Mathematical Sciences (MASC)

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Department of Mathematical Sciences Website (http://fulbright.uark.edu/departments/math/)

Degrees Conferred:
M.S., Ph.D. (MATH)

Primary Areas of Faculty Research: Analysis, algebra, geometric topology, numerical analysis, statistics.

M.S. in Mathematics

Prerequisites to Degree Program: Prospective candidates for the Master of Science degree in Mathematics are expected to have completed a program equivalent to that required by the department for a B.S. degree, as set forth in the current catalog of the Fulbright College of Arts and Sciences. Deficiencies may be removed either by taking the appropriate undergraduate courses or by examination. In addition to the application for admission to the Graduate School and the transcripts required for Graduate School admission, applicants for admission to the degree programs of the Department of Mathematical Sciences must submit a) three letters of recommendation from persons familiar with the applicant's previous academic and professional performance and b) official scores from the Graduate Record Examination (General Test).

The degree of Master of Science is intended for collegiate teachers of mathematics, non-teaching professional mathematicians, and those who desire to continue advanced study.

Requirements for the Master of Science Degree: This degree is offered under three separate options: a general option, a computational mathematics option, and a thesis option. The general and thesis options are intended for students who plan to be collegiate teachers of mathematics, continue advanced study in mathematics, or obtain a broad background for preparation as a non-teaching professional mathematician. The computational mathematics option is intended for students who intend to specialize in computational and applied mathematics in preparation for professional employment in an interdisciplinary or computationally intensive environment.

The program of a candidate will be determined in conference with the candidate's graduate adviser. A comprehensive examination must be passed by each candidate for the Master of Science degree. It should be taken near the end of the last semester of residence. At least four weeks prior to the scheduled date, students must notify the department of their intention to take the examination. No student may take the comprehensive examination more than three times. MATH 5040V, MATH 5070V, MATH 50103, and MATH 50303 are not applicable to the Master of Science degree in mathematics. The program will include at least two semesters of one-hour credit in MATH 5100V Mathematics Seminar.

All candidates must complete a minimum of 32 semester hours of approved graduate course work, including 12 semester hours in mathematics at the 5000-6000 level (excluding MATH 5100V). All selected courses are subject to the approval of the Graduate Committee.

Students in the general option may include up to nine semester hours of graduate work in courses outside the department. The comprehensive examination for the general option will be a written exam including material covered in graduate course work.

The candidate for the computational mathematics option must include at least six but not more than twelve semester hours of graduate work in courses outside of mathematics. The comprehensive examination for the computational mathematics option will be similar to the examination for the general option but must include material covered in six semester hours of MATH 53903 and MATH 53803.

Students in the thesis option must complete 6 semester hours of MATH 6100V with the candidate's thesis adviser, which will count toward the 32 semester hours of approved graduate course work. In addition to a written comprehensive exam, the candidate will be required to complete an oral defense of the thesis. Reading copies of the thesis should be delivered to members of the Thesis Committee at least three weeks prior to undertaking the final examination.

Students should also be aware of Graduate School requirements with regard to master's degrees (http://catalog.uark.edu/graduatecatalog/degreerequirements/#mastersdegreestext).

Ph.D. in Mathematics

Requirements for the Doctor of Philosophy Degree: Candidates for the degree of Doctor of Philosophy with a major in mathematics will be required to earn not less than 60 semester hours of course credit beyond the bachelor's degree in mathematics and closely related fields. The number of hours and the courses for each student will be determined by the advisory committee. The candidate must fulfill the course requirements for the Master of Science degree in mathematics.

The basic requirement for the Ph.D. degree is the preparation of an acceptable dissertation. This dissertation must demonstrate the candidate's ability to do independent, original, and significant work in mathematics. It is required that this dissertation possess the degree of excellence of research papers ordinarily published in the leading mathematical journals.

Students should also be aware of Graduate School requirements with regard to doctoral degrees (http://catalog.uark.edu/graduatecatalog/degreerequirements/#phdandedddegreestext).

A comprehensive examination is given each year during the weeks preceding the beginning of the fall and spring semesters. This examination is taken by all students in the graduate program who have completed the course requirements for the M.S. degree. The prospective candidate for the Ph.D. will be allowed to take the examination at most three times. A third failure to qualify eliminates a student from the graduate program in mathematics. After qualifying, a candidacy examination will be given covering the intended areas of specialization beyond the level of the qualifying comprehensive examination. It may be repeated once.

Students who wish to specialize in mathematics education must complete four education graduate courses to study quantitative methods in education research and qualitative methods in education research. The recommended courses are ESRM 64103, ESRM 64203, ESRM 65303, and ESRM 66503, although these may be altered depending on the student's previous study of STAT courses. Students must complete 15 hours of independent study in mathematics education to prepare for dissertation research. The areas of this study are: K-14 curriculum; learning theory; art of teaching and teacher education; and assessment and technology. The 15 hours must include a three-hour research project that will result in a pre-dissertation research report.

In addition to extending knowledge by personal reading and research, a doctoral graduate in mathematics will normally communicate knowledge to others. Therefore each student in the Ph.D. program is required to acquire the equivalent of one semester of full-time experience in teaching; this requirement may be fulfilled by part-time experience over several semesters. Typically, teaching assistantship appointments will satisfy this requirement, but other similar experience may qualify as approved by the department.

Graduate Faculty

Arnold, Mark E., Ph.D., B.S. (Northern Illinois University), A.S. (Rock Valley College), Associate Professor, 1993, 1999.
Barton, Ariel, Ph.D., M.S. (University of Chicago), B.S. (Harvey Mudd College), Associate Professor, 2016, 2021.
Bergdall, John, Ph.D. (Brandeis University), B.S. (University of Minnesota), Assistant Professor, 2022.
Bradshaw, Zachary, Ph.D. (University of Virginia), B.S. (Virginia Commonwealth University), Associate Professor, 2017, 2022.
Chakraborty, Avishek, Ph.D (Duke University), M.S., B.S. (Indian Statistical Institute), Associate Professor, 2014, 2020.
Clay, Matt, Ph.D., M.S. (University of Utah), B.S. (University of Oregon), Professor, 2012, 2021.
Day, Matthew B., Ph.D., M.S. (University of Chicago), B.S. (University of Texas), Associate Professor, 2011, 2016.
Dingman, Shannon Wayne, Ph.D., M.S. (University of Missouri-Columbia), M.S. (Pittsburg State University), Professor, 2007, 2020.
Harrington, Phil, Ph.D., M.S. (University of Notre Dame), B.S. (Whitworth College), Professor, 2009, 2019.
Harriss, Edmund O., Ph.D. (Imperial College, London), M.M. (University of Warwick), Assistant Professor, 2010, 2022.
Johnson, Mark, Ph.D. (Michigan State University), M.S. (Purdue University), B.S. (City University of New York, Brooklyn College), Professor, 1995, 2015.
Kaman, Tulin, Ph.D. (Stony Brook University), M.S. (Istanbul Technical University), B.S. (Yildiz Technical University), Associate Professor, 2017, 2023.
Mantero, Paolo, Ph.D. (Purdue University), M.Sc., B.Sc. (University of Genova, Italy), Associate Professor, 2015, 2021.
Miller, Lance E., Ph.D. (University of Connecticut), M.S. (New Mexico State University), Associate Professor, 2013, 2019.
Namakshi, Nama, Ph.D., M.Ed. (Texas State University), B.S. (Angelo State University), Teaching Assistant Professor, 2016.
Niu, Wenbo, Ph.D. (University of Illinois at Chicago), M.S., B.S. (Fudan University, China), Associate Professor, 2015, 2021.
Petris, Giovanni, Ph.D., M.S. (Duke University), B.S. (Universita degli Studi di Milano, Italy), Professor, 1999, 2016.
Plummer, Sean, Ph.D., M.S. (Texas A&M University), B.S. (North Carolina State University), Assistant Professor, 2022.
Raich, Andrew Seth, Ph.D., M.A. (University of Wisconsin-Madison), B.A. (Williams College), Professor, 2008, 2018.
Raoux, Katherine, Ph.D. (Brandeis University), B.A. (New College of Florida), Assistant Professor, 2022.
Rieck, Yo'av, Ph.D. (University of Texas at Austin), B.A. (Israel Institute of Technology), Professor, 2000, 2010.
Tjani, Maria, Ph.D. (Michigan State University), M.S. (Purdue University), B.S. (University of Ioannina, Greece), Professor, 2003, 2020.
Uraltsev, Gennady, Ph.D. (Universitat Bonn), Assistant Professor, 2023.

Van Horn-Morris, Jeremy, Ph.D. (University of Texas at Austin), B.S. (University of Oregon), Associate Professor, 2012, 2018.
Woodland, Janet C., Ph.D., M.A. (State University of New York at Stony Brook), B.A. (King's College), Teaching Assistant Professor, 1993.
Zhang, Qingyang, Ph.D. (Northwestern University), M.S. (Loyola University–Chicago), B.S. (Beijing Normal University), Associate Professor, 2015, 2021.

Courses

MATH 50103. Abstract Algebra with Connections to School Mathematics. 3 Hours.
Basic structures of abstract algebra (rings, fields, groups, modules and vector spaces) with emphasis on rings and fields as generalizations of the ring of integers and field of rational numbers. Graduate degree credit will not be awarded for both MATH 41103 (or MATH 51203) and MATH 50103. Prerequisite: Graduate standing or departmental consent. (Typically offered: Irregular)

MATH 50203. Geometry with Connections to School Mathematics. 3 Hours.
School geometry from an advanced perspective including conformity to the Common Core State Standards for Mathematics. Study will include historical developments and geometry based on transformations of two- and three-dimensional space. Prerequisite: Graduate standing. (Typically offered: Fall Odd Years)

MATH 50303. Advanced Calculus with Connections to School Mathematics Teaching. 3 Hours.
Rigorous development of the real numbers, continuity, differentiation, and integration. Graduate degree credit will not be awarded for both MATH 45103 (or MATH 55003) and MATH 50303. Prerequisite: Departmental consent. (Typically offered: Irregular)

MATH 5040V. Special Topics for Teachers. 1-6 Hour.
Current topics in mathematics of interest to secondary school teachers. Prerequisite: Graduate standing or departmental consent. (Typically offered: Irregular) May be repeated for degree credit.

MATH 50503. Probability & Statistics with Connections to School Mathematics. 3 Hours.
An advanced perspective of probability and statistics as contained in the high school mathematics curriculum with connections to other components of school mathematics. The content is guided by the content of the high school probability and statistics of the Common Core State Standards for Mathematics. Prerequisite: Graduate standing. (Typically offered: Spring)

MATH 5070V. Professional Development for Secondary Mathematics Teaching. 1-6 Hour.
Validated participation in professional development mathematics workshops or institutes sanctioned by national or international educational organizations such as the College Board, International Baccalaureate Program, and the National Board for Professional Teaching Standards. Prerequisite: Departmental consent. (Typically offered: Irregular) May be repeated for up to 6 hours of degree credit.

MATH 5100V. Mathematical Seminar. 1-3 Hour.
Members of the faculty and advanced students meet for presentation and discussion of topics. Prerequisite: Graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall and Spring) May be repeated for up to 3 hours of degree credit.

MATH 51103. Introduction to Abstract Algebra II. 3 Hours.
Topics in abstract algebra including finite abelian groups, linear groups, factorization in commutative rings and Galois theory. Graduate degree credit will not be given for both MATH 41103 and MATH 51103. Prerequisite: MATH 31103. (Typically offered: Spring)

MATH 51203. Algebra I. 3 Hours.
What the beginning graduate student should know about algebra: groups, rings, fields, modules, algebras, categories, homological algebra, and Galois Theory. Prerequisite: MATH 31103, and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall)

MATH 51303. Algebra II. 3 Hours.
Continuation of MATH 51203. Prerequisite: MATH 51203, and graduate standing in mathematics or statistics. (Typically offered: Spring)

MATH 51503. Advanced Linear Algebra. 3 Hours.
Linear functionals, matrix representation of linear transformations, scalar product, and spectral representation of linear transformations. Graduate degree credit will not be given for both MATH 41003 and MATH 51503. Prerequisite: Graduate standing. (Typically offered: Fall)

MATH 51603. Dynamic Models in Biology. 3 Hours.
Mathematical and computational techniques for developing, executing, and analyzing dynamic models arising in the biological sciences. Both discrete and continuous time models are studied. Applications include population dynamics, cellular dynamics, and the spread of infectious diseases. Graduate degree credit will not be given for both MATH 41603 and MATH 51603. Prerequisite: MATH 24004. (Typically offered: Irregular)

MATH 52103. Advanced Calculus I. 3 Hours.
The real and complex number systems, basic set theory and topology, sequences and series, continuity, differentiation, and Taylor's theorem. Emphasis is placed on careful mathematical reasoning. Graduate degree credit will not be given for both MATH 45103 and MATH 52103. Prerequisite: Graduate standing. (Typically offered: Fall)

MATH 52203. Advanced Calculus II. 3 Hours.
The Riemann-Stieltjes integral, uniform convergence of functions, Fourier series, implicit function theorem, Jacobians, and derivatives of higher order. Graduate degree credit will not be given for both MATH 45203 and MATH 52203. Prerequisite: MATH 45103 or MATH 52103. (Typically offered: Spring)

MATH 5250V. Internship in Professional Practice. 1-3 Hour.
Professional work experience involving significant use of mathematics or statistics in business, industry or government. Graduate degree credit will not be given for both MATH 4050V and MATH 5250V. (Typically offered: Fall, Spring and Summer) May be repeated for up to 3 hours of degree credit.

MATH 52603. Symbolic Logic I. 3 Hours.
Rigorous analyses of the concepts of proof, consistency, equivalence, validity, implication, and truth. Full coverage of truth-functional logic and quantification theory (predicate calculus). Discussion of the nature and limits of mechanical procedures (algorithms) for proving theorems in logic and mathematics. Informal accounts of the basic facts about infinite sets. Graduate degree credit will not be given for both MATH 42503 and MATH 52603. Prerequisite: MATH 26103, MATH 28003, or PHIL 22003. (Typically offered: Fall)
This course is cross-listed with PHIL 52503.

MATH 53103. Partial Differential Equations. 3 Hours.
Laplace's equation, Heat equation, Wave Equation, Method of Characteristics. Prerequisite: MATH 44203, MATH 45103, and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall)

MATH 53203. Partial Differential Equations II. 3 Hours.
Fourier Transforms, Sobolev Spaces, Elliptic Regularity. Prerequisite: MATH 53103 and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Spring)

MATH 53503. Mathematical Modeling. 3 Hours.
Mathematical techniques for formulating, analyzing, and criticizing deterministic models taken from the biological, social, and physical sciences. Techniques include graphical methods, stability, optimization, and phase plane analysis. Graduate degree credit will not be given for both MATH 41503 and MATH 53503. Prerequisite: MATH 25804. (Typically offered: Irregular)

MATH 53603. Scientific Computation and Numerical Methods. 3 Hours.
An introduction to numerical methods used in solving various problems in engineering and the sciences. May not earn credit for this course and MATH 43503 or MATH 43603. Prerequisite: Graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall)
This course is cross-listed with PHYS 53603.

MATH 53703. Finite Element Methods and Solution of Sparse Linear. 3 Hours.
Provides an in-depth understanding of numerical methods for the solution of partial differential equations using Finite Element Methods, Direct and Iterative Methods for the Sparse Linear Systems. Prerequisite: MATH 53903. (Typically offered: Spring)

MATH 53803. Numerical Analysis. 3 Hours.
General iterative techniques, error analysis, root finding, interpolation, approximation, numerical integration, and numerical solution of differential equations. Graduate degree credit will not be given for both MATH 43603 and MATH 53803. Prerequisite: Graduate standing. (Typically offered: Fall)

MATH 53903. Numerical Linear Algebra. 3 Hours.
Numerical methods for problems of linear algebra, including the solution of very large systems, eigenvalues, and eigenvectors. Graduate degree credit will not be given for both MATH 43503 and MATH 53903. Prerequisite: Graduate standing. (Typically offered: Spring)
This course is equivalent to MATH 43503.

MATH 54003. Numerical Linear Algebra II. 3 Hours.
Provides an in-depth understanding of numerical methods for the solution of large scale eigenvalue problems arising in science and engineering applications including theory, implementation and applications. Prerequisite: MATH 53903. (Typically offered: Fall)

MATH 54203. Introduction to Partial Differential Equations. 3 Hours.
Separation of variables, Fourier transform, and Laplace transform methods for the solution of partial differential equations. Topics include Fourier series, Fourier-Bessel series, orthogonal expansions, and the error function. Does not count towards degree credit in MATH. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer)

MATH 54403. Complex Variables. 3 Hours.
Complex analysis, series, and conformal mapping. Graduate degree credit will not be given for both MATH 44403 and MATH 54403. Prerequisite: MATH 26103 or MATH 28003, and MATH 25804. (Typically offered: Fall)

MATH 54503. Functional Analysis I. 3 Hours.
Banach Spaces, Hilbert Spaces, operator theory, compact operators, dual spaces and adjoints, spectral theory, Hahn-Banach, open mapping and closed graph theorems, uniform boundedness principle, weak topologies. Prerequisite: MATH 55103, and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Spring Odd Years)

MATH 55003. Theory of Functions of a Real Variable I. 3 Hours.
Real number system, Lebesque measure, Lebesque integral, convergence theorems, differentiation of monotone functions, absolute continuity and the fundamental theorem of calculus L^P spaces, Holder and Minkowski inequalities, and bounded linear functionals on the L^P spaces. Prerequisite: MATH 45203 or MATH 52203, and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall)

MATH 55103. Theory of Functions of a Real Variable II. 3 Hours.
Measure and integration on abstract measure spaces, signed measures, Hahn decomposition, Radon-Nikdoym theorem, Lebesque decomposition, measures on algebras and their extensions, product measures, and Fubini's theorem. Prerequisite: MATH 55003, and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Spring)

MATH 55203. Theory of Functions of a Complex Variable I. 3 Hours.
Complex numbers, analytic functions, power series, complex integration, Cauchy's Theorem and integral formula, maximum principle, singularities, Laurent series, and Mobius maps. Prerequisite: MATH 45103 or MATH 52103. (Typically offered: Fall)

MATH 55303. Theory of Functions of a Complex Variable II. 3 Hours.
Riemann Mapping Theorem, analytic continuation, harmonic functions, and entire functions. Prerequisite: MATH 55203, and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Spring)

MATH 56003. Differential Geometry. 3 Hours.
Topics include: classical differential geometry of curves and surfaces in 3-space, differential forms and vector fields. Graduate degree credit will not be given for both MATH 45003 and MATH 56003. Prerequisite: MATH 26004. (Typically offered: Irregular)

MATH 57003. Topology I. 3 Hours.
An introduction to topology. Topics include metric spaces, topological spaces and general point-set topology, homotopy and the fundamental group, covering spaces, the classification of surfaces. Prerequisite: MATH 45103 or MATH 52103, and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall Even Years)

MATH 57103. Topology II. 3 Hours.
The continuation of Topology I. Topics include: advanced homotopy and covering spaces, the Seifert-van Kampen theorem, homology and the Mayer-Vietoris sequence. Prerequisite: MATH 57003, and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Spring Odd Years)

MATH 57203. Differential Topology I. 3 Hours.
An introduction to the topology of smooth manifolds: applications of the inverse function theorem to smooth maps, Sard's theorem, transversality, intersection theory, degrees of maps, vector fields and differential forms on manifolds, integration on manifolds. Prerequisite: MATH 45103 or MATH 52103 and graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall Odd Years)

MATH 57303. Differential Topology II. 3 Hours.
The continuation of Differential Topology I, with additional advanced topics. Possible advanced topics may include: Morse theory, de Rham cohomology theory, Poincare duality, Riemannian geometry, and Lie groups and Lie algebras. Prerequisite: MATH 57203 and graduate standing in mathematics or statistics, or department consent. (Typically offered: Spring Even Years)

MATH 58003. Introduction to Point-Set Topology. 3 Hours.
A study of topological spaces including continuous transformations, connectedness and compactness. Graduate degree credit will not be given for both MATH 47003 and MATH 58003. Prerequisite: MATH 45103 or MATH 52103. (Typically offered: Irregular)

MATH 5990V. Research Topics in Mathematics. 1-3 Hour.
Current research interests in mathematics. Graduate degree credit will not be given for both MATH 4990V and MATH 5990V. Prerequisite: Departmental consent. (Typically offered: Irregular) May be repeated for up to 12 hours of degree credit.

MATH 6100V. Directed Readings. 1-6 Hour.
Directed readings. Prerequisite: Departmental consent. (Typically offered: Irregular) May be repeated for up to 18 hours of degree credit.

MATH 6190V. Topics in Algebra. 1-6 Hour.
Current research interests in algebra. Prerequisite: Graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

MATH 62003. Theory of Probability. 3 Hours.
A rigorous mathematical treatment based on measure theory of the fundamental notions and results of the theory of probability. Topics covered include laws of large numbers, central limit theorems, conditional expectations. Additional topics that may be covered include martingales, Markov chains, Brownian motion and stochastic integration. Prerequisite: MATH 55103. (Typically offered: Fall)

MATH 62103. Mathematical Statistics. 3 Hours.
A rigorous mathematical treatment of the fundamental principles and results in the theory of Statistics. Topics include exponential families of distributions, estimation of unknown parameters, the classical theory of theory of hypothesis testing, Large sample approximations, large sample properties of estimators. Prerequisite: MATH 62003. (Typically offered: Spring)

MATH 6590V. Topics in Analysis. 1-6 Hour.
Current research interests in analysis. Prerequisite: Graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

MATH 6790V. Topics in Topology. 1-6 Hour.
Current research interest in topology. Prerequisite: Graduate standing in mathematics or statistics, or departmental consent. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

MATH 7000V. Doctoral Dissertation. 1-18 Hour.
Doctoral Dissertation. Prerequisite: Doctoral candidacy in mathematics. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.