

Comparison of automated procedures for ARMA model identification

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This article evaluates the performance of three automated procedures for ARMA model identification commonly available in current versions of SAS for Windows: MINIC, SCAN, and ESACF. Monte Carlo experiments with different model structures, parameter values, and sample sizes were used to compare the methods. On average, the procedures either correctly identified the simulated structures or selected parsimonious nearly equivalent mathematical representations in at least 60% of the trials conducted. For autoregressive models, MINIC achieved the best results. SCAN was superior to the other two procedures for mixed structures. For moving-average processes, ESACF obtained the most correct selections. For all three methods, model identification was less accurate for low dependency than for medium or high dependency processes. The effect of sample size was more pronounced for MINIC than for SCAN and ESACF. SCAN and ESACF tended to select higher-order mixed structures in larger samples. These findings are confined to stationary nonseasonal time series.

Time series analysis deals with repeated and equally spaced observations on a single unit. Classical statistical techniques are no longer appropriate here because data points cannot be assumed independent and uncorrelated. One of the most widely employed procedures for time series data is the *autoregressive integrated moving-average* (ARIMA) approach proposed by Box and Jenkins (1970). Since Glass, Willson, and Gottman (1975) introduced the ARIMA technique to the social and behavioral sciences, this methodology has been increasingly employed in different research fields (Delcor, Cadopi, Delignières, & Mesure, 2002; Fortes, Ninot, & Delignières, 2005; McCleary & Hay, 1980; Ninot, Fortes, & Delignières, 2005; Velicer & Colby, 1997; Velicer & Fava, 2003; Wagenmakers, Farrell, & Ratcliff, 2004).

The idea behind the Box–Jenkins procedure is to infer the true data generating process from an observed time series. The ARIMA strategy is based on a three-step iterative cycle of model identification, model estimation, and diagnostic checks in model accuracy. (For detailed treatments of the technique, see Bowerman & O'Connell, 1993; Box, Jenkins, & Reinsel, 1994; Brockwell & Davis, 2002; and Makridakis, Wheelwright, & Hyndman, 1998.) *Model identification* step provides insight into properties of the underlying stochastic process of the variable under study. Once the process has been inferred, it can be used either to test some hypothesis about its generating mechanism, forecast future values of the series, or remove dependency from the data so that it meets assumptions of the general linear model, as in interrupted time series experiments. In the first two cases, accurate model selection is indispensable.

Especially in theory testing, where model identification represents the primary goal of the analysis, model mis-

specification implies serious conceptual consequences and should be omitted. For instance, autoregressive models are characteristic of behavior containing internal temporal regularity, whereas moving-average models are characteristic of systems depending on external and occasional events. Thus autoregressive patterns are typically found in the studies investigating addictive behaviors (Rosel & Elósegui, 1994; Velicer, Redding, Richmond, Greeley, & Swift, 1992; Velicer, Rossi, Diclemente, & Prochaska, 1996). For nonaddictive habits of occasional smokers or drinkers, however, moving-average models are more appropriate. Analyzing travel behavior of different population groups, Fraschini and Axausten (2001) found that autoregressive models predominated in the age classes between 35 and 65 years old, reflecting more regular behavior probably caused by fixed employment and a more settled lifestyle. In contrast, moving-average patterns were mainly identified for younger participants, indicating the predominance of external influences on subject behavior. According to Velicer and Fava (2003), three popular hypotheses concerning nicotine's role in maintaining smoking, such as the fixed effect, nicotine regulation, and multiple regulation models, imply competing ARIMA patterns.

When the goal of research is to determine the efficacy of a specific intervention, as in interrupted time series analysis, model identification represents an intermediate step serving to transform the data (Glass et al., 1975). Hence, accurate model selection is not crucial here. Several alternative procedures avoiding model identification have been proposed in the last three decades (Algina & Swaminathan, 1977, 1979; Crosbie, 1993; Gottman, 1981; McKnight, McKean, & Huitema, 2000; Simonson, 1977; Velicer & McDonald, 1984,

Arma Model Identification

**Wayne A. Woodward, Henry L.
Gray, Alan C Elliott**



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ARMA Model Identification ByoungSeon Choi, 2012-12-06 During the last two decades considerable progress has been made in statistical time series analysis The aim of this book is to present a survey of one of the most active areas in this field the identification of autoregressive moving average models i e determining their orders Readers are assumed to have already taken one course on time series analysis as might be offered in a graduate course but otherwise this account is self contained The main topics covered include Box Jenkins method inverse autocorrelation functions penalty function identification such as AIC BIC techniques and Hannan and Quinn s method instrumental regression and a range of pattern identification methods Rather than cover all the methods in detail the emphasis is on exploring the fundamental ideas underlying them Extensive references are given to the research literature and as a result all those engaged in research in this subject will find this an invaluable aid to their work *An Exploration of Time Series ARMA Model Identification Techniques* James Arthur

Calvin, Colorado State University. Department of Statistics, 1980 **Model Identification and Data Analysis** Sergio Bittanti, 2019-04-02 This book is about constructing models from experimental data It covers a range of topics from statistical data prediction to Kalman filtering from black box model identification to parameter estimation from spectral analysis to predictive control Written for graduate students this textbook offers an approach that has proven successful throughout the many years during which its author has taught these topics at his University The book Contains accessible methods explained step by step in simple terms Offers an essential tool useful in a variety of fields especially engineering statistics and mathematics Includes an overview on random variables and stationary processes as well as an introduction to discrete time models and matrix analysis Incorporates historical commentaries to put into perspective the developments that have brought the discipline to its current state Provides many examples and solved problems to complement the presentation and facilitate comprehension of the techniques presented **Time Series Modelling of Water Resources and Environmental**

Systems K.W. Hipel, A.I McLeod, 1994-04-07 This is a comprehensive presentation of the theory and practice of time series modelling of environmental systems A variety of time series models are explained and illustrated including ARMA autoregressive moving average nonstationary long memory three families of seasonal multiple input single output intervention and multivariate ARMA models Other topics in environmetrics covered in this book include time series analysis in decision making estimating missing observations simulation the Hurst phenomenon forecasting experiments and causality Professionals working in fields overlapping with environmetrics such as water resources engineers environmental scientists hydrologists geophysicists geographers earth scientists and planners will find this book a valuable resource Equally environmetrics systems scientists economists mechanical engineers chemical engineers and management scientists will find the time series methods presented in this book useful **Model Identification and Adaptive Control** Graham

Goodwin, 2012-12-06 This book is based on a workshop entitled Model Identification and Adaptive Control From Windsurfing

to Telecommunications held in Sydney Australia on December 16 2000 The workshop was organized in honour of Professor Brian D.O. Anderson in recognition of his seminal contributions to systems science over the past 4 decades The chapters in the book have been written by colleagues friends and students of Brian Anderson A central theme of the book is the inter relationship between identification and the use of models in real world applications This theme has underpinned much of Brian Anderson's own contributions The book reflects on these contributions as well as making important statements about possible future research directions The subtitle of the book From Windsurfing to Telecommunications recognizes the fact that many common life experiences such as those we encounter when learning to ride a windsurfer are models for design methods that can be used on real world advanced technological control problems In deed Brian Anderson extensively explored this link in his research work

Autoregressive Moving-average (ARMA) Model Identification for Degenerate Time Series with Application to Maneuvering Target Tracking Norman Owen Speakman, 1985 Research was conducted in the general areas of time series analysis and stochastic realization Results were then applied to the specific problem of tracking a highly maneuverable aircraft target An algorithm was developed to identify the order and parameters of the minimum autoregressive moving average ARMA model of a multi variable system given the output autocorrelation sequence Studies were also conducted in the area of degenerate time series modeling It was found that degeneracy in vector valued time series is caused by the presence of one or more deterministic relationships in the time series ARMA models for degenerate time series can be identified by finding and extracting the deterministic relationships from the time series The result is a reduced dimension stochastic model of the system The model found will have fewer white noise inputs than outputs An AR

Identification and Control Using Volterra Models F.J.III Doyle, R.K. Pearson, B.A. Ogunnaike, 2012-12-06 Much has been written about the general difficulty of developing the models required for model based control of processes whose dynamics exhibit significant nonlinearity for further discussion and references see Chapter 1 In fact the development of these models stands as a significant practical impediment to widespread industrial application of techniques like nonlinear model predictive control NMPC whose linear counterpart has profoundly changed industrial practice One of the reasons for this difficulty lies in the enormous variety of nonlinear models different classes of which can be less similar to each other than they are to the class of linear models Consequently it is a practical necessity to restrict consideration to one or a few specific nonlinear model classes if we are to succeed in developing understanding and using nonlinear models as a basis for practical control schemes Because they represent a highly structured extension of the class of linear finite impulse response FIR models on which industrially popular linear MPC implementations are based this book is devoted to the class of discrete time Volterra models and a few other closely related nonlinear model classes The objective of this book is to provide a useful reference for researchers in the field of process control and closely related areas collecting a reasonably wide variety of results that may be found in different parts of the large literature that exists on the general

topics of process control nonlinear systems theory statistical time series models biomedical engineering and digital signal processing among others **Automatic Autocorrelation and Spectral Analysis** Petrus M.T. Broersen, 2006-08-02

Automatic Autocorrelation and Spectral Analysis gives random data a language to communicate the information they contain objectively It takes advantage of greater computing power and robust algorithms to produce enough candidate models of a given group of data to be sure of providing a suitable one Improved order selection guarantees that one of the best often the best will be selected automatically Written for graduate signal processing students and for researchers and engineers using time series analysis for applications ranging from breakdown prevention in heavy machinery to measuring lung noise for medical diagnosis this text offers tuition in how power spectral density and the autocorrelation function of stochastic data can be estimated and interpreted in time series models extensive support for the MATLAB ARMAse1 toolbox applications showing the methods in action appropriate mathematics for students to apply the methods with references for those who wish to develop them further **Advances in Neural Networks - ISNN 2004** Fuliang Yin, Jun Wang, Chengan Guo, 2011-04-07

This book constitutes the proceedings of the International Symposium on Neural Networks ISNN 2004 held in Dalian Liaoning China during August 19-21 2004 ISNN 2004 received over 800 submissions from authors in 46 continents Asia Europe North America South America and Oceania and 23 countries and regions mainland China Hong Kong Taiwan South Korea Japan Singapore India Iran Israel Turkey Hungary Poland Germany France Belgium Spain UK USA Canada Mexico Venezuela Chile and Australia Based on reviews the Program Committee selected 329 high quality papers for presentation at ISNN 2004 and publication in the proceedings The papers are organized into many topical sections under 11 major categories theoretical analysis learning and optimization support vector machines blind source separation independent component analysis and principal component analysis clustering and classification robotics and control telecommunications signal image and time series processing detection diagnostics and computer security biomedical applications and other applications covering the whole spectrum of the recent neural network research and development In addition to the numerous contributed papers 46 distinguished scholars were invited to give plenary speeches at ISNN 2004 ISNN 2004 was an inaugural event It brought together a few hundred researchers educators scientists and practitioners to the beautiful coastal city Dalian in northeastern China It provided an international forum for the participants to present new results to discuss the state of the art and to exchange information on emerging areas and future trends of neural network research It also created a nice opportunity for the participants to meet colleagues and make friends who share similar research interests *Applied Modeling of Hydrologic Time Series* Jose D. Salas, 1980 **Advanced, Contemporary Control** Marek Pawelczyk, Dariusz Bismor, Szymon Ogonowski, Janusz Kacprzyk, 2023-06-15 This book introduces the reader to the hottest topics in current control sciences and robotics as seen by scientists from Poland and other European countries Volume 1 comprises 37 chapters which specifically address topics connected to modeling identification and analysis of automation systems to design

of control systems and to fault diagnosis and fault tolerant control The contributions were presented during XXI Polish Control Conference held in Gliwice Poland from June 26 to 29 2023 This book is extremely useful to all persons who want to know the latest trends in automation and robotics Recent Advances in Total Least Squares Techniques and Errors-in-variables Modeling Sabine van Huffel,1997-01-01 An overview of the computational issues statistical numerical and algebraic properties and new generalizations and applications of advances on TLS and EIV models Experts from several disciplines prepared overview papers which were presented at the conference and are included in this book **Applied Time Series Analysis** Wayne A. Woodward, Henry L. Gray, Alan C Elliott, 2011-10-26 Virtually any random process developing chronologically can be viewed as a time series In economics closing prices of stocks the cost of money the jobless rate and retail sales are just a few examples of many Developed from course notes and extensively classroom tested Applied Time Series Analysis includes examples across a variety of fields develops theory and provides software to address time series problems in a broad spectrum of fields The authors organize the information in such a format that graduate students in applied science statistics and economics can satisfactorily navigate their way through the book while maintaining mathematical rigor One of the unique features of Applied Time Series Analysis is the associated software GW WINKS designed to help students easily generate realizations from models and explore the associated model and data characteristics The text explores many important new methodologies that have developed in time series such as ARCH and GARCH processes time varying frequencies TVF wavelets and more Other programs some written in R and some requiring S plus are available on an associated website for performing computations related to the material in the final four chapters *Random Iterative Models* Marie Duflo, 2013-03-09 Be they random or non random iterative methods have progressively gained sway with the development of computer science and automatic control theory Thus being easy to conceive and simulate stochastic processes defined by an iterative formula linear or functional have been the subject of many studies The iterative structure often leads to simpler and more explicit arguments than certain classical theories of processes On the other hand when it comes to choosing step by step decision algorithms sequential statistics control learning recursive decision methods are indispensable They lend themselves naturally to problems of the identification and control of iterative stochastic processes In recent years know how in this area has advanced greatly this is reflected in the corresponding theoretical problems many of which remain open At Whom Is This Book Aimed I thought it useful to present the basic ideas and tools relating to random iterative models in a form accessible to a mathematician familiar with the classical concepts of probability and statistics but lacking experience in automatic control theory Thus the first aim of this book is to show young research workers that work in this area is varied and interesting and to facilitate their initiation period The second aim is to present more seasoned probabilists with a number of recent original techniques and arguments relating to iterative methods in a fairly classical environment *Networked Digital Technologies, Part II* Filip Zavoral, Jakub Yaghob, Pit Pichappan, Eyas

El-Qawasmeh,2010-06-30 On behalf of the NDT 2010 conference the Program Committee and Charles University in Prague Czech Republic we welcome you to the proceedings of the Second International Conference on Networked Digital Technologies NDT 2010 The NDT 2010 conference explored new advances in digital and Web technology applications It brought together researchers from various areas of computer and information sciences who addressed both theoretical and applied aspects of Web technology and Internet applications We hope that the discussions and exchange of ideas that took place will contribute to advancements in the technology in the near future The conference received 216 papers out of which 85 were accepted resulting in an acceptance rate of 39% These accepted papers are authored by researchers from 34 countries covering many significant areas of Web applications Each paper was evaluated by a minimum of two reviewers Finally we believe that the proceedings document the best research in the studied areas We express our thanks to the Charles University in Prague Springer the authors and the organizers of the conference

Principles of Neural Model Identification, Selection and Adequacy Achilleas Zapranis,Apostolos-Paul N. Refenes,2012-12-06 Neural networks have had considerable success in a variety of disciplines including engineering control and financial modelling However a major weakness is the lack of established procedures for testing mis specified models and the statistical significance of the various parameters which have been estimated This is particularly important in the majority of financial applications where the data generating processes are dominantly stochastic and only partially deterministic Based on the latest most significant developments in estimation theory model selection and the theory of mis specified models this volume develops neural networks into an advanced financial econometrics tool for non parametric modelling It provides the theoretical framework required and displays the efficient use of neural networks for modelling complex financial phenomena Unlike most other books in this area this one treats neural networks as statistical devices for non linear non parametric regression analysis

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Time Series Modeling of Neuroscience Data Tohru Ozaki, 2012-01-26 Recent advances in brain science measurement technology have given researchers access to very large scale time series data such as EEG MEG data 20 to 100 dimensional and fMRI 140 000 dimensional data To analyze such massive data efficient computational and statistical methods are required Time Series Modeling of Neuroscience Data shows how to

Geophysical Inversion J. Bee Bednar, 1992-01-01 This collection of papers on geophysical inversion contains research and survey articles on where the field has been and where it s going and what is practical and what is not Topics covered include seismic tomography migration and inverse scattering

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