

# MATHEMATICS

Karnoutsos Hall, Room 506  
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The Mathematics Department (<https://www.njcu.edu/academics/schools-colleges/william-j-maxwell-college-arts-sciences/departments/mathematics/>) prepares students for careers in a modern, complex society that has become increasingly dependent on mathematics. Faculty scholarship includes research ranging from methods for teaching mathematics to historical and analytical studies of mathematics. The Department is a member of the Mathematical Association of America and the National Council of Teachers of Mathematics and hosts an annual Mathematics Awareness Day. The Mathematics Department also sponsors a club for mathematics majors and a chapter of Kappa Mu Epsilon National Mathematics Honor Society.

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Various discipline-specific concentrations that will prepare students for multiple fields of employment or areas of additional undergraduate/graduate study are noted below. Course requirements for each concentration are explained in detail. The requirements for graduation, in addition to completion of the major area, are listed on "Undergraduate Degree Requirements (<https://catalog.njcu.edu/undergraduate/undergraduate-degree-requirements/>)."

- Mathematics, B.A.
- Mathematics—Teacher Certification, B.A.
- Mathematics—Concentration: Actuarial Science, B.A
- Mathematics, Minor

## Mathematics (MATH)

### MATH 1XX Mathematics Transfer Credit (0 Credits)

### MATH 2XX Mathematics Transfer Credit (0 Credits)

### MATH 90 Developmental Mathematics (4 Credits)

Course develops the computational and algebraic skills that are necessary for success in college. Topics include operations and applications of whole numbers, integers, rational numbers, and percentages; operations with signed numbers; algebraic expressions; equations and inequalities; graphs of linear equations; basic geometry; and an introduction to descriptive statistics.

### MATH 91 Math Lab (1 Credit)

### MATH 95 Basic College Mathematics (3 Credits)

This course develops computational skills involving operations and applications of whole numbers, integers, and rational numbers, with an emphasis on use of calculators. Short introductions to the areas of algebra, geometry, statistics, and graphical interpretation are included. This is a 3-hour, 3 non-college credit course and the only grades earned are P (Passing) and R (Repeat).

### MATH 96 Beginning Algebra (2 Credits)

This course develops the algebraic skills necessary for success in Algebra for College Students. Topics include: linear equations and inequalities in one and two variables and applications; basic operations with exponents and polynomials; linear functions, their graphs, and applications; square roots and radical expressions; solving quadratic equations.

**Pre-Requisite(s):** MATH 90 and Co-Requisite(s): MATH 106

**Co-Requisite(s):** MATH 106

**MATH 97 Math Express (1 Credit)**

This course is designed for students who received a grade of "R" in MATH 095 but almost passed. It has the same syllabus as 095. Instructor recommendation is required. This course can also be taken by other students who almost passed the placement exam. Recommendation from Testing Office and Math Academic Foundations Coordinator is required. This is an intensive (one-week) course which is usually offered during the Winter Intersession, the week before Summer Session I, and at the end of August.

**MATH 98 Algebra for College (4 Credits)**

This course is an introduction to algebra which concentrates on graphic representation, problem solving, and the use and manipulation of polynomials and other algebraic expressions to model and interpret real-life situations. The central themes are the applications of linear and quadratic relationships. This is a 4-hour, 4 non-college credit course and the only two grades are P (Passing) and R (Repeat).

**Pre-requisite:** MATH 095 Basic College Math or COMP EXAM

**MATH 99 Algebra Express (1 Credit)**

This course is designed for students who received a grade of "R" in MATH 098 but almost passed. It has the same syllabus as MATH 098. Instructor recommendation is required. This course can also be taken by other students who almost passed the placement exam. Recommendation from Testing Office and Math Academic Foundations Coordinator is required. This is an intensive (one-week) course which is usually offered during the Winter Intersession, the week before Summer Session I, and at the end of August.

**MATH 102 Fundamentals of Mathematics (3 Credits)**

Students seeking a general knowledge of mathematics should take this course. Topics included are: set theory, mathematical logic, number theory, number systems, algebra and geometry. This course may fulfill an All University Requirement.

**Pre-Requisite(s):** MATH 098, Algebra for College or equivalent in High School

**MATH 105 Mathematics Analysis (3 Credits)****MATH 106 Algebra for College Students (3 Credits)**

This course develops the algebraic skills necessary for success in Algebra for college Students. Topics include: linear equations and inequalities in one and two variables; polynomials; rational expressions; exponents and radicals; quadratic equations and inequalities; linear, quadratic, polynomial, and rational functions and applications; and systems of linear equations and inequalities and applications.

**Pre-Requisite(s):** MATH 90 and Co-Requisite(s): MATH 96

**Co-Requisite(s):** MATH 96

**MATH 112 Intermediate Algebra (3 Credits)**

This course contains many topics usually taught in a second-year algebra course including functions and relations. It is an advanced review of algebra designed for students who desire sufficient knowledge for Precalculus and Calculus. It is a useful aid for increasing one's ability to solve problems in business, nursing, education, and science.

**Pre-requisite:** MATH 096 or MATH 098

**MATH 114 Contemporary Mathematics (3 Credits)**

Course introduces the student to the role of mathematics in various aspects of contemporary life. Emphasis is on the use of quantitative descriptions and models to solve real-world problems. Examples of specific topics include the mathematics of social choice, data handling, growth and form, and optimization.

**Pre-Requisite(s):** MATH 90, MATH 96, MATH 98 or MATH 112

**MATH 140 Statistics I (3 Credits)**

Statistics I is a study of mode, median, mean, standard deviation, various descriptive techniques, the binomial and normal distributions, and an introduction to statistical inference. Statistical concepts are applied primarily to the natural and social sciences, business administration, and criminal justice using packaged software such as Minitab and SPSS.

**Pre-Requisite(s):** MATH 90, MATH 96, MATH 98 or MATH 112

**MATH 164 Pre-Calculus for Business Students (4 Credits)**

This course introduces the student to the role and applications of mathematics in business. Topics include: polynomial, rational, exponential, and logarithmic equations and functions and their applications in business; interest, annuities, present and future values, sinking funds, and amortization, systems of linear equations and inequalities; and matrices and their applications in business.

**Pre-Requisite(s):** MATH 112 or MATH 106

**MATH 165 Pre Calculus (3 Credits)**

Selected topics from algebra, exponential and logarithmic functions, trigonometry and analytic geometry are chosen to provide a suitable background for Calculus I.

**Pre-Requisite(s):** MATH 112 Intermediate or its equivalent in High School or College.

**MATH 166 Elementary Functions (3 Credits)**

An introductory treatment of properties of elementary functions with emphasis on graphical analysis is presented in this course. The course also investigates the graphical meaning of the derivative and integral.

**Prerequisite:** MATH 165 or MATH 175

**MATH 167 Mathematics for the Secondary School (3 Credits)****MATH 175 Enhanced Precalculus (4 Credits)**

Selected topics from algebra, exponential and logarithmic functions, and trigonometry are chosen to provide suitable background for Calculus I.

**Pre-Requisite(s):** MATH 106 or MATH 112.

**MATH 190 Calculus I (3 Credits)**

Differential calculus of polynomial and trigonometric functions is the topic in this course. The course includes topics such as limits, derivatives and applications of differentiation.

**Pre/Co-Requisite(s):** MATH 175 Enhanced Precalculus or MATH 165 Pre Calculus

**MATH 191 Calculus II (3 Credits)**

This course offers a study of integral calculus, antiderivatives, definite and indefinite integrals. Logarithmic and exponential functions, hyperbolic functions and techniques of integration are also studied.

**Pre-Requisite(s):** MATH 190 Calculus I or its equivalent.

**MATH 192 Calculus and Analytic Geometry I (4 Credits)**

This course presents a study of differential calculus of polynomial and trigonometric functions, applications of differentiation including maximum minimum problems and Newton's Method and Rolle's Theorem. Anti-differentiation, definite, and indefinite integrals are also involved. This course is part of 12 semester hour sequence in Calculus for Pre-Engineering students.

**Pre/Co-Requisite(s):** MATH 175 Enhanced Precalculus or MATH 165 Pre Calculus

**MATH 193 Calculus and Analytic Geometry II (4 Credits)**

This course deals with the applications of the definite integral including area and volume problems, surface area, and work problems. Logarithmic and Exponential Functions, Hyperbolic Functions, Techniques of Integration, L'Hopital's Rule, and Infinite Series are also included.

**Pre-Requisite:** Math 192 Calculus and Analytic Geometry I with a grade of C or better

**MATH 200 Calculus for Business (3 Credits)**

Course introduces the student to the role of calculus in business. Topics include: limits, continuity, derivatives and applications, and integration and applications.

**Pre-Requisite(s):** MATH 164 or 1165

**MATH 205 Problem Solving (3 Credits)**

This course seeks to prepare education majors to pass the national test required for teacher certification. Provides a thorough review of problem solving skills through Pre-Calculus for others.

**Pre-Requisite(s):** MATH 112 Intermediate Algebra or equivalent.

**MATH 215 Problem Solving in Mathematics (3 Credits)**

Course provides elementary education majors a deeper understanding of the mathematics they will teach through an exploration of number systems and place value, arithmetic algorithms, and mathematical structures using a problem solving approach. Students will be required to reason and communicate mathematically with various representations, models, and procedures.

**Pre-Requisite(s):** Tier 1 Math Course, or MATH 96 or MATH 98

**MATH 220 Applications of Mathematics (3 Credits)**

This course includes topics in the theory of optimization. The topics include the maximization and/or minimization of univariate functions (using such methods as exhaustive search, interval search, random search, and Fibonacci search), and multivariate functions (using techniques such as the method of steepest descent). The linear programming problem is introduced and the simplex method is used for solving it. Topics are covered in the context of decision-making.

**Pre-Requisite(s):** MATH 191 Calculus II or equivalent.

**MATH 225 Mathematics makes a Case: Global Climate Change (3 Credits)**

The main objectives of this course are: to examine scientific facts of global climate change with abstract mathematical expressions, to process real data and evaluate evidence to see patterns, and to apply math skills to understand real-life issues and problems. Basic algebraic functions and statistics will be included.

**Pre-Requisite(s):** MATH 98 or MATH 112, or its equivalent.

**MATH 240 Introduction to Number Theory (1 Credit)**

This course serves as an introduction to number theory. Questions in elementary number theory include divisibility properties of integers, properties of primes, congruences, and integer solutions to basic equations (e.g. Diophantine Equations).

**Pre-Requisite(s):** MATH 193 Calculus and Analytic Geometry II

**MATH 245 Introduction to Graph Theory (1 Credit)**

This course serves as an introduction to graph theory. Topics include graphs, digraphs, trees, connectivity, circuits, Eulerian and Hamilton paths, vertex-edge coloring, and applications in networks in the fields of telecommunication, biology, computer science, and other areas.

**Pre-Requisite(s):** Math 193 Calc And Analytic Geometry II

**MATH 250 Introduction to Combinatorics (1 Credit)**

This course serves as an introduction to combinatorics. Topics in combinatorics include techniques of enumeration, combinations, permutations, binomial coefficients, Pascal's triangle, Fibonacci numbers, partitions, Pigeon Hole Principle, Inclusion - Exclusion Principle, recurrence relations, and applications.

**Pre-Requisite(s):** MATH 193

**MATH 255 Financial Mathematics (3 Credits)**

This course introduces students to the role of mathematics in financial markets and is a building block to learners in the field of finance. The frequent application of financial mathematics has become essential to the financial and insurance industry. The course emphasizes the fundamental concepts interest theory and financial economics.

**Pre-Requisite(s):** MATH 192

**MATH 260 Linear Algebra (3 Credits)**

Algebra of matrices and vector spaces and applications to the solution of systems of linear equations and geometric transformations are studied in this course.

**Pre-Requisite(s):** MATH 191 Calculus II or MATH 193 or its equivalent

**MATH 271 Algebra and Probability in Elementary Education (3 Credits)**

This course provides elementary education majors a deeper understanding of the mathematics they will teach through an exploration of algebraic structures, elementary probability, statistics, and data analysis using a problem-solving process approach. Students will be required to reason and communicate mathematically with various representations, models, and procedures.

**Prerequisite:** MATH 106 or MATH 112

**MATH 290 Calculus III (3 Credits)**

This is a continuation of Calculus II. Topics studied include improper integrals, L'Hopital's Rule, infinite series, conic sections, polar coordinates, parametric equations and introduction to vectors.

**Pre-Requisite(s):** MATH 191 Calculus II or equivalent.

**MATH 291 Calculus IV (3 Credits)**

As a continuation of Calculus III, this course includes the study of three-dimensional spaces, vectors, vector valued functions, partial derivatives, multiple integration, line integrals and Green's Theorem.

**Pre-Requisite(s):** MATH 290 Calculus III or equivalent.

**MATH 292 Calculus & Analytical Geometry III (4 Credits)**

This course (with 192, 193) is part of a 12 cr. sequence in calculus for pre-engineering students. Topics include polar coordinates and parametric equations, three-dimensional space, vectors, vector valued functions, partial derivatives, multiple integrals and topics in vector calculus.

**Pre-requisite:** MATH 193 with a grade of C or better

**MATH 295 Survey of Modern Mathematics (3 Credits)**

This course provides a transition to higher mathematics. Topics include elementary set theory, elementary symbolic logic, elementary number theory, equivalence relations and functions. Emphasis is on techniques of proofs. It is strongly recommended that students complete this course as a preparation for MATH 370 Abstract Algebra.

**Pre-Requisite:** or Co-Requisite: MATH 191 or MATH 193

**Co-Requisite:** MATH 191 or MATH 193

**MATH 307 Finite Mathematics I (3 Credits)****MATH 310 Differential Equations (3 Credits)**

This is the first course in differential equations, including such topics as separate variables, homogeneous equations, integrating factors, linear and higher order differential equations and applications.

**Pre-Requisite(s):** MATH 290 Calculus III or equivalent.

**MATH 311 Differential Equations for Engineers (4 Credits)**

This course is more thorough than Math 310 and is designed for pre-engineering students.

**Pre-Requisite(s):** MATH 292 Calculus and Analytic Geometry.

**MATH 320 Modern Geometry I (3 Credits)**

Reformulation of Euclidean Geometry from an advanced viewpoint is taught. Distance, Congruences, Betweenness, Separation in planes and space, Geometric Inequalities and the Euclidean concept of congruence without distance.

**Pre-Requisite(s):** MATH 191 or MATH 193

**MATH 321 Modern Geometry II (3 Credits)**

The three geometries, parallel postulates and projections, area functions, perpendicular lines and planes, Saccheri quadrilaterals, inversion and reflection, hyperbolic geometry, absolute geometry, Bolyai's theorem, defects and area, and consistency of the hyperbolic postulates are studied in this course.

**Pre-Requisite(s):** MATH 320

**MATH 330 Mathematical Statistics I (3 Credits)**

This course is an introduction to Calculus-based mathematics of statistics. Topics include: basic combinatorial methods, random variables, probability distributions and densities, expectation, and the binomial and normal distributions.

**Pre-Requisite(s):** MATH 290 or MATH 292

**MATH 331 Mathematical Statistics II (3 Credits)**

An analysis of applications of probability and mathematical statistics is presented in this course. Topics include sampling distributions, point estimation, interval estimation, hypothesis testing, regression and correlation, and analysis of variance.

**Pre-Requisite(s):** MATH 330 Mathematical Statistics or equivalent.

**MATH 350 Elements of Numerical Analysis (3 Credits)**

Error analysis, finite differences, integrative methods, interpolation, and numerical differentiation and integration are the topics studied in this class.

**Pre-Requisite(s):** MATH 290 or MATH 292

**MATH 370 Abstract Algebra (3 Credits)**

This is the first course in abstract (modern) algebra. Topics include: study of groups, permutations, cyclic groups, subgroups, isomorphism, cosets, rings, fields, and integral domains. Pre-requisite: MATH 191 Calculus II or equivalent.

**Pre-requisite(s):** MATH 295 with a grade of C or better and MATH 191 or MATH 193

**MATH 371 Abstract Algebra II (3 Credits)**

Abstract Algebra II is a study of groups, rings, ideals, lattices, solvable groups, and roots of polynomial equations. A continuation MATH 370.

**Pre-Requisite(s):** Math 370 Abstract Algebra I or equivalent

**MATH 380 Real Analysis (3 Credits)**

This is a study of sets, mappings, sequences, connected, open and closed sets, continuity, uniform convergence, and metric spaces. Introduction to measure theory.

**Pre-requisite:** MATH 295 and either MATH 191 or MATH 193

**MATH 385 Reading in Mathematics (3 Credits)****MATH 407 Teaching Mathematics in Secondary Schools (3 Credits)****MATH 410 History of Mathematics (3 Credits)**

This course is an introduction to the development of major mathematical ideas and concepts over the centuries. It is a historical narrative.

Students will concentrate on related problems and their applications, providing them with valuable information in business, science, education, and research. A knowledge of the rudiments of mathematics through calculus would be desirable for the course.

**Pre-Requisite(s):** MATH 191 or MATH 193

**MATH 430 Topology (3 Credits)**

Introductory course in which sets, functions, topological spaces, subspaces, continuity, connectedness, compactness, separation properties, metric spaces and product spaces are studied.

**Pre-Requisite(s):** MATH 291 or MATH 292

**MATH 440 Number Theory (3 Credits)**

This course offers a study of divisibility, the division algorithm, Euclid's algorithm prime numbers, congruence, number theoretic functions, and quadratic reciprocity.

**Pre-Requisite(s):** MATH 290 or MATH 292

**MATH 445 Complex Variables (3 Credits)**

This is the first course in the theory of functions of one complex variable. The course introduces the student to a wide range of topics in the theory of complex variables including: analyticity, Cauchy-Riemann equations, harmonic functions, Cauchy's integral theorem, and the residue theorem.

**Pre-Requisite(s):** MATH 292 or equivalent

**MATH 450 Advanced Calculus I (3 Credits)**

In this course advanced topics of calculus are presented. Elementary calculus, real number system, properties of continuous functions, extensions of the mean-value theorem, Taylor series, and functions of several variables are rigorously considered.

**Pre-Requisite(s):** MATH 291 or MATH 292

**MATH 451 Advanced Calculus II (3 Credits)**

Elements of partial differentiation, implicit function theorems, inverse function theorem, line integrals, Green's Theorem, transformation of double integrals, uniform continuity, theory of integration, uniform convergence, and infinite series are studied in this course.

**Pre-requisite:** MATH 450

**MATH 482 Mathematics in Junior High School (3 Credits)****MATH 495 Independent Study (1 Credit)**

This course enables students to investigate areas of advanced mathematics with the help of an individual instructor. Honors may be granted to students who submit high-quality research papers. It is only open to Juniors and Seniors who are Mathematics majors and who have attained a 3.0 cumulative average in Math. Registration only by permission of the chairperson.

**Pre-Requisite(s):** Permission of the Chairperson.

**MATH 501 Mathematics Content PRAXIS Review (1 Credit)**

A review of the mathematical concepts included in the ETS PRAXIS (Professional Assessments for Beginning Teachers) Mathematics Content Knowledge secondary teachers' examination. (PASS/FAIL) Requirement: 24 credits in mathematics or permission of the Department Chairperson.

**MATH 503 Computers in Mathematics (3 Credits)**

This course provides students, who have basic computer literacy and some elementary knowledge of computer programming, specific skills in using mathematical software. Problems and projects are taken from a variety of mathematical subjects including: precalculus, calculus, number theory, geometry, linear algebra, abstract algebra, and statistics. Explanations and introductions to these subjects are provided.

**MATH 508 Professionalized Subject Matter in Arithmetic (3 Credits)**

This course offers a study of procedures in arithmetic. Attention is given to concepts in manipulative and problem solving areas. Various services for diagnostic and remedial measures are introduced and evaluated.

**MATH 510 Professionalized Subject Matter in Algebra (3 Credits)**

This course provides the student with a reappraisal of the fundamental concepts of algebra. Emphasis is placed on the manner in which these concepts can be used to teach algebra more effectively. This course demands evidence of effective use of taught concepts in the student's own classroom. Topics include: number, set, relations, functions, operation structure, and problem solving.

**MATH 511 Professionalized Subject Matter in Middle School Mathematics (3 Credits)**

This course stresses mathematical concepts and skills required of children entering the junior high school curriculum in recent years, as well as those, which are appropriate for junior high students with less interest and ability in mathematics. The student will be required to show evidence of use of some of these in the student's own classroom. Topics include: modular arithmetic, numeration, geometry, descriptive statistics, algebra, and mathematical games.

**UG Pre-requisite:** Perm of Chair for Undergraduates only

**MATH 512 Professionalized Subject Matter in Geometry (3 Credits)**

This course provides a review of fundamental concepts of geometry and an investigation of their significance in the teaching of secondary school mathematics. Concepts to be analyzed include: logic, proof, and axiomatic systems; physical and geometric models; sets, relations, and transformation; non-metric and metric concepts, duality and dimensionality; and coordination of spaces. Attention is given to: historical considerations bearing on the teaching of geometry; integration of geometry with algebra and science; and significant literature on the subject. This course requires evidence that the student is making effective use of these concepts in the student's own classroom.

**MATH 514 Professionalized Subject Matter in Pre-Calculus Mathematics (3 Credits)**

This course presents pre-calculus topics, particularly trigonometry and matrix operations. Attention is given to historical considerations and to current trends in teaching this content. This course requires evidence that the student is making effective use of these concepts in the student's own classroom.

**MATH 515 Math Manipulatives I (3 Credits)**

This course explores the use of manipulative such as geoboards, Cuisenaire rods, number lines, software and CD ROM materials in the teaching of mathematics in elementary and middle schools. Both commercial and teacher-made manipulative are utilized.

**MATH 516 Mathematics Manipulative II (3 Credits)**

This course continues the exploration of using manipulatives to teach mathematics. The student is required to show evidence of the ability to use these concepts and skills in a classroom.

**MATH 517 Calculators in the K-8 Classroom (3 Credits)**

This course explores the use of calculators in the teaching of mathematics K-8. Topics include using calculators to reinforce the elementary and middle school mathematics curriculum and constructing student projects which make use of the calculator.

**MATH 518 Calculators in the Secondary Classroom (3 Credits)**

This course explores the use of graphing calculators in the teaching of secondary school mathematics. The use of calculators is demonstrated for algebra, geometry, trigonometry, and calculus. Student projects are constructed which make use of the calculator.

**MATH 526 Algorithmic Number Theory (3 Credits)**

This course presents number theory from an historical point of view and emphasizes significant discoveries from ancient to modern times, as well as presenting unsolved problems and areas of current interest. Topics include: prime numbers and related theorems; Euclidean algorithm and quadratic reciprocity; Pythagorean numbers and continued fractions.

**MATH 531 Numerical Analysis (3 Credits)**

Topics include iterative methods of solving equations; interpolation and polynomial approximation; numerical differentiation and integration; numerical solution of differential equations; solution of linear systems by direct and iterative methods; matrix inversion and calculation of eigenvalues and eigenvectors of matrices. Selected algorithms may be programmed in FORTRAN and APL for solution on electronic computers at NJCU Computer Center.

**MATH 536 Mathematical Modeling (3 Credits)**

The main objectives of this course are: to explore mathematical models of real world situations, to set up such models, and to review the mathematics needed to treat such models. Analysis of computer simulations of the models plays a major role in this course.

**MATH 540 Graph Theory (3 Credits)**

Topics studied in this course include paths, walks, networks, trees, connected graphs, subgroups and related applications.

**MATH 598 Mathematical Principles of Computer Graphics (3 Credits)**

Topics include: two dimensional algorithms; transformations, scaling, translations, rotations, matrix notation, line clipping, b-spline curve fitting, and recursion. Geometric tools for three-dimensional algorithms, and affine and projective geometry are included. Viewing and perspective transformations, wire frame models, algorithms for the triangle decomposition of polygons and hidden-line elimination are included. Object-oriented programming using C++ is included.

**MATH 1165 Pre-Calculus for Business (3 Credits)**

This course is directed to the needs of the business major. Topics include: polynomial and rational functions and graphs, exponential and logarithmic functions, systems of equations and matrices, linear programming and introduction to calculus.

**Pre-Requisite(s):** MATH 112 Intermediate Algebra or its equivalent.

**MATH 1495 Independent Study in Mathematics (1 Credit)**

This course enables students to investigate areas of advanced mathematics with the help of an individual instructor. Honors may be granted to students who submit high-quality research papers. It is only open to Juniors and Seniors who are Math Majors and who have attained a 3.0 cumulative average in Math. Registration only by permission of the chairperson.

**MATH 2495 Independent Study Mathematics (1 Credit)**

This course enables students to investigate areas of advanced mathematics with the help of an individual instructor. Honors may be granted to students who submit high-quality research papers. It is only open to Juniors and Seniors who are Math Majors and who have attained a 3.0 cumulative average in Math. Registration only by permission of the chairperson.