Algebra and Algebraic Geometry

Holomorphic Automorphic Forms and Cohomology

Roelof Bruggeman, Universiteit Utrecht, The Netherlands, Youngju Choie, Pohang University of Science and Technology, South Korea, and Nikolaos Diamantis, University of Nottingham, United Kingdom

This item will also be of interest to those working in number theory.

Contents: Introduction; Part I. Cohomology with values in Holomorphic Functions: Definitions and notations; Modules and cocycles; The image of automorphic forms in cohomology; One-sided averages; Part II. Harmonic Functions: Harmonic functions and cohomology; Boundary germs; Polar harmonic functions; Part III. Cohomology with values in Analytic Boundary Germs: Highest weight spaces of analytic boundary germs; Tessellation and cohomology; Boundary germ cohomology and automorphic forms; Automorphic forms of integral weights at least 2 and analytic boundary germ cohomology; Part IV. Miscellaneous: Isomorphisms between parabolic cohomology groups; Cocycles and singularities; Quantum automorphic forms; Remarks on the literature; Appendix A. Universal covering group and representations; Bibliography; Indices.

Memoirs of the American Mathematical Society, Volume 253, Number 1212


Introduction to Algebraic Geometry

Steven Dale Cutkosky, University of Missouri, Columbia, MO

This book presents a readable and accessible introductory course in algebraic geometry, with most of the fundamental classical results presented with complete proofs. An emphasis is placed on developing connections between geometric and algebraic aspects of the theory. Differences between the theory in characteristic 0 and positive characteristic are emphasized. The basic tools of classical and modern algebraic geometry are introduced, including varieties, schemes, singularities, sheaves, sheaf cohomology, and intersection theory. Basic classical results on curves and surfaces are proved. More advanced topics such as ramification theory, Zariski’s main theorem, and Bertini’s theorems for general linear systems are presented, with proofs, in the final chapters.

With more than 200 exercises, the book is an excellent resource for teaching and learning introductory algebraic geometry.

Contents: A crash course in commutative algebra; Affine varieties; Projective varieties; Regular and rational maps of quasi-projective varieties; Products; The blow-up of an ideal; Finite maps of quasi-projective varieties; Dimension of quasi-projective algebraic sets; Zariski’s main theorem; Nonsingularity; Sheaves; Applications to regular and rational maps; Divisors; Differential forms and the canonical divisor; Schemes; The degree of a projective variety; Cohomology; Curves; An introduction to intersection theory; Surfaces; Ramification and étale maps; Bertini’s theorem and general fibers of maps; Bibliography; Index.

Graduate Studies in Mathematics, Volume 188

Since Oscar Zariski organized a meeting in 1954, there has been a major algebraic geometry meeting every decade: Woods Hole (1964), Arcata (1974), Bowdoin (1985), Santa Cruz (1995), and Seattle (2005). The American Mathematical Society has supported these summer institutes for over 50 years. Their proceedings volumes have been extremely influential, summarizing the state of algebraic geometry at the time and pointing to future developments.

The most recent Summer Institute in Algebraic Geometry was held July 2015 at the University of Utah in Salt Lake City, sponsored by the AMS with the collaboration of the Clay Mathematics Institute. These two volumes include surveys growing out of plenary lectures and seminar talks during the meeting. Some present a broad overview of their topics, while others develop a distinctive perspective on an emerging topic.

Topics span both complex algebraic geometry and arithmetic questions, specifically, analytic techniques, enumerative geometry, moduli theory, derived categories, birational geometry, tropical geometry, Diophantine questions, geometric representation theory, characteristic p and p-adic tools, etc. The resulting articles will be important references in these areas for years to come.

Each volume in this set is sold separately. For more information about each one, see the New Publication entries that follow.

Proceedings of Symposia in Pure Mathematics, Volume 97


This is Part 1 of a two-volume set.

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Contents: Part 1: A. Bayer, Wall-crossing implies Brill-Noether applications of stability conditions on surfaces; R. J. Berman, Kähler-Einstein metrics, canonical random point processes and birational geometry; T. Bridgeland, Hall algebras and Donaldson-Thomas invariants; S. Cantat, The Cremona group; A.-M. Castravet, Mori dream spaces and blow-ups; T. de Fernex, The space of arcs of an algebraic variety; S. Donaldson, Stability of algebraic varieties and Kähler geometry; L. Ein and R. Lazarsfeld, Syzygies of projective varieties of large degree: Recent progress and open problems; E. Gonzalez, P. Solis, and C. T. Woodward, Stable gauged maps; D. Greb, S. Kebekus, and B. Taji, Uniformisation of higher-dimensional minimal varieties; H. D. Hacon, J. McKernan, and C. Xu, Boundedness of varieties of log general type; D. Halpern-Leistner, δ-stratifications, δ-reductive stacks, and applications; A. Höring and T. Peternell, Bimeromorphic geometry of Kähler threefolds; S. J. Kovács, Moduli of stable log-varieties–An update; A. Koffukov, Enumerative geometry and geometric representation theory; R. Pandharipande, A calculus for the moduli space of curves; Z. Patakfalvi, Frobenius techniques in birational geometry; M. Păun, Singular Hermitian metrics and positivity of direct images of pluricanonical bundles; M. Popa, Positivity for Hodge modules and geometric applications; R. P. Thomas, Positive...
Algebraic Geometry: Salt Lake City 2015

Tomasso de Fernex, University of Utah, Salt Lake City, UT, Brendan Hassett, Brown University, Providence, RI, Mircea Mustaţă, University of Michigan, Ann Arbor, MI, Martin Olsson, University of California, Berkeley, CA, Mihnea Popa, Northwestern University, Evanston, IL, and Richard Thomas, Imperial College of London, United Kingdom, Editors

This is Part 2 of a two-volume set.

Since Oscar Zariski organized a meeting in 1954, there has been a major algebraic geometry meeting every decade: Woods Hole (1964), Arcata (1974), Bowdoin (1985), Santa Cruz (1995), and Seattle (2005). The American Mathematical Society hassupported these summer institutes for over 50 years. Their proceedings volumes have been extremely influential, summarizing the state of algebraic geometry at the time and pointing to future developments.

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Contents: Part 2: D. Ben-Zvi and D. Nadler, Betti geometric Langlands; B. Bhatt, Specializing varieties and their cohomology from characteristic 0 to characteristic $p$; T. D. Browning, How often does the Hasse principle hold?; L. Caporaso, Tropical methods in the moduli theory of algebraic curves; R. Cavalieri, P. Johnson, H. Markwig, and D. Ranganathan, A graphical interface for the Gromov-witten theory of curves; H. Esnault, Some fundamental groups in arithmetic geometry; L. Fargues, From local class field to the curve and vice versa; M. Gross and B. Siebert, Intrinsic mirror symmetry and punctured Gromov-Witten invariants; E. Katz, J. Rabinoff, and D. Zureick-Brown, Diophantine and tropical geometry, and uniformity of rational points on curves; K. S. Kedlaya and J. Pottharst, On categories of $(\varphi, \Gamma)$-modules; M. Kim, Principal bundles and reciprocity laws in number theory; B. Klingler, E. Ullmo, and A. Yafaev, Bi-algebraic geometry and the André-Oort conjecture; M. Lieblich, Moduli of sheaves: A modern primer; J. Nicaise, Geometric invariants for non-archimedean semialgebraic sets; T. Pantev and G. Vezzosi, Symplectic and Poisson derived geometry and deformation quantization; A. Pirutka, Varieties that are not stably rational, zero-cycles and unramified cohomology; T. Saito, On the proper push-forward of the characteristic cycle of a constructible sheaf; T. Szamuely and G. Zabradi, The $p$-adic Hodge decomposition according to Beilinson; A. Tamagawa, Specialization of $\ell$-adic representations of arithmetic fundamental groups and applications to arithmetic of abelian varieties; O. Wittenberg, Rational points and zero-cycles on rationally connected varieties over number fields.
Applying the Classification of Finite Simple Groups

**A User’s Guide**

Stephen D. Smith, University of Illinois at Chicago, IL

Classification of Finite Simple Groups (CFSG) is a major project involving work by hundreds of researchers. The work was largely completed by about 1983, although final publication of the “quasithin” part was delayed until 2004. Since the 1980s, CFSG has had a huge influence on work in finite group theory and in many adjacent fields of mathematics. This book attempts to survey and sample a number of such topics from the very large and increasingly active research area of applications of CFSG.

The book is based on the author’s lectures at the September 2015 Venice Summer School on Finite Groups. With about 50 exercises from original lectures, it can serve as a second-year graduate course for students who have had first-year graduate algebra. It may be of particular interest to students looking for a dissertation topic around group theory. It can also be useful as an introduction and basic reference; in addition, it indicates fuller citations to the appropriate literature for readers who wish to go on to more detailed sources.

**Contents:** Background: Simple groups and their properties; Outline of the proof of the CFSG: Some main ideas; Thompson factorization—and its failure: FF-methods; Recognition theorems for simple groups; Some applications close to finite group theory; Some applications farther afield from finite groups; Appendix A: Some supplementary notes to the text; Appendix B: Further remarks on certain exercises; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 230


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Globally Generated Vector Bundles with Small c₁ on Projective Spaces

Cristian Anghel, The Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania, Justin Coanda, The Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania, and Nicolae Manolache, The Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania

**Contents:** Introduction; Acknowledgements; Preliminaries; Some general results; The cases c₁ = 4 and c₁ = 5 on ℙ²; The case c₁ = 4, c₂ = 5, 6 on ℙ³; The case c₁ = 4, c₂ = 7 on ℙ³; The case c₁ = 4, c₂ = 8 on ℙ³; The case c₁ = 4, 5 ≤ c₂ ≤ 8 on ℙⁿ, n ≥ 4; Appendix A. The case c₁ = 4, c₂ = 8, c₃ = 2 on ℙ³; Appendix B. The case c₁ = 4, c₂ = 8, c₃ = 4 on ℙ³; Bibliography.

Memoirs of the American Mathematical Society, Volume 253, Number 1209


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Analysis

Advances in Ultrametric Analysis

Alain Escassut, Université Clermont Auvergne, Aubiere, France, Cristina Perez-Garcia, Universidad de Cantabria, Santander, Spain, and Khodr Shamseddine, University of Manitoba, Winnipeg, Canada, Editors

This book contains the proceedings of the 14th International Conference on p-adic Functional Analysis, held from June 30–July 5, 2016, at the Université d’Auvergne, Aurillac, France.

Articles included in this book feature recent developments in various areas of non-Archimedean analysis: summation of p-adic series, rational maps on the projective line over Qp, non-Archimedean Hahn-Banach theorems, ultrametric Calkin algebras, G-modules with a convex base, non-compact Trace class operators and Schatten-class operators in p-adic Hilbert spaces, algebras of strictly differentiable functions, inverse function
In this monograph the authors study the well-posedness of boundary value problems of Dirichlet and Neumann type for elliptic systems on the upper half-space with coefficients independent of the transversal variable and with boundary data in fractional Hardy–Sobolev and Besov spaces. The authors use the so-called “first order approach” which uses minimal assumptions on the coefficients and thus allows for complex coefficients and for systems of equations.

This self-contained exposition of the first order approach offers new results with detailed proofs in a clear and accessible way and will become a valuable reference for graduate students and researchers working in partial differential equations and harmonic analysis.

Titles in this series are co-published with the Centre de Recherches Mathématiques.

Contents: Introduction; Function space preliminaries; Operator theoretic preliminaries; Adapted Besov–Hardy–Sobolev spaces; Spaces adapted to perturbed Dirac operators; Classification of solutions to Cauchy–Riemann systems and elliptic equations; Applications to boundary value problems; Bibliography; Index.

CRM Monograph Series, Volume 37

Elliptic PDEs on Compact Ricci Limit Spaces and Applications

Shouhei Honda, Kyushu University, Fukuoka, Japan, and Tohoku University, Sendai, Japan

Contents: Introduction; Preliminaries; $L^p$-convergence revisited; Poisson's equations; Schrödinger operators and generalized Yamabe constants; Rellich type compactness for tensor fields; Differential forms; Bibliography.

Memoirs of the American Mathematical Society, Volume 253, Number 1211

Differential Equations

Elliptic Boundary Value Problems with Fractional Regularity Data

The First Order Approach

Alex Amenta, Delft University of Technology, The Netherlands, and Pascal Auscher, Université Paris-Sud, Orsay, France
This volume contains the proceedings of the AMS Special Session on Higher Genus Curves and Fibrations in Mathematical Physics and Arithmetic Geometry, held on January 8, 2016, in Seattle, Washington.

Algebraic curves and their fibrations have played a major role in both mathematical physics and arithmetic geometry. This volume focuses on the role of higher genus curves; in particular, hyperelliptic and superelliptic curves in algebraic geometry and mathematical physics.

The articles in this volume investigate the automorphism groups of curves and superelliptic curves and results regarding integral points on curves and their applications in mirror symmetry. Moreover, geometric subjects are addressed, such as elliptic $K3$ surfaces over the rationals, the birational type of Hurwitz spaces, and links between projective geometry and abelian functions.

This item will also be of interest to those working in algebra and algebraic geometry and mathematical physics.

Contents: J. Russell and A. Wootton, A lower bound for the number of finitely maximal $C_p$-actions on a compact oriented surface; S. A. Broughton, Galois action on regular dessins d’enfant with simple group action; D. Swinarski, Equations of Riemann surfaces with automorphisms; L. Beshaj, Minimal integral Weierstrass equations for genus 2 curves; L. Beshaj, R. Hidalgo, S. Kruk, A. Malmendier, S. Quispe, and T. Shaska, Rational points in the moduli space of genus two; C. Magyar and U. Whitcher, Strong arithmetic mirror symmetry and toric isogenies; A. Kumar and M. Kuwata, Inose’s construction and elliptic $K3$ surfaces with Mordell-Weil rank 15 revisited; C. M. Shor, Higher-order Weierstrass weights of branch points on superelliptic curves; E. Previato, Poncelet’s porism and projective fibrations; A. Levin, Extending Runge’s method for integral points; D. Joyner and T. Shaska, Self-injective polynomials, curves, and codes; A. Deopurkar and A. Patel, Syzygy divisors on Hurwitz spaces.

Contemporary Mathematics, Volume 703

New Publications Offered by the AMS

Mathematical Physics

Mathematical Study of Degenerate Boundary Layers: A Large Scale Ocean Circulation Problem
Anne-Laure Dalibard, Université Pierre et Marie Curie, Paris, France, and Laure Saint-Raymond, École Normale Supérieure, Paris, France

This item will also be of interest to those working in differential equations.

Contents: Introduction; Multiscale analysis; Construction of the approximate solution; Proof of convergence; Discussion: Physical relevance of the model; Appendix; Bibliography.

Memoirs of the American Mathematical Society, Volume 253, Number 1206

Number Theory

An Open Door to Number Theory
Duff Campbell, Hendrix College, Conway, AR

A well-written, inviting textbook designed for a one-semester, junior-level course in elementary number theory. The intended audience will have had exposure to proof writing, but not necessarily to abstract algebra. That audience will be well prepared by this text for a second-semester course focusing on algebraic number theory. The approach throughout is geometric and intuitive; there are over 400 carefully designed exercises, which include a balance of calculations, conjectures, and proofs. There are also nine substantial student projects on topics not usually covered in a first-semester course, including Bernoulli numbers and polynomials, geometric approaches to number theory, the p-adic numbers, quadratic extensions of the integers, and arithmetic generating functions.

Contents: The integers, \( \mathbb{Z} \); Modular arithmetic in \( \mathbb{Z}/m\mathbb{Z} \); Quadratic extensions of the integers, \( \mathbb{Z} \sqrt{d} \); An interlude of analytic number theory; Quadratic residues; Further topics; Appendix A: Tables; Appendix B: Projects; Bibliography; Index.


An Experimental Introduction to Number Theory
Benjamin Hutz, Saint Louis University, MO

This book presents material suitable for an undergraduate course in elementary number theory from a computational perspective. It seeks to not only introduce students to the standard topics in elementary number theory, such as prime factorization and modular arithmetic, but also to develop their ability to formulate and test precise conjectures from experimental data. Each topic is motivated by a question to be answered, followed by some experimental data, and, finally, the statement and proof of a theorem. There are numerous opportunities throughout the chapters and exercises for the students to engage in (guided) open-ended exploration. At the end of a course using this book, the students will understand how mathematics is developed from asking questions to gathering data to formulating and proving theorems.

The mathematical prerequisites for this book are few. Early chapters contain topics such as integer divisibility, modular arithmetic, and applications to cryptography, while later chapters contain more specialized topics, such as Diophantine approximation, number theory of dynamical systems, and number theory with polynomials. Students of all levels will be drawn in by the patterns and relationships of number theory uncovered through data driven exploration.

Contents: Introduction; Integers; Modular arithmetic; Quadratic reciprocity and primitive roots; Secrets; Arithmetic functions; Algebraic numbers; Rational and irrational numbers; Diophantine equations; Elliptic curves; Dynamical systems; Polynomials; Bibliography; List of algorithms; List of notations; Index.

Pure and Applied Undergraduate Texts, Volume 31
Schubert Varieties, Equivariant Cohomology and Characteristic Classes

IMPANGA 15

Jarosław Buczyński, Polish Academy of Sciences, Warsaw, Poland, and University of Warsaw, Poland, Mateusz Michałek, Polish Academy of Sciences, Warsaw, Poland, and Max Planck Institute, Leipzig, Germany, and Elisa Postinghel, Loughborough University, United Kingdom, Editors

This volume contains the proceedings of the workshop on Algebraic Varieties and Automorphism Groups, which was held at RIMS, Kyoto University from July 7–11, 2014. The volume consists of fifteen original research articles by specialists in fast developing areas of algebraic geometry including various aspects of algebraic varieties (singularities, toric surfaces, weak positivity of log canonical pairs, Fano threefolds with cylinders, etc.), algebraic group actions on algebraic varieties (actions of additive group, unipotent group, semi-abelian variety, etc.), automorphism groups of affine varieties and Cremona groups.

Published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

Advanced Studies in Pure Mathematics, Volume 75
December 2017, 474 pages, Hardcover, ISBN: 978-4-86497-048-8, 2010 Mathematics Subject Classification: 14-06, 14R20, 14R10, 14E07, 14J26, 05E18, 14E05, 14E30, 14J10, 14J45, AMS members US$64, List US$80, Order code ASPM/75
Number Theory

Foundations of Rigid Geometry I

Kazuhiro Fujiwara, Nagoya University, Japan, and Fumiharu Kato, Tokyo Institute of Technology, Japan

In this research monograph, foundational aspects of rigid geometry are discussed, with an emphasis on birational and topological features of rigid spaces.

Besides the rigid geometry itself, topics include the general theory of formal schemes and formal algebraic spaces, based on a theory of complete rings which are not necessarily Noetherian. Also included is a discussion of the relationship with Tate’s original rigid analytic geometry, V. G. Berkovich’s analytic geometry, and R. Huber’s adic spaces. As a model example of applications, a proof of Nagata’s compactification theorem for schemes is given in the appendix. The book is encyclopedic and almost self-contained.

This item will also be of interest to those working in algebra and algebraic geometry.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

EMS Monographs in Mathematics, Volume 7