



Nonnegative Matrices in the Mathematical Sciences



Abraham Berman
Robert J. Plemmons

C · L · A · S · S · I · C · S

In Applied Mathematics

Nonnegative Matrices In The Mathematical Sciences Computer Science And Applied Mathematics

**Sung-Min Hong, Anh-Tuan
Pham, Christoph Jungemann**



Nonnegative Matrices In The Mathematical Sciences Computer Science And Applied Mathematics:

Nonnegative Matrices in the Mathematical Sciences Abraham Berman, Robert J. Plemmons, 1994-01-01 Here is a valuable text and research tool for scientists and engineers who use or work with theory and computation associated with practical problems relating to Markov chains and queuing networks economic analysis or mathematical programming Originally published in 1979 this new edition adds material that updates the subject relative to developments from 1979 to 1993 Theory and applications of nonnegative matrices are blended here and extensive references are included in each area You will be led from the theory of positive operators via the Perron Frobenius theory of nonnegative matrices and the theory of inverse positivity to the widely used topic of M matrices On the way semigroups of nonnegative matrices and symmetric nonnegative matrices are discussed Later applications of nonnegativity and M matrices are given for numerical analysis the example is convergence theory of iterative methods for probability and statistics the examples are finite Markov chains and queuing network models for mathematical economics the example is input output models and for mathematical programming the example is the linear complementarity problem Nonnegativity constraints arise very naturally throughout the physical world Engineers applied mathematicians and scientists who encounter nonnegativity or generalizations of nonnegativity in their work will benefit from topics covered here connecting them to relevant theory Researchers in one area such as queuing theory may find useful the techniques involving nonnegative matrices used by researchers in another area say mathematical programming Exercises and biographical notes are included with each chapter

Nonnegative Matrices in the Mathematical Sciences Abraham Berman, Robert J. Plemmons, 2014-05-10 *Nonnegative Matrices in the Mathematical Sciences* provides information pertinent to the fundamental aspects of the theory of nonnegative matrices This book describes selected applications of the theory to numerical analysis probability economics and operations research Organized into 10 chapters this book begins with an overview of the properties of nonnegative matrices This text then examines the inverse positive matrices Other chapters consider the basic approaches to the study of nonnegative matrices namely geometrical and combinatorial This book discusses as well some useful ideas from the algebraic theory of semigroups and considers a canonical form for nonnegative idempotent matrices and special types of idempotent matrices The final chapter deals with the linear complementary problem LCP This book is a valuable resource for mathematical economists mathematical programmers statisticians mathematicians and computer scientists

Engineering Mathematics II Sergei Silvestrov, Milica Rančić, 2017-02-10 This book highlights the latest advances in engineering mathematics with a main focus on the mathematical models structures concepts problems and computational methods and algorithms most relevant for applications in modern technologies and engineering It addresses mathematical methods of algebra applied matrix analysis operator analysis probability theory and stochastic processes geometry and computational methods in network analysis data classification ranking and optimisation The individual chapters cover both theory and applications and include a wealth of

figures schemes algorithms tables and results of data analysis and simulation Presenting new methods and results reviews of cutting edge research and open problems for future research they equip readers to develop new mathematical methods and concepts of their own and to further compare and analyse the methods and results discussed The book consists of contributed chapters covering research developed as a result of a focused international seminar series on mathematics and applied mathematics and a series of three focused international research workshops on engineering mathematics organised by the Research Environment in Mathematics and Applied Mathematics at M lardalen University from autumn 2014 to autumn 2015 the International Workshop on Engineering Mathematics for Electromagnetics and Health Technology the International Workshop on Engineering Mathematics Algebra Analysis and Electromagnetics and the 1st Swedish Estonian International Workshop on Engineering Mathematics Algebra Analysis and Applications It serves as a source of inspiration for a broad spectrum of researchers and research students in applied mathematics as well as in the areas of applications of mathematics considered in the book

Polynomial and Rational Matrices Tadeusz Kaczorek, 2007-01-19 This book reviews new results in the application of polynomial and rational matrices to continuous and discrete time systems It provides the reader with rigorous and in depth mathematical analysis of the uses of polynomial and rational matrices in the study of dynamical systems It also throws new light on the problems of positive realization minimum energy control reachability and asymptotic and robust stability

Numerical Analysis and Its Applications Svetozar Margenov, Lubin Vulkov, 2009-03-09 This book constitutes the thoroughly refereed post conference proceedings of the 4th International Conference on Numerical Analysis and Its Applications NAA 2008 held in Lozenetz Bulgaria in June 2008 The 61 revised full papers presented together with 13 invited papers were carefully selected during two rounds of reviewing and improvement The papers address all current aspects of numerical analysis and discuss a wide range of problems concerning recent achievements in physics chemistry engineering and economics A special focus is given to numerical approximation and computational geometry numerical linear algebra and numerical solution of transcendental equations numerical methods for differential equations numerical modeling and high performance scientific computing

Linear Matrix Inequalities in System and Control Theory Stephen Boyd, Laurent El Ghaoui, Eric Feron, Venkataramanan Balakrishnan, 1994-01-01 In this book the authors reduce a wide variety of problems arising in system and control theory to a handful of convex and quasiconvex optimization problems that involve linear matrix inequalities These optimization problems can be solved using recently developed numerical algorithms that not only are polynomial time but also work very well in practice the reduction therefore can be considered a solution to the original problems This book opens up an important new research area in which convex optimization is combined with system and control theory resulting in the solution of a large number of previously unsolved problems

Handbook of Discrete and Combinatorial Mathematics Kenneth H. Rosen, 2017-10-19 Handbook of Discrete and Combinatorial Mathematics provides a comprehensive reference volume for mathematicians computer scientists

engineers as well as students and reference librarians The material is presented so that key information can be located and used quickly and easily Each chapter includes a glossary Individual topics are covered in sections and subsections within chapters each of which is organized into clearly identifiable parts definitions facts and examples Examples are provided to illustrate some of the key definitions facts and algorithms Some curious and entertaining facts and puzzles are also included Readers will also find an extensive collection of biographies This second edition is a major revision It includes extensive additions and updates Since the first edition appeared in 1999 many new discoveries have been made and new areas have grown in importance which are covered in this edition

Finite Volumes for Complex Applications VI Problems & Perspectives Jaroslav Fořt, Jiří Fürst, Jan Halama, Raphaële Herbin, Florence Hubert, 2011-07-21 Finite volume methods are used for various applications in fluid dynamics magnetohydrodynamics structural analysis or nuclear physics A closer look reveals many interesting phenomena and mathematical or numerical difficulties such as true error analysis and adaptivity modelling of multi phase phenomena or fitting problems stiff terms in convection diffusion equations and sources To overcome existing problems and to find solution methods for future applications requires many efforts and always new developments The goal of The International Symposium on Finite Volumes for Complex Applications VI is to bring together mathematicians physicists and engineers dealing with Finite Volume Techniques in a wide context This book divided in two volumes brings a critical look at the subject new ideas limits or drawbacks of methods theoretical as well as applied topics

Spatial Autoregression (SAR) Model Baris M. Kazar, Mete Celik, 2012-03-02 Explosive growth in the size of spatial databases has highlighted the need for spatial data mining techniques to mine the interesting but implicit spatial patterns within these large databases This book explores computational structure of the exact and approximate spatial autoregression SAR model solutions Estimation of the parameters of the SAR model using Maximum Likelihood ML theory is computationally very expensive because of the need to compute the logarithm of the determinant $\log \det$ of a large matrix in the log likelihood function The second part of the book introduces theory on SAR model solutions The third part of the book applies parallel processing techniques to the exact SAR model solutions Parallel formulations of the SAR model parameter estimation procedure based on ML theory are probed using data parallelism with load balancing techniques Although this parallel implementation showed scalability up to eight processors the exact SAR model solution still suffers from high computational complexity and memory requirements These limitations have led the book to investigate serial and parallel approximate solutions for SAR model parameter estimation In the fourth and fifth parts of the book two candidate approximate semi sparse solutions of the SAR model based on Taylor's Series expansion and Chebyshev Polynomials are presented Experiments show that the differences between exact and approximate SAR parameter estimates have no significant effect on the prediction accuracy In the last part of the book we developed a new ML based approximate SAR model solution and its variants in the next part of the thesis The new approximate SAR model solution is called the Gauss Lanczos approximated

SAR model solution We algebraically rank the error of the Chebyshev Polynomial approximation Taylor s Series approximation and the Gauss Lanczos approximation to the solution of the SAR model and its variants In other words we established a novel relationship between the error in the log det term which is the approximated term in the concentrated log likelihood function and the error in estimating the SAR parameter for all of the approximate SAR model solutions

Large-Scale Scientific Computing Ivan Lirkov,Svetozar D. Margenov,Jerzy Wasniewski,2010-05-10 This book constitutes the thoroughly refereed post conference proceedings of the 7th International Conference on Large Scale Scientific Computations LSSC 2009 held in Sozopol Bulgaria in June 2009 The 93 revised full papers presented together with 5 plenary and invited papers were carefully reviewed and selected from numerous submissions for inclusion in the book The papers are organized in topical sections on multilevel and multiscale preconditioning methods multilevel and multiscale methods for industrial applications environmental modeling control and uncertain systems application of metaheuristics to large scale problems monte carlo methods applications distributed computing grid and scientific and engineering applications reliable numerical methods for differential equations novel applications of optimization ideas to the numerical Solution of PDEs and contributed talks

Abelian Networks IV. Dynamics of Nonhalting Networks Swee Hong Chan,Lionel Levine,2022-04-08 View the abstract

Computer Methods, Part C ,2010-12-24 The combination of faster more advanced computers and more quantitatively oriented biomedical researchers has recently yielded new and more precise methods for the analysis of biomedical data These better analyses have enhanced the conclusions that can be drawn from biomedical data and they have changed the way that experiments are designed and performed This volume along with the 2 previous Computer Methods volumes for the Methods in Enzymology serial aims to inform biomedical researchers about recent applications of modern data analysis and simulation methods as applied to biomedical research Presents step by step computer methods and discusses the techniques in detail to enable their implementation in solving a wide range of problems Informs biomedical researchers of the modern data analysis methods that have developed alongside computer hardware Presents methods at the nuts and bolts level to identify and resolve a problem and analyze what the results mean

Positive Systems Rafael Bru,Sergio Romero-Vivó,2009-08-26 This volume contains the proceedings of the Third Multidisciplinary Symposium on Positive Systems Theory and Applications POSTA09 held in Valencia Spain September 2 4 2009 This is the only world congress whose main topic is focused on this field

Game Theory and Networks Surajit Borkotokey,Rajnish Kumar,Diganta Mukherjee,K. S. Mallikarjuna Rao,Sudipta Sarangi,2022-01-01 This book is a collection of selected papers presented at the consecutively held international conferences on Game Theory and Networks organized by the Department of Mathematics Dibrugarh University India in collaboration with the Economics Department of Queen s University Belfast UK during September 6 9 2019 and September 13 15 2018 The book includes chapters on network measures and network formation application of network theory to contagion biological data and finance and macroeconomics as expository articles

The book also contains chapters on fair allocation in the context of queuing rationing and cooperative games with transferable utilities for engaged researchers A few survey chapters on non cooperative game theory evolutionary game theory mechanism design and social choice theory are also incorporated to cater to the needs of the beginners in the field This book discusses the use of game theoretic tools and network models across disciplines mathematics statistics economics computer science political science sociology and psychology It aims at providing a suitable learning experience to beginners on the basics of cooperative games networks and mechanism design as well as recent developments to research scholars having the basic knowledge of these topics

Semirings and Affine Equations over Them Jonathan S. Golan, 2013-03-14

Semiring theory stands with a foot in each of two mathematical domains The first being abstract algebra and the other the fields of applied mathematics such as optimization theory the theory of discrete event dynamical systems automata theory and formal language theory as well as from the allied areas of theoretical computer science and theoretical physics Most important applications of semiring theory in these areas turn out to revolve around the problem of finding the equalizer of a pair of affine maps between two semimodules In this volume we chart the state of the art on solving this problem and present many specific cases of applications This book is essentially the third part of a trilogy along with Semirings and their Applications and Power Algebras over Semirings both written by the same author and published by Kluwer Academic Publishers in 1999 While each book can be read independently of the others to get the full force of the theory and applications one should have access to all three This work will be of interest to academic and industrial researchers and graduate students The intent of the book is to bring the applications to the attention of the abstract mathematicians and to make the abstract mathematics available to those who are using these tools in an ad hoc manner without realizing the full force of the theory

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

Deterministic Solvers for the Boltzmann Transport Equation Sung-Min Hong, Anh-Tuan Pham, Christoph Jungemann, 2011-07-31 The book covers all aspects from the expansion of the Boltzmann transport equation with harmonic functions to application to devices where transport in the bulk and in inversion layers is considered The important aspects of stabilization and band structure mapping are discussed in detail This is done not only for the full band structure of the 3D k space but also for the warped band structure of the quasi 2D hole gas Efficient methods for building the Schrödinger equation for arbitrary surface or strain directions gridding of the 2D k space and solving it together with the other two equations are presented

Bio-inspired Computing: Theories and Applications Linqiang Pan, Gheorghe Paun, Mario J. Pérez-Jiménez, Tao Song, 2014-09-19 This book constitutes the proceedings of the 9th International Conference on Bio inspired Computing Theories and Applications BIC TA 2014 held in Wuhan China in October 2014 The 109 revised full papers presented were carefully reviewed and selected from 204 submissions The papers focus on four main topics namely evolutionary computing neural computing DNA computing and membrane computing

Algorithms for Quadratic Matrix and Vector Equations Federico Poloni, 2012-03-13 This book is devoted to studying algorithms for the solution of a class of quadratic matrix and vector equations These equations appear in different forms in several practical applications especially in applied probability and control theory The equations are first presented using a novel unifying approach then specific numerical methods are presented for the cases most relevant for applications and new algorithms and theoretical results developed by the author are presented The book focuses on matrix multiplication rich iterations such as cyclic reduction and the structured doubling algorithm SDA and contains a variety of new research results which as of today are only available in articles or preprints

Matrix Inequalities for Iterative Systems Hanjo Taubig, 2017-02-03 The book reviews inequalities for weighted entry sums of matrix powers Applications range from mathematics and CS to pure sciences It unifies and generalizes several results for products and powers of sesquilinear forms derived from powers of Hermitian positive semidefinite as well as nonnegative matrices It shows that some inequalities are valid only in specific cases How to translate the Hermitian matrix results into results for alternating powers of general rectangular matrices Inequalities that compare the powers of the row and column sums to the row and column sums of the matrix powers are refined for nonnegative matrices Lastly eigenvalue bounds and derive results for iterated kernels are improved

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