. Hatamian

Auto-regressive (AR) linear prediction is a method commonly used to forecast the future values for a time series generated by a linear-stationary system. Extension of the method to (stationary) nonlinear systems requires a bit of non-trivial work. The basic derivation of these methods and several examples are discussed in the context of forecasting stock or futures prices.

The ABC's of BDS 22

Kenneth Lin

The BDS statistic represents a widely-used modern tool for testing serial dependence in a time series. It has demonstrated capabilities for detecting serial correlation even in difficult chaotic time series where others methods fail. It can thus be an effective tool for determining the forecastability of a time series. A very brief guide to the BDS test along with examples and software is presented.

Market Volatility as a Leading Indicator 27

James Hampton

Technical Analytica

Residual Analysis for Neural Network Financial Predictors:  
An Introduction 30

Mark R. Thomason

The Neurophyte

Product Review: Neural Connection 36  
Edward Weiss

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September/October 1997

Vol.5, No.5

Title: On Qualitative versus Quantitative Methods

An Appraisal of Various Linear and Nonlinear Methods

Utilized for Combining Neural Network Predictors:

A Practitioner's Perspective 5

Robert J. Van Eyden

Seeing a phenomenon once does not mean it is de facto or de rigour. However, multiple observations can lead to the conclusion that it is to be expected or may be considered a natural consequence. The same notions hold for time series forecasting especially in the financial markets where the data is inherently noisy. In this arena, reliance on a single neural network result could be deemed unacceptable. This study seeks to combine the results of a collection of neural network forecasters in various manners to determine the best combination method for forecasting the South African long bond rates.

Modelling the Merval Index with Neural Networks

and the Discrete Wavelet Transform 15

Sara M. Abecasis and Evangelina S. Lapenta

The crux of this research is the evaluation of the effectiveness of a neural network implementation for modelling the share prices of the Argentine stock index named MERVAL, taking into account the influence of different indices of the New York Stock Exchange. Four methods of sensitivity analysis and the Discrete Wavelet Transform are considered. Different metrics were applied for the purpose of determining the performance of the neural networks implemented.

Neural Network Approximation of Option-Pricing

Formulas for Analytically Intractable Option-Pricing Models 20

Michael Hanke

A new method which combines numerical approximation techniques and artificial neural networks is used to approximate formulas for option prices and derivatives. Using this method, highly precise analytical formulas can be derived for option types (American, Asian, binaries,...) and models (GARCH, stochastic volatility,...) that are otherwise analytically intractable. Using the formulas derived according to this new approach, option prices and greeks under these models can be computed instantaneously.

The Construction of Risk-Adjusted Returns as Target Variables 28

James Hampton

Technical Analytica

A Primer on Radial Basis Function Networks for

Financial Forecasting 32

Mark R. Thomason

The Neurophyte

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Mark R. Thomason

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November/December 1997  
Vol.5, No.6  
Title: On the Science of Finance

Backtesting Trading Systems	5
Raphael N. Markellos	
Several procedures are described that can be used to assess the historical performance of trading systems on the basis of statistical and financial criteria. These procedures range from informal graphical analysis to sophisticated statistical techniques that employ GARCH modelling, cointegration analysis and bootstrapping simulation.	
Adaptive Supervised Learning Decision Networks for Trading and Portfolio Management	11
Lei Xu and Yiu-Ming Cheung	
A trading and portfolio management system is proposed, based on an Adaptive Supervised Learning Decision Network, which learns the best past investment decisions directly instead of making predictions first and then making investment decisions based on the predictions. Without any additional effort, this network can be realized directly utilizing any existing adaptive supervised-learning neural network.	
Multivariate Embedding Methods: Forecasting High-Frequency Financial Data in the First INFFC	17
Carol Alexander and Ian Giblin	
A forecasting method is described, where each point to be forecast is embedded in an m-dimensional library made from historic data. The approach is based on the well-known 'nearest neighbor' algorithm but there are important differences, including the facility for multivariate embedding, the use of predictor variables which may be different from the embedding variables, and the 'rolling library' which is of a constant size but is continuously updated as each successive point is forecast.	
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January/February 1998

Vol.6, No.1

Title: Special Topic: Improving Generalization for Nonlinear Financial  
Forecasting Models

## Wavelet-based Density Estimator Model for Forecasting 6

Zuohong Pan and Xiaodi Wang

A nonparametric model for financial time series forecasting is presented. To address the issue of generalization in estimation, a density estimator based on wavelets is first established. Then, information in the given data is denoised through wavelet shrinkage to extract the true pattern, while ignoring the disturbing noises.

Exploiting Local Relations as Soft Constraints to  
Improve Forecasting 14

Andreas S. Weigend and Hans Georg Zimmermann

This paper introduces a new architecture for the development of predictive models for financial data. On the output side, we predict dynamical variables such as first derivatives and curvatures on different time spans. On the input side, we propose a new internal preprocessing layer connected with a diagonal matrix of positive weights to a layer of squashing functions.

The Use of Parsimonious Neural Networks for  
Forecasting Financial Time Series 24

Robert Dorsey and Randall Sexton

A genetic algorithm is used for global search and, by modifying the objective function, is used to simultaneously select a parsimonious structure. The chosen structure often eliminates all connections to unnecessary variables and thus identifies irrelevant variables. Models with the complete architecture are compared to those with the reduced structure. Based on the preliminary model analysis a composite model is constructed.

## Adaptive Local Linear Models for Financial Time Series 32

Claudio Pizzi and Paolo Pellizzari

An adaptive local linear approach to model and forecast financial time series is developed. Local Linear Approximation (LLA) is estimated by a fuzzy weighted regression, where weights are essentially similarities between vectors of lagged observations (patterns). Hence, forecasts are mainly due to patterns that most resemble the vector containing the current observation. The method represents a flexible tool both in modeling nonlinearities and in coping with weak non-stationarities.

## Rough Set Theory: The Basics (Part 2) 40

James Hampton

The Practitioner: Technology

## Dynamic Normalization: Outliers and Time 43

Mark R. Thomason

The Practitioner: Method

## Product Review: ROSETTA 45

James Hampton

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March/April 1998

Vol.6, No.2

Title: Special Topic: New Directions in Financial Research

Wavelet-Based Feature Extraction and Decomposition Strategies  
for Financial Forecasting 5

Alex Aussem, Jonathan Campbell, and Fionn Murtagh

A wavelet decomposition of the original time series, with an adaptation accounting for the time-varying nature of the data, is first carried out to decompose the data into varying scales of temporal resolution. In transform space, a dynamic recurrent neural network (DRNN) is trained to provide five-day ahead forecasts for the S&P500 closing prices.

A Genetic Adaptive Neural Network Approach to Pricing Options:  
A Simulation Analysis 13

A. Jay White

This study examines a Genetic Adaptive Neural Network's (GANN) ability to approximate a pre-specified option-pricing function. It is shown that the GANN is able to approximate, to a high degree of accuracy, the complex, nonlinear option-pricing function used to produce the simulated call and put option prices.

Intelligent Stock Trading Decision Support System through the Integration  
of Artificial Neural Networks and Fuzzy Delphi Models 24

R.J. Kuo, L.C.Lee and C.F.Lee

Most research on the stock market is limited to the study of quantitative factors, such as price and volume data, instead of qualitative factors, such as political effects. However, qualitative factors play a critical role in the stock market environment. The proposed system consists of four parts: (1) factors collection, (2) a quantitative model, (3) a qualitative model, and (4) a decision integration.

## Rough Set Theory: The Basics (Part 3) 35

James Hampton

The Practitioner: Technology

## Predicting and Trading the Sharpe Ratio 38

Mark R. Thomason

The Practitioner: Method

## Product Review: BrainMaker Professional/MMX 42

James Hampton

## FROM THE EDITOR new directions in financial research 4

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May/June 1998

Vol.6, No.3

Title: On Market Efficiency and the Internet

Hierarchical and Feed-Forward Fuzzy Logic Systems for Interest  
Rate Prediction 5

Masoud Mohammadian, Mark Kingham and Bob Bignall

The development of novel hierarchical and feed-forward fuzzy logic systems using genetic algorithms is discussed. The systems developed are used for the prediction and modelling of fluctuations in interest rates in Australia. A genetic algorithm is proposed as a method for learning the fuzzy rules. The



results from the hierarchical and feed-forward fuzzy logic systems are compared.

Discovering Lawlike Regularities in Financial Time Series 12  
Boris Kovalerchuk and Evgenii Vityaev

This paper seeks to discover regularities in financial time series using Machine Methods for Discovering Regularities (MMDR) and a related "discovery" software system. This is accomplished by combining mathematical logic and probability theory in data mining. Discovered regularities were used for forecasting a target variable, represented by the relative difference in percent between today's closing price for the S&P 500 daily index and the price five days ahead.

Application of Reasoning Neural Networks to Financial Swaps 27  
Ray Tsaih, Wei-Kuang Chen and Yi-Ping Lin

This study investigated two learning procedures to see which is better at extracting the trend of asset price movements. One is the Back Propagation learning algorithm, the other is a learning procedure call Reasoning Networks using Back Propagation. For this investigation, the application of these two learning procedures to forecasting the trends of interest-rate swap midrates is considered.

Model Validation by the Bootstrap 38  
James Hampton and Edward Weiss  
The Practitioner: Method and Tools

Product Review: S-PLUS 4.0 44  
Mark R. Thomason

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July/August 1998

Vol.6, No.4

Title: Complexity and Dimensionality Reduction in Finance - Part 1

Complexity Reduction for Co-Trending Variables 6

Raphael N. Markellos and Terence C. Mills

Complexity reduction techniques for systems comprising co-trending variables are commonly used by financial practitioners in the form of simple ratios.

The construction of ratios and ratio-based forecasting models and be formalized and improved upon using cointegration analysis and error-correction modeling, respectively. This paper reviews these methods and discusses a complexity reduction example in finance.

Forecasting Financial Time Series Using Stacked Generalization 14  
James V. Hansen and Ray D. Nelson

This paper explores the efficacy of stacking models that in tandem accomplish data filtering and feature extraction, utilizing methods from both the statistics and machine learning communities. A meta-algorithm is provided along with evidence on reduction in the dimensionality of the search presented to the highest-level generalizer.

Applying Quantitative Representations to Data Mining in Financial Time-Series Databases 25

Xuemei Shi and Man-Chung Chan

One quantitative approach to data mining involves the extraction of general patterns from massive original data in terms of qualitative and linguistic variables. A critical problem associated with applying qualitative representations to time-series data is maintaining linguistic variables which are consistent over time. A new technique is proposed in

this paper for solving this problem.

## Non-Traditional PCA for Dimensionality Reduction of Financial Forecasting Models 34

Mark R. Thomason

The Practitioner: Method and Tools

## Product Review: SIMSTAT for Windows 40

Mark R. Thomason

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evolutionary algorithms in engineering applications

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September/October 1998

Vol.6, No.5

Title: Complexity and Dimensionality Reduction in Finance - Part 2

## Bayesian Ying-Yang Dimension Reduction and Determination 6

Lei Xu

A new general theory is proposed for dimension reduction and determination (DRD), based on the so-called Bayesian Ying-Yang (BYY) learning theory developed in recent years. Examples presented include (a) a new algorithm for factor analysis in both batch and adaptive modes, (b) criteria for determining the number of factors and the dimension of the PCA subspace, (c) a procedure for implementing a specific nonlinear BYY DRD based on gaussian mixtures, and (d) extensions for auto-association and LMSER-based nonlinear PCA. Some experimental results are provided.

## Time Deformation: Definition and Comparisons 19

Gaelle Le Fol and Ludovic Mercier

The practical importance of time deformation is to give a preprocessing technique to obtain a regularly spaced grid of data. A new trading strategy in which the trading timepoints are endogenous to prices is presented. It is shown that a changing timescale can improve daily gains.

## Identifying Irrelevant Input Variables in Chaotic Time Series Problems:

Using a Genetic Algorithm for Training Neural Networks 34

Randall S. Sexton

Because gradient search techniques are incapable of identifying unneeded weights in a solution, researchers have not been able to distinguish contributing inputs from those that are irrelevant. By using a global search technique (the genetic algorithm) for neural network optimization, it is possible to identify unneeded network weights and, thus, irrelevant input variables. This paper demonstrates, through an intensive Monte Carlo study, that the genetic algorithm can be utilized to automatically reduce the dimensionality of neural network models during network optimization.

## Reducing Serial Bias of Direction-Oriented Forecasting Metrics 42

Mark R. Thomason and Randall B. Caldwell

The Practitioner: Method

Most financial forecasting performance criteria of practical benefit are functions of market direction. However, performance criteria that reward correct forecasts of market direction will naturally over-estimate performance on datasets that exhibit significant serial dependency in market direction. Here, two of many possible approaches for working with performance measures that are inherently biased in trending markets are considered.

## Product Review: NeuroShell Trader

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November/December 1998

Vol.6, No.6

Title: On Intra-Market Analysis

#### Self-Organizing Maps for Data Analysis: An Application to the Belgian Leasing Market

5

Eric de Bodt, Emmanuel-Frederic Henrion, Marie Cottrell, and  
Charles Van Wymeersch

Self-Organizing Maps (SOM) have been used a great deal for data analysis in recent years. Here, we propose an application to a large real dataset, composed of the financial ratios of more than 12,000 Belgian companies. The objective of the study is to understand the role of leasing as a financing tool at the disposal of companies. The results clearly emphasize that the nonlinear and robust properties of SOM make this tool very useful for gaining a deeper understanding of the financing behavior of firms through the analysis of their accounting data.

#### Building a Warrant Trading System using Hierarchical Neural Networks

25

Kwok-fai Cheung and Kin-hong Wong

In this paper, a warrant trading system based on the warrant sensitivity formula is proposed. The estimation of parameter functions of the warrant sensitivity model is carried out by two methods: (1) computed analytically, (2) estimated by a hierarchical Correlation Basis Function (CBF) network. From our simulation results using 43 warrants, both the hierarchical CBF network trading system and the CBF network valuation trading system can outperform the analytical Black-Scholes formula and the warrant sensitivity formula respectively with regard to profitability.

#### Optimization of a Trading System using Global Search Techniques and Local Optimization

36

Donald L. Iglehart and Siegfried Voessner

In this paper, we present a Hybrid Algorithm (HA) that combines a robust genetic algorithm (GA) with a local optimization technique (LOT). The LOT uses a quasi-Newton algorithm (QNA) for continuous variables and a hill-climbing algorithm (HCA) for discrete variables. HA is applied to a rule-based system for trading the S&P500 Index using daily closing prices. The HA, which we compare to other algorithms, is shown to improve the performance of this trading system in a reasonable amount of computer time without using any previous knowledge of good parameter values.

#### Risk Management: The Equity Curve Revisited

47

James Hampton

The Practitioner: Method and Tools

Parameters that describe risk management criteria will naturally vary among investors and traders. One popular indicator for measuring risk is maximum equity drawdown. This article takes a new look at equity curves and drawdown as part of an investigation that encompasses equity variance and trendlines.

#### Product Review: BioComp Profit

51

Mark R. Thomason

#### FROM THE EDITOR on intra-market relationships

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#### REVIEWS IN BRIEF

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a guide to econometrics, 4th edition (book)

MUSINGS OF NOTE reflections on the literature

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January/February 1999

Vol.7, No.1

Title: On Frequentist versus Bayesian Inferencing

Predicting Real Estate Returns using Neural Networks 5

Rakesh Bharati, Vijay S. Desai, and Manoj Gupta

Examined are the predictability of returns on real estate assets by employing variables used in the finance and economics literature. Rather than using conventional linear regression models to predict returns, a class of nonlinear models, namely neural networks, are used. The use of neural networks is motivated by the statistical evidence of neglected nonlinearity reported in this paper. A variety of methods for testing nonlinearity are employed.

Chaotic Prediction Applied to Financial Time Series 16

Carlos. A. Thompson, Claudio F. Silva, and Fabio Hochleitner

This paper deals with the development of a nonlinear Chaotic Prediction Method (CPM) to calculate the one-day-ahead forecasts for several values of the learning set size  $s$ , the maximum memory  $p$  and the retained dominant modes  $d$ . A software package especially developed for this work demonstrates, throughout computer experiments, that the predicted values strongly depend on the variation of these parameters. Artificial Neural Networks (ANN) are also used as an independent tool to estimate the time series data.

Neural Networks vs. Black-Scholes: An Empirical Comparison  
of the Pricing Accuracy of Two Fundamentally Different Option  
Pricing Methods 26

Michael Hanke

The aim of this paper is to empirically compare the pricing accuracy of the Black-Scholes formula to that of option pricing formulas approximated by neural networks. After demonstrating that previous comparisons found in the literature do not distinguish between forecasting and pricing capabilities of neural networks, it is shown that even in a framework that is advantageous for the Black-Scholes model, neural networks prove superior in terms of pricing accuracy.

Cointegration 101 35

James Hampton

The Practitioner: Method and Tools

Cointegration, as a tool for removing nonstationarity and reducing model dimensionality, can be perplexing to any new user. This article provides a brief overview of cointegration, unit root tests and error correction models for the purpose of preparing practitioners for the effort that may be required of them should they want to explore this tool in detail.

Product Review: Time Series and Forecasting for SimStat 39

Mark R. Thomason

Journal Index 42

An index to journal articles and reviews for Volumes 1 - 6.

FROM THE EDITOR on frequentist versus bayesian inferencing 4

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REVIEWS IN BRIEF 47

industrial applications of neural networks (two books of the same title)

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March/April 1999

Vol.7, No.2

Title: Financial News Analysis using Distributed Data Mining

Text Processing for Classification 6

Vincent Cho, Beat Wüthrich and Jian Zhang

These days textual information becomes increasingly available through the Web. This makes text an attractive resource from which to mine knowledge. The major difficulty in mining textual data is that the information is unstructured. Hence the data has to be preprocessed first so as to obtain some form of structured data which is amenable to data mining techniques. This paper focuses on this preprocessing step. The prediction accuracy achieved by the best text processing method is very close to what can be expected by human experts.

Analysis of Dealers' Processing Financial News  
Based on an Artificial Market Approach  
Kiyoshi Izumi and Kazuhiro Ueda

23

In this study we used a new agent-based approach to analyze the ways that dealers in a foreign exchange market process the information in financial news. An artificial market model is constructed using a Genetic Algorithm. Using the simulation results, we classified, according to the ways that agents regard the news, three categories of news data. We conclude that emergent phenomena can be explained by the phase transition of forecast variety, which is due to the interaction of agent forecasts and the demand-supply balance.

IE-Expert: Integrating Natural Language Processing and Expert System  
Techniques For Real-Time Equity Derivatives Trading  
Marco Costantino

34

Quantitative data are today largely analyzed by automatic computer programs based on traditional or artificial intelligent techniques, which provide traders with quantitative information that helps them hedge their risks. Qualitative data and, in particular, articles from on-line news agencies are instead not yet successfully processed. As a result, financial operators, notably traders, suffer from qualitative data-overload. This paper describes how Natural Language Processing, Information Extraction and Expert Systems can be used for reducing the traders' qualitative information overload.

Mining Financial News  
James Hampton

53

The Practitioner: Method and Tools

Data-driven market-forecasting tools primarily rely on quantitative information. Such information conforms well to forecasting models that are developed using algorithms which sequence through explicit, discrete samples of numbers. However, because of this, an abundance of potentially beneficial market information in the form of textual and non-periodic financial news is largely overlooked by most active investors and traders. Here, we take a look at how we might utilize this information for financial forecast modeling.

Product Review: Matlab and the Financial Toolbox  
Mark R. Thomason

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May/June 1999  
Vol.7, No.3

Title: On Global Minds and Markets

Utilization of Vector Autoregressions and Neural Networks  
in Identifying the Return Interaction among Global,  
Asia-Pacific Regional and Local Stock Markets  
Chih-Chou Chiu and Yin-Hua Yeh

5

This study investigates the interactions in the returns of the Global, Asia Pacific regional, and Local stock markets using the vector autoregressions (VAR) and artificial neural networks. As the results reveal, influences on the Hong Kong and Singapore stock markets by the stock market of South East

Asia do exist prior to the financial crisis in July 1997. This finding may explain why the stock market in South East Asia affected the stock markets in other Asian countries after the financial crisis.

The Wavelet Transform for Filtering Financial Data Streams 18  
 Zheng Gonghui, Jean-Luc Starck, Jonathan Campbell, and Fionn Murtagh  
 Relating this work to earlier results, the authors introduce a new wavelet transform, the Haar à trous transform. Its advantages for modeling and predicting financial data streams are described. The basic principles of decomposing the financial signal into scale-related components and fusing the forecasts at each scale remain the same. The denoising of time series data is also discussed. A multilayer perceptron is used to provide predictions, and to demonstrate the advantages of the new wavelet transform and wavelet-based denoising.

A Basic Neural Network-based Trading System 36  
 Project Revisited (Parts 1 and 2)  
 Mark R. Thomason  
 Due to reader interest, we revisit The Neurophyte, one of the most popular series ever published on the application of neural networks in finance for the novice. This included a neural network-based trading system project published in 6 parts. In this issue, we present an updated version of parts 1 and 2 of that project, published in November 1994 and January 1995, respectively.

Product Review: e Professional version 1.3 46  
 Mark R. Thomason

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 specifying and diagnostically testing econometric models, second ed.  
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July/August 1999  
 Vol.7, No.4  
 Title: On Performance Metrics

Performance Metrics for Financial Time Series Forecasting 5  
 Sara M. Abecasis, Evangelina S. Lapenta and Carlos E. Pedreira  
 In this paper the state of the art of performance metrics for financial time series forecasting is presented. The focus of interest is centered on prediction performance. However, part of the paper addresses the relevance of metrics to trading performance. Characteristics of prediction performance metrics are described. After we present the nomenclature, we describe each of the performance metrics in detail. Characteristics of interest to financial time series forecasting are noted. Finally, a survey on univariate and multivariate financial time series is presented. Our purpose is to provide a review of published research in this area as well as an opening for future research.

Multi-Agent Approach as a Catalyst to a 24  
 Dynamic Financial Knowledge Discovery Process  
 Soe-Tsyr Yuan  
 Currently, most KDD research is focused on the automation of data mining, although users still setup up and integrate other processes (such as data collection and data engineering) manually. When confronting dynamic KDD extensive manual effort. Basically, dynamic KDD applications are characterized by dynamic data hunting and dynamic mining. Therefore, in the search for a generation of flexible KDD applications, what should the KDD flexible KDD applications? Our hypothesis is that the multi-agent approach fills this role perfectly. We support this hypothesis through our demonstration here of a cooperative information system for automating dynamic KDD applications from a large amount of stock data using multi-agent technology.

A Basic Neural Network-based Trading System

Mark R. Thomason

Due to reader interest, we revisit The Neurophyte, one of the most popular series ever published on the application of neural networks in finance for the novice. This included a neural network-based trading system project published in 6 parts. In this issue, we present an updated version of parts 3 and 4 of that project, published in March and May 1995, respectively.

Product Review: NeuroShell Predictor, Classifier and  
Run-Time Server

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Mark R. Thomason

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September/October 1999

Vol.7, No.5

Title: Advancements in Option Pricing Using Computational Intelligence

Literature Review:

The Problem With Modern Parametric Option Pricing 6

Paul Lajbcygier

Conventional parametric option-pricing models based on the Black-Scholes have been generalized to form a new class of models referred to as the modern parametric option-pricing models. The aim of this literature review is to introduce and critique the modern parametric option-pricing models. Conventional option pricing, although very accurate, has been shown to be persistently, systematically and significantly biased. In the hope of rectifying these biases, the assumptions of the conventional parametric option-pricing models (OPMs) have been generalized to produce the modern parametric OPMs.

Extraction of Intraday Implied Probability Distributions  
in Illiquid Option Markets 24

Fernando Gonzalez and Neil Burgess

This paper describes a method for recovering the risk neutral market's perceived probability distribution (RND) of European options on the FTSE100 Index in an hourly time basis. A nonparametric procedure is used to choose probabilities that minimize an objective function subject to requiring that the obtained probabilities comply with observed option prices. The optimization technique for estimating probability distributions incorporates a 'smoothness' and a 'variability' factor in the objective function to account for situations where little smoothness and high variability in the posterior distributions are plausible due to problems in the data.

Adaptive Hybrid Neural Network Option Pricing 33

Michael Hanke

Standard option pricing models show well-known deviations when compared to market prices. The best-known of these phenomena is the smile in implied market volatilities calculated from the Black/Scholes formula. In this paper, feedforward networks are used in an adaptive fashion to fit the smile on a day-to-day basis. This approach has some advantages compared to designs previously used in the literature, e.g. drastically reduced training times through a smaller number of parameters, resulting from the reduction of the input space dimension to one and smaller network sizes.

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computational intelligence 4

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computation, causation and discovery

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Literature Review:

The non-parametric models 6

Paul Lajbcygier

Empirical option pricing is going through a crisis. Once, the seminal Black-Scholes model was thought to be the last word on option pricing: all that was needed, it was thought, was some adjustments and it could then be applied to any new instrument: futures, foreign exchange and bonds. However, in the past decade, increases in the bias of the Black-Scholes model (and the conventional parametric option pricing models derived using similar approaches) have led researchers to develop new models (coined modern parametric option pricing models).

An Artificial Neural Network Approach to the Valuation  
of Options and Forecasting of Volatility 19

David S. Geigle and Jay E. Aronson

Using data from the S&P 500 futures options from 1991 through 1996, artificial neural networks were trained to estimate the value of an option and forecast volatility of the underlying futures contract. Using the same variables as are used in the Black-Scholes and ISD formulas, ten artificial neural networks were trained in the valuation of an option and three artificial neural networks were trained in the forecasting of future volatility. The results of the artificial neural networks were compared to actual prices and the Black-Scholes results for the valuation analysis and to realized volatility, historical volatility and ISD for the volatility forecast analysis. The artificial neural networks performed well in both evaluations.

Option Pricing with the Genetic Programming Approach 26

Christian Keber

In this paper we derive analytical approximations for the valuation of American put options on non-dividend paying stocks using the genetic programming approach. Using experimental data sets we can show that the genetically determined formulas outperform other formulas presented in the literature. Furthermore, we derive a pure analytical approximation for determining the killing price used in several classical option valuation models. We can show that the results obtained by our formula are very close to the numerically calculated killing prices.

A Basic Neural Network-based Trading System  
Project Revisited (Parts 5 and 6) 37

Mark R. Thomason

Due to reader interest, we revisit The Neurophyte, one of the most popular series ever published on the application of neural networks in finance for the novice. This included a neural network-based trading system project published in 6 parts. In this issue, we present an updated version of parts 5 and 6 of that project, first published in July and September 1995, respectively.

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derivatives: a powerplus picture book

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