NUMERICAL MATHEMATICS AND SCIENTIFIC COMPUTATION

Numerical Methods for Structured Markov Chains

DARIO A. BINI,
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$$P = \begin{bmatrix} B_0 & B_1 & B_2 & B_3 & \cdots \\ A_{-1} & A_0 & A_1 & A_2 & \cdots \\ & A_{-1} & A_0 & A_1 & \ddots \\ & & A_{-1} & A_0 & \ddots \\ 0 & & & \ddots & \ddots \end{bmatrix}$$

$$G = A_{-1} + A_0 G + A_1 G^2 + A_2 G^3 + \cdots$$

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Numerical Methods For Structured Markov Chains

Srinivas R. Chakravarthy

Numerical Methods For Structured Markov Chains:

Numerical Methods for Structured Markov Chains Dario A. Bini,Guy Latouche,Beatrice Meini,2005-02-03 Intersecting two large research areas numerical analysis and applied probability queuing theory this book is a self contained introduction to the numerical solution of structured Markov chains which have a wide applicability in queuing theory and stochastic modeling and include M G 1 and GI M 1 type Markov chain quasi birth death processes non skip free queues and tree like stochastic processes Written for applied probabilists and numerical analysts but accessible to engineers and scientists working on telecommunications and evaluation of computer systems performances it provides a systematic treatment of the theory and algorithms for important families of structured Markov chains and a thorough overview of the current literature The book consisting of nine Chapters is presented in three parts Part 1 covers a basic description of the fundamental concepts related to Markov chains a systematic treatment of the structure matrix tools including finite Toeplitz matrices displacement operators FFT and the infinite block Toeplitz matrices their relationship with matrix power series and the fundamental problems of solving matrix equations and computing canonical factorizations Part 2 deals with the description and analysis of structure Markov chains and includes M G 1 quasi birth death processes non skip free queues and tree like processes Part 3 covers solution algorithms where new convergence and applicability results are proved Each chapter ends with bibliographic notes for further reading and the book ends with an appendix collecting the main general concepts and results used in the book a list of the main annotations and algorithms used in the book and an extensive index Numerical Methods for Structured Markov Chains ,2008 Markov Chains: Models, Algorithms and Applications Wai-Ki Ching,Michael K. Ng,2006-06-05 Markov chains are a particularly powerful and widely used tool for analyzing a variety of stochastic probabilistic systems over time This monograph will present a series of Markov models starting from the basic models and then building up to higher order models Included in the higher order discussions are multivariate models higher order multivariate models and higher order hidden models In each case the focus is on the important kinds of applications that can be made with the class of models being considered in the current chapter Special attention is given to numerical algorithms that can efficiently solve the models Therefore Markov Chains Models Algorithms and Applications outlines recent developments of Markov chain models for modeling queueing sequences Internet re manufacturing systems reverse logistics inventory systems bio informatics DNA sequences genetic networks data mining and many other practical systems

Numerical Methods for Structured Markov Chains ,2008 **Analyzing Markov Chains using Kronecker Products** Tugrul Dayar,2012-07-25 Kronecker products are used to define the underlying Markov chain MC in various modeling formalisms including compositional Markovian models hierarchical Markovian models and stochastic process algebras The motivation behind using a Kronecker structured representation rather than a flat one is to alleviate the storage requirements associated with the MC With this approach systems that are an order of magnitude larger can be analyzed on

the same platform The developments in the solution of such MCs are reviewed from an algebraic point of view and possible areas for further research are indicated with an emphasis on preprocessing using reordering grouping and lumping and numerical analysis using block iterative preconditioned projection multilevel decompositional and matrix analytic methods Case studies from closed queueing networks and stochastic chemical kinetics are provided to motivate decompositional and matrix analytic methods respectively Matrix-Analytic Methods in Stochastic Models Guy Latouche,Vaidyanathan Ramaswami,Jay Sethuraman,Karl Sigman,Mark S. Squillante,David Yao,2012-12-04 Matrix analytic and related methods have become recognized as an important and fundamental approach for the mathematical analysis of general classes of complex stochastic models Research in the area of matrix analytic and related methods seeks to discover underlying probabilistic structures intrinsic in such stochastic models develop numerical algorithms for computing functionals e g performance measures of the underlying stochastic processes and apply these probabilistic structures and or computational algorithms within a wide variety of fields This volume presents recent research results on the theory algorithms and methodologies concerning matrix analytic and related methods in stochastic models and the application of matrix analytic and related methods in various fields which includes but is not limited to computer science and engineering communication networks and telephony electrical and industrial engineering operations research management science financial and risk analysis and bio statistics These research studies provide deep insights and understanding of the stochastic models of interest from a mathematics and or applications perspective as well as identify directions for future research *Applied Modeling Techniques and Data Analysis 1* Yiannis Dimotikalis,Alex Karagrigoriou,Christina Parpoula,Christos H. Skiadas,2021-05-11 BIG DATA ARTIFICIAL INTELLIGENCE AND DATA ANALYSIS SET Coordinated by Jacques Janssen Data analysis is a scientific field that continues to grow enormously most notably over the last few decades following rapid growth within the tech industry as well as the wide applicability of computational techniques alongside new advances in analytic tools Modeling enables data analysts to identify relationships make predictions and to understand interpret and visualize the extracted information more strategically This book includes the most recent advances on this topic meeting increasing demand from wide circles of the scientific community Applied Modeling Techniques and Data Analysis 1 is a collective work by a number of leading scientists analysts engineers mathematicians and statisticians working on the front end of data analysis and modeling applications The chapters cover a cross section of current concerns and research interests in the above scientific areas The collected material is divided into appropriate sections to provide the reader with both theoretical and applied information on data analysis methods models and techniques along with appropriate applications Introduction to Matrix Analytic Methods in Queues 1 Srinivas R. Chakravarthy,2022-09-21 Matrix analytic methods MAM were introduced by Professor Marcel Neuts and have been applied to a variety of stochastic models since In order to provide a clear and deep understanding of MAM while showing their power this book presents MAM concepts and explains the results using a number

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Handbook of Linear Algebra Leslie Hogben,2013-11-26 With a substantial amount of new material the Handbook of Linear Algebra Second Edition provides comprehensive coverage of linear algebra concepts applications and computational software packages in an easy to use format It guides you from the very elementary aspects of the subject to the frontiers of current research Along with revisions and *Fundamentals of Matrix-Analytic Methods* Qi-Ming He,2013-08-13 Fundamentals of Matrix Analytic Methods targets advanced level students in mathematics engineering and computer science It focuses on the fundamental parts of Matrix Analytic Methods Phase Type Distributions Markovian arrival processes and Structured Markov chains and matrix geometric solutions New materials and techniques are presented for the first time in research and engineering design This book emphasizes stochastic modeling by offering probabilistic interpretation and constructive proofs for Matrix Analytic Methods Such an approach is especially useful for engineering analysis and design Exercises and examples are provided throughout the book **Trends in Ambient Intelligent Systems** Kiran Kumar Ravulakollu,Mohammad Ayoub Khan,Ajith Abraham,2016-03-18 This book demonstrates the success of Ambient Intelligence in providing possible solutions for the daily needs of humans The book addresses implications of ambient intelligence in areas of domestic living elderly care robotics communication philosophy and others The objective of this edited volume is to show that Ambient Intelligence is a boon to humanity with conceptual philosophical methodical and applicative understanding The book also aims to schematically demonstrate developments in the direction of augmented sensors embedded systems and behavioral intelligence towards Ambient Intelligent Networks or Smart Living Technology It contains chapters in the field of Ambient Intelligent Networks which received highly positive feedback during the review process The book contains research work with in depth state of the art from augmented sensors embedded technology and artificial intelligence along with

cutting edge research and development of technologies and applications of Ambient Intelligent Networks This book is intended to introduce ideas methods technologies of the future development of humanity Science and Technology

Markov Chains Wai-Ki Ching,Ximin Huang,Michael K. Ng,Tak-Kuen Siu,2013-03-27 This new edition of Markov Chains Models Algorithms and Applications has been completely reformatted as a text complete with end of chapter exercises a new focus on management science new applications of the models and new examples with applications in financial risk management and modeling of financial data This book consists of eight chapters Chapter 1 gives a brief introduction to the classical theory on both discrete and continuous time Markov chains The relationship between Markov chains of finite states and matrix theory will also be highlighted Some classical iterative methods for solving linear systems will be introduced for finding the stationary distribution of a Markov chain The chapter then covers the basic theories and algorithms for hidden Markov models HMMs and Markov decision processes MDPs Chapter 2 discusses the applications of continuous time Markov chains to model queueing systems and discrete time Markov chain for computing the PageRank the ranking of websites on the Internet Chapter 3 studies Markovian models for manufacturing and re manufacturing systems and presents closed form solutions and fast numerical algorithms for solving the captured systems In Chapter 4 the authors present a simple hidden Markov model HMM with fast numerical algorithms for estimating the model parameters An application of the HMM for customer classification is also presented Chapter 5 discusses Markov decision processes for customer lifetime values Customer Lifetime Values CLV is an important concept and quantity in marketing management The authors present an approach based on Markov decision processes for the calculation of CLV using real data Chapter 6 considers higher order Markov chain models particularly a class of parsimonious higher order Markov chain models Efficient estimation methods for model parameters based on linear programming are presented Contemporary research results on applications to demand predictions inventory control and financial risk measurement are also presented In Chapter 7 a class of parsimonious multivariate Markov models is introduced Again efficient estimation methods based on linear programming are presented Applications to demand predictions inventory control policy and modeling credit ratings data are discussed Finally Chapter 8 re visits hidden Markov models and the authors present a new class of hidden Markov models with efficient algorithms for estimating the model parameters Applications to modeling interest rates credit ratings and default data are discussed This book is aimed at senior undergraduate students postgraduate students professionals practitioners and researchers in applied mathematics computational science operational research management science and finance who are interested in the formulation and computation of queueing networks Markov chain models and related topics Readers are expected to have some basic knowledge of probability theory Markov processes and matrix theory **Numerical Methods for Finance** John Miller,David Edelman,John Appleby,2007-09-21 Featuring international contributors from both industry and academia Numerical Methods for Finance explores new and relevant numerical methods for the solution of practical problems in

finance It is one of the few books entirely devoted to numerical methods as applied to the financial field Presenting state of the art methods in this area **Introduction to Matrix-Analytic Methods in Queues 2** Srinivas R. Chakravarthy,2022-10-18 Matrix analytic methods MAM were introduced by Professor Marcel Neuts and have been applied to a variety of stochastic models since In order to provide a clear and deep understanding of MAM while showing their power this book presents MAM concepts and explains the results using a number of worked out examples This book s approach will inform and kindle the interest of researchers attracted to this fertile field To allow readers to practice and gain experience in the algorithmic and computational procedures of MAM Introduction to Matrix Analytic Methods in Queues 2 provides a number of computational exercises It also incorporates simulation as another tool for studying complex stochastic models especially when the state space of the underlying stochastic models under analytic study grows exponentially This book s detailed approach will make it more accessible for readers interested in learning about MAM in stochastic models

Constructive Computation in Stochastic Models with Applications Quan-Lin Li,2011-02-02 Constructive Computation in Stochastic Models with Applications The RG Factorizations provides a unified constructive and algorithmic framework for numerical computation of many practical stochastic systems It summarizes recent important advances in computational study of stochastic models from several crucial directions such as stationary computation transient solution asymptotic analysis reward processes decision processes sensitivity analysis as well as game theory Graduate students researchers and practicing engineers in the field of operations research management sciences applied probability computer networks manufacturing systems transportation systems insurance and finance risk management and biological sciences will find this book valuable Dr Quan Lin Li is an Associate Professor at the Department of Industrial Engineering of Tsinghua University China Measurement, Modeling, and Evaluation of Computing Systems and Dependability and Fault Tolerance Jens B. Schmitt,2012-03-08 This book constitutes the refereed proceedings of the 16th International GI ITG Conference on Measurement Modeling and Evaluation of Computing Systems and Dependability and Fault Tolerance MMB DFT 2012 held in Kaiserslautern Germany in March 2012 The 16 revised full papers presented together with 5 tool papers and 5 selected workshop papers were carefully reviewed and selected from 54 submissions MMB DFT 2012 covers diverse aspects of performance and dependability evaluation of systems including networks computer architectures distributed systems software fault tolerant and secure systems **Milestones in Matrix Computation** Raymond Chan,Chen Greif,Dianne O'Leary,2007-02-22 The text presents and discusses some of the most influential papers in Matrix Computation authored by Gene H Golub one of the founding fathers of the field The collection of 21 papers is divided into five main areas iterative methods for linear systems solution of least squares problems matrix factorizations and applications orthogonal polynomials and quadrature and eigenvalue problems Commentaries for each area are provided by leading experts Anne Greenbaum Ake Bjorck Nicholas Higham Walter Gautschi and G W Pete Stewart Comments on each paper are also included by the original

authors providing the reader with historical information on how the paper came to be written and under what circumstances the collaboration was undertaken Including a brief biography and facsimiles of the original papers this text will be of great interest to students and researchers in numerical analysis and scientific computation **Exploiting Hidden Structure in Matrix Computations: Algorithms and Applications** Michele Benzi,Dario Bini,Daniel Kressner,Hans Munthe-Kaas,Charles Van Loan,2017-01-24 Focusing on special matrices and matrices which are in some sense near to structured matrices this volume covers a broad range of topics of current interest in numerical linear algebra Exploitation of these less obvious structural properties can be of great importance in the design of efficient numerical methods for example algorithms for matrices with low rank block structure matrices with decay and structured tensor computations Applications range from quantum chemistry to queuing theory Structured matrices arise frequently in applications Examples include banded and sparse matrices Toeplitz type matrices and matrices with semi separable or quasi separable structure as well as Hamiltonian and symplectic matrices The associated literature is enormous and many efficient algorithms have been developed for solving problems involving such matrices The text arose from a C I M E course held in Cetraro Italy in June 2015 which aimed to present this fast growing field to young researchers exploiting the expertise of five leading lecturers with different theoretical and application perspectives Mathematical Methods for the Magnetohydrodynamics of Liquid Metals Jean-Frédéric Gerbeau,Claude Le Bris,Tony Lelièvre,2006-08-31 This comprehensive text focuses on mathematical and numerical techniques for the simulation of magnetohydrodynamic phenomena with an emphasis laid on the magnetohydrodynamics of liquid metals and on a prototypical industrial application Aimed at research mathematicians engineers and physicists as well as those working in industry and starting from a good understanding of the physics at play the approach is a highly mathematical one based on the rigorous analysis of the equations at hand and a solid numerical analysis to found the simulations At each stage of the exposition examples of numerical simulations are provided first on academic test cases to illustrate the approach next on benchmarks well documented in the professional literature and finally whenever possible on real industrial cases

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