

Discrete Mathematics



Martin Aigner, Freie
Universitat Berlin

Praise for the German edition
'... This book is a well-written
introduction to discrete
mathematics and is highly
recommended to every
student of mathematics and
computer science as well as
to teachers of these topics.'

Konrad Engel for
MathSciNet

The advent of fast computers and the search for efficient algorithms revolutionized combinatorics and brought about the field of discrete mathematics. This book is an introduction to the main ideas and results of discrete mathematics, and with its emphasis on algorithms it should be interesting to mathematicians and computer scientists alike. The book is organized into three parts: enumeration, graphs and algorithms, and algebraic systems. There are 600 exercises with hints and solutions to about half of them. The only prerequisites for understanding everything in the book are linear algebra and calculus at the undergraduate level.

April 2007 | 388 pages | American Mathematical Society

978-0-8218-4151-8, HARDBACK

£34.50/\$59.00

Nonlinear Equations and Spectral Theory

M. S. Birman and N. N. Uraltseva, both at St. Petersburg State University

This volume is devoted to the memory of the famous Saint Petersburg mathematician Olga Aleksandrovna Ladyzhenskaya. For many years she ran the Saint Petersburg Seminar on mathematical physics, which became a basis for the scientific school she created. The ten articles in the volume, written by students and colleagues of O. A. Ladyzhenskaya, are mainly devoted to boundary value problems for partial differential equations and to spectral problems for differential operators.

American Mathematical Society Translations—Series 2
(Advances in the Mathematical Sciences) No. 220

May 2007 | approximately 248 pages |
American Mathematical Society

978-0-8218-4209-6, HARDBACK

£63.50/\$109.00

Assistantships and Graduate Fellowships in the Mathematical Sciences 2006

This valuable reference source brings together a wealth of information about resources available for graduate study in mathematical sciences departments in the U.S. and Canada.

February 2007 | 112 pages | American Mathematical Society

978-0-8218-4152-5, PAPERBACK

£14.50/\$23.00

1001 Problems in Classical Number Theory

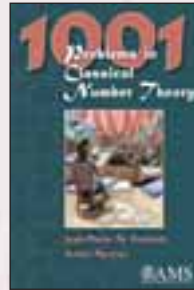
Jean-Marie De
Koninck, Universite
Laval, Canada, and
Armel Mercier,
Universite du Quebec
a Chicoutimi

In the spirit of *The Book of the One Thousand and One Nights*, the authors offer 1001 problems in number theory in a way that entices the reader to immediately attack the next problem. Whether a novice or an experienced mathematician, anyone fascinated by numbers will find a great variety of problems—some simple, others more complex—that will provide them with a wonderful mathematical experience.

May 2007 | 336 pages |
American Mathematical Society

978-0-8218-4224-9, HARDBACK

£28.50/\$49.00



Moduli Spaces and Arithmetic Geometry (Kyoto, 2004)

Shigeru Mukai, Kyoto University, Yoichi Miyaoka, University of Tokyo, Shigefumi Mori, Kyoto University, Atsushi Moriwaki, Kyoto University, Japan, and Iku Nakamura, Hokkaido University

Since its birth, algebraic geometry has been closely related to and deeply motivated by number theory. The modern study of moduli spaces and arithmetic geometry demonstrates that these two areas have many important techniques and ideas in common. With this close relation in mind, the RIMS conference 'Moduli Spaces and Arithmetic Geometry' was held at Kyoto University during September 8–15, 2004 as the 13th International Research Institute of the Mathematical Society of Japan. This volume is the outcome of this conference and consists of thirteen papers by invited speakers, including C. Soule, A. Beauville and C. Faber, and other participants. All papers, with two exceptions by C. Voisin and Yoshinori Namikawa, treat moduli problem and/or arithmetic geometry. Algebraic curves, Abelian varieties, algebraic vector bundles, connections and D-modules are the subjects of those moduli papers. Arakelov geometry and rigid geometry are studied in arithmetic papers. In the two exceptions, integral Hodge classes on Calabi-Yau threefolds and symplectic resolutions of nilpotent orbits are studied.

Advanced Studies in Pure Mathematics No. 45

April 2007 | 432 pages | American Mathematical Society

978-4-931469-38-9, HARDBACK

£59.50/\$102.00

What's Happening in the Mathematical Sciences

Dana Mackenzie and Barry Cipra

The AMS series *What's Happening in the Mathematical Sciences* distills the amazingly rich brew of current research in mathematics down to a few choice samples. This volume leads off with an update on the Poincare Conjecture, a hundred-year-old problem that has apparently been solved by Grigory Perelman of St. Petersburg, Russia. So what did topologists do when the oldest and most famous problem about closed manifolds was vanquished? As the second chapter describes, they confronted a suite of problems concerning the 'ends' of open manifolds ... and solved those, too. Not to be outdone, number theorists accomplished several unexpected feats in the first five years of the new century, from computing a trillion digits of pi to finding arbitrarily long equally-spaced sequences of prime numbers. Undergraduates made key discoveries, as explained in the chapters on Venn diagrams and primality testing. In applied mathematics, the Navier-Stokes equations of fluid mechanics continued to stir up interest. One team proved new theorems about the long-term evolution of vortices, while others explored the surprising ways that insects use vortices to move around. The random jittering of Brownian motion became a little less mysterious. Finally, an old and trusted algorithm of computer science had its trustworthiness explained in a novel way. Barry Cipra explains these new developments in his wry and witty style, familiar to readers of Volumes 1–5, and is joined in this volume by Dana Mackenzie. Volume 6 of *What's Happening* will convey to all readers—from mathematical novices to experts—the beauty and wonder that is mathematics.

What's Happening in the Mathematical Sciences No. 6

February 2007 | 122 pages | American Mathematical Society

978-0-8218-3585-2, PAPERBACK

£14.50/\$23.00

Data Depth: Robust Multivariate Analysis, Computational Geometry and Applications

Regina Y. Liu, Rutgers University, Robert Serfling, University of Texas at Dallas, and Diane L. Souvaine, Tufts University

The book is a collection of some of the research presented at the workshop of the same name held in May 2003 at Rutgers University. The workshop brought together researchers from two different communities: statisticians and specialists in computational geometry. The main idea unifying these two research areas turned out to be the notion of data depth, which is an important notion both in statistics and in the study of efficiency of algorithms used in computational geometry. Many of the articles in the book lay down the foundations for further collaboration and interdisciplinary research. Information for our distributors: Co-published with the Center for Discrete Mathematics and Theoretical Computer Science beginning with Volume 8. Volumes 1–7 were co-published with the Association for Computer Machinery (ACM).

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science No. 72

February 2007 | 246 pages | American Mathematical Society

978-0-8218-3596-8, HARDBACK

£50.75/\$89.00



Multiple Dirichlet Series, Automorphic Forms, and Analytic Number Theory

Solomon Friedberg, Boston College, **Daniel Bump**, Stanford University, **Dorian Goldfeld**, Columbia University, and **Jeffrey Hoffstein**, Brown University

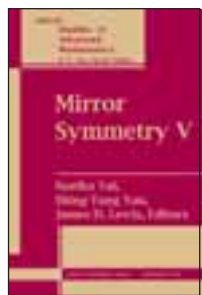
Multiple Dirichlet series are Dirichlet series in several complex variables. A multiple Dirichlet series is said to be perfect if it satisfies a finite group of functional equations and has meromorphic continuation everywhere. The earliest examples came from Mellin transforms of metaplectic Eisenstein series and have been intensively studied over the last twenty years. More recently, many other examples have been discovered and it appears that all the classical theorems on moments of L -functions as well as the conjectures (such as those predicted by random matrix theory) can now be obtained via the theory of multiple Dirichlet series. Furthermore, new results, not obtainable by other methods, are just coming to light. This volume offers an account of some of the major research to date and the opportunities for the future. It includes an exposition of the main results in the theory of multiple Dirichlet series, and papers on moments of zeta- and L -functions, on new examples of multiple Dirichlet

Proceedings of Symposia in Pure Mathematics No. 75

January 2007 | 306 pages | American Mathematical Society

978-0-8218-3963-8, **HARDBACK** £39.50/\$69.00

Mirror Symmetry V



Noriko Yui, Queen's University, **Shing-Tung Yau**, Harvard University, and **James D. Lewis**, University of Alberta

Since its discovery in the early 1990s, mirror symmetry, or more generally, string theory, has exploded onto the mathematical landscape.

This topic touches upon

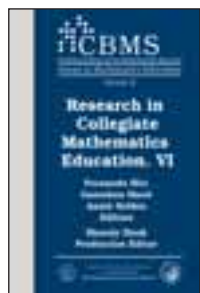
many branches of mathematics and mathematical physics, and has revealed deep connections between subjects previously considered unrelated. The papers in this volume treat mirror symmetry from the perspectives of both mathematics and physics. The articles can be roughly grouped into four sub-categories within the topic of mirror symmetry: arithmetic aspects, geometric aspects, differential geometric and mathematical physics aspects, and geometric analytic aspects. In these works, the reader will find mathematics addressing, and in some cases solving, problems inspired and influenced by string theory.

AMS/IP Studies in Advanced Mathematics No. 38

January 2007 | 576 pages | American Mathematical Society

978-0-8218-4251-5, **PAPERBACK** £62.25/\$109.00

Research in Collegiate Mathematics Education. VI



Fernando Hitt, Université du Québec à Montréal, **Guershon Harel**, University of California, and **Shandy Hauk**, University of Northern Colorado

The sixth volume of *Research in Collegiate Mathematics Education* presents state-of-the-art research on understanding, teaching, and learning mathematics

at the postsecondary level. The articles advance our understanding of collegiate mathematics education while being readable by a wide audience of mathematicians interested in issues affecting their own students. This is a collection of useful and informative research regarding the ways our students think about and learn mathematics. The volume opens with studies on students' experiences with calculus reform and on the effects of concept-based calculus instruction. The next study uses technology and the van Hiele framework to help students construct concept images of sequential convergence. The volume continues with studies on developing and assessing specific competencies in real analysis, on introductory complex analysis, and on using geometry in teaching and learning linear algebra. It closes with a study on the processes used in proof construction and another on the transition to graduate studies in mathematics. Whether they are specialists in education or mathematicians interested in finding out about the field, readers will obtain new insights about teaching and learning and will take away ideas that they can use.

CBMS Issues in Mathematics Education No. 13

February 2007 | 248 pages | American Mathematical Society

978-0-8218-4243-0, **PAPERBACK** £28.00/\$49.00

Number-Theoretic Algorithms in Cryptography

O. N. Vasilenko, Moscow State University

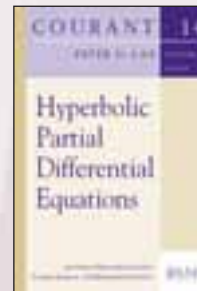
Algorithmic number theory is a rapidly developing branch of number theory, which, in addition to its mathematical importance, has substantial applications in computer science and cryptography. Among the algorithms used in cryptography, the following are especially important: algorithms for primality testing; factorization algorithms for integers and for polynomials in one variable; applications of the theory of elliptic curves; algorithms for computation of discrete logarithms; algorithms for solving linear equations over finite fields; algorithms for performing arithmetic operations on large integers. The book describes the current state of these and some other algorithms. It also contains extensive bibliography.

Translations of Mathematical Monographs No. 232

January 2007 | approximately 248 pages | American Mathematical Society

978-0-8218-4090-0, **HARDBACK** £50.75/\$89.00

Hyperbolic Partial Differential Equations



Peter D. Lax, New York University, Courant Institute

The theory of hyperbolic equations is a large subject, and its applications are many. This book is an introduction to most facets of the theory and is an ideal text for a second-year graduate course on the subject. The first part deals with the basic theory: the relation of hyperbolicity to the finite propagation of signals, the concept and role of characteristic surfaces and rays, energy, and energy inequalities. The structure of solutions of equations with constant coefficients is explored with the help of the Fourier and Radon transforms. The existence of solutions of equations with variable coefficients with prescribed initial values is proved using energy inequalities. The propagation of singularities is studied with the help of progressing waves. The second part describes finite difference approximations of hyperbolic equations, presents a streamlined version of the Lax-Phillips scattering theory, and covers basic concepts and results for hyperbolic systems of conservation laws, an active research area today. Four brief appendices sketch topics that are important or amusing, such as Huygens' principle and a theory of mixed initial and boundary value problems. A fifth appendix by Cathleen Morawetz describes a nonstandard energy identity and its uses.

Courant Lecture Notes No. 14

January 2007 | 217 pages | American Mathematical Society

978-0-8218-3576-0, **PAPERBACK** £19.00/\$33.00

Invariant Theory

Sara D. Neusel, Texas Tech University

This book presents the characteristic zero invariant theory of finite groups acting linearly on polynomial algebras. The author assumes basic knowledge of groups and rings, and introduces more advanced methods from commutative algebra along the way. The theory is illustrated by numerous examples and applications to physics, engineering, numerical analysis, combinatorics, coding theory, and graph theory. A wide selection of exercises and suggestions for further reading makes the book appropriate for an advanced undergraduate or first-year graduate level course.

Student Mathematical Library No. 36

February 2007 | 314 pages | American Mathematical Society

978-0-8218-4132-7, **PAPERBACK** £28.00/\$49.00



Approximately Calculus

Shahriar Shahriari, Pomona College

Is there always a prime number between n and $2n$? Where, approximately, is the millionth prime? And just what does calculus have to do with answering either of these questions? It turns out that calculus has a lot to do with both questions, as this book demonstrates. The theme of the book is approximations. Calculus is a powerful tool because it allows us to approximate complicated functions with simpler ones. Indeed, replacing a function locally with a linear—or higher order—approximation is at the heart of calculus. The real star of the book, though, is the task of approximating the number of primes up to a number x . This leads to the famous Prime Number Theorem—and to the answers to the two questions about primes. While emphasizing the role of approximations in calculus, most major topics are addressed, such as derivatives, integrals, the Fundamental Theorem of Calculus, sequences, series, and so on. However, our particular point of view also leads us to many unusual topics: curvature, Pade approximations, public key cryptography, and an analysis of the logistic equation, to name a few. The reader takes an active role in developing the material by solving problems. Most topics are broken down into a series of manageable problems, which guide you to an understanding of the important ideas. There is also ample exposition to fill in background material and to get you thinking appropriately about the concepts. *Approximately Calculus* is intended for the reader who has already had an introduction to calculus, but wants to engage the concepts and ideas at a deeper level. It is suitable as a text for an honors or alternative second semester calculus course.

January 2007 | approximately 305 pages |
American Mathematical Society

978-0-8218-3750-4, HARDBACK £28.00/\$49.00

Combined Membership List 2006–2007

The *Combined Membership List (CML)* is a comprehensive directory of the membership of the American Mathematical Society, the American Mathematical Association of Two-Year Colleges, the Association for Women in Mathematics, the Canadian Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. It includes a complete alphabetical list of all individual members in all six organizations. For each member, the CML provides an address, title, department, institution, telephone number (if available), and electronic address (if provided) and also indicates membership in the six participating societies. In addition, the CML lists academic, institutional, and corporate members of the six participating societies providing addresses and telephone numbers of mathematical sciences departments. The CML is an invaluable reference for keeping in touch with colleagues and for making connections in the mathematical sciences community in the United States and abroad.

February 2007 | 350 pages | American Mathematical Society

978-0-8218-3909-6, PAPERBACK £40.50/\$71.00

AMS CHELSEA PUBLISHING

A History of the Calculus of Variations in the Eighteenth Century

Robert Woodhouse

Shortly after the invention of differential and integral calculus, the calculus of variations was developed. The new calculus looks for functions that minimize or maximize some quantity, such as the brachistochrone problem, which was solved by Johann Bernoulli, Leibniz, Newton, Jacob Bernoulli and l'Hopital and is sometimes considered as the starting point of the calculus of variations. In Woodhouse's book, first published in 1810, he has interwoven the historical progress with the scientific development of the subject. The reader will have the opportunity to see how calculus, during its first one hundred years, developed by seemingly tiny increments to become the highly polished subject that we know today.

AMS Chelsea Publishing

June 2007 | 154 pages | American Mathematical Society

978-0-8218-3647-7, HARDBACK £18.25/\$29.00

Mathematical Papers by William Kingdon Clifford

Robert Tucker

William Clifford (1845–1879) was an important mathematician of his day. He is most remembered today for his invention of Clifford algebras, which are fundamental in modern differential geometry and mathematical physics. His ideas on the connection between energy and matter and the curvature of space were important in the eventual formulation of general relativity. Clifford was particularly interested in non-Euclidean geometry. However, in his relatively brief career, he made contributions to diverse fields of mathematics: elliptic functions, Riemann surfaces, biquaternions, motion in Euclidean and non-Euclidean space, spaces of constant curvature, syzygies, and so on. He was also well-known as a teacher and for his ideas on the philosophy of science. This work covers the life and mathematical work of Clifford, from his early education at Templeton (Exeter) to King's College, London, to Trinity (Cambridge) and ultimately to his professorship at University College, London—a post which he occupied until the time of his death. Tucker discusses Clifford's Fellowship at the Royal Society and his Council post at the London Mathematical Society. His papers and talks are presented and peppered with entertaining anecdotes relating Clifford's associations with his private tutor, family members, and his wide circle of personal friends and professional colleagues.

AMS Chelsea Publishing

May 2007 | 658 pages | American Mathematical Society

978-0-8218-4252-2, HARDBACK £33.75/\$59.00

Untersuchungen über höhere arithmetik

Carl Friedrich Gauss

In this volume are included all of Gauss's number-theoretic works: his masterpiece, *Disquisitiones Arithmeticae*, published when Gauss was only 25 years old; several papers published during the ensuing 31 years; and papers taken from material found in Gauss's handwriting after his death. These papers include a fourth, fifth, and sixth proof of the *Quadratic Reciprocity Law*, researches on biquadratic residues, quadratic forms, and other topics. This reprint of the German translation from Latin of the second edition published in 1889 includes an extensive appendix and concludes with a commentary on the papers (with references, where appropriate, to the relevant pages of the *Disquisitiones*).

AMS Chelsea Publishing

May 2007 | 695 pages |
American Mathematical Society

978-0-8218-4213-3, HARDBACK £33.75/\$59.00



The Calculus of Finite Differences

L. M. Milne-Thomson

From the Preface: 'The object of this book is to provide a simple and connected account of the subject of Finite Differences and to present the theory in a form which can be readily applied ... not only the useful material of Boole ... but also the more modern developments of the finite calculus ... [T]he book is suitable for a first course as well as for more advanced reading ... Operational and symbolic methods have been freely used throughout the book.'

AMS Chelsea Publishing

May 2007 | 558 pages | American Mathematical Society

978-0-8218-3816-7, HARDBACK £33.75/\$59.00

Filtering for Stochastic Processes with Applications to Guidance

Richard S. Bucy and Peter D. Joseph

This second edition preserves the original text of 1968, with clarification and added references. From the Preface to the Second Edition: 'Since the First Edition of this book, numerous important results have appeared—in particular stochastic integrals with respect to martingales, random fields, Riccati equation theory and realization of nonlinear filters, to name a few. In Appendix D, an attempt is made to provide some of the references that the authors have found useful and to comment on the relation of the cited references to the field ... [W]e hope that this new edition will have the effect of hastening the day when the nonlinear filter will enjoy the same popularity in applications as the linear filter does now.'

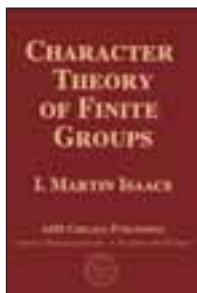
AMS Chelsea Publishing

May 2007 | 217 pages | American Mathematical Society

978-0-8218-3782-5, HARDBACK £20.00/\$35.00



Character Theory of Finite Groups



I. Martin Isaacs, University of Wisconsin

The book begins by developing the module theory of complex group algebras. After the module-theoretic foundations are laid in the first chapter, the focus is primarily on characters. This enhances the accessibility of the material for students,

which was a major consideration in the writing. Also with students in mind, a large number of problems are included, many of them quite challenging. In addition to the development of the basic theory (using a cleaner notation than previously), a number of more specialized topics are covered with accessible presentations. These include projective representations, the basics of the Schur index, irreducible character degrees and group structure, complex linear groups, exceptional characters, and a fairly extensive introduction to blocks and Brauer characters. This is a corrected reprint of the original 1976 version, later reprinted by Dover. Since 1976 it has become the standard reference for character theory, appearing in the bibliography of almost every research paper in the subject. It is largely self-contained, requiring of the reader only the most basic facts of linear algebra, group theory, Galois theory and ring and module theory.

AMS Chelsea Publishing

January 2007 | 303 pages | American Mathematical Society
978-0-8218-4229-4, HARDBACK £25.75/\$45.00

Calcul des probabilités

J. Bertrand

'A much-quoted classical work. Few writers on probability are quoted more often than Bertrand—and with good reason. He is clear and to the point. His eyes are open clearly to the traps and pitfalls of his subject and he is able to open his readers' eyes as well. And he is immensely readable. Simple and direct ... everywhere common sense and mother wit ... and conspicuously displayed.'

E. W. Davis

AMS/Chelsea Publication

January 2007 | 332 pages | American Mathematical Society
978-0-8218-3778-8, HARDBACK £22.25/\$0.00

MEMOIRS OF THE AMERICAN MATHEMATICAL SOCIETY

Exponential Genus Problems in One-Relator Products of Groups

A. J. Duncan, University of Newcastle

Exponential equations in free groups were studied initially by Lyndon and Schutzenberger and then by Comerford and Edmunds. Comerford and Edmunds showed that the problem of determining whether or not the class of quadratic exponential equations have solution is decidable, in finitely generated free groups. In this paper the author shows that for finite systems of quadratic exponential equations decidability passes, under certain hypotheses, from the factor groups to free products and one-relator products.

Memoirs of the American Mathematical Society No. 186

March 2007 | 156 pages | American Mathematical Society
978-0-8218-3945-4, PAPERBACK £37.75/\$66.00

The Hilbert Function of a Level Algebra

Anthony V. Geramita, Queen's University,
Tadahito Harima, Hokkaido University of Education,
Juan C. Migliore, University of Notre Dame, and
Yong Su Shin, Sungshin Women's University

Let R be a polynomial ring over an algebraically closed field and let S be a standard graded Cohen-Macaulay quotient of R . The authors state that S is a level algebra if the last module in the minimal free resolution of S (as R -module) is of the form $R(-s)^a$, where s and a are positive integers. When $a=1$ these are also known as Gorenstein algebras. The basic question addressed in this paper is: What can be the Hilbert Function of a level algebra? The authors consider the question in several particular cases, e.g., when S is an Artinian algebra, or when S is the homogeneous coordinate ring of a reduced set of points, or when S satisfies the Weak Lefschetz Property. The authors give new methods for showing that certain functions are NOT possible as the Hilbert function of a level algebra and also give new methods to construct level algebras. In a (rather long) appendix, the authors apply their results to give complete lists of all possible Hilbert functions in the case that the codimension of $A=3$, s is small and a takes on certain fixed values.

Memoirs of the American Mathematical Society No. 186

March 2007 | 139 pages | American Mathematical Society
978-0-8218-3940-9, PAPERBACK £36.50/\$64.00

On Necessary and Sufficient Conditions for SL_p -Estimates of Riesz Transforms Associated to Elliptic Operators on \mathbb{R}^n and Related Estimates

Pascal Auscher, Universite Paris-Sud, Orsay

This memoir focuses on SL_p estimates for objects associated to elliptic operators in divergence form: its semigroup, the gradient of the semigroup, functional calculus, square functions and Riesz transforms. The author introduces four critical numbers associated to the semigroup and its gradient that completely rule the ranges of exponents for the SL_p estimates. It appears that the case $p < 2$ already treated earlier is radically different from the case $p > 2$ which is new. The author thus recovers in a unified and coherent way many SL_p estimates and gives further applications. The key tools from harmonic analysis are two criteria for SL_p boundedness, one for $p < 2$ and the other for $p > 2$ but in ranges different from the usual intervals $(1, 2)$ and $(2, \infty)$.

Memoirs of the American Mathematical Society No. 186

March 2007 | 75 pages | American Mathematical Society
978-0-8218-3941-6, PAPERBACK £34.25/\$60.00

Hypergeometrie et Fonction Zeta de Riemann

Krattenthaler, Universite Claude Bernard, and **Rivoal**, Universite de Grenoble I

The authors prove Rivoal's "denominator conjecture" concerning the common denominators of coefficients of certain linear forms in zeta values. These forms were recently constructed to obtain lower bounds for the dimension of the vector space over \mathbb{Q} spanned by $\zeta(1), \zeta(m), \zeta(m+2), \dots, \zeta(m+2h)$, where m and h are integers such that $m \geq 2$ and $h \geq 0$. In particular, the authors immediately get the following results as corollaries: at least one of the eight numbers $\zeta(5), \zeta(7), \dots, \zeta(19)$ is irrational, and there exists an odd integer j between 5 and 165 such that $1, \zeta(3)$ and $\zeta(j)$ are linearly independent over \mathbb{Q} . This strengthens some recent results. The authors also prove a related conjecture, due to Vasilyev, and as well a conjecture, due to Zudilin, on certain rational approximations of $\zeta(4)$. The proofs are based on a hypergeometric identity between a single sum and a multiple sum due to Andrews. The authors hope that it will be possible to apply their construction to the more general linear forms constructed by Zudilin, with the ultimate goal of strengthening his result that one of the numbers $\zeta(5), \zeta(7), \zeta(9), \zeta(11)$ is irrational.

Memoirs of the American Mathematical Society No. 186

March 2007 | 87 pages | American Mathematical Society
978-0-8218-3961-4, PAPERBACK £34.25/\$60.00

Semisolvability of Semisimple Hopf Algebras of Low Dimension

Sonia Natale, Universidad Nacional de Cordoba

The author proves that every semisimple Hopf algebra of dimension less than 60 over an algebraically closed field K of characteristic zero is either upper or lower semisolvable up to a cocycle twist.

Memoirs of the American Mathematical Society No. 186

March 2007 | 123 pages | American Mathematical Society
978-0-8218-3948-5, PAPERBACK £35.50/\$62.00

Homological and Homotopical Aspects of Torsion Theories

Apostolos Beligiannis, University of Ioannina, and **Idun Reiten**, Norwegian University of Science and Technology

In this paper the authors investigate homological and homotopical aspects of a concept of torsion which is general enough to cover torsion and cotorsion pairs in abelian categories, $\mathcal{S}\mathcal{T}$ -structures and recollements in triangulated categories, and torsion pairs in stable categories. The proper conceptual framework for this study is the general setting of pretriangulated categories, an omnipresent class of additive categories which includes abelian, triangulated, stable, and more generally (homotopy categories of) closed model categories in the sense of Quillen, as special cases. The main focus of their study is on the investigation of the strong connections and the interplay between (co)torsion pairs and tilting theory in abelian, triangulated and stable categories on one hand, and universal cohomology theories induced by torsion pairs on the other hand. These new universal cohomology theories provide a natural generalization of the Tate-Vogel (co)homology theory. The authors also study the connections between torsion theories and closed model structures, which allow them to classify all cotorsion pairs in an abelian category and all torsion pairs in a stable category, in homotopical terms. For instance they obtain a classification of (co)tilting modules along these lines. Finally they give torsion theoretic applications to the structure of Gorenstein and Cohen-Macaulay categories, which provide a natural generalization of Gorenstein and Cohen-Macaulay rings.

Memoirs of the American Mathematical Society No. 188
July 2007 | 207 pages | American Mathematical Society
978-0-8218-3996-6, PAPERBACK £42.00/\$72.00

Asymptotic Behaviour of Tame Harmonic Bundles and an Application to Pure Twistor $\mathcal{S}\mathcal{D}$ -Modules, Part 2

Takuro Mochizuki, Kyoto University

The author studies the asymptotic behaviour of tame harmonic bundles. First he proves a local freeness of the prolongment of deformed holomorphic bundle by an increasing order. Then he obtains the polarized mixed twistor structure from the data on the divisors. As one of the applications, he obtains the norm estimate of holomorphic or flat sections by weight filtrations of the monodromies. As another application, the author establishes the correspondence of semisimple regular holonomic $\mathcal{S}\mathcal{D}$ -modules and polarizable pure imaginary pure twistor $\mathcal{S}\mathcal{D}$ -modules through tame pure imaginary harmonic bundles, which is a conjecture of C. Sabbah. Then the regular holonomic version of M. Kashiwara's conjecture follows from the results of Sabbah and the author.

Memoirs of the American Mathematical Society No. 185
February 2007 | 240 pages | American Mathematical Society
978-0-8218-3943-0, PAPERBACK £44.50/\$78.00

Recent Developments in the Theory of Lorentz Spaces and Weighted Inequalities

Maria J. Carro, **Jose A. Raposo**, and **Javier Soria**, all at University of Barcelona

The main objective of this work is to bring together two well known and, a priori, unrelated theories dealing with weighted inequalities for the Hardy-Littlewood maximal operator $\mathcal{M}\mathcal{S}$. For this, the authors consider the boundedness of $\mathcal{M}\mathcal{S}$ in the weighted Lorentz space $L^p(\lambda, w)$. Two examples are historically relevant as a motivation: If $\lambda w = 1$, this corresponds to the study of the boundedness of $\mathcal{M}\mathcal{S}$ on $L^p(u)$, which was characterized by B. Muckenhoupt in 1972, and the solution is given by the so called $\mathcal{S}A_p$ weights. The second case is when we take $\lambda w = 1$. This is a more recent theory, and was completely solved by M.A. Arino and B. Muckenhoupt in 1991. It turns out that the boundedness of $\mathcal{M}\mathcal{S}$ on $L^p(\lambda, w)$ can be seen to be equivalent to the boundedness of the Hardy operator $\mathcal{S}A$ restricted to decreasing functions of $L^p(w)$, since the nonincreasing rearrangement of $\mathcal{M}\mathcal{S}f$ is pointwise equivalent to $\mathcal{S}A^*f$. The class of weights satisfying this boundedness is known as $\mathcal{S}B_p$. Even though the $\mathcal{S}A_p$ and $\mathcal{S}B_p$ classes enjoy some similar features, they come from very different theories, and so are the techniques used on each case: Calderon-Zygmund decompositions and covering lemmas for $\mathcal{S}A_p$, rearrangement invariant properties and positive integral operators for $\mathcal{S}B_p$. This work aims to give a unified version of these two theories. Contrary to what one could expect, the solution is not given in terms of the limiting cases above considered (i.e., $\lambda w = 1$ and $\lambda w = 1$), but in a rather more complicated condition, which reflects the difficulty of estimating the distribution function of the Hardy-Littlewood maximal operator with respect to general measures.

Memoirs of the American Mathematical Society No. 187
May 2007 | 128 pages | American Mathematical Society
978-0-8218-4237-9, PAPERBACK £36.25/\$62.00

Asymptotic Behaviour of Tame Harmonic Bundles and an Application to Pure Twistor $\mathcal{S}\mathcal{D}$ -Modules, Part 1

Takuro Mochizuki, Kyoto University

The author studies the asymptotic behaviour of tame harmonic bundles. First he proves a local freeness of the prolongment of deformed holomorphic bundle by an increasing order. Then he obtains the polarized mixed twistor structure from the data on the divisors. As one of the applications, he obtains the norm estimate of holomorphic or flat sections by weight filtrations of the monodromies. As another application, the author establishes the correspondence of semisimple regular holonomic $\mathcal{S}\mathcal{D}$ -modules and polarizable pure imaginary pure twistor $\mathcal{S}\mathcal{D}$ -modules through tame pure imaginary harmonic bundles, which is a conjecture of C. Sabbah. Then the regular holonomic version of M. Kashiwara's conjecture follows from the results of Sabbah and the author.

Memoirs of the American Mathematical Society No. 185
March 2007 | 324 pages | American Mathematical Society
978-0-8218-3942-3, PAPERBACK £48.50/\$85.00

KAM Stability and Celestial Mechanics

Alessandra Celletti, Universita di Roma Tor Vergata, Italy, and **Luigi Chierchia**, Universita 'Roma Tre', Italy

KAM theory is a powerful tool apt to prove perpetual stability in Hamiltonian systems, which are a perturbation of integrable ones. The smallness requirements for its applicability are well known to be extremely stringent. A long standing problem, in this context, is the application of KAM theory to 'physical systems' for 'observable' values of the perturbation parameters. The authors consider the Restricted, Circular, Planar, Three-Body Problem (RCP3BP), i.e., the problem of studying the planar motions of a small body subject to the gravitational attraction of two primary bodies revolving on circular Keplerian orbits (which are assumed not to be influenced by the small body). When the mass ratio of the two primary bodies is small, the RCP3BP is described by a nearly-integrable Hamiltonian system with two degrees of freedom; in a region of phase space corresponding to nearly elliptical motions with non-small eccentricities, the system is well described by Delaunay variables. The Sun-Jupiter observed motion is nearly circular and an asteroid of the Asteroidal belt may be assumed not to influence the Sun-Jupiter motion. The Jupiter-Sun mass ratio is slightly less than 1/1000. The authors consider the motion of the asteroid 12 Victoria taking into account only the Sun-Jupiter gravitational attraction regarding such a system as a prototype of a RCP3BP. For values of mass ratios up to 1/1000, they prove the existence of two-dimensional KAM tori on a fixed three-dimensional energy level corresponding to the observed energy of the Sun-Jupiter-Victoria system. Such tori trap the evolution of phase points 'close' to the observed physical data of the Sun-Jupiter-Victoria system. As a consequence, in the RCP3BP description, the motion of Victoria is proven to be forever close to an elliptical motion. The proof is based on: 1) a new iso-energetic KAM theory; 2) an algorithm for computing iso-energetic, approximate Lindstedt series; 3) a computer-aided application of (1)+(2) to the Sun-Jupiter-Victoria system. The paper is self-contained but does not include the (sim) 12000 lines) computer programs, which may be obtained by sending an e-mail to one of the authors.

Memoirs of the American Mathematical Society No. 187
May 2007 | 134 pages | American Mathematical Society
978-0-8218-4169-3, PAPERBACK £37.25/\$64.00



Borel Liftings of Borel Sets: Some Decidable and Undecidable Statements

Gabriel Debs, Institut de Mathematique de Jessieu, and **Jean Saint Raymond**, Institut de Mathematique de Jessieu

One of the aims of this work is to investigate some natural properties of Borel sets which are undecidable in SZFCs. The authors' starting point is the following elementary, though non-trivial result: Consider $X \subseteq 2^\omega \times 2^\omega$, set $Y = \pi(X)$, where π denotes the canonical projection of $2^\omega \times 2^\omega$ onto the first factor, and suppose that (\star) : "Any compact subset of Y is the projection of some compact subset of X ". If moreover X is \mathbb{P}_1 then (\star) : "The restriction of π to some relatively closed subset of X is perfect onto Y " it follows that in the present case Y is also \mathbb{P}_1 . Notice that the reverse implication $(\star) \Rightarrow (\star)$ holds trivially for any X and Y .

But the implication $(\star) \Rightarrow (\star)$ for an arbitrary Borel set $X \subseteq 2^\omega \times 2^\omega$ is equivalent to the statement " $\forall \alpha \in \omega_1, \aleph_1$ is inaccessible in $SL(\alpha)$ ". More precisely The authors prove that the validity of $(\star) \Rightarrow (\star)$ for all $X \in \Sigma_{1+1}$, is equivalent to " $\aleph_1 < \aleph_1$ ". However we shall show independently, that when X is Borel one can, in SZFCs, derive from (\star) the weaker conclusion that Y is also Borel and of the same Baire class as X . This last result solves an old problem about compact covering mappings.

In fact these results are closely related to the following general boundedness principle $Lift(X, Y)$: "If any compact subset of Y admits a continuous lifting in X , then Y admits a continuous lifting in X ", where by a lifting of $Z \subseteq \mathbb{P}$ in X we mean a mapping on Z whose graph is contained in X . The main result of this work will give the exact set theoretical strength of this principle depending on the descriptive complexity of X and Y . The authors also prove a similar result for a variation of $Lift(X, Y)$ in which "continuous liftings" are replaced by "Borel liftings", and which answers a question of H. Friedman.

Among other applications the authors obtain a complete solution to a problem which goes back to Lusin concerning the existence of \mathbb{P}_1 sets with all constituents in some given class Γ of Borel sets, improving earlier results by J. Stern and R. Sami.

The proof of the main result will rely on a nontrivial representation of Borel sets (in SZFCs) of a new type, involving a large amount of "abstract algebra". This representation was initially developed for the purposes of this proof, but has several other applications.

Memoirs of the American Mathematical Society No. 187
 May 2007 | 118 pages | American Mathematical Society
 978-0-8218-3971-3, PAPERBACK £36.25/\$62.00

Betti Numbers of the Moduli Space of Rank 3 Parabolic Higgs Bundles

Garcia-Prada, Consejo Superior de Investigaciones Cientificas, **Gothen**, Universidade do Porto, and **Munoz**, Consejo Superior de Investigaciones Cientificas

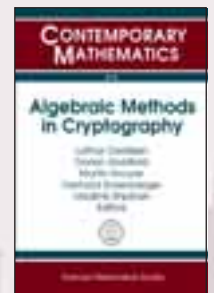
Parabolic Higgs bundles on a Riemann surface are of interest for many reasons, one of them being their importance in the study of representations of the fundamental group of the punctured surface in the complex general linear group. In this paper the authors calculate the Betti numbers of the moduli space of rank 3 parabolic Higgs bundles with fixed and non-fixed determinant, using Morse theory. A key point is that certain critical submanifolds of the Morse function can be identified with moduli spaces of parabolic triples. These moduli spaces come in families depending on a real parameter and the authors carry out a careful analysis of them by studying their variation with this parameter. Thus the authors obtain in particular information about the topology of the moduli spaces of parabolic triples for the value of the parameter relevant to the study of parabolic Higgs bundles. The remaining critical submanifolds are also described: one of them is the moduli space of parabolic bundles, while the remaining ones have a description in terms of symmetric products of the Riemann surface. As another consequence of their Morse theoretic analysis, the authors obtain a proof of the parabolic version of a theorem of Laumon, which states that the nilpotent cone (the preimage of zero under the Hitchin map) is a Lagrangian subvariety of the moduli space of parabolic Higgs bundles.

Memoirs of the American Mathematical Society No. 187
 May 2007 | 80 pages | American Mathematical Society
 978-0-8218-3972-0, PAPERBACK £33.25/\$57.00

CONTEMPORARY MATHEMATICS

Algebraic Methods in Cryptography

Lothar Gerritzen, Ruhr-Universität Bochum, **Dorian Goldfeld**, **Martin Kreuzer**, Universität Dortmund, **Gerhard Rosenberger**, Universität Dortmund, and **Vladimir Shpilrain**, The City College of New York



The book consists of contributions related mostly to public-key cryptography, including the design of new cryptographic primitives as well as cryptanalysis of previously suggested schemes. Most papers are original research papers in the area that can be loosely defined as 'non-commutative cryptography'; this means that groups (or other algebraic structures) which are used as platforms are non-commutative.

Contemporary Mathematics No. 418
 January 2007 | 178 pages | American Mathematical Society
 978-0-8218-4037-5, PAPERBACK £33.75/\$59.00

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Groups, Rings and Algebras

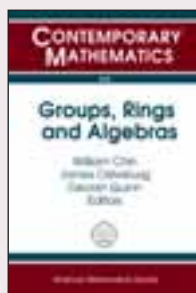
William Chin, DePaul University, **James Osterburg**, University of Cincinnati, and **Declan Quinn**, Syracuse University

This is a companion volume to the conference in honor of Donald S. Passman held in Madison, Wisconsin in June 2005. It contains research papers on Algebras, Group Rings, Hopf Algebras, Invariant Theory, Lie Algebras and their Enveloping Algebras, Noncommutative Algebraic Geometry, Noncommutative Rings, and other topics. The papers represent an important part of the latest research in these areas.

Contemporary Mathematics No. 420

January 2007 | 301 pages | American Mathematical Society

978-0-8218-3904-1, PAPERBACK £50.75/\$89.00



Algebraic Geometry

JongHae Keum, Korea Institute for Advanced Study, and **Shigeyuki Kondo**, Nagoya University

This volume contains the proceedings of the Korea-Japan Conference on Algebraic Geometry in honor of Igor Dolgachev on his sixtieth birthday. The articles in this volume explore a wide variety of problems that illustrate interactions between algebraic geometry and other branches of mathematics. Among the topics covered by this volume are algebraic curve theory, algebraic surface theory, moduli space, automorphic forms, Mordell-Weil lattices, and automorphisms of hyperkähler manifolds. This book is an excellent and rich reference source for researchers.

Contemporary Mathematics No. 422

March 2007 | approximately 234 pages | American Mathematical Society

978-0-8218-4201-0, PAPERBACK £39.50/\$69.00

Combinatorial Group Theory, Discrete Groups, and Number Theory

Benjamin Fine, Fairfield University, **Anthony M. Gaglione**, U.S. Naval Academy, Annapolis, and **Dennis Spellman**, Temple University

This volume consists of contributions by participants and speakers at two conferences. The first was entitled Combinatorial Group Theory, Discrete Groups and Number Theory and was held at Fairfield University, December 8–9, 2004. It was in honor of Professor Gerhard Rosenberger's sixtieth birthday. The second was the AMS Special Session on Infinite Group Theory held at Bard College, October 8–9, 2005. The papers in this volume provide a very interesting mix of combinatorial group theory, discrete group theory and ring theory as well as contributions to noncommutative algebraic cryptography.

Contemporary Mathematics No. 421

March 2007 | 273 pages | American Mathematical Society

978-0-8218-3985-0, PAPERBACK £45.00/\$79.00

Algebraic and Geometric Combinatorics

Christos A. Athanasiadis, University of Athens, **Victor V. Batyrev**, Universität Tübingen, **Dimitrios I. Dais**, University of Crete, **Martin Henk**, Otto von Guericke University, and **Francisco Santos**, University of Cantabria

This volume contains original research and survey articles stemming from the Euroconference 'Algebraic and Geometric Combinatorics'. The papers discuss a wide range of problems that illustrate interactions of combinatorics with other branches of mathematics, such as commutative algebra, algebraic geometry, convex and discrete geometry, enumerative geometry, and topology of complexes and partially ordered sets. Among the topics covered are combinatorics of polytopes, lattice polytopes, triangulations and subdivisions, Cohen-Macaulay cell complexes, monomial ideals, geometry of toric surfaces, groupoids in combinatorics, Kazhdan-Lusztig combinatorics, and graph colorings. This book is aimed at researchers and graduate students interested in various aspects of modern combinatorial theories.

Contemporary Mathematics No. 423

April 2007 | approximately 453 pages | American Mathematical Society

978-0-8218-4080-1, PAPERBACK £50.75/\$89.00

Advances in Logic

Su Gao and **Steve Jackson**, both at the University of North Texas, and **Yi Zhang**, Sun Yat-Sen University, Guangzhou

The articles in this book are based on talks given at the North Texas Logic Conference in October of 2004. The main goal of the editors was to collect articles representing diverse fields within logic that would both contain significant new results and be accessible to readers with a general background in logic. Included in the book is a problem list, jointly compiled by the speakers, that reflects some of the most important questions in various areas of logic. This book should be useful to graduate students and researchers alike across the spectrum of mathematical logic.

Contemporary Mathematics No. 425

April 2007 | 150 pages | American Mathematical Society

978-0-8218-3819-8, PAPERBACK £28.75/\$49.00

The Interaction of Analysis and Geometry

V. I. Burenkov, Cardiff University, **T. Iwaniec**, Syracuse University, and **S. K. Vodopyanov**, Sobolev Institute of Mathematics

The papers in this volume are based on talks given at the International Conference on Analysis and Geometry in honor of the 75th birthday of Yurii Reshetnyak (Novosibirsk, 2004). The topics include geometry of spaces with bounded curvature in the sense of Alexandrov, quasiconformal mappings and mappings with bounded distortion (quasiregular mappings), nonlinear potential theory, Sobolev spaces, spaces with fractional and generalized smoothness, variational problems, and other modern trends in these areas. Most articles are related to Reshetnyak's original works and demonstrate the vitality of his fundamental contribution in some important fields of mathematics such as the geometry in the 'large', quasiconformal analysis, Sobolev spaces, potential theory and variational calculus.

Contemporary Mathematics No. 424

April 2007 | 344 pages | American Mathematical Society

978-0-8218-4060-3, PAPERBACK £57.50/\$99.00

Algebra and its Applications

Dinh V. Huynh, **S. K. Jain**, and **S. R. Lopez-Permouth**, all at Ohio University

This volume consists of contributions by speakers at a Conference on Algebra and its Applications that took place in Athens, Ohio, in March of 2005. It provides a snapshot of the diversity of themes and applications that interest algebraists today. The papers in this volume include some of the latest results in the theory of modules, noncommutative rings, representation theory, matrix theory, linear algebra over noncommutative rings, cryptography, error-correcting codes over finite rings, and projective-geometry codes, as well as expository articles that will provide algebraists and other mathematicians, including graduate students, with an accessible introduction to areas outside their own expertise. The book will serve both the specialist looking for the latest result and the novice seeking an accessible reference for some of the ideas and results presented here.

Contemporary Mathematics No. 419

January 2007 | 319 pages | American Mathematical Society

978-0-8218-3842-6, PAPERBACK £50.75/\$89.00

Jack, Hall-Littlewood and Macdonald Polynomials

Vadim B. Kuznetsov and **Siddhartha Sahi**, both at Rutgers University

The subject of symmetric functions began with the work of Jacobi, Schur, Weyl, Young and others on the Schur polynomials. In the 1950's and 60's, far-reaching generalizations of Schur polynomials were obtained by Hall and Littlewood (independently) and, in a different direction, by Jack. In the 1980's, Macdonald unified these developments by introducing a family of polynomials associated with arbitrary root systems. The last twenty years have witnessed considerable progress in this area, revealing new and profound connections with representation theory, algebraic geometry, combinatorics, special functions, classical analysis and mathematical physics. All these fields and more are represented in this volume, which contains the proceedings of a conference on 'Jack, Hall-Littlewood and Macdonald polynomials' held at ICMS, Edinburgh, during September 23–26, 2003. In addition to new results by leading researchers, the book contains a wealth of historical material, including brief biographies of Hall, Littlewood, Jack and Macdonald; the original papers of Littlewood and Jack; notes on Hall's work by Macdonald; and a recently discovered unpublished manuscript by Jack (annotated by Macdonald).

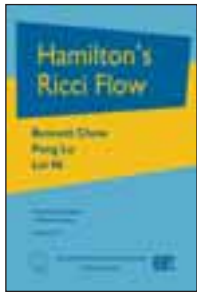
Contemporary Mathematics No. 417

January 2007 | 360 pages | American Mathematical Society

978-0-8218-3683-5, PAPERBACK £56.50/\$99.00

GRADUATE STUDIES IN MATHEMATICS

Hamilton's Ricci Flow



Bennett Chow, University of California, **Peng Lu**, University of Oregon, and **Lei Ni**, University of California

Ricci flow is a powerful analytic method for studying the geometry and topology of manifolds. This book is an introduction to Ricci flow for graduate students and mathematicians interested in working in the subject.

To this end, the first chapter is a review of the relevant basics of Riemannian geometry. For the benefit of the student, the text includes a number of exercises of varying difficulty. The book also provides brief introductions to some general methods of geometric analysis and other geometric flows. Comparisons are made between the Ricci flow and the linear heat equation, mean curvature flow, and other geometric evolution equations whenever possible. Several topics of Hamilton's program are covered, such as short time existence, Harnack inequalities, Ricci solitons, Perelman's no local collapsing theorem, singularity analysis, and ancient solutions. A major direction in Ricci flow, via Hamilton's and Perelman's works, is the use of Ricci flow as an approach to solving the Poincaré conjecture and Thurston's geometrization conjecture.

Graduate Studies in Mathematics No. 77

January 2007 | 608 pages | American Mathematical Society

978-0-8218-4231-7, HARDBACK

£45.00/\$79.00

Linear Algebra in Action

Harry Dym, Weizmann Institute of Science

Linear algebra permeates mathematics, perhaps more so than any other single subject. It plays an essential role in pure and applied mathematics, statistics, computer science, and many aspects of physics and engineering. This book conveys in a user-friendly way the basic and advanced techniques of linear algebra from the point of view of a working analyst. The techniques are illustrated by a wide sample of applications and examples that are chosen to highlight the tools of the trade. In short, this is material that the author wishes he had been taught as a graduate student. Roughly the first third of the book covers the basic material of a first course in linear algebra. The remaining chapters are devoted to applications drawn from vector calculus, numerical analysis, control theory, complex analysis, convexity and functional analysis. In particular, fixed point theorems, extremal problems, matrix equations, zero location and eigenvalue location problems, and matrices with nonnegative entries are discussed. Appendices on useful facts from analysis and supplementary information from complex function theory are also provided for the convenience of the reader. The book is suitable as a text or supplementary reference for a variety of courses on linear algebra and its applications, as well as for self-study.

Graduate Studies in Mathematics No. 78

April 2007 | 518 pages | American Mathematical Society

978-0-8218-3813-6, HARDBACK

£45.00/\$79.00

Modular Forms, a Computational Approach

William Stein, University of Washington

'This marvellous and highly original book fills a significant gap in the extensive literature on classical modular forms. This is not just yet another introductory text to this theory, though it could certainly be used as such in conjunction with more traditional treatments. Its novelty lies in its computational emphasis throughout: Stein not only defines what modular forms are, but shows in illuminating detail how one can compute everything about them in practice. This is illustrated throughout the book with examples from his own (entirely free) software package SAGE, which really bring the subject to life while not detracting in any way from its theoretical beauty. The author is the leading expert in computations with modular forms, and what he says on this subject is all tried and tested and based on his extensive experience. As well as being an invaluable companion to those learning the theory in a more traditional way, this book will be a great help to those who wish to use modular forms in applications, such as in the explicit solution of Diophantine equations. There is also a useful Appendix by Gunnells on extensions to more general modular forms, which has enough in it to inspire many PhD theses for years to come. While the book's main readership will be graduate students in number theory, it will also be accessible to advanced undergraduates and useful to both specialists and non-specialists in number theory.'

John E. Cremona, University of Nottingham

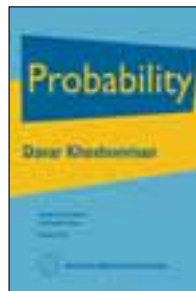
Graduate Studies in Mathematics No. 79

March 2007 | 268 pages | American Mathematical Society

978-0-8218-3960-7, HARDBACK

£31.50/\$55.00

Probability



Davar Khoshnevisan, University of Utah, and **Davar Khoshnevisan**

This is a textbook for a one-semester graduate course in measure-theoretic probability theory, but with ample material to cover an ordinary year-long course at a more leisurely pace. Khoshnevisan's approach

is to develop the ideas that are absolutely central to modern probability theory, and to showcase them by presenting their various applications. As a result, a few of the familiar topics are replaced by interesting non-standard ones. The topics range from undergraduate probability and classical limit theorems to Brownian motion and elements of stochastic calculus. Throughout, the reader will find many exciting applications of probability theory and probabilistic reasoning. There are numerous exercises, ranging from the routine to the very difficult. Each chapter concludes with historical notes.

Graduate Studies in Mathematics No. 80

May 2007 | 226 pages | American Mathematical Society

978-0-8218-4215-7, HARDBACK

£26.25/\$45

Exposition by Emil Artin: A Selection

Michael Rosen, Brown University, USA

Emil Artin was one of the great mathematicians of the twentieth century. He had the rare distinction of having solved two of the famous problems posed by David Hilbert in 1900. He showed that every positive definite rational function of several variables was a sum of squares. He also discovered and proved the Artin reciprocity law, the culmination of over a century and a half of progress in algebraic number theory. Artin had a great influence on the development of mathematics in his time, both by means of his many contributions to research and by the high level and excellence of his teaching and expository writing. In this volume we gather together in one place a selection of his writings wherein the reader can learn some beautiful mathematics as seen through the eyes of a true master. The volume's Introduction provides a short biographical sketch of Emil Artin, followed by an introduction to the books and papers included in the volume. The reader will first find three of Artin's short books, titled *The Gamma Function*, *Galois Theory*, and *Theory of Algebraic Numbers*, respectively. These are followed by papers on algebra, algebraic number theory, real fields, braid groups, and complex and functional analysis. The three papers on real fields have been translated into English for the first time. The flavor of these works is best captured by the following quote of Richard Brauer: 'There are a number of books and sets of lecture notes by Emil Artin. Each of them presents a novel approach. There are always new ideas and new results. It was a compulsion for him to present each argument in its purest form, to replace computation by conceptual arguments, to strip the theory of unnecessary ballast. What was the decisive point for him was to show the beauty of the subject to the reader.'

History of Mathematics No. 30

January 2007 | approximately 343 pages | American Mathematical Society

978-0-8218-4172-3, PAPERBACK

£33.75/\$59.00





The Volterra Chronicles: The Life and Times of an Extraordinary Mathematician 1860–1940

Judith R. Goodstein, California Institute of Technology, Pasadena

The life of Vito Volterra, one of the finest scientists and mathematicians Italy ever produced, spans the period from the unification of the Italian peninsula in 1860 to the onset of the Second World War—an era of unparalleled progress and unprecedented turmoil in the history of Europe. Born into an Italian Jewish family in the year of the liberation of Italy's Jewish ghettos, Volterra was barely in his twenties when he made his name as a mathematician and took his place as a leading light in Italy's modern scientific renaissance. This book, based in part on unpublished personal letters and interviews, traces the extraordinary life and times of one of Europe's foremost scientists and mathematicians, from his teenage struggles to avoid the stifling life of a 'respectable' bank clerk in Florence, to his seminal mathematical work—which today influences fields as diverse as economics, physics, and ecology—and from his spirited support of Italy's scientific and democratic institutions during his years as an Italian Senator, to his steadfast defiance of the Fascists and Mussolini. In recounting the life of this outstanding scientist, European Jewish intellectual, committed Italian patriot, and devoted if frequently distracted family man, *The Volterra Chronicles* depicts a remarkable individual in a prodigious age and takes the reader on a vivid and splendidly detailed historical journey.

History of Mathematics No. 31

March 2007 | approximately 315 pages | American Mathematical Society

978-0-8218-3969-0, HARDBACK

£33.75/\$59.00

The Moduli Problem for Plane Branches

Oscar Zariski

Moduli problems in algebraic geometry date back to Riemann's famous count of the $3g-3$ parameters needed to determine a curve of genus g . In this book, Zariski studies the moduli space of curves of the same equisingularity class. After setting up and reviewing the basic material, Zariski devotes one chapter to the topology of the moduli space, including an explicit determination of the rare cases when the space is compact. Chapter V looks at specific examples where the dimension of the generic component can be determined through rather concrete methods. Zariski's last chapter concerns the application of deformation theory to the moduli problem, including the determination of the dimension of the generic component for a particular family of curves. An appendix by Bernard Teissier reconsiders the moduli problem from the point of view of deformation theory. He gives new proofs of some of Zariski's results, as well as a natural construction of a compactification of the moduli space.

University Lecture Series No. 39

January 2007 | 151 pages | American Mathematical Society

978-0-8218-2983-7, PAPERBACK

£20.00/\$35.00

Nonlinear Dynamics and Time Series: Building a Bridge Between the Natural and Statistical Sciences

Building a Bridge Between the Natural and Statistical Sciences

Colleen D. Cutler, University of Waterloo, and **Daniel T. Kaplan**, McGill University

This book is a collection of research and expository papers reflecting the interfacing of two fields: nonlinear dynamics (in the physiological and biological sciences) and statistics. It presents the proceedings of a four-day workshop entitled 'Nonlinear Dynamics and Time Series: Building a Bridge Between the Natural and Statistical Sciences' held at the Centre de Recherches Mathématiques (CRM) in Montreal in July 1995. The goal of the workshop was to provide an exchange forum and to create a link between two diverse groups with a common interest in the analysis of nonlinear time series data. The editors and peer reviewers of this work have attempted to minimize the problems of maintaining communication between the different scientific fields. The result is a collection of interrelated papers that highlight current areas of research in statistics that might have particular applicability to nonlinear dynamics and new methodology and open data analysis problems in nonlinear dynamics that might find their way into the toolkits and research interests of statisticians.

Fields Institute Communications No. 11

January 2007 | 252 pages | American Mathematical Society

978-0-8218-4185-3, PAPERBACK

£49.75/\$87.00

Systolic Geometry and Topology

Mikhail G. Katz, Bar Ilan University

The systole of a compact metric space X is a metric invariant of X , defined as the least length of a noncontractible loop in X . When X is a graph, the invariant is usually referred to as the girth, ever since the 1947 article by W. Tutte. The first nontrivial results for systoles of surfaces are the two classical inequalities of C. Loewner and P. Pu, relying on integral-geometric identities, in the case of the two-dimensional torus and real projective plane, respectively. Currently, systolic geometry is a rapidly developing field, which studies systolic invariants in their relation to other geometric invariants of a manifold. This book presents the systolic geometry of manifolds and polyhedra, starting with the two classical inequalities, and then proceeding to recent results, including a proof of M. Gromov's filling area conjecture in a hyperelliptic setting. It then presents Gromov's inequalities and their generalisations, as well as asymptotic phenomena for systoles of surfaces of large genus, revealing a link both to ergodic theory and to properties of congruence subgroups of arithmetic groups. The author includes results on the systolic manifestations of Massey products, as well as of the classical Lusternik-Schnirelmann category.

Mathematical Surveys and Monographs No. 137

May 2007 | 222 pages | American Mathematical Society

978-0-8218-4177-8, HARDBACK

£40.25/\$69.00

Parametrized Homotopy Theory

J. P. May, The University of Chicago, and **J. Sigurdsson**, University of Sheffield

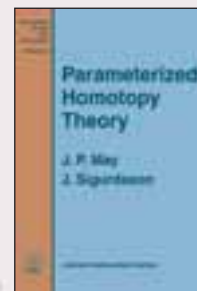
This book develops rigorous foundations for parametrized homotopy theory, which is the algebraic topology of spaces and spectra that are continuously parametrized by the points of a base space. It also begins the systematic study of parametrized homology and cohomology theories. The parametrized world provides the natural home for many classical notions and results, such as orientation theory, the Thom isomorphism, Atiyah and Poincaré duality, transfer maps, the Adams and Wirthmüller isomorphisms, and the Serre and Eilenberg-Moore spectral sequences. But in addition to providing a clearer conceptual outlook on these classical notions, it also provides powerful methods to study new phenomena, such as twisted K \mathbb{Z} -theory, and to make new constructions, such as iterated Thom spectra. Duality theory in the parametrized setting is particularly illuminating and comes in two flavors. One allows the construction and analysis of transfer maps, and a quite different one relates parametrized homology to parametrized cohomology. The latter is based formally on a new theory of duality in symmetric bicategories that is of considerable independent interest. The text brings together many recent developments in homotopy theory. It provides a highly structured theory of parametrized spectra, and it extends parametrized homotopy theory to the equivariant setting. The theory of topological model categories is given a more thorough treatment than is available in the literature. This is used, together with an interesting blend of classical methods, to resolve basic foundational problems that have no nonparametrized counterparts.

Mathematical Surveys and Monographs No. 132

January 2007 | 441 pages | American Mathematical Society

978-0-8218-3922-5, HARDBACK

£56.50/\$99.00



Traces of Hecke Operators

Andrew Knightly, University of Maine, and Charles Li, Academia Sinica

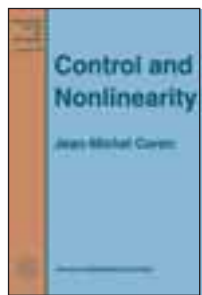
The Fourier coefficients of modular forms are of widespread interest as an important source of arithmetic information. In many cases, these coefficients can be recovered from explicit knowledge of the traces of Hecke operators. The original trace formula for Hecke operators was given by Selberg in 1956. Many improvements were made in subsequent years, notably by Eichler and Hijikata. This book provides a comprehensive modern treatment of the Eichler-Selberg/Hijikata trace formula for the traces of Hecke operators on spaces of holomorphic cusp forms of weight $k > 2$ for congruence subgroups of $SL_2(\mathbb{Z})$. The first half of the text brings together the background from number theory and representation theory required for the computation. This includes detailed discussions of modular forms, Hecke operators, adèles and ideles, structure theory for $GL_2(\mathbb{A})$, strong approximation, integration on locally compact groups, the Poisson summation formula, adelic zeta functions, basic representation theory for locally compact groups, the unitary representations of $GL_2(\mathbb{R})$, and the connection between classical cusp forms and their adelic counterparts on $GL_2(\mathbb{A})$. The second half begins with a full development of the geometric side of the Arthur-Selberg trace formula for the group $GL_2(\mathbb{A})$. This leads to an expression for the trace of a Hecke operator, which is then computed explicitly. The exposition is virtually self-contained, with complete references for the occasional use of auxiliary results. The book concludes with several applications of the final formula.

Mathematical Surveys and Monographs No. 133

January 2007 | 378 pages | American Mathematical Society

978-0-8218-3739-9, HARDBACK £54.25/\$95.00

Control and Nonlinearity



Jean-Michel Coron, Université de Paris-Sud, and Jean-Michel Coron

This book presents methods to study the controllability and the stabilization of nonlinear control systems in finite and infinite dimensions. The emphasis is put on specific phenomena due to nonlinearities. In particular, many examples

are given where nonlinearities turn out to be essential to get controllability or stabilization. Various methods are presented to study the controllability or to construct stabilizing feedback laws. The power of these methods is illustrated by numerous examples coming from such areas as celestial mechanics, fluid mechanics, and quantum mechanics. The book is addressed to graduate students in mathematics or control theory, and to mathematicians or engineers with an interest in nonlinear control systems governed by ordinary or partial differential equations.

Mathematical Surveys and Monographs No. 136

May 2007 | approximately 427 pages | American Mathematical Society

978-0-8218-3668-2, HARDBACK £57.75/\$99

Crossed Products of C^* -Algebras

Dana P. Williams, Dartmouth College

The theory of crossed products is extremely rich and intriguing. There are applications not only to operator algebras, but to subjects as varied as noncommutative geometry and mathematical physics. This book provides a detailed introduction to this vast subject suitable for graduate students and others whose research has contact with crossed product C^* -algebras. In addition to providing the basic definitions and results, the main focus of this book is the fine ideal structure of crossed products as revealed by the study of induced representations via the Green-Mackey-Rieffel machine. In particular, there is an in-depth analysis of the imprimitivity theorems on which Rieffel's theory of induced representations and Morita equivalence of C^* -algebras are based. There is also a detailed treatment of the generalized Effros-Hahn conjecture and its proof due to Gootman, Rosenberg, and Sauvageot. This book is meant to be self-contained and accessible to any graduate student coming out of a first course on operator algebras. There are appendices that deal with ancillary subjects, which while not central to the subject, are nevertheless crucial for a complete understanding of the material. Some of the appendices will be of independent interest. To view another book by this author, please visit Morita Equivalence and Continuous-Trace C^* -Algebras.

Mathematical Surveys and Monographs No. 134

April 2007 | 528 pages | American Mathematical Society

978-0-8218-4242-3, HARDBACK £62.25/\$109.00

Algebraic Geometric Codes: Basic Notions

Michael Tsfasman, French-Russian Poncelet Laboratory (CNRS and Ind. Univ. Moscow), and Institute for Information Transmission Problems, Serge Vladut, Institut de Mathématiques de Luminy, and Institute for Information Transmission Problems, and Dmitry Nogin, Institute for Information Transmission Problems

The book is devoted to the theory of algebraic geometric codes, a subject formed on the border of several domains of mathematics. On one side there are such classical areas as algebraic geometry and number theory; on the other, information transmission theory, combinatorics, finite geometries, dense packings, etc. The authors give a unique perspective on the subject. Whereas most books on coding theory build up coding theory from within, starting from elementary concepts and almost always finishing without reaching a certain depth, this book constantly looks for interpretations that connect coding theory to algebraic geometry and number theory. There are no prerequisites other than a standard algebra graduate course. The first two chapters of the book can serve as an introduction to coding theory and algebraic geometry respectively. Special attention is given to the geometry of curves over finite fields in the third chapter. Finally, in the last chapter the authors explain relations between all of these: the theory of algebraic geometric codes.

Mathematical Surveys and Monographs No. 139

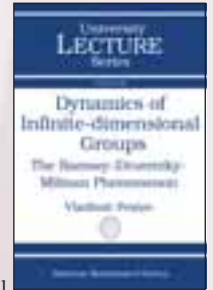
October 2007 | 338 pages | American Mathematical Society

978-0-8218-4306-2, HARDBACK £52.00/\$89.00

Dynamics of Infinite-dimensional Groups

The Ramsey-Dvoretzky-Milman Phenomenon

Vladimir Pestov, University of Ottawa



The 'infinite-dimensional groups' in the title refer to unitary groups of Hilbert spaces, the infinite symmetric group, groups of homeomorphisms of manifolds, groups of transformations of measure spaces, etc. The book presents an approach to the study of such groups based on ideas from geometric functional analysis and from exploring the interplay between dynamical properties of those groups, combinatorial Ramsey-type theorems, and the phenomenon of concentration of measure. The dynamics of infinite-dimensional groups is very much unlike that of locally compact groups. For instance, every locally compact group acts freely on a suitable compact space (Veech). By contrast, a 1983 result by Gromov and Milman states that whenever the unitary group of a separable Hilbert space continuously acts on a compact space, it has a common fixed point. In the book, this new fast-growing theory is built strictly from well-understood examples up. The book has no close counterpart and is based on recent research articles. At the same time, it is organized so as to be reasonably self-contained. The topic is essentially interdisciplinary and will be of interest to mathematicians working in geometric functional analysis, topological and ergodic dynamics, Ramsey theory, logic and descriptive set theory, representation theory, topological groups, and operator algebras.

University Lecture Series No. 40

January 2007 | 192 pages | American Mathematical Society

978-0-8218-4137-2, PAPERBACK £22.25/\$39.00

Universality and Renormalization: From Stochastic Evolution to Renormalization of Quantum Fields

Ilia Binder, University of Toronto, and Dirk Kreimer, Institut des Hautes Etudes Scientifiques

This book covers a wide range of phenomena in the natural sciences dominated by notions of universality and renormalization. The contributions in this volume are equally broad in their approach to these phenomena, offering the mathematical as well as the perspective of the applied sciences. They explore renormalization theory in quantum field theory and statistical physics, and its connections to modern mathematics as well as physics on scales from the microscopic to the macroscopic.

Fields Institute Communications No. 50

April 2007 | 404 pages | American Mathematical Society

978-0-8218-4273-7, HARDBACK £67.75/\$119.00