Research Areas

The five main areas of concentration are Algebra, Analysis, Combinatorics, Geometry/Topology, and Statistics/Probability.

Algebraic and Geometric Topology	Graph Theory
 John Abou-Rached (VAP) 	Quaid Iqbal (VAP)
 Laura Anderson 	 <u>Tan Nhat Tran</u> (VAP)
 Michael Dobbins 	 Thomas Zaslavsky
 <u>Ross Geoghegan</u> (emeritus) 	
 Cary Malkiewich 	
Pedro Ontaneda	
Lorenzo Ruffoni	Group Theory
Jenya Sapir Denial Churchennend	
Daniel Studenmund Danika Van Niel (VAD)	 <u>Benjamin Brewster</u> (emeritus)
	<u>Robert Bieri</u> (visiting)
	<u>Matthew Brin</u> (emeritus)
	<u>Walter Carlip</u> (visiting)
	 <u>Ross Geognegan</u> (emeritus)
Algebra related to logic and computer	 Fernando Guzman (emeritus) Luise Charlette Kappe (ameritus)
science	- Tae Young Lee (VAP)
 Fernando Guzman (emeritus) 	 Marcin Mazur
<u> </u>	 Daniel Studenmund
	 Inna Sysoeya (visiting)
	 Hung Tong-Viet
Applied and Computational Mathematics	
- Minghao Rostami	
	Machine Learning
	 Zeyu Ding (courtesy)
Arithmetic Algebraic Geometry	 Yuan Fang (courtesy)
Antimical Algebraic decineary	<u>Guifang Fu</u>
 <u>Alexander Borisov</u> 	 Xingye Qiao
 Adrian Vasiu 	 Minjie Wang
/	
Combinatorial Geometry	Number Theory

<u>Alexander Borisov</u>

Laura Anderson

Department of Mathematics and Statistics, Binghamton University - http://www2.math.binghamton.edu/

<u>Alexander Borisov</u>	 <u>Walter Carlip</u> (visiting)
<u>Michael Dobbins</u> Tap Nhat Trap ()(AD)	Luise-Charlotte Kappe (emeritus)
- Thomas Zaslavsky	Marcin Mazur Adrian Vasiu
Combinatorics	Partial Differential Equations
 Laura Anderson 	Paul Loya
 Michael Dobbins 	 Emmett Wyman
 <u>Quaid Iqbal</u> (VAP) 	 Xiangjin Xu
 <u>William Kazmierczak</u> 	<u>Gang Zhou</u>
 <u>Tan Nhat Tran</u> (VAP) Thomas Zaslavsky 	
	Probability
Coometric Analysis	 Vladislav Kargin
Geometric Analysis	David Renfrey
 Paul Loya 	Anton Schick
 Pedro Ontaneda 	<u>Gang Zhou</u>
 Emmett Wyman 	
 Xiangjin Xu 	
 Gang Zhou 	
	Representation Theory
	Alex Feingold
Geometric Group Theory	 Dikran Karagueuzian
	 <u>Tae Young Lee</u> (VAP)
 John Abou-Rached (VAP) 	 Inna Sysoeva (visiting)
 <u>Matthew Brin</u> (emeritus) 	 Hung Tong-Viet
 <u>Ross Geoghegan</u> (emeritus) 	
 Fernando Guzman (emeritus) 	
 James Hyde 	
Lorenzo Ruffoni	Statistics
Jenya Sapir	
 <u>Daniel Studenmund</u> 	 <u>Mei-Hsiu Chen</u> (director of consulting)
	 Yuan Fang (courtesy)
	Guifang Fu
	 Vladislav Kargin
Geometry of Manifolds	 Aleksey Polunchenko
-	 Xingye Qiao
 Pedro Ontaneda 	Anton Schick
 Lorenzo Ruffoni 	 Minjie Wang
Pedro Ontaneda Lorenzo Ruffoni	Anton Schick Minjie Wang

research

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Qiqing Yu

John Abou-Rached - Robert Riley Visiting Assistant Professor

Areas of Interest: Dynamical systems, Geometry, and Number theory

Description: I study dynamics on moduli space and homogeneous dynamics, with a most recent focus on obtaining quantitative equidistribution results in new settings. Applications are to geometry and number theory.

Laura Anderson - Associate Professor

Areas of Interest: Combinatorics, Topology

Description: My research focuses on interactions between combinatorics and topology, particularly those involving oriented matroids, convex polytopes, and other concepts from discrete geometry. Much of my work involves combinatorial models for topological structures such as differential manifolds and vector bundles. The aims of such models include both combinatorial answers to topological questions (e.g., combinatorial formulas for characteristic classes), and topological methods for combinatorics (e.g. on topology of posets). I have also worked on applications of oriented matroids to data analysis in psychology.

Robert Bieri - Visiting Professor

Areas of Interest: Geometric, homological, combinatorial and asymptotic methods in group theory
 Description: My original interest in homological methods for infinite groups (cohomological dimension and
 Poincare type duality) shifted towards geometric and -- more recently -- asymptotic methods. I find it interesting to relate geometric properties at infinity of groups and G-spaces with algebraic properties of these groups, their group rings and their modules. The focus is on familar groups like metabelian, soluble, free and linear ones, or fundamental groups of 3-manifolds, but I also met Thompson's group F and other PL-homeomorphism groups on the way, and had an encounter with tropical geometry.

Alexander Borisov - Associate Professor

Areas of Interest: Algebraic Geometry, Number Theory, Discrete Geometry

Description: My general research area is algebraic geometry and number theory, broadly interpreted. Particular topics of interest include birational geometry, toric geometry and convex discrete geometry, polynomial morphisms, integer polynomials, Arakelov geometry.

Walter Carlip - Visiting Associate Professor

Areas of Interest: Finite Group Theory, Number Theory

Description: My first love was the theory of finite groups. I worked with Prof. George Glauberman at the University of Chicago, where my thesis and early publications concerned regular orbits and the structure of solvable groups. I also worked with Prof. Glauberman on his revision (with Prof. Helmut Bender) of the Feit-Thompson Odd Order Theorem. More recently I have been interested in recursive sequences, working to complete a classification of second-order sequences and their stability. I have also studied pseudoprimes, Lucas d-pseudoprimes, and Carmichael-Lucas numbers. I have several publications on iteration graphs, and have a long-standing interest in computational algorithms both in number theory and algebra.

Mei-Hsiu Chen - Director of Statistical Consulting

Areas of Interest: Biostatistics, Statistics

Description: My initial research focuses on designing and conducting clinical trials in evaluating imaging as screening tools for cancers. After a long hiatus from research, my current research focuses on statistical education via statistical consultation in matching appropriate statistical methods with different objectives from various disciplines. My work includes uncovering racial biases in crimes and in public school disciplinary actions, and identifying the role of mechanobiology on endothelial to mesenchymal transformation.

Zeyu Ding - Assistant Professor (by courtesy)

Areas of Interest: Data privacy, statistical disclosure control, formal methods, machine learning **Description:** My research lies in the intersection of data privacy, statistical disclosure control, formal methods and machine learning. The overarching goal of my work is to protect sensitive personal information from being leaked in unintended ways. My current research focuses on differential privacy and its interactions with formal verification, numerical optimization, privacy-preserving statistical inference and machine learning.

Michael Dobbins - Associate Professor

Areas of Interest: Convex polytopes, oriented matroids, topological methods in discrete geometry, the existential theory of the reals, and computational complexity

Description: Recently I have been focused on combinatorial and topological analogs of geometric objects, and circumventing some challenges of real algebraic geometry. In particular, I have constructed a classifying space for vector bundles from topological representations of oriented matroids, and I am working on extending these results.

Yuan Fang - Assistant Professor (by courtesy)

Areas of Interest: Statistics, bioinformatics

Description: My current research focuses on studying lipid profiles for ceramide pathways in boys with Duchenne Muscular Dystrophy using multi-omics statistical and bioinformatics approaches. I am also interested in extending existing models and statistical approaches for clustering longitudinal data.

Alex Feingold - Professor

Areas of Interest: Algebra, Lie algebras, conformal field theory

Description: Finite dimensional semisimple Lie algebras, tensor product decomposition of irreducible modules, representation theory of the infinite dimensional Kac-Moody Lie algebras, bosonic and fermionic creation and annihilation operators, affine and hyperbolic Kac-Moody algebras, topics in combinatorics, power series identities, modular forms and functions, Siegel modular forms, conformal field theory, string theory, and statistical mechanical models, vertex operator algebras, their modules and intertwining operators, the theory of fusion rules.

Guifang Fu - Associate Professor

Areas of Interest: Statistics, high-dimensional inference, functional data analysis

Description: My main focus is to develop advanced statistical models and computational methodologies to unravel the genetic and environmental mechanisms that regulate complex biological traits, including morphology/shape, biomedical problems and disease. I am particularly interested in high-dimensional, "big data" modeling, and functional data analysis. My genetic leaf shape project was awarded a three-year NSF grant. I enjoy collaborating on interdisciplinary projects, working with researchers from the application domains and addressing real-life data analysis questions.

James Hyde - Assistant Professor

Areas of Interest: Groups of homeomorphisms and the properties of simplicity, finite generation, finite presentation and (left)-orderability

Description: I work broadly in the area of geometric group theory. Some of my work involves constructing examples of groups with novel combinations properties. I'm also interested in the Boone-Higman Conjecture and variants of finite generation.

Areas of Interest: Combinatorics, Spectral Graph Theory

Description: My area of research is in algebraic graph theory and combinatorics, especially, distance regular graphs and its complete characterization with fixed parameters. I am interested in complete characterization of distance regular graphs by its Intersection number, fixed eigenvalue, fixed diameter, and valency (Regularity). Currently, I am working that when a distance-i graph has fever eigenvalues? I worked on the characterization of distance regular graphs with diameter 3, whose distance-2 graph is strongly regular. Recently, With Prof. Thomas Zaslavsky also working on strongly regular signed graphs. I am also interested in the existence and non-existence problems of a graph.

Dikran Karagueuzian - Associate Professor

Areas of Interest: Algebraic topology, representation theory, group cohomology

Description: My research for the past few years has been primarily in the representations and cohomology of finite groups. For the past few years I have been studying problems in algebra that arise from techniques of algebraic topology. Sometimes there is a theorem hidden behind the feasibility of a well-known method. An example of this phenomenon is my most recent preprint, written in collaboration with Peter Symonds of the University of Manchester Institute of Science and Technology. In this case the theorem was uncovered through exploration with the computer algebra package Magma, which is well worth checking out. Often such software lets us investigate mathematical phenomena which would be very difficult to understand otherwise.

Vladislav Kargin - Associate Professor

Areas of Interest: Probability, Statistics

Description: My research focuses on probability theory, with much of my work centered on random matrices and free probability. I am also interested in applying probability theory to the analysis of large datasets, statistical physics, and combinatorics.

$\underline{\textbf{Tae Young Lee}} \text{ - Robert Riley Visiting Assistant Professor}$

Areas of Interest: Finite groups and their representation theory

Description: I am interested in finite (or sometimes algebraic) groups, their representations, and connections to other topics in mathematics. My last few papers were about local systems (continuous representations of étale fundamental groups) and their monodromy groups (the images of these representations). I classified a specific kind of local systems, called hypergeometric sheaves, when they have specific type of finite monodromy groups, using representation theory of these groups and some number theoretic method. I am also working on problems about characters of finite symmetric groups. I would be also happy to discuss general problems about finite groups and their representations, or even some problems in discrete mathematics with algebraic points of view.

Paul Loya - Associate Professor

Areas of Interest: Global and geometric analysis, Elliptic theory of differential operators on manifolds with singularities, Partial differential equations

Description: The underlying theme of my research is the investigation of topological, geometric, and spectral invariants of (singular) Riemannian manifolds using techniques from partial differential equations. For example, the Euler characteristic of a surface is a topological invariant based its usual definition in terms of a triangulation of the surface. However, it may also be considered geometric in view of the Gauss-Bonnet theorem or spectral in view of the Hodge theorem. I am interested in such relationships on general singular Riemannian manifolds.

Cary Malkiewich - Associate Professor

Areas of Interest: Algebraic topology, especially stable homotopy theory, algebraic K-theory, applications to manifolds and cell complexes.

Description: My primary research area is algebraic topology. I like to apply stable homotopy theory (spectra) to questions about manifolds and cell complexes. My work has taken a recent turn towards scissors congruence: in 2022 I proved that it is described by a Thom spectrum, and I am developing the consequences of this surprising result for the higher scissors congruence groups.

Marcin Mazur - Professor

Areas of Interest: Algebraic number theory, group theory

Description: My research interests concentrate around areas where number theory and group theory intersect. Topics of particular interest are group rings, group schemes over rings of algebraic integers, Galois module structures and Galois representations.

Ryan McCulloch - Visiting Associate Professor

Areas of Interest: Group theory, combinatorics

Description: My research interests are in general group theory, finite group theory, and related structures such as lattices of subgroups of a group. I am also interested in combinatorics, and have recently been looking at relationships between designs and other combinatorial objects.

Pedro Ontaneda - Distinguished Professor

Areas of Interest: Topology and differential geometry

Description: My general interest is the geometry and topology of aspherical spaces. I have done some work in the study of the relationship between exotic structures and (negative, non-positive) curvature, and its applications to the limitations of PDE methods in geometry. Other interests: geometric group theory, K-theory, mechanics.

Aleksey Polunchenko - Associate Professor

Areas of Interest: Statistics, sequential analysis.

Description: Mathematical statistics and specifically the problem of sequential (quickest) change-point detection, currently focusing on the case of composite hypotheses.

Xingye Qiao - Professor and Chair

Areas of Interest: Statistics, machine learning, causal inference

Description: My research interests encompass statistics, machine learning, and data science. I develop and analyze predictive and inferential tools for complex data problems such as imbalanced classes, high-dimensional data, transfer learning, and observational studies. My focus is on designing theoretically sound and efficient learning algorithms that address sample, time, and space complexity challenges. I aim to enhance the trustworthiness and reliability of statistics and machine learning methods, particularly in critical domains like healthcare. My work includes developing user-friendly prediction tools with built-in confidence measures and methods for individualized estimation, prediction, and recommendation from observational and interventional data.

David Renfrew - Assistant Professor

Areas of Interest: Probability, Random Matrix

Description: My research lies in Probability and Random Matrices. I am particularly interested in non-Hermitian random matrices and the interplay between random matrices and free probability. I am also interested in applications to biologic systems.

Minghao Rostami - Associate Professor

Areas of Interest: Computational fluid dynamics, numerical methods, and mathematical biology Description:

Lorenzo Ruffoni - Assistant Professor

Areas of Interest: Algebraic and Geometric Topology, Geometry of Manifolds, Geometric Group Theory Description: I am interested in Geometry and Topology, and in particular: geometric group theory, geometric structures on manifolds and cell complexes.

Eugenia Sapir - Assistant Professor

Areas of Interest: Low dimensional topology, geometric topology, geometric group theory, dynamics Description: I work in geometric topology, combining tools from geometry, geometric group theory and dynamics, as well as combinatorial techniques, to study various structures on Riemann surfaces of negative Euler characteristic. Primarily, I am interested in various counting problems for closed curves, and in the geometry of the space of geodesic currents, which is a space that contains many of the important objects of study.

Anton Schick - Bartle Professor

Areas of Interest: Statistics, probability

Description: Uses of large sample theory in statistics, the characterization and construction of efficient estimators and tests for semiparametric and nonparametric models, statistical inference for Markov chains and stochastic processes, estimation and comparison of curves, the behavior of plug-in estimators, optimal inference for bivariate distributions with constraints on the marginal, modelling with incomplete data, and the theory and application of finite and infinite order U-statistics.

Daniel Studenmund - Assistant Professor

Areas of Interest: Geometric group theory, discrete subgroups of Lie groups, group cohomology **Description:** My research addresses questions arising at the intersection of geometric group theory and the study of discrete subgroups of Lie groups. I am particularly interested in invariants associated to the collection of finite-index subgroups of a given group G. One example is the abstract commensurator Comm(G), the group of all isomorphisms between finite-index subgroups of G, modulo equivalence. Other examples are growth rates of various functions associated to the collection of finite-index subgroups, which can be thought of as helping to "quantify" residual finiteness of G. I also study other invariants of groups, such as superrigidity and cohomology of arithmetic groups, using algebraic and geometric methods.

Inna Sysoeva - Visiting Researcher

Areas of Interest: Group Theory

Description: My main research area is group theory. More specifically, in the recent years I have been interested in braid groups and their representations.

Hung Tong-Viet - Professor

Areas of Interest: Representation theory and character theory of finite groups, permutation groups and abstract finite groups.

Description: My main research interests lie in the representation and character theory of finite groups, permutation groups and applications to number theory and combinatorics, and finite group theory in general. I am interested in studying groups or group structures using several important numerical invariants of the groups such as character degrees (ordinary and modular), p-parts of the degrees or character values such as zeros of characters. In permutation group theory, I study derangements, that is, permutations without fixed points, and their applications in number theory and graph theory, permutation characters and permutation polytopes. Recently, I am also interested in studying the influence of real conjugacy class sizes on the group structures.

Tan Nhat Tran - Robert Riley Visiting Assistant Professor

Areas of Interest: Algebraic Combinatorics, Hyperplane Arrangement

Description: I am dedicated to research in combinatorics, and especially its connections with commutative algebra, algebraic topology and probability theory. My research over the past few years has focused on the theory of arrangements of hyperplanes, especially how the combinatorial properties of hyperplane arrangements interact with the discrete geometric structures (e.g., graph, polytope, root system), topological objects (e.g., Poincaré polynomial, CW-complex), algebraic concepts (e.g., logarithmic derivation, Hopf algebra) and probabilistic models (e.g., expectation, vine copula).

Danika Van Niel - Robert Riley Visiting Assistant Professor

Areas of Interest: Algebraic topology, equivariant homotopy theory, equivariant algebra, algebraic K-theory, and homotopical combinatorics

Description: My primary research area is equivariant homotopy theory. I like to study equivariant analogues of algebraic objects and apply this knowledge to do computations. For example, part of my thesis work was on Mackey fields, an equivariant analogue of fields, which led to a new computation of another equivariant object called

twisted topological Hochschild homology. I also study homotopical combinatorics, for this I use combinatorial objects such as transfer systems to study properties and structures within equivariant homotopy theory.

Adrian Vasiu - Professor

Areas of Interest: Arithmetic Algebraic Geometry

Description: My area of research is Arithmetic Algebraic Geometry, which is the common part of Number Theory, Algebra, and Geometry. I am very much interested in moduli spaces, group schemes, Lie algebras, formal group schemes, representation theory, cohomology theories, Galois theory, and the classification of projective, smooth, connected varieties. My research is focused on:

- 1. Shimura varieties of Hodge type (which are moduli spaces of polarized abelian varieties endowed with Hodge cycles),
- 2. arithmetic properties of abelian schemes,
- 3. classification of \$p\$-divisible groups,
- 4. representations of Lie algebras and reductive group schemes,
- 5. crystalline cohomology of large classes of polarized varieties, and
- 6. Galois representations associated to abelian varieties.

Minjie Wang - Assistant Professor

Areas of Interest: Statistics, machine learning, graphical models, data integration, high-dimensional statistics, variable selection

Description: I am interested in developing novel statistical machine learning methods to help scientists make data-driven discoveries from large-scale and complex data. My research interests include causal discovery, graphical models, data integration, high-dimensional statistics, and variable selection. My methodological research is driven by the goal of solving real-world problems, including biomedical and neuroscience applications.

Emmett Wyman - Assistant Professor

Areas of Interest: Spectral asymptotics, spectral geometry, Fourier integral operators

Description: I study Laplace-Beltrami eigenfunctions of large eigenvalue and how their asymptotics relate to the geometric or dynamical structure of the space in which they live. This area is related to classical and quantum physics and number theory.

Xiangjin Xu - Associate Professor

Areas of Interest: Harmonic Analysis and PDEs Description:

- 1. Harmonic Analysis on Manifolds: eigenfunction estimates and multiplier problems on Riemannian manifolds, Gibbs' phenomenon and Pinsky's phenomenon for Fourier inversion and eigenfunction expansion.
- Nonlinear differential equations: Well-posedness problems for nonlinear hyperbolic differential equations on manifolds; Boundary stabilization, controllability problems for (linear and nonlinear) parabolic and hyperbolic PDE's on manifolds; Periodic solutions, subharmonics and homoclinic orbits

Qiqing Yu - Professor

Areas of Interest: Statistics

Description: My research interests are mainly in three fields.

1. Survival analysis. Since 1987, I have been working in this field, in particular on modeling the interval censored data, studying consistency and asymptotic normality of the generalized maximum likelihood estimator (MLE) of survival function or the semi-parametric estimator under linear regression model.

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- 2. Statistical decision theory. My thesis was on admissibility and minimaxity of the best invariant estimator of a distribution function.
- 3. Probability model and computing methods for pattern recognition in the Genome project.

Thomas Zaslavsky - Professor

Areas of Interest: Combinatorics, graph theory

Description: My research is in combinatorics, especially matroids and their connections with combinatorial geometry and graph theory. The main topic of my work is signed, gain, and biased graphs. These are graphs with additional structure that leads to new graphical matroids and other new kinds of graph theory, such as colorings and geometrical representations, of which ordinary graphical matroids, colorings, etc., are special cases. In combinatorial geometry I work on arrangements of hyperplanes and lattice-point counting. Other research interests are in graph theory and in generalizing Sperner's theorem.

Gang Zhou - Associate Professor

Areas of Interest: Mathematical Physics, Geometric Analysis, and Probability Description:

geometric analysis: mean curvature flow and Ricci flows by methods different from the classical ones, formation of singularities in finite time, flow through singularities.

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