Mathematics

The undergraduate program in Mathematics leads to a Bachelor of Arts degree in Mathematics and has been designed to provide the students with options suitable for various career plans. The choice of concentration determines the set of mathematics courses required, as well as those that can be taken as electives. Mathematics Majors at Northeastern Illinois University can choose any of the two concentrations: Concentration in Applied Mathematics and Concentration in Secondary Mathematics.

All students enrolled in Mathematics Major Program have to complete the entire set of required core courses, all of the courses required for a given concentration, as well as some elective courses, for the total of at least 46 credit hours. While each mathematics course has prerequisites, there are no prerequisites for entering the program.

Undergraduate Programs

- Major in Mathematics (http://catalog.neiu.edu/arts-sciences/mathematics/mathematics/) (Applied and Secondary Education-Mathematics Tracks. Note: The BA in Math (Secondary Education) is used to prepare students for getting a future degree in Secondary Education.)
- Elementary Education and Humanities Mathematics Minor (http://catalog.neiu.edu/arts-sciences/mathematics/elementary-education-humanities-mathematics-minor/)
- Minor in Applied Mathematics (http://catalog.neiu.edu/arts-sciences/mathematics/minor-applied-mathematics/)
- Minor in M (http://catalog.neiu.edu/arts-sciences/mathematics/minor-applied-mathematics/)athematical & Statistical Modeling of Complex Systems (http://catalog.neiu.edu/arts-sciences/mathematics/mathematical-statistical-modeling-minor/)

- Master of Science in Mathematics (http://catalog.neiu.edu/arts-sciences/mathematics/master-science-mathematics/) (Applied and Secondary Education-Mathematics)
- Master of Arts in Pedagogical Content Knowledge for Teaching Elementary and Middle School Mathematics (http://catalog.neiu.edu/arts-sciences/mathematics/master-arts-pedagogical-content-knowledge-teaching-elementary-middle-school-mathematics/) --- (*currently not accepting applications*)

Lidia Z. Filus, Ph.D., Professor, Chair
Katherine Bird, Ph.D., Associate Professor
Sarah Cordell, D.A., Professor
Matthew Graham, Ph.D., Associate Professor
Joseph E. Hibdon, Jr., Ph.D., Associate Professor
Nabil Kahouadji, Ph.D., Associate Professor
Anna Mitina, Ph.D., Professor
Marina Polyashuk, Ph.D., Professor
Nancy Wrinkle, Ph.D., Professor

MATH-011A. Developmental Stretch I: Statistics In Daily Life. 2 Hours.
Math 011A must be taken concurrently with Math 111A. These two courses comprise the first semester in a two semester sequence. Students completing each of Math 011A, 011B, 111A, and 111B with a C or better will have satisfied the Math 112 requirement and earned a total of 4 college credits. These courses comprise an elementary introduction to statistics. Students will learn: to process and classify observational, experimental, and sampling data; to make decisions using descriptive statistics; to use inferential statistics to test hypotheses and draw conclusions about a population; and to use spreadsheets to perform these tasks.
Corequisite: MATH-111A.

MATH-011B. Developmental Stretch II: Statistics In Daily Life. 2 Hours.
Math 011B must be taken concurrently with Math 111B. These two courses comprise the second semester in a two semester sequence. Students completing each of Math 011A, 011B, 111A, and 111B with a C or better will have satisfied the Math 112 requirement and earned a total of 4 college credits. These courses comprise an elementary introduction to statistics. Students will learn: to process and classify observational, experimental, and sampling data; to make decisions using descriptive statistics; to use inferential statistics to test hypotheses and draw conclusions about a population; and to use spreadsheets to perform these tasks.
Prerequisite: MATH-011A with a minimum grade of C.
Corequisite: MATH-111B.

MATH-048A. Developmental Stretch I: Math For Elementary Teachers I. 3 Hours.
Math 048A must be taken concurrently with Math 148A. These two courses comprise the first semester in a two semester sequence. Students completing each of Math 048A, 048B, 148A, and 148B with a C or better will have satisfied the Math 149 requirement and earned a total of 4 college credits. These courses comprise a mathematical introduction for elementary and middle school teachers. Topics include place value, models for and the development of arithmetic, mental math, estimation, word problems, algorithms, factors, primes, proofs, prealgebra, fractions, ratios, rates, and percentages. The development of elementary mathematics from an advanced standpoint is emphasized.
Corequisite: MATH-148A.

MATH-048B. Developmental Stretch II: Math For Elementary Teachers I. 3 Hours.
Math 048B must be taken concurrently with Math 148B. These two courses comprise the second semester in a two semester sequence. Students completing each of Math 048A, 048B, 148A, and 148B with a C or better will have satisfied the Math 149 requirement and earned a total of 4 college credits. These courses comprise a mathematical introduction for elementary and middle school teachers. Topics include place value, models for and the development of arithmetic, mental math, estimation, word problems, algorithms, factors, primes, proofs, prealgebra, fractions, ratios, rates, and percentages. The development of elementary mathematics from an advanced standpoint is emphasized.
Prerequisite: MATH-048A with a minimum grade of C.
Corequisite: MATH-148B.

MATH-090. Elementary Algebra. 3 Hours.
This course develops the foundations of algebra, beginning with the real number system and its operations. Topics include: variable expressions, linear equations, exponents and polynomials, applications of proportion, percent, and the use of formulas to develop problem solving skills. Freshman students are initially placed into mathematics courses by their MATH ACT scores, their NEIU Mathematics Placement Test scores, or by an appropriate score on the Advanced Placement Test in Calculus. (This course does not count toward graduation or GPA.).
Prerequisite: NEIU Math Placement Result 00 - 40 (or ACT Math 01 - 36 or Accuplacer Elementary Algebra 020 - 040 or SAT Math 200 - 800 or Accuplacer QR, Algebra, & Stat 200 - 300).

MATH-0901. Math Enrichment Workshop For Math 090. 1 Hour.
Mathematics enrichment workshop for students currently enrolled in MATH-090. The workshops draw on the Peer Led Team Learning (PLTL) and Emerging Scholars Program (ESP) models, which have been nationally identified for increasing students' probability of earning higher grades in their required mathematics courses. Workshop participants will attend a workshop during the same day and time each week; collaboratively solve problems related to their standard Math 090 course within small peer groups; receive guidance from math instructors who are specially trained to facilitate the workshops; and participate in social events with workshop peers during the semester.
Corequisite: MATH-090.

MATH-091. Intermediate Algebra I. 3 Hours.
This course develops the foundations of algebra, beginning with the real number system and its operations. Topics include: variable expressions, linear equations and systems of equations, exponents, polynomials, factoring trinomials, and solving equations by factoring. Freshman students are initially placed into mathematics courses by their MATH ACT scores, their NEIU Mathematics Placement Test scores, or by an appropriate score on the Advanced Placement Test in Calculus. (This course does not count toward graduation of GPA.).
Prerequisite: (MATH-090 or NEIU Math Placement Result 01 - 45 or ACT Math 17 - 18 or Accuplacer Elementary Algebra 041 - 059 or Accuplacer QR, Algebra, & Stat 237 - 249 or SAT Math 460 - 490).

MATH-0911. Math Enrichment Workshop For Math 091. 1 Hour.
Mathematics enrichment workshop for students currently enrolled in MATH-091. The workshops draw on the Peer Led Team Learning (PLTL) and Emerging Scholars Program (ESP) models, which have been nationally identified for increasing students' probability of earning higher grades in their required mathematics courses. Workshop participants will attend a workshop during the same day and time each week; collaboratively solve problems related to their standard Math 091 course within small peer groups; receive guidance from math instructors who are specially trained to facilitate the workshops; and participate in social events with workshop peers during the semester.
Corequisite: MATH-091.

MATH-092. Intermediate Algebra II. 3 Hours.
This course further develops the concepts and structures of intermediate algebra. A review of linear equations, polynomials, and factoring, prepares students for the study of linear, quadratic, exponential, and logarithmic equations and functions. Additional topics to prepare students for college algebra include: rational expressions and equations, complex numbers, rational exponents, graphing and applications of quadratic functions, and properties of logarithms. Freshman students are initially placed into mathematics courses by MATH ACT scores, NEIU Mathematics Placement Test scores, or by an appropriate score on the Advanced Placement Test in Calculus. (This course does not count toward graduation or GPA.).
Prerequisite: (MATH-091 - 499 or MATH-091A - 499Z or NEIU Math Placement Result 02 - 45 or ACT Math 19 - 36 or Accuplacer Elementary Algebra 060 - 084 or Accuplacer College Level Math 020 - 120 or Accuplacer Adv. Algebra & Func 200 - 300 or SAT Math 500 - 800).

MATH-0921. Math Enrichment Workshop For Math 092. 1 Hour.
Mathematics enrichment workshop for students currently enrolled in MATH-092. The workshops draw on the Peer Led Team Learning (PLTL) and Emerging Scholars Program (ESP) models, which have been nationally identified for increasing students' probability of earning higher grades in their required mathematics courses. Workshop participants will attend a workshop during the same day and time each week; collaboratively solve problems related to their standard Math 092 course within small peer groups; receive guidance from math instructors who are specially trained to facilitate the workshops; and participate in social events with workshop peers during the semester.
Corequisite: MATH-092.

MATH-092C. College Algebra Express I. 3 Hours.
MATH-092C College Algebra Express I must be taken concurrently with Math 173C College Algebra Express II. Math 092C and Math 173C are collectively a 6-credit co-requisite course that provides students a path to finish developmental coursework and college algebra in ONE semester. Background topics which are necessary for a student to successfully complete Math 173C will be covered in Math 092C. Such topics include fractions, factoring polynomials, functions, exponents, and operating with radical and rational expressions. Students who complete MATH-173C with a minimum grade of C will have satisfied the college algebra requirement.
Prerequisite: Accuplacer Elementary Algebra with a score of 60 or ACT Math with a score of 19 or SAT Mathematics with a score of 500.
Corequisite: MATH-173C.

MATH-097. Mathematical Literacy. 4 Hours.
Mathematical Literacy for College Students is a one semester course for non-math and non-science majors integrating numeracy, proportional reasoning, algebraic reasoning, and functions. Students will develop conceptual and procedural tools that support the use of key mathematical concepts in a variety of contexts. Throughout the course, college success content will be integrated with mathematical topics. Upon passing this course, one can enroll in Math 112 (Statistics) or Math 113 (Mathematical Reasoning). (This course is in place of the Math 091/092 sequence and has no college credit. This course does not count toward graduation or GPA).
Prerequisite: (MATH-090 - 499 or MATH-090A - 499Z or Accuplacer Elementary Algebra 041 - 120 or ACT Math 17 - 36 or Accuplacer QR, Algebra, & Stat 237 - 300 or SAT Math 460 - 800).

MATH-101A. Basic Mathematical Reasoning 1. 2 Hours.
This first part of a two-semester stretch course (equivalent to Math 113) provides a foundation for students to become confident and critical users of quantitative information of all kinds: numerical, graphical and verbal. Students analyze data and ideas from a variety of fields, such as psychology, economics, finance, sociology and political science. The course is taught in a computer laboratory environment, where students are introduced to tools for data analysis and presentation. Active learning and reasoning are emphasized. By completing Math 101A and 101B, students needing one credit math course will have completed their math requirement.
Prerequisite: (Accuplacer Elementary Algebra 041 - 120 (or (ACT Math 17 - 36) or (Accuplacer QR, Algebra, & Stat 237 - 300 or (SAT Math 460 - 800).

MATH-101B. Basic Mathematical Reasoning 2. 2 Hours.
This second part of a two-semester stretch course (equivalent to Math 113) provides a foundation for students to become confident and critical users of quantitative information of all kinds: numerical, graphical and verbal. Students analyze data and ideas from a variety of fields, such as psychology, economics, finance, sociology and political science. The course is taught in a computer laboratory environment, where students are introduced to tools for data analysis and presentation. Active learning and reasoning are emphasized. By completing Math 101A and 101B, students needing one credit math course will have completed their math requirement.
Prerequisite: MATH-101A with a minimum grade of C.

MATH-111A. Stretch I: Statistics In Daily Life. 2 Hours.
Math 111A must be taken concurrently with Math 011A. These two courses comprise the first semester in a two semester sequence. Students completing each of Math 011A, 011B, 111A, and 111B with a C or better will have satisfied the Math 112 requirement and earned a total of 4 college credits. These courses comprise an elementary introduction to statistics. Students will learn: to process and classify observational, experimental, and sampling data; to make decisions using descriptive statistics; to use inferential statistics to test hypotheses and draw conclusions about a population; and to use spreadsheets to perform these tasks.
Prerequisite: Accuplacer Elementary Algebra 020 - 040 (or Accuplacer QR, Algebra, & Stat 200 - 236).
Corequisite: MATH-011A.

MATH-111B. Stretch II: Statistics In Daily Life. 2 Hours.
Math 111B must be taken concurrently with Math 011B. These two courses comprise the second semester in a two semester sequence. Students completing each of Math 011A, 011B, 111A, and 111B with a C or better will have satisfied the Math 112 requirement and earned a total of 4 college credits. These courses comprise an elementary introduction to statistics. Students will learn: to process and classify observational, experimental, and sampling data; to make decisions using descriptive statistics; to use inferential statistics to test hypotheses and draw conclusions about a population; and to use spreadsheets to perform these tasks.
Prerequisite: MATH-111A with a minimum grade of C.
Corequisite: MATH-011B.

MATH-112. Statistics In Daily Life. 3 Hours.
Process of classifying and drawing conclusions form data obtained from observations, experiment, or sampling. Decision making under uncertainty with emphasis on the behavioral fields. Study of frequency distributions and their use in the decision making process. Usage of computer and prepared software make plus a graphic calculator (TI-83 or equivalent) is required.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-113. Quantitative Reasoning. 3 Hours.
This course provides a foundation for students to become confident and critical users of quantitative information of all kinds: numerical, graphical and verbal. Students analyze data and ideas from a wide variety of fields, such as psychology, economics, finance, sociology and political science. The course is taught in a hands-on laboratory environment where students are introduced to computer tools for data analysis and presentation. active learning and reasoning are emphasized, and technology is an intefral part of the course. Students write critiques of quantitative arguments, gather data and present arguments based on their analysis.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-141. College Mathematics I. 3 Hours.
The purpose of this course is to introduce the students to several of the mathematical tools that are used in all areas of mathematics including subjects that are strongly mathematics driven; these tool facilitate (1) problem-solving in mathematics and (2) mathematical communication and connection with other branches and other disciplines. Graphing calculator will be required and used to facilitate better understanding of some mathematical models, algorithms and applications. Other topics include expressions, mathematical functions, equations, inequalities and complex numbers.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-143. College Mathematics II. 3 Hours.
The purpose of this course is to introduce the new teachers to the structure of Mathematics which include: mathematical reasoning; mathematical communication and connection with other branches and other disciplines; and problem-solving. Topics: number theory, combinatorics, geometry, probability and statistics, mathematics of finance.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-145. Algebra Concepts For Educators. 4 Hours.
This course focuses on algebra concepts. Course design incorporates the Illinois Learning Standards for Mathematics K-12, the National Council of Teachers of Mathematics Teaching Principles, Standards, and Expectations, and a focus on preparing future educators in the implementation of interdisciplinary math and science curricula. Students will engage in learning algebraic processes (creating and solving equations and inequalities, graphing, and transformations) as well as developing algebraic habits of mind (seeing structure in expressions and equations, generalizing from repeated reasoning, and modeling with mathematics). Concepts covered include linear, quadratic, and exponential functions, systems of equations, absolute value and inequalities, and basic probability. Problem solving and generalizing patterns with and without technology will be emphasized. Written assignments and reflections on the learning process will be introduced as appropriate. This course is paired and integrated with Bios 110, and it is strongly suggested that they are taken together.
Prerequisite: MATH-150 with a minimum grade of C or MATH-151 with a minimum grade of C.

MATH-147. Statistical Concepts For Educators. 4 Hours.
This course has been designed keeping in mind the NCTM teacher standards, Common Core Mathematical Practices, Content and ELA Standards in Mathematics and the ISBE mathematics teacher standards and the content within the paired interdisciplinary science course. There will be three principle components of the course: 1) descriptive statistics, 2) basic probability theory and central limit theorem, 3) applied statistics in the form of confidence intervals and hypothesis testing. Contemporary critical technologies such as data warehousing and mining, and concept modeling may be considered. This course is linked with BIO-104 Environmental Biology, and BIO-105Environmental Biology Lab.
Prerequisite: MATH-141 with a minimum grade of C or MATH-108 with a minimum grade of C or NEIU Math Placement Result with a score of 30 or ACT Math with a score of 22 or ACT Math with a score of 23 or ACT Math with a score of 24 or Accuplacer College Level Math with a score of 020 or Accuplacer College Level Math with a score of 021 or Accuplacer College Level Math with a score of 022 or Accuplacer College Level Math with a score of 023 or Accuplacer College Level Math with a score of 024 or Accuplacer College Level Math with a score of 025 or Accuplacer College Level Math with a score of 026 or Accuplacer College Level Math with a score of 027 or Accuplacer College Level Math with a score of 028 or Accuplacer College Level Math with a score of 029 or Accuplacer College Level Math with a score of 030.
Corequisites: BIO-104, BIO-105.

MATH-148A. Stretch I: Math For Elementary Teachers I. 2 Hours.
Math 148A must be taken concurrently with Math 048A. These two courses comprise the fist semester in a two semester sequence. Students completing each of Math 048A, 048B, 148A, and 148B with a C or better will have satisfied the Math 149 requirement and earned a total of 4 college credits. These courses comprise a mathematical introduction for elementary and middle school teachers. Topics include place value, models for and the development of arithmetic, mental math, estimation, word problems, algorithms, factors, primes, proofs, prealgebra, fractions, ratios, rates, and percentages. The development of elementary mathematics from an advanced standpoint is emphasized.
Prerequisite: Accuplacer Elementary Algebra with a score of 20.
Corequisite: MATH-048A.

MATH-148B. Stretch II: Math For Elementary Teachers I. 2 Hours.
Math 148B must be taken concurrently with Math 048B. These two courses comprise the second semester in a two semester sequence. Students completing each of Math 048A, 048B, 148A, and 148B with a C or better will have satisfied the Math 149 requirement and earned a total of 4 college credits. These courses comprise a mathematical introduction for elementary and middle school teachers. Topics include place value, models for and the development of arithmetic, mental math, estimation, word problems, algorithms, factors, primes, proofs, prealgebra, fractions, ratios, rates, and percentages. The development of elementary mathematics from an advanced standpoint is emphasized.
Prerequisite: MATH-148A with a minimum grade of C.
Corequisite: MATH-048B.

MATH-149. Math For Elementary Teachers I. 4 Hours.
This is a foundational class in mathematics for those interested in becoming elementary or middle grades teachers. Topics include place value, models for and the development of arithmetic, mental math, estimation, word problems, algorithms, factors, primes, proofs, prealgebra, fractions, ratios, rates, and percentages. Emphasis on the development of elementary mathematics from an advanced standpoint.
Prerequisite: MATH-092 with a minimum grade of C.

MATH-150. Math For Elementary Teachers II With Problem Solving. 5 Hours.
This is a foundational class in mathematics for those interested in becoming elementary or middle grades teachers. Topics include measurement, geometric reasoning, similarity and congruence, applications of geometry, geometric proofs, area, volume, surface area, and probability and statistics. Problem solving and mathematical thinking activities covering both number and operations and geometry content will be integrated. Emphasis is on the development of elementary mathematics from an advanced standpoint.
Prerequisite: MATH-149 with a minimum grade of C.

MATH-151. Bridge Course In Mathematics For Elementary Teachers. 3 Hours.
MATH-151 is a course designed for students who have completed two college-level courses in math for elementary teaching at a community college. The transferred courses should focus on numbers and operations and geometry and measurement, respectively. NEIU's College of Education requires that Elementary Education majors complete at least 9 semester hours in mathematics for teachers that meet a set of common outcomes adopted by the college. This course focuses on concepts addressed by the outcomes that are not typically covered in depth by most 2-course sequences in mathematics for teaching: algebra, data analysis, statistics, probability, problem-solving and mathematical thinking. Prerequisite: MATH-151 is restricted to students majoring in Early Childhood Education, Elementary Education, Bilingual/Bicultural Education, and TCP. Enrollment by permit only.

MATH-163. Mathematical Modeling With Elementary Functions For Business. 3 Hours.
This course, at the College Alebra level, is designed to provide quantitative understanding and tools for business students. Students work extensively with the most important functions and equations used for applications in their fields: linear, polynomial, rational, exponential, and logarithmic.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-164. Modeling With Elementary Functions For Business Seminar. 1 Hour.
Enrichment Seminar accompanying MATH-163. Students engage in problem solving in collaborative learning groups on material derived from and complementing Mathematical Modeling with elementary functions in Business to gain a deeper understanding of concepts and application.
Corequisite: MATH-163.

MATH-165. Finite Mathematics For Business And The Social Sciences. 3 Hours.
Introduction to matrices, linear programming and probability with emphasis on mathematical models in the social, managerial and behavioral sciences and mathematics of finance.
Prerequisite: (MATH-163 - 499 or MATH-163A - 499Z or NEIU Math Placement Result 35 - 40 or ACT Math 25 - 36 or Accuplacer College Level Math 031 - 120 or SAT Math 580 - 800 or Accuplacer Adv. Algebra & Func 250 - 300).

MATH-167. Business Calculus I. 4 Hours.
Elements of analytic geometry, deifferential and integral calculus with application to business, economic and finance.
Prerequisite: (MATH-163 - 499 or MATH-163A - 499Z or NEIU Math Placement Result 35 - 40 or ACT Math 25 - 36 or Accuplacer College Level Math 031 - 120 or SAT Math 580 - 800 or Accuplacer Adv. Algebra & Func 250 - 300).

MATH-173. College Algebra. 4 Hours.
This course emphasizes the concept of a function as a unifying approach to the topics of college algebra. Families of functions studied in the course include: polynomial, rational, exponential and logarithmic functions. Other topics include conic sections, and sequences and series. Applications and problem solving skills are emphasized throughout the course.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-173C. College Algebra Express II. 4 Hours.
MATH-173C College Algebra Express II must be taken concurrently with Math 092C College Algebra Express I. Math 092C and Math 173C are collectively a 7-credit co-requisite course that provides students a path to finish developmental coursework and college algebra in one semester. This course emphasizes the study of functions and their graphs, inequalities, and linear, quadratic, piece-wise defined, rational, polynomial, exponential, and logarithmic functions. Student will learn how to apply various technologies to these topics. Students who complete the co-requisite courses Math 092C and Math 173C with a minimum grade of C will have satisfied the college algebra requirement.
Prerequisite: Accuplacer Elementary Algebra with a score of 60 or ACT Math with a score of 19 or SAT Mathematics with a score of 500.
Corequisite: MATH-092C.

MATH-173W. College Algebra & Math Enrichment Workshop. 4 Hours.
This course emphasizes the concept of a function as a unifying approach to the topics of college algebra. Topics include: polynomial, rational, exponential and logarithmic functions, conic sections, sequences, and series. Each week students will participate in an enrichment workshop where they will collaboratively solve college algebra problems within peer groups while receiving guidance from a Peer Leader. The workshop draws on the Peer Led Team Learning and Emerging Scholars Program models, which have been nationally identified for increasing students' probability of earning higher grades in their mathematics courses. Students will pay a $25 fee to support the workshop.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-174. Math Enrichment Workshop For College Algebra. 1 Hour.
Mathematics enrichment workshop for students currently enrolled in MATH-173. The workshops draw on the Peer Led Team Learning (PLTL) and Emerging Scholars Program (ESP) models, which have been nationally identified for increasing students' probability of earning higher grades in their required mathematics courses. Workshop participants will attend a workshop during the same day and time each week; collaboratively solve problems related to their standard MATH-173 course within small peer groups; receive guidance from math instructors who are specially trained to facilitate the workshops; and participate in social events with workshop peers during the semester.
Corequisite: MATH-173.

MATH-175. Trigonometry. 3 Hours.
For students who intend to continue with Calculus I, this course uses the concept of a function as a unifying approach to the topics of trigonometry. The course studies trigonometric functions, trigonometric identities and equations, and inverse trigonometric functions. Other topics include: solving triangles, polar coordinates, complex numbers and DeMoivre's theorem; parametric equations, and vectors. Applications and problem solving skills are emphasized throughout the course.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-175W. Trigonometry & Math Enrichment Workshop. 3 Hours.
This course uses the concept of a function as a unifying approach to the topics of trigonometry. Topics include: trigonometric functions, identities, and equations, inverse trigonometric functions, solving triangles, and polar coordinates. Each week students will participate in an enrichment workshop where they will collaboratively solve trigonometry problems within peer groups while receiving guidance from a Peer Leader. The workshop draws on the Peer Led Team Learning and Emerging Scholars Program models, which have been nationally identified for increasing students' probability of earning higher grades in their mathematics courses. Students will pay a $25 fee to support the workshop.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-176. Mathematics Enrichment Workshop For Trigonometry. 1 Hour.
Mathematics enrichment workshop for students currently enrolled in MATH-175. The workshops draw on the Peer Led Team Learning (PLTL) and Emerging Scholars Program (ESP) models, which have been nationally identified for increasing students' probability of earning higher grades in their required mathematics courses. Workshop participants will attend a workshop during the same day and time each week; collaboratively solve problems related to their standard MATH-175 course within small peer groups; receive guidance from math instructors who are specially trained to facilitate the workshops; and participate in social events with workshop peers during the semester.
Corequisite: MATH-175.

MATH-177. Elementary Functions In The Sciences/Math. 3 Hours.
This is an application inspired college algebra course which covers linear, quadratic, general polynomial, exponential and logarithmic functions using applications from science and mathematics. Arithmetic and geometric sequences are introduced as difference equations to motivate the study of quantities that change over time. Curve fitting is used to interpret data. A graphing calculator is required.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-178. Elementary Functions In The Sciences/Math Seminar. 1 Hour.
Enrichment Seminar accompanying MATH-177. Students do problem solving in collaborative learning groups on material derived from and complementing Mathematical Modeling with Elementary Functions in the Sciences and Mathematics to gain a deeper understanding of concepts and applications. The contend of the seminar is closely aligned with the contend of MATH-177.
Corequisite: MATH-177.

MATH-185. Precalculus. 4 Hours.
A functional approach to College Algebra and Trigonometry, for students who intend to continue with Calculus I.
Prerequisite: (MATH-173 - 499 or MATH-173A - 499Z or NEIU Math Placement Result 35 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 031 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 250 - 300).

MATH-185W. Precalculus & Math Enrichment Workshop. 4 Hours.
This course offers a functional approach to college algebra and trigonometry, for students who intend to continue with Calculus I. Each week students will participate in an enrichment workshop where they will collaboratively solve precalculus problems within peer groups while receiving guidance from a Peer Leader. The workshop draws on the Peer Led Team Learning and Emerging Scholars Program models, which have been nationally identified for increasing students' probability of earning higher grades in their mathematics courses. Students will pay a $25 fee to support the workshop.
Prerequisite: (MATH-173 - 499 or MATH-173A - 499Z or NEIU Math Placement Result 35 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 031 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 250 - 300).

MATH-186. Mathematics Enrichment Workshop For Precalculus. 1 Hour.
Enrichment workshop accompanying MATH-185. Students do problem solving in collaborative learning groups on material derived from and supplementing Precalculus to gain a deeper understanding of concepts and applications. Prereq.: Restricted to students taking MATH-185 concurrently.
Corequisite: MATH-185.

MATH-187. Calculus I. 4 Hours.
Introdcution to analytic geometry, limits and derivatives, applications, integration, fundamental theorem of calculus.
Prerequisites: (MATH-185 - 499 or MATH-185A - 499Z or NEIU Math Placement Result 40 - 45 or ACT Math 28 - 36 or Accuplacer College Level Math 061 - 120 or (MATH-173 and MATH-175) or SAT Math 640 - 800 or Accuplacer Adv. Algebra & Func 276 - 300).

MATH-187W. Calculus I & Math Enrichment Workshop. 4 Hours.
This course provides an introduction to analytic geometry, limits and derivatives, integration, and the fundamental theorem of calculus. Each week students will participate in an enrichment workshop where they will collaboratively solve calculus I problems within peer groups while receiving guidance from a Peer Leader. The workshop draws on the Peer Led Team Learning and Emerging Scholars Program models, which have been nationally identified for increasing students' probability of earning higher grades in their mathematics courses. Students will pay a $25 fee to support the workshop.
Prerequisites: (MATH-185 - 499 or MATH-185A - 499Z or NEIU Math Placement Result 40 - 45 or ACT Math 28 - 36 or Accuplacer College Level Math 061 - 120 or (MATH-173 and MATH-175) or SAT Math 640 - 800 or Accuplacer Adv. Algebra & Func 276 - 300).

MATH-188. Mathematics Enrichment Workshop for Calculus I. 1 Hour.
Enrichment Seminar accompanying MATH-107. Students do problem solving in collaborative learning groups on material derived from and supplementing Calculus I to gain a deeper understanding of concept and applications.
Corequisite: MATH-187.

MATH-199S. Topics In Probability And Statistics For Middle School Teaching. 4 Hours.

MATH-202. Calculus II. 4 Hours.
Integration techniques, applications, differential equations and series.
Prerequisite: (MATH-187 or MATH-107 or NEIU Math Placement Result 40 - 45 or Accuplacer College Level Math 061 - 120 or Accuplacer Adv. Algebra & Func 276 - 300).

MATH-202W. Calculus II & Math Enrichment Workshop. 4 Hours.
This course provides an introduction to analytic geometry, limits and derivatives, integration, and the fundamental theorem of calculus. Each week students will participate in an enrichment workshop where they will collaboratively solve calculus II problems within peer groups while receiving guidance from a Peer Leader. The workshop draws on the Peer Led Team Learning and Emerging Scholars Program models, which have been nationally identified for increasing students' probability of earning higher grades in their mathematics courses. Students will pay a $25 fee to support the workshop.
Prerequisite: MATH-187 with a minimum grade of C or MATH-107 with a minimum grade of C.

MATH-203. Calculus III. 4 Hours.
3-D analytic geometry, partial derivatives, multiple integrals and vector fields.
Prerequisite: MATH-202 with a minimum grade of C.

MATH-203W. Calculus III & Math Enrichment Workshop. 4 Hours.
This course focuses on three-dimensional analytic geometry, partial derivatives and multiple integrals. Each week students will participate in an enrichment workshop where they will collaboratively solve calculus III problems within peer groups while receiving guidance from a Peer Leader. The workshop draws on the Peer Led Team Learning and Emerging Scholars Program models, which have been nationally identified for increasing students' probability of earning higher grades in their mathematics courses. Students will pay a $25 fee to support the workshop.
Prerequisite: MATH-202 with a minimum grade of C.

MATH-204. Math Enrichment Workshop For Math 203. 1 Hour.
Mathematics enrichment workshop for students currently enrolled in MATH-203. The workshops draw on the Peer Led Team Learning (PLTL) and Emerging Scholars Program (ESP) models, which have been nationally identified for increasing students' probability of earning higher grades in their required mathematics courses. Workshop participants will attend a workshop during the same day and time each week; collaboratively solve problems related to their standard Math 203 course within small peer groups; receive guidance from math instructors who are specially trained to facilitate the workshops; and participate in social events with workshop peers during the semester.
Corequisite: MATH-203.

MATH-251W. Introduction To Advanced Mathematics & Math Enrichment Workshop. 5 Hours.
Math 251 is a bridge course between calculus and advanced mathematics. Students study the tools and proof techniques that serve as the basis for theoretical mathematics. Each week students will participate in an enrichment workshop where they will collaboratively solve Math 251 problems within peer groups while receiving guidance from a Peer Leader. The workshop draws on the Peer Led Team Learning and Emerging Scholars Program models, which have been nationally identified for increasing students' probability of earning higher grades in their mathematics courses. Students will pay a $25 fee to support the workshop.
Prerequisite: MATH-187 with a minimum grade of C or (NEIU Math Placement Result with a score of 40 and ENGL-101 with a minimum grade of C).

MATH-252. Math Enrichment Workshop For Math 251. 1 Hour.
Mathematics enrichment workshop for students currently enrolled in MATH-251. The workshops draw on the Peer Led Team Learning (PLTL) and Emerging Scholars Program (ESP) models, which have been nationally identified for increasing students' probability of earning higher grades in their required mathematics courses. Workshop participants will attend a workshop during the same day and time each week; collaboratively solve problems related to their standard Math 251 course within small peer groups; receive guidance from math instructors who are specially trained to facilitate the workshops; and participate in social events with workshop peers during the semester.
Corequisite: MATH-251.

MATH-253. Linear Algebra I. 3 Hours.
This course covers matrix theory and linear algebra. Linear algebra is the branch of mathematics that studies systems of linear equations and the properties of matrices, which includes among other topics: vector spaces; linear transformations and the matrices that represent them; determinants and inner product spaces; and properties of vectors in n-dimensional space and their applications. Linear algebra has a broad range of applications and is critical to many disciplines such as physics, the social and natural sciences, engineering, and economics.
Prerequisite: (MATH-091 - 499 or MATH-091A - 499Z or NEIU Math Placement Result 02 - 45 or ACT Math 19 - 36 or Accuplacer Elementary Algebra 060 - 084 or Accuplacer College Level Math 020 - 120 or Accuplacer Adv. Algebra & Func 200 - 300 or SAT Math 500 - 800).

MATH-262. Mathematics Enrichment Workshop For Calculus II. 1 Hour.
Enrichment Seminar accompanying MATH-202. Students do problem solving in collaborative learning groups on material derived from and supplementing Calculus II to gain a deeper understanding of concepts and applications.
Corequisite: MATH-202.

MATH-273. Statistics With Applications. 4 Hours.
Prerequisite: (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

MATH-275. Applied And Computational Statistics. 4 Hours.
This course introduces students to the basic concepts, logic, and issues involved in statistical reasoning with wide variety of applications. It is designed to familiarize students with statistical vocabulary and concepts. Major topics include exploratory data analysis, an introduction to research methods, probability, statistical inference, and regression-based analysis of well-defined examples from biology, ecology, environmental sciences, finance, medicine, public health, psychology, and sociology. Computing will be carried out using R or any appropriate statistical software in the course.

MATH-280. Geometry Concepts For Educators And Art. 4 Hours.
This course focuses on the concepts of plane and solid geometry and trigonometry. Course design incorporates the Illinois Learning Standards for Mathematics K-12, the National Council of Teachers of Mathematics Teaching Principles, Standards, and Expectations, and a focus on preparing future educators in the implementation of interdisciplinary math and science curricula.The topics include basic definitions and properties of plane and solid figures, congruence, similarity, constructions, measurements, transformations, Pythagorean theorem, right angle trigonometry, and the unit circle trigonometry. Problem solving using a calculator and computer programs is emphasized throughout. Writing assignments, coding in geometric constructions, and art are also part of the course. This course is paired and integrated with PHYS-108, and it is strongly suggested that they are taken together.
Prerequisite: MATH-150 with a minimum grade of C or MATH-151 with a minimum grade of C.

MATH-281. Number Concepts For Educators. 4 Hours.
This course contains a wide range of topics across number theory and measurement and is intended to give students a grasp of the depth and breadth of mathematics outside of the traditional course structure. Course design incorporates the Illinois Learning Standards for Mathematics K-12, the National Council of Teachers of Mathematics Teaching Principles, Standards, and Expectations, and a focus on preparing future educators in the implementation of interdisciplinary math and science curricula. Problem solving, estimation, measurements, and construction of simple theories of numbers will be treated with and without the use of technology. Writing assignments, as appropriate to the discipline, are part of the course. This course is paired and integrated with CHEM-108, and it is strongly suggested that they are taken together.
Prerequisite: MATH-150 with a minimum grade of C or MATH-151 with a minimum grade of C or MATH-141 with a minimum grade of C.

MATH-300. Interdisciplinary Seminar In STEM. 2 Hours.
This course uses a hands-on approach to modern inquiry-based research problems and techniques in the physical and computational sciences. The course is structured around a series of modular problem-based exercises, covering topics from the fields of Chemistry, Computer Science, Earth Science, Mathematics and Physics and is designed to provide the content and pedagogical background for students to be successful peer leaders. The cross-disciplinary modules will draw connections between scientific disciplines, and showcase common research tools and techniques used in the sciences. The workshop will also incorporate discussions on a range of topics, from scientific ethics, scientific methodology and error analysis.
Prerequisite: MATH-185 with a minimum grade of C.

MATH-301. Ordinary Differential Equations I. 4 Hours.
This course focuses on the techniques and applications of solving ordinary differentials equations, with a focus on first and second order differential equations. Topics include: constant coefficients, nonlinear, numerical methods, Laplace transform, series solutions, and geometric techniques.
Prerequisite: MATH-203 with a minimum grade of C.

MATH-302. Ordinary Differential Equations II. 3 Hours.
Linear and nonlinear systems, matrix methods and applications to problems in the sciences. Existence and stability theory. Boundary value problems and Fourier series.
Prerequisite: MATH-301 with a minimum grade of C.

MATH-303. Partial Differential Equations. 3 Hours.
This course covers linear partial differential equations that model physical problems and arise in a variety of contexts. Topics include the study of explicit formulas for solutions (when feasible) and study of the behavior of solutions. Equations covered include: wave equations, diffusion equations, and Laplace's equation on different domains. Other topics discussed are Fourier series, separation of variables, harmonic functions, and Green's functions.
Prerequisite: MATH-301 with a minimum grade of C.

MATH-304. Introduction To Numerical Analysis. 3 Hours.
Solutions of equations of one variable, interpolation and polynomial approximation, numerical integration and methods of solutions of linear systems.
Prerequisite: MATH-203 with a minimum grade of C and MATH-253 with a minimum grade of C and MATH-340 with a minimum grade of C.

MATH-305. Probability And Statistics. 4 Hours.
This course is an introduction to the probability and statistics. Topics include fundamental rules of probability, discrete and continuous distributions of random variables, central limit theorem, descriptive statistics, confidence intervals and hypothesis tests. Students will build on their basic knowledge of probabilities and distributions; illustrate statistical inference by constructing confidence intervals and hypothesis tests; and calculate basic statistical analysis manually and by computer software. Applications of probability and connections between probability and statistics are emphasized.
Prerequisite: MATH-202 with a minimum grade of C.

MATH-306. Linear Programming And Extensions. 3 Hours.
Linear Programming is the methodology that can be applied to optimize a linear function of several variables subject to linear constraints. This course focuses on geometric and algebraic foundations of Linear Programming and studies the Simplex Method and its variations, duality, Dual Simplex Method, sensitivity analysis, and methods of Integer Programming.
Prerequisite: MATH-203 with a minimum grade of C and MATH-253 with a minimum grade of C.

MATH-307. Introduction To Stochastic Processes. 3 Hours.
This course focuses on basic mathematical aspects of stochastic models with the emphasis on problem solving. Topics include Markov processes, Markov chains, and Queuing Theory.
Prerequisite: MATH-305 with a minimum grade of C or MATH-334 with a minimum grade of C.

MATH-309. Numerical Analysis II. 3 Hours.
Iterative methods for linear and non-linear systems of equations, approximation of eigenvalues, initial value problems, ordinary and partial boundary value problems and approximation theory.
Prerequisite: MATH-304 with a minimum grade of C.

MATH-311. Writing Intensive Program: Introduction To Advanced Mathematics. 5 Hours.
A bridge course between calculus and advanced mathematics. Students study the tools and proof techniques that serve as the basis for theoretical mathematics. Mathematical structure and the development of proficiency in reading, analyzing and constructing mathematical proofs are emphasized. Topics include logic, set theory, methods of proof, combinatorics, relations, functions and cardinality.
Prerequisite: (MATH-187 with a minimum grade of C or MATH-107 with a minimum grade of C or NEIU Math Placement Result with a score of 40) and ENGL-101 with a minimum grade of C.

MATH-312. Foundations Of Geometry. 3 Hours.
This course is a rigorous study of Euclidean and non-Euclidean geometries. Topics include transformational and projective geometry, axiomatic systems, and models.
Prerequisite: MATH-253 with a minimum grade of C and (MATH-251 with a minimum grade of C or MATH-311 with a minimum grade of C).

MATH-315. Introduction To Applied And Computational Topology. 3 Hours.
This course is an introduction to the mathematical field of topology, with a focus on applications and computational techniques. Examples of topology topics covered may include but are not limited to manifolds, complexes, sequences, homology and persistent homology, homotopy, the Euler characteristic, Morse theory. Examples of applications topics covered may include but are not limited to robotics, phylogenetic trees, topological data analysis (TDA,) and graph theory. Students will complete a project exploring a specific application of topology to a problem of their choice.
Prerequisite: MATH-311 with a minimum grade of C or MATH-251 with a minimum grade of C.

MATH-321. History Of Mathematics. 3 Hours.
History of Mathematics is a chronological survey of the historical growth of mathematical ideas from its non-Western origins to the modern day. This includes famous mathematicians and their contributions to the development of modern mathematics. Specific themes may be chosen to align with faculty and/or student interest.
Prerequisite: MATH-187 with a minimum grade of C and (MATH-251 with a minimum grade of C or MATH-311 with a minimum grade of C).

MATH-322. Number Theory. 3 Hours.
This course focuses on integers and their fundamental properties, congruences, quadratic residues, Diophantine equations, primitive roots and discrete logarithms, and cryptography.
Prerequisite: MATH-251 with a minimum grade of C and MATH-253 with a minimum grade of C.

MATH-324. Independent Study In Mathematics. 3 Hours.
This course offers students an opportunity to conduct an individualized investigation into a mathematical topic with a mathematics department faculty. The mathematical topic is a topic that would not normally be discussed in the current courses being offered by the math department. The course requires the approval of the instructor, department chair, and the Dean.

MATH-326. Real Analysis. 3 Hours.
An introduction to the methods of classical analysis as applied to the formulation of the theory of Riemann integrable functions and to the theoretical examination of the behavior of sequences and series of functions of a real variable.
Prerequisite: MATH-338 with a minimum grade of C.

MATH-328. Complex Variables. 3 Hours.
This course is an introduction to the functions of a complex variable. Topics include elementary functions of a complex variable, Cauchy-Riemann Equations, Cauchy integral theorems, Taylor and Laurent series expansions, contour integrals, and residue calculus.
Prerequisite: MATH-203 with a minimum grade of B or MATH-338 with a minimum grade of C.

MATH-331. Abstract Algebra I. 3 Hours.
This course is an introduction to the mathematical theory of groups. Topics include: properties of groups,homomorphisms, isomorphisms, Lagrange's Theorem and factor groups. Students will build on their basic knowledge of number systems, linear algebra, set theory, functions and mathematical proofs in order to understand, construct and apply algebraic proofs; illustrate algebraic concepts or disprove false statements by providing examples; and calculate with algebraic objects. Applications of algebra and connections between algebra and other fields of mathematical study are emphasized.
Prerequisite: MATH-253 with a minimum grade of C and (MATH-251 with a minimum grade of C or MATH-311 with a minimum grade of C).

MATH-332. Abstract Algebra II. 3 Hours.
This course is a continuation of Math 331 with a focus on the mathematical theory of rings and fields. Topics include: ideals, factor rings, finite fields, field extensions, and selected applications. Students will build on their prior knowledge of algebraic systems and algebraic proofs in order to understand, construct, and apply proofs about rings and fields; illustrate ring- and field- theoretic concepts or disprove false statements by providing examples; and calculate with algebraic objects. Applications of algebra and connections between algebra and other fields of mathematical study are emphasized.
Prerequisite: MATH-331 with a minimum grade of C.

MATH-334. Mathematical Statistics I. 3 Hours.
This course is an introduction to probability and mathematical statistics. Topics include fundamental rules of probability, expectations, moment generating functions, common distributions and central limit theorem. The mathematical theories to develop probability and statistical methods are emphasized in this course.
Prerequisite: MATH-203 with a minimum grade of C.

MATH-336. Statistical Inference. 4 Hours.
Statistical inference is the process of drawing conclusions about populations or scientific truths from data. This course presents the fundamentals of inference in a practical approach for statistical analysis procedures, such as interval estimation, tests of hypothesis, general procedures for developing tests, analyzing different types of data, and linear regression. After taking this course, students will understand the broad directions of statistical inference and use this information for making informed choices in analyzing data using computer software.
Prerequisite: MATH-334 with a minimum grade of C or MATH-305 with a minimum grade of C.

MATH-337. Theory Of Equations. 3 Hours.
This course is an advanced study of algebraic equations. Topics include the existence and properties of solutions, and algebraic, numerical, and algorithmic methods of solving equations.
Prerequisite: MATH-253 with a minimum grade of C and (MATH-251 with a minimum grade of C or MATH-311 with a minimum grade of C).

MATH-338. Introduction To Real Analysis. 3 Hours.
This course is an introductory course in the theory of functions of a real variable. It develops the properties of the real numbers as a complete ordered field and introduces the topological concepts of neighborhoods, open sets, closed sets, and compact sets. Based on this, the course provides a rigorous treatment of: a) sequences of real numbers (convergence, boundedness, upper and lower limits); b) real functions of a single variable including continuity, uniform continuity (optional), differentiability, integrability, and related properties; c) series of real numbers (convergence and absolute convergence); d) introduction to function series (power series).
Prerequisite: MATH-203 with a minimum grade of C and MATH-251 with a minimum grade of C.

MATH-339. Vector Calculus. 4 Hours.
This course is a natural extension of differential and integral calculus, where the variables and values of functions are vectors instead of numbers. Such concepts as limits and continuity, derivatives and integrals, extrema and approximation are generalized for multi-dimensional Euclidean spaces. The course also introduces vector fields, line and surface integrals as well as fundamental theorems based on these concepts.
Prerequisite: MATH-203 with a minimum grade of C and MATH-253 with a minimum grade of C.

MATH-340. Computing For Mathematicians. 4 Hours.
Fundamentals of compouter programming, experimentation, and simulation in mathematics with Maple and Fortran programming language. Introduction to documentation, electronic communication and problem solving in mathematical sciences. No prior computer skills required.
Prerequisite: MATH-202 with a minimum grade of C.

MATH-343. Linear Algebra II. 3 Hours.
Linear Algebra arose from studying systems of linear equations and their geometric applications. Linear Algebra is the study of vector spaces and the linear maps between them. This second course in Linear Algebra will emphasize theoretical implications and will focus on "why" and "how" questions, such as how can we use eigenvectors and eigenvalues of a linear operator to study the operator itself and the vector space that it acts on. Particular topics that will be covered are: abstract vector spaces; invariant subspaces; Spectral Theorem; LU, QR, and SVD factorizations; Jordan Form; and various computational methods.
Prerequisite: MATH-203 with a minimum grade of C and MATH-253 with a minimum grade of C.

MATH-347. Probability For Actuaries With Actuarial Exam Preparation. 4 Hours.
This course is a probability class tailored for students/professionals pursuing a career in the actuarial profession (such as, but not limited to, insurance, finance, banking, and industries) and/or are preparing for the actuarial exams. The course provides knowledge of the fundamental probability tools for quantitatively assessing risk and the application of these tools to problems encountered in actuarial science is emphasized. Topics include general probability theory, counting techniques, combinatorial probabilities, random variables with univariate and/or multivariate probability distributions, and The Central Limit Theorem.
Prerequisite: MATH-203 with a minimum grade of C.

MATH-357. Financial Mathematics For Actuaries With Actuarial Exam Preparation. 4 Hours.
This course is a financial mathematics class tailored for students/professionals pursuing a career in the actuarial profession (such as, but not limited to, insurance, finance, banking, and industries) and/or are preparing for the actuarial exams. The course provides an understanding of the fundamental concepts of financial mathematics, and how those concepts are applied in calculating present and accumulated values for various streams of cash flows such as, loans, annuities, rate of return of an investment, bonds, stocks, and financial derivatives.
Prerequisite: MATH-347 with a minimum grade of C or MATH-305 with a minimum grade of C or MATH-334 with a minimum grade of C.

MATH-361. Set Theory. 3 Hours.
Set theory is one language/structure that mathematics is constructed within. In this course a brief, but rigorous, history of set theory will be given that pays particular attention to the necessary modifications that have been made throughout the twentieth century. Particular attention will be paid to understanding the Axiom of Choice, Zorn's Lemma, and the Well Ordering Principle. Additional topics might include gentle introductions to Category Theory, Topos Theory, Axiomatic Set Theory, or Gödel's Incompleteness theorem.
Prerequisite: MATH-311 with a minimum grade of C.

MATH-362. Metric Spaces And Topology. 3 Hours.
This course is an introduction to topological spaces with an emphasis on metric spaces. The covered topics include open neighborhoods, limits, closure/interior/boundary of topological/metric spaces; functions, continuity, homeomorphism between topological/metric spaces; and product of topological/metric spaces. The concepts of connectedness, compactness, and completeness will be studied along with fundamental results and examples. This course forms a foundation for all advanced courses in analysis and geometry.
Prerequisite: MATH-311 with a minimum grade of C.

MATH-365. Statistical Computer And Data Analysis Packages. 3 Hours.
This course introduces statistical programming packages R and SPSS. Students will use the statistical software to: study basic functions and graphs; give descriptive analysis; implement testing; and study various modeling techniques.
Prerequisite: MATH-305 with a minimum grade of C or MATH-334 with a minimum grade of C.

MATH-370. Mathematical Modeling In The Natural Sciences. 4 Hours.
This course focuses on the formulation, analysis, and interpretation of mathematical models describing certain phenomena in the natural sciences. Topics include: difference equations, systems of difference equations, nonlinear difference equations, continuous models, phase planes – stability analysis, and limit cycles.
Prerequisite: MATH-202 with a minimum grade of C.

MATH-371. Mathematical Modeling For Cancer Risk Assessment. 4 Hours.
The Cancer Modeling Seminar is an essential educational component for students from the Complex Systems minor, Physics, Chemistry and Biomathematics. The course consists of lectures, research projects, interdisciplinary collaborations, presentations and/or posters and conference trips. Students will experience first-hand the research process, employ data analysis tools, contribute, discuss and present their projects under the guidance of the course instructor and experts in cancer research. Students will also learn advanced, high-quality typesetting systems designed for technical and scientific documentation and presentation.
Prerequisite: MATH-187 with a minimum grade of C and (MATH-275 with a minimum grade of C or MATH-305 with a minimum grade of C).

MATH-374. Modeling And Simulations Of Complex Systems Networks. 4 Hours.
This course covers basic mathematical and statistical methods for analyzing computational spatial models in various applications, focusing on individual attributes (social influence or contagion) and network structure of groups. The course will incorporate simple graph theoretical approaches as well as construction and analysis of network-based models (NBM) and agent-based models (ABM) with complex systems applications from epidemiology, finance/business, medicine, psychology, and social sciences. The NBM involves the characterization of the structures of social networks or subsets of these networks to understand their influence on behaviors and outcomes. The ABM involves the use of stochastic analysis and simulations of individuals, in space, over time to understand how macro-level distribution patterns of outcomes may emerge from explicitly modeled, micro-level behaviors, social interactions, and movement of these individuals in their environments. Students will interpret published research and produce a research proposal by the end of the semester.
Prerequisite: (MATH-173 - 499 or MATH-173A - 499Z or NEIU Math Placement Result 35 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 031 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 250 - 300).

MATH-376. Introduction To Risk Analysis. 3 Hours.
The Introduction to Risk Analysis course is an applied method course focusing on the application of statistical analysis methods on economics using Risk Analysis approaches. Topics include but are not limited to basic concepts of risk analysis, probability theory, probabilistic modeling and application to research projects.
Prerequisite: MATH-187 with a minimum grade of C.

MATH-380. Calculus Concepts For Educators. 3 Hours.
This course provides a foundational experience in calculus through an emphasis on topics related to middle school teaching. Course design incorporates the Illinois Learning Standards for Mathematics K-12, the National Council of Teachers of Mathematics Teaching Principles, Standards, and Expectations, and a focus on preparing future educators in the implementation of interdisciplinary math and science curricula. Topics include: functions, deriving formulas for patterns, direct and recursive sequence formulas, arithmetic and geometric sequence formulas, limits of sequences, convergence/divergence of sequences, series, derivatives, integration, the fundamental theorem of calculus, and differential equations. Course integrates conceptual, content specific, and pedagogical knowledge. Course includes applications to ecology, finance, middle school teaching, and technology. This course is paired and integrated with BIOS-310, and it is strongly suggested that they are taken together.
Prerequisite: MATH-150 with a minimum grade of C or MATH-151 with a minimum grade of C.

MATH-381. Concepts In Discrete Mathematics For Educators. 3 Hours.
This course provides a foundational experience in discrete mathematics through an emphasis on topics in graph theory. Course design incorporates the Illinois Learning Standards for Mathematics K-12, the National Council of Teachers of Mathematics Teaching Principles, Standards, and Expectations, and a focus on preparing future educators in the implementation of interdisciplinary math and science curricula. Students will learn about mathematics as an active process of making conjectures, testing ideas, and proving conclusions. Special emphasis is given to mathematical communication, problem-solving, and applications to the sciences. Possible topics include: the Four Color Theorem, trees, digraphs, bipartite graphs, planar graphs, Platonic solids, Euler and Hamilton circuits, the P+NP Problem, algorithms and combinatorial explosion. Course integrates conceptual, content specific, and pedagogical knowledge.
Prerequisite: MATH-150 with a minimum grade of C or MATH-151 with a minimum grade of C.

MATH-406. Linear Programming: Theory And Practice. 3 Hours.
Optimization models; theoretical foundations of simplex algorithms and duality; revised and dual algorithms; sensivity and analysis; additional topics from extended LP interger programming, networks, recent trends.

MATH-408. Mathematics Structures For Elementary School Teachers I. 3 Hours.
Mathematics topics and techniques that are relevant to advanced mathematics learning and the teaching of mathematics in the schools: Elementary logic, elementary sets, binary operations, introduction to algebraic structures, number systems, geometry and elements of graph theory.

MATH-409. Mathematical Functions For Elementary School Teachers I. 3 Hours.
For elementary school teachers. The function concept; polynomial functions; solution of linear and quadratic equations; simultaneous equations; the binomial theorem; circular functions; solution of triangles; trigonometric identities and equations; exponential and logarithmic functions; rectangular and polar coordinate systems; the conic sections. Graphics calculator required.
Prerequisite: MATH-408 with a minimum grade of C.

MATH-410. Modern Analysis For The Elementary School Teacher. 3 Hours.
Limits and continuity, derivatives, applications, integral calculus, applications.
Prerequisite: MATH-435 with a minimum grade of C.

MATH-421. Modern Geometry. 3 Hours.
Classification of geometrical systems; introduction to Euclidean and non-Euclidean geometries, projective geometry; finite geometries.
Prerequisite: MATH-312 with a minimum grade of C.

MATH-430. Discrete Mathematical Structures. 3 Hours.
Provides a working knowldge of mathematical logic, sets, relations, functions, graphs, and counting techniques.

MATH-432. Applied Combinatorics. 3 Hours.
The course offers broad exposure to combinatorial mathematics using applications to emphasize fundamental concepts and techniques, including graph theory, inclusion/exclusion principle, graph algorithms, and network flows.
Requirement: Admission to MS in Mathematics program or approval of the instructor or graduate advisor in the math department.

MATH-435. Mathematics Structure II. 3 Hours.
The real number system, mathematical systems, inductive and deductive methods, permutations and combinations.
Prerequisite: MATH-408 with a minimum grade of C.

MATH-436. Modern Algebra. 3 Hours.
Prerequisite: MATH-331 with a minimum grade of C.

MATH-439. Computers In Education. 3 Hours.
Investigation into the use of computers for CAI, statistical packages and solutions of mathematical problems. Students learn to write programs in Basic.
Prerequisite: MATH-438 with a minimum grade of C.

MATH-441. Multivariate Statistical Analysis. 3 Hours.
The essential methods of the multivariate statistical analysis; Hotteling's T, discriminant function, principal components, factor analysis, canonical correlations and cluster analysis with emphasis on application and real data analysis.
Prerequisite: MATH-336 with a minimum grade of C.

MATH-442. Applied Regression Analysis. 3 Hours.
Methodology of regression analysis with attention to model building, evaluating fit, and examining reliability of the model; regression and general least squares theory, estimation of regression coefficients, polynomial regression, step-wise regression, residual analysis, choice of transformation for variable and forecasting; with applications and real data analysis.
Prerequisite: MATH-336 with a minimum grade of C.

MATH-443. Experimental Design. 3 Hours.
One-way and two-way analysis of variance, fixed and random effects models, multiple comparisons, completely randomized and randomized block designs.
Prerequisite: MATH-336 with a minimum grade of C.

MATH-444. Problem Solving, Modeling, And Project In Mathematics With Technology. 4 Hours.
This course is problem solving and project oriented, and provides the students with the background in computers and technology needed to be effective teachers of mathematics in the secondary/high schools. The course deals with (1) hands-on applications of (a) a current geometric visualization software (e.g., Geometer's Sketchpad) as a problem solving tool in mathematics and geometry, (b) a statistical package (e.g., Minitab, R) as a problem solving tool in mathematics and statistics, and (c) other technologies (e.g., excel software) as a tool for modeling in mathematics and statistics; and (2) introduction to research methods in the mathematical sciences.

MATH-457. Recent Trends In Mathematics. 3 Hours.
Extended applications of mathematical thinking, operations research, mathematical models, information theory, theory of games, and linear programming.
Prerequisite: MATH-435 with a minimum grade of C.

MATH-465. Advanced Topics In Numerical Analysis. 3 Hours.
This course aims to teach participants advanced theories, algorithms and computational techniques of numerical analysis. Topics include numerical linear algebra, iteration methods and convex programming, numerical methods for ordinary and partial differential equations, functional approximation and data analysis, digital spectral analysis, design and analysis of mathematical software, and mathematical methods in computer graphics. Participants will become familiar with the process of solving scientific and engineering problems by applying/modifying numerical algorithms that are implemented in standard software packages, designing new algorithms, conducting analysis on accuracy, efficiency and stability, as well as interpreting computational results through graphics and simulations.
Prerequisite: MATH-304 with a minimum grade of C.

MATH-466. Galois Theory: Historical And Modern. 3 Hours.
Classical and modern Galois theory. Cardano's formulas, symmetric polynomials, permutation groups, field extensions, field automorphisms, the fundamental theorem of Galois theory.
Prerequisite: MATH-331 with a minimum grade of C.

MATH-471. Introduction To Stochastic Models. 3 Hours.
Markov Chains: the Poisson process; continuous time Markov processes; Renewal Theory; Queuing Theory.
Prerequisite: MATH-305 with a minimum grade of C.

MATH-472. Simulation Modeling And Analysis. 3 Hours.
Design and analysis of computer simulations of complex systems. Network, discrete event and continuous models are treated in a unifying setting. Computer model of a variety of systems are implemented and analyzed using a general purpose simulation language.
Prerequisite: MATH-334 with a minimum grade of C.

MATH-473D. Advanced Topics In Operations Research: Decision Theory. 3 Hours.

MATH-474. Mathematical Modeling. 3 Hours.
Formulation, analysis and interpretation of mathematical models describing phenomena from the natural and social sciences. Topics may include: model construction, explicative versus predictive models, model fitting, optimization, empirical models, simulation models, dynamical models, dimensional analysis and other related topics. A term project (team or individual) will be required.

MATH-475. Advanced Topics In Operations Research: Mathematical Programming. 3 Hours.
This course offers an overview of deterministic optimization models and methods including linear programming methods, multi-objective optimization, methods of discrete optimization, and nonlinear programming methods.
Prerequisite: MATH-253 with a minimum grade of C and MATH-339 with a minimum grade of C.

MATH-477. Risk Analysis. 3 Hours.
This course introduces students to the application of statistical analysis in economics using risk analysis. Students will use probability theory, probabilistic modeling, and statistical tools to analyze case studies and current research in risk analysis.

MATH-491. Independent Study In Mathematics. 1 Hour.
Individual investigation into a topic of interest of the student's choice.

MATH-492. Independent Study In Mathematics. 2 Hours.
(See MATH-491 for descriptions.).

MATH-493. Independent Study In Mathematics. 3 Hours.
(See MATH-491 for descriptions.).

MATH-495. Project In Mathematics. 3 Hours.
Students prepare a project involving both the theory and computational tools learned in their concetration. Students present both written and oral reports to the deparment.

MATH-5901. Thesis Hours. 1 Hour.
Guidance of students conducting research and writing a thesis to fulfill requirements for the Master of Science degree in Mathematics is conducted in this course. Students may register for 1-4 credits per term with 6 credits required for the thesis option of the Master of Science in Mathematics. All MATH-590 credits must be earned within the equivalent of 2 academic years.

MATH-5902. Thesis Hours. 2 Hours.
See course description for MATH-5901.

MATH-5903. Thesis Hours. 3 Hours.
See course description for MATH-5901.