Mathematics (MATH)

See Course Description Symbols and Terms (https://catalog.csuchico.edu/academic-standards-policies/course-description-symbols-terms/) for an explanation of course description terminology and symbols, the course numbering system, and course credit units.

- In certain courses, at the discretion of the instructor, you may be required to buy a computer program and/or graphing calculator.
- Enrollment in any mathematics course requires a grade of C- or higher in all prerequisite courses or their transfer equivalents.

Mathematics (MATH)

MATH 5L Foundational Mathematics B 1 Unit
Prerequisite: Credit in Math 031 or GE Math Ready with Support.
Corequisites: MATH 105.
Typically Offered: Fall and spring
Foundational level California Common Core State Standards mathematics topics in support of general education mathematics. This course is a supplemental requirement for Math Ready with Support students required to enroll in designated general education courses. 3 hours laboratory. (005498)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 1 unit
Course Attributes: Pre-Collegiate

MATH 7L Foundational Mathematics B 1 Unit
Prerequisite: Credit in Math 031 or GE Math Ready with Support.
Corequisites: MATH 107.
Typically Offered: Fall and spring
Foundational level California Common Core State Standards mathematics topics in support of general education mathematics. This course is a supplemental requirement for Math Ready with Support students required to enroll in designated general education courses. 3 hours laboratory. (022081)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 1 unit
Course Attributes: Pre-Collegiate

MATH 10L Foundational Mathematics B 1 Unit
Prerequisite: Credit in Math 031 or GE Math Ready with Support.
Corequisites: MATH 110.
Typically Offered: Fall and spring
Foundational level California Common Core State Standards mathematics topics in support of general education mathematics. This course is a supplemental requirement for Math Ready with Support students required to enroll in designated general education courses. 3 hours laboratory. (022082)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 1 unit
Course Attributes: Pre-Collegiate

MATH 16L Foundational Mathematics B 1 Unit
Prerequisite: Credit in Math 031 or GE Math Ready with Support.
Corequisites: MATH 116.
Typically Offered: Fall and spring
Foundational level California Common Core State Standards mathematics topics in support of general education mathematics. This course is a supplemental requirement for Math Ready with Support students required to enroll in designated general education courses. 3 hours laboratory. (022083)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 1 unit
Course Attributes: Pre-Collegiate

MATH 31B Foundational Mathematics A 1 Unit
Prerequisite: GE Math Ready with Support and Early Start Program.
Corequisites: BIOL 102.
Typically Offered: Fall and spring
Foundational level California Common Core State Standards mathematics topics. Satisfactory completion of this course fulfills the prerequisite for enrollment in Math 005L, MATH 007L, MATH 010L, and MATH 016L. This course is a supplemental requirement for Math Ready with Support, Early Start Program Required students required to enroll in designated general education courses. 3 hours laboratory. (022087)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 1 unit
Course Attributes: Pre-Collegiate

MATH 31G Foundational Mathematics A 1 Unit
Prerequisite: GE Math Ready with Support and Early Start Program.
Corequisites: ERTH 130.
Typically Offered: Fall and spring
Foundational level California Common Core State Standards mathematics topics. Satisfactory completion of this course fulfills the prerequisite for enrollment in Math 005L, MATH 007L, MATH 010L, and MATH 016L. This course is a supplemental requirement for Math Ready with Support, Early Start Program Required students required to enroll in designated general education courses. 3 hours laboratory. (022086)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 1 unit
Course Attributes: Pre-Collegiate

MATH 31N Foundational Mathematics A 1 Unit
Prerequisite: GE Math Ready with Support and Early Start Program.
Corequisites: SCED 101.
Typically Offered: Fall and spring
Foundational level California Common Core State Standards mathematics topics. Satisfactory completion of this course fulfills the prerequisite for enrollment in Math 005L, MATH 007L, MATH 010L, and MATH 016L. This course is a supplemental requirement for Math Ready with Support, Early Start Program Required students required to enroll in designated general education courses. 3 hours laboratory. (005493)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 1 unit
Course Attributes: Pre-Collegiate
MATH 31P  Foundational Mathematics A  1 Unit
Prerequisite: GE Math Read with Support and Early Start Program.
Corequisites: PSSC 101.
Typically Offered: Fall and spring
Foundational level California Common Core State Standards mathematics topics. Satisfactory completion of this course fulfills the prerequisite for enrollment in Math 005L, MATH 007L, MATH 010L, and MATH 016L. This course is a supplemental requirement for Math Ready with Support, Early Start Program Required students required to enroll in designated general education courses. 3 hours laboratory. (022085)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 1 unit
Course Attributes: Pre-College

MATH 101  Patterns of Mathematical Thought  3 Units GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready or Ready with Support.
Typically Offered: Fall and spring
An informal approach to mathematics designed to bring an appreciation and workable knowledge of the subject to non-majors. Not acceptable for a mathematics major or minor. 1 hour discussion, 2 hours lecture. (005154)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 105  Introduction to Statistics  3 Units GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
Summary of numerical data, distributions, linear regression, and introduction to statistical inference. Statistical software is used. 1.5 hours discussion, 1.5 hours lecture. (005501)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 107  Finite Mathematics for Business  3 Units GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
Solutions to systems of linear equations, matrices, linear programming, combinatorics, probability, binomial and normal distributions. 1.5 hours discussion, 1.5 hours lecture. (005521)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 108  Statistics of Business and Economics  3 Units GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
Descriptive statistics, sampling theory, statistical inference and test of hypotheses, analysis of variance, chi-square tests, simple regression and correlation, and multiple regression and correlation. 1.5 hours discussion, 1.5 hours lecture. (001042)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 109  Survey of Calculus  4 Units GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready; MATH 110 and MATH 119 (or equivalent) with a C- or higher, or a qualifying score on the department administered calculus readiness assessment in addition to high school trigonometry and precalculus with a C- or higher.
Typically Offered: Fall and spring
This course covers the fundamental concepts and techniques of differential and integral calculus with an introduction to differential equations. Emphasis on applications from the Life Sciences. This course is not intended for majors in mathematics, physics, chemistry, or engineering. No credit for students with credit in MATH 120. A score that meets department guidelines on a department administered calculus readiness exam must be achieved by those who claim high school equivalence. 4 hours discussion. (005512)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division

MATH 110  Concepts and Structures of Mathematics  3 Units GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
Structure of the real number system, operations on real numbers, number theory. Not acceptable for a mathematics major or minor. 3 hours discussion. (005522)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 116  College Algebra  4 Units GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
This course covers advanced algebra concepts beyond the scope of Intermediate Algebra. The topics include algebraic simplifying, conics, theory and solution of equations and inequalities, systems of equations, linear functions, exponential and logarithmic functions, polynomial and rational functions, binomial expansion, and partial fractions. 4 hours lecture. (021954)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division

MATH 117  Hands-On Lab, Mathematics  2 Units
Prerequisite: MATH 110.
Corequisites: MATH 210 or faculty permission.
Typically Offered: Fall and spring
The Hands-On Lab for Mathematics provides a rich, sustained, and guided teaching experience for undergraduate students preparing to be elementary or middle school teachers. By developing, refining, and repeatedly teaching a lesson aligned to California mathematics standards, prospective teachers gain insights into the complexities of teaching mathematics content. In addition, prospective teachers engage in Lesson Study with the teachers for these children, thus acquiring experience in a collegial relationship with practicing professionals. 2 hours seminar. (020430)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division
MATH 118  Trigonometry  3 Units  GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
Trigonometric functions, graphs, identities and conditional equations, logarithms, solutions of triangles, and complex numbers. 3 hours discussion. (005500)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 119  Precalculus Mathematics  4 Units  GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready, and either 1/2 year of high school trigonometry or MATH 118 (may be taken concurrently).
Typically Offered: Fall and spring
Functions and graphs, including polynomial, rational, exponential, logarithmic, and trigonometric functions. Systems of equations and inequalities, polar and parametric equations, complex numbers, and analytic trigonometry. 4 hours discussion. (005504)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division

MATH 119X  Precalculus Problem Session  1 Unit
Prerequisite: Faculty permission.
Corequisites: MATH 119.
Typically Offered: Fall and spring
Designed to supplement MATH 119 with additional applications. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 3 hours independent study. (005505)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 120  Analytic Geometry and Calculus  4 Units  GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready; MATH 118 and MATH 119 (or equivalent) with a C- or higher, or a qualifying score on the department administered calculus readiness assessment in addition to high school trigonometry and precalculus with a C- or higher.
Typically Offered: Fall and spring
Limits and continuity. The derivative and applications to related rates, maxima and minima, and curve sketching. Transcendental functions. An introduction to the definite integral and area. 4 hours discussion. (005506)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division

MATH 120X  Calculus Problem Session  1 Unit
Prerequisite: Faculty permission.
Corequisites: MATH 120.
Typically Offered: Fall and spring
Designed to supplement MATH 120 with additional applications of introductory calculus. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 3 hours independent study. (005510)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 121  Analytic Geometry and Calculus  4 Units
Prerequisite: MATH 120.
Typically Offered: Fall and spring
The definite integral and applications to area, volume, work, differential equations, etc. Sequences and series, vectors and analytic geometry in 2 and 3-space, polar coordinates, and parametric equations. 4 hours discussion. (005507)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division

MATH 121X  Calculus Problem Session  1 Unit
Prerequisite: Concurrent enrollment in MATH 121, faculty permission.
Typically Offered: Fall and spring
Designed to supplement MATH 121 with additional applications and expanded explanations of concepts encountered in second-semester calculus. Provides the student with the opportunity for additional assistance in coming to an understanding of the concepts of calculus. 3 hours independent study. (005511)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 125  Advanced Number and Operation  3 Units
Prerequisite: Successful completion of high school precalculus, concurrent enrollment in MATH 118 or 119, or faculty permission.
Typically Offered: Fall only
Investigate number and operation through calculation and abstraction, find patterns and relationships through computation, develop and test mathematical conjectures, and develop an appreciation of proof and an ability to make mathematical arguments. Basic concepts from Number Theory are explored, culminating in proof of the Fundamental Theorem of Arithmetic and related theorems in other number sets. 3 hours discussion. (021846)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 130  Introduction to R  1 Unit
Typically Offered: Fall and spring
This accelerated short-course is designed as a primer to get the complete novice up and running with the basic knowledge of how to use the statistical programming language R. Target audience is anyone who wants to become the boss of their own data and conduct their own analysis. We cover how to get data into R, how to manipulate it into analyzable format, and how to create informative plots. Emphasis is placed on reproducibility and literate programming. The course culminates with a data exploration project. This course requires the use of a laptop computer and appropriate software. Typically offered as 3 hour discussion for 5 weeks. 1 hour discussion. (021774)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 2 units
Course Attributes: Lower Division; Laptop required
MATH 131  Introduction to Python  1 Unit
Typically Offered: Fall and spring
This course is designed as a primer to get the complete novice up and running with the basic knowledge of how to use the statistical programming language Python in an environment that emphasizes reproducible research and literate programming for data analysis. The target audience is anyone who wants to do their own data analysis. The course will cumulate with an exploratory data analysis on either a pre-specified data set or your data set of choice. 1 hour lecture. (022516)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 2 units
Course Attributes: Lower Division

MATH 185  Data Analytics for Social Good  3 Units GE
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
This course introduces students how to start harnessing the power of data to intelligently cope with the requirements of citizenship, employment, and family to be prepared for a healthy, happy and productive life. Students practice collecting and wrangling data into a usable form, visualizing large data sets to discover patterns, representing data in a meaningful way, exploring varying interpretations of the data and results, and discussing potentials for misuse and abuse. This course promotes critical reflection on the ethical, social, cultural, and political dimensions of data as well as providing direct hands on experience with both spreadsheets, and the programming language R. Students from all majors are welcome, no prior programming experience is expected. 1 hour activity, 2 hours lecture. (022285)
General Education: Quantitative Reasoning (B4)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division; Laptop required

MATH 195  Project MATH Seminar Year 1  1 Unit
Typically Offered: Fall and spring
The Project M.A.T.H. Seminar - Year 1 is a biweekly seminar for students in their first year of Project M.A.T.H., an innovative program for students interested in becoming secondary mathematics teachers. Students work with mentor teachers, prepare and present lessons, and participate in a structured early field experience. Completion of the seminar series satisfies the Credential Program's Early Field Experience requirement. 3 hours laboratory. (020431)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 2 units
Course Attributes: Lower Division

MATH 198  Special Topics  1-3 Units
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered. 3 hours discussion. (005528)
Grade Basis: Graded
Repeatability: You may take this course more than once
Course Attributes: Lower Division

MATH 199  Special Problems  1-3 Units
Typically Offered: Fall and spring
This course is an independent study of special problems offered for 1.0-3.0 units. 9 hours supervision. (020782)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Lower Division

MATH 210  Concepts and Structures of Mathematics  3 Units
Prerequisite: MATH 110.
Typically Offered: Fall and spring
Problem-solving, probability and statistics, measurement and the metric system, geometry. Not acceptable for a mathematics major or minor. 3 hours discussion. (005523)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 217  Discrete Mathematics  3 Units
Prerequisite: GE Mathematics/Quantitative Reasoning Ready, CSCI 111 with a grade of C or higher (may be taken concurrently), MATH 119 (or equivalent).
Typically Offered: Fall and spring
Offers an intensive introduction to discrete mathematics as used in computer science. Topics include sets, relations, propositional and predicate logic, basic proof methods including mathematical induction, digital logic circuits, complexity of algorithms, elementary combinatorics, and solving linear recurrence relations. 3 hours discussion. (005550)
Cross listing(s): CSCI 217
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 220  Analytic Geometry and Calculus  4 Units
Prerequisite: MATH 121.
Typically Offered: Fall and spring
Vector functions and space curves. Functions of several variables, partial derivatives, and multiple integrals. Vector calculus line integrals, surface integrals, divergence/curl, Green’s Theorem, Divergence Theorem, and Stokes’ Theorem. 4 hours discussion. (005508)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division

MATH 220X  Calculus Problem Session  1 Unit
Corequisites: MATH 220.
Typically Offered: Fall and spring
Designed to supplement MATH 220 with broader and deeper applications of calculus, providing students with opportunities for additional problem-solving skill building. Twenty hours activity minimum for credit, but 40 hours are available to students. 3 hours independent study. (020358)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division
MATH 225  Algebra Functions, Real and Complex Number Systems 3 Units
Prerequisite: MATH 125.
Typically Offered: Spring only
This course focuses on developing your abilities in making sense of algebraic manipulation in the context of functions, polynomial rings, and matrices. The course and the classroom are structured as a supportive, collaborative learning environment in which mathematical discourse is valued and exploration encouraged. You will investigate algebra and polynomials through calculation and abstraction, find patterns and relationships through computation, develop and test mathematical conjectures, and develop an appreciation of proof and an ability to construct mathematical arguments. More advanced concepts from Number Theory are explored, culminating in proofs of the Unique Prime Factorization Theorem and the Division Algorithm for different rings. 3 hours discussion. (021953)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 230  An Introduction to Computational Mathematics 3 Units
Prerequisite: MATH 121, no previous computer experience required.
Typically Offered: Fall only
An introduction to the use of mathematical computer software. This course provides an introduction to a programming environment, preparing math majors to use computers to explore and solve varied math problems. The software used in this class depends on the instructor and may be chosen from Mathematica, GP/PARI, GAP, SAS, R, etc. This course satisfies the computer literacy requirement for mathematics majors. 3 hours discussion. (005526)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 9 units
Course Attributes: Lower Division

MATH 235  Elementary Linear Algebra 3 Units
Prerequisite: MATH 120.
Typically Offered: Fall and spring
Matrices, determinants, cartesian n-space (basis and dimension of a subspace, rank, change of basis), linear transformations, eigenvalues. Numerical problems will be emphasized. 3 hours discussion. (005553)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 241  Secondary Math Early Field Experience 1 Unit
Typically Offered: Fall and spring
This seminar and the associated CAVE field experience give prospective teachers early exposure to issues relevant to the profession of teaching secondary mathematics. In particular, the experience helps these future teachers develop a deeper understanding of the K-12 mathematics curriculum, understand connections between their university subject matter preparation and K-12 academic content, and reflect on developmental and social factors that affect K-12 students’ learning of mathematics. 1 hour seminar. (020432)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division

MATH 260  Elementary Differential Equations 4 Units
Prerequisite: MATH 121.
Typically Offered: Fall and spring
First order separable, linear, and exact equations; second order linear equations, Laplace transforms, series solutions at an ordinary point, systems of first order linear equations, and applications. 4 hours discussion. (005509)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Lower Division

MATH 260X  Elementary Differential Equations Problem Session 1 Unit
Corequisites: MATH 260.
Typically Offered: Fall and spring
Designed to supplement MATH 260 with broader and deeper applications of differential equations, providing the student with opportunities for additional problem-solving skills. A minimum of 20 hours of activity are required to earn credit for the class; forty hours are available. 3 hours independent study. (020315)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Lower Division

MATH 290  Mathematics and Statistics Tutoring 1 Unit
Corequisites: Concurrent enrollment in a course offered through the Dept of Mathematics Statistics at CSU, Chico.
Typically Offered: Fall and spring
This course provides supplemental mathematics statistics tutoring. 3 hours independent study. (020823)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 8 units
Course Attributes: Lower Division

MATH 295  Project M.A.T.H. Seminar Year 2 1 Unit
Prerequisite: MATH 195.
Typically Offered: Fall and spring
The Project M.A.T.H. Seminar - Year 2 is the continuation of a biweekly seminar for students in Project M.A.T.H., an innovative program for students interested in becoming secondary mathematics teachers. Students work with mentor teachers, prepare and present lessons, and participate in a structured early field experience. They also take on a leadership role in the seminar. Completion of the seminar series satisfies the Credential Program's Early Field Experience requirement. 3 hours laboratory. (020433)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 2 units
Course Attributes: Lower Division

MATH 298  Special Topics 1-3 Units
Typically Offered: Inquire at department
This course is for special topics offered for 1.0 - 3.0 units. Typically the topic is offered on a one-time-only basis and may vary from semester to semester and be different for different sections. See the class schedule for the specific topic being offered. 0 hours supervision. (021615)
Grade Basis: Graded
Repeatability: You may take this course more than once
Course Attributes: Lower Division
MATH 299  Special Problems  1-3 Units
Prerequisite: Faculty permission.
Typically Offered: Inquire at department
This course is an independent study of special problems offered for 1.0-3.0 units. You must register directly with a supervising faculty member. 0 hours supervision.  (021629)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Lower Division

MATH 300  Undergraduate Mathematics Seminar  2 Units
Prerequisite: GE Mathematics/Quantitative Reasoning Ready.
Typically Offered: Fall and spring
This course is designed to expose you to mathematics not normally covered in your regular curriculum. Guest speakers are drawn from the ranks of our faculty, including other disciplines, our students, and industry. Talks are interactive, participatory, and fun. There is no prerequisite, except an interest in interesting mathematics. Topics typically include selections from number theory, math education, statistics, problem solving, undergraduate research, calculus, differential equations, spatial and planar geometry, probability, computer applications, mathematical operations, modeling, topology, trigonometry, metric measurements, elliptical curves, and bubbles, among others. This exposure broadens your horizons and expands your curiosity in hopes that you will explore mathematics beyond your required courses. 2 hours lecture.  (021647)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 8 units
Course Attributes: Upper Division

MATH 305  Conceptual and Practical Statistics  3 Units
Prerequisite: MATH 120 or MATH 109 (may be taken concurrently).
Typically Offered: Spring only
Design of statistical experiments, graphing, sampling techniques, probability, and common probability distributions will be discussed, with an emphasis on practical applications. Uses and misuses of statistics, misrepresentation of data, and proper and improper statistical analyses will be discussed. 3 hours discussion.  (005532)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 310  Patterns and Structures in Mathematics  3 Units
Prerequisite: MATH 110; MATH 210 or MATH 225.
Typically Offered: Fall and spring
Builds upon student's understanding of numbers and operations to develop their algebraic and proportional reasoning. Probability viewed as an application of proportional reasoning. Foundational statistics is also covered. Overall focus on developing a deep understanding of mathematics that is relevant to the teaching of Kindergarten-8th grade. Not acceptable for a mathematics major or minor except the Foundational Math Education option and Math Education minor. 3 hours discussion.  (005542)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 311  Intuitive Foundations of Geometry  3 Units
Prerequisite: MATH 110, MATH 210; or MATH 225.
Typically Offered: Spring only odd years
An intuitive approach to problem-solving in Euclidean, coordinate, motion, and space geometry. Concrete models are used for analyzing abstract ideas. Not acceptable for a mathematics major or minor other than the Math Education minor. 3 hours discussion.  (005543)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 314  Probability and Statistics for Science and Technology  4 Units
Prerequisite: MATH 121; and one of the following: CSCI 111, MATH 130 (may be taken concurrently), MATH 230 or MECH 208.
Typically Offered: Fall and spring
Basic concepts of probability and statistics with emphasis on models used in science and technology. Probability models for statistical estimation and hypothesis testing. Confidence limits. One- and two-sample inference, simple regression, one- and two-way analysis of variance. Credit cannot be received for both MATH 314 and MATH 315. 4 hours discussion.  (005533)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Upper Division; Laptop required

MATH 315  Applied Statistical Methods I  3 Units
Prerequisite: MATH 105, MATH 109, or MATH 120, or faculty permission.
Typically Offered: Fall and spring
Single and two sample inference, analysis of variance, multiple regression, analysis of co-variance, experimental design, repeated measures, nonparametric procedures, and categorical data analysis. Examples are drawn from biology and related disciplines. The statistical programming language R is used. Appropriate for biology, agriculture, nutrition, psychology, social science and other majors. 3 hours discussion.  (005568)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 317  Cryptography  4 Units
Prerequisite: CSCI 111; MATH 217 or MATH 330W.
Typically Offered: Spring only
This is the first course in cryptography with an emphasis on public key cryptosystems, digital signature schemes, and the underlying mathematical principles on which they are based. Students implement algorithms and solve problems in programming-based assignments. Some time is devoted to getting familiar with the Python programming language and the SageMath Software system. 4 hours discussion.  (022044)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Upper Division
MATH 318  Topological Data Analysis  3 Units
Prerequisite: MATH 217 or MATH 330W; CSCI 111 or faculty permission.
Typically Offered: Spring only odd years
In this course students use the tools of topology to study data sets in terms of their shape. Students become familiar with the basics of topology, and master a subset of algorithms for computing Betti number, topological persistence, homology cycles, Reeb graphs, and Laplace spectra. Students become familiar with designing algorithms for problems in applications dealing with data, and how to research the background of a topic in data analysis or machine learning. 3 hours discussion. (022453)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 330W Methods of Proof (W)  3 Units
Prerequisite: GE Written Communication (A2) requirement and MATH 121.
Typically Offered: Fall and spring
A survey of elementary principles of logic, emphasizing the nature of proof. Standard methods of proof will be illustrated with examples from various branches of mathematics, including set theory and the theory of functions and relations. Other possible sources of examples include the calculus, number theory, theory of equations, topology of the real line. 3 hours seminar. (005530)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division; Writing Course

MATH 333 History of Mathematics  3 Units
Prerequisite: MATH 121; MATH 220 or MATH 225; and at least one upper division mathematics course. Recommended: MATH 330W.
Typically Offered: Spring only
Study of the historical development of mathematics, with particular emphasis on the relationship between mathematics and society. 3 hours discussion. (005531)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 337 Introduction to the Theory of Numbers  3 Units
Prerequisite: MATH 121, MATH 330W.
Typically Offered: Fall only
Basic properties of the integers, division algorithm, fundamental theorem of arithmetic, number-theoretic functions, Diophantine equations, congruences, quadratic residues, continued fractions. 3 hours discussion. (005585)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 341 Mathematical Topics for the Credential  3 Units
Prerequisite: MATH 212 or MATH 225.
Typically Offered: Fall only
This course is designed to supplement the mathematical background of the candidate for the single subject credential in mathematics. The mathematical topics will be discussed from the student’s and the teacher’s points of view to aid the candidate in making the transition to secondary school mathematics. Topics include mathematical problem-solving, conceptual ideas using algebra, geometry, and functions, incorporating technology into the mathematics curriculum, and finite systems. 3 hours seminar. (005544)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 342 Math Topics for the Credential  3 Units
Prerequisite: MATH 341.
Typically Offered: Spring only
This course focuses on having students examine mathematical pedagogy and the understanding and evaluations of students as mathematical learners as it analyzes secondary mathematics curriculum from an advanced standpoint. Students will have opportunities to be involved in the facilitation of mathematical learning. Topics include: history of mathematics education, contemporary mathematics curricula, problem solving, mathematical reasoning and methods of proof, mathematical learning theories, communication, assessment and collaborative learning communities. 3 hours discussion. (005545)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 344 Graph Theory  3 Units
Prerequisite: MATH 121; CSCI 217, MATH 217, or MATH 330W.
Typically Offered: Fall only odd years
An introduction to graph theory and network theory. Directed graphs, trees, connectivity, duality, coloring, and planarity are studied both from a theoretical perspective as well as with respect to efficient algorithms. 3 hours discussion. (005591)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 346 College Geometry  3 Units
Prerequisite: MATH 220 or MATH 225; MATH 330W.
Typically Offered: Spring only
An exploration of axioms and models for Euclidean and non-Euclidean geometries focusing on the independence of the Parallel Postulate. Additional topics will be chosen from Euclidean plane geometry, transformation geometry, and the geometry of polyhedra. 3 hours discussion. (005561)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 350 Introduction to Probability and Statistics  3 Units
Prerequisite: MATH 121.
Typically Offered: Fall and spring
Probability theory and application, discrete and continuous random variables and their distribution, basic sampling distributions, theory and concepts of expectations and variance. Statistical software may be used. 3 hours discussion. (005534)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Prerequisite(s)</th>
<th>Typically Offered</th>
<th>Grade Basis</th>
<th>Repeatability</th>
<th>Course Attributes</th>
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<tbody>
<tr>
<td>MATH 351</td>
<td>Introduction to Probability and Statistics</td>
<td>3</td>
<td>MATH 350.</td>
<td>Spring only</td>
<td>Graded</td>
<td>You may take this course for a maximum of 3 units</td>
<td>Upper Division</td>
</tr>
<tr>
<td>MATH 360</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
<td>MATH 260.</td>
<td>Spring only</td>
<td>Graded</td>
<td>You may take this course for a maximum of 3 units</td>
<td>Upper Division</td>
</tr>
<tr>
<td>MATH 361</td>
<td>Boundary Value Problems and Partial Differential Equations</td>
<td>3</td>
<td>MATH 260.</td>
<td>Fall only</td>
<td>Graded</td>
<td>You may take this course for a maximum of 3 units</td>
<td>Upper Division</td>
</tr>
<tr>
<td>MATH 385</td>
<td>Introduction to Data Science</td>
<td>3</td>
<td>CSCI 111, MATH 130, or MATH 230, MATH 109 or MATH 120.</td>
<td>Fall only</td>
<td>Graded</td>
<td>You may take this course for a maximum of 3 units</td>
<td>Upper Division</td>
</tr>
<tr>
<td>MATH 398</td>
<td>Special Topics in Math</td>
<td>1-3</td>
<td>At least one 100- or 200-level mathematics course appropriate to the subject, faculty permission.</td>
<td>Fall and spring</td>
<td>Graded</td>
<td>You may take this course more than once</td>
<td>Upper Division</td>
</tr>
<tr>
<td>MATH 399</td>
<td>Special Problems</td>
<td>1-3</td>
<td>MATH 350 cannot be used to fulfill major requirements without prior approval of the advisor and department chair. 0 hours supervision.</td>
<td>Fall and spring</td>
<td>Credit/No Credit</td>
<td>You may take this course for a maximum of 6 units</td>
<td>Upper Division</td>
</tr>
<tr>
<td>MATH 401</td>
<td>CMP Institute - Summer 1</td>
<td>2</td>
<td>MATH 385.</td>
<td>Summer session only</td>
<td>Credit/No Credit</td>
<td>You may take this course for a maximum of 4 units</td>
<td>Upper Division</td>
</tr>
<tr>
<td>MATH 405</td>
<td>Cmp Institute-Sp</td>
<td>1</td>
<td>MATH 260.</td>
<td>Spring only</td>
<td>Credit/No Credit</td>
<td>You may take this course for a maximum of 2 units</td>
<td>Upper Division</td>
</tr>
<tr>
<td>MATH 420W</td>
<td>Advanced Calculus (W)</td>
<td>3</td>
<td>GE Written Communication (A2) requirement, MATH 220, MATH 330W, upper-division standing.</td>
<td>Fall and spring</td>
<td>W, GW</td>
<td>You may take this course for a maximum of 3 units</td>
<td>Upper Division; Writing Course; Graduation Writing Assessment</td>
</tr>
<tr>
<td>MATH 421</td>
<td>Advanced Calculus</td>
<td>3</td>
<td>MATH 420W.</td>
<td>Spring only even years</td>
<td>Graded</td>
<td>You may take this course for a maximum of 3 units</td>
<td>Upper Division</td>
</tr>
</tbody>
</table>
MATH 425W Computational and Communication in Mathematical Modeling (W) 3 Units W, GW
Prerequisite: GE Written Communication (A2) requirement, completion of computer literacy requirement, MATH 225, MATH 235, MATH 330W, and upper division standing.
Typically Offered: Fall only
In this course, intended for pre-service teachers, student experience mathematical modeling with content common in the secondary setting (algebra through calculus) as well as from their undergraduate coursework and develop and produce formal modeling reports. Students use technology to aid in exploring real-world circumstances, make sense of and analyze existing models, and develop their own mathematical models. 3 hours discussion. (021977)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division; Writing Course; Graduation Writing Assessment

MATH 428 Differential Geometry 3 Units
Prerequisite: MATH 220, MATH 330W.
Typically Offered: Fall only odd years
The geometry of curves and surfaces in Euclidean 3-space. 3 hours lecture. (005566)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 435 Linear Algebra 3 Units
Prerequisite: MATH 220, MATH 235, MATH 330W.
Typically Offered: Spring only even years
Vector spaces, linear operators, bilinear forms and scalar products, unitary spaces; matrix polynomials, eigenvalues, and Jordan normal form. 3 hours discussion. (005581)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 437 Topology 3 Units
Prerequisite: MATH 220, MATH 330W.
Typically Offered: Fall only even years
Metric spaces, continuous functions, homeomorphisms, separation, and covering axioms, connectedness. 3 hours discussion. (005563)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 442 Mathematics and the Teaching of Mathematics 3 Units
Prerequisite: MATH 342.
Typically Offered: Fall only
Completes a three course series, started with two semesters of Mathematics for the Credential, MATH 341 and MATH 342. Students compare instructional strategies and explore the role content and pedagogical content knowledge has in these strategies. Central to the class is a lesson study project which entails a cycle of lesson development, implementation, reflection and revision, and implementation again. Students concurrently enrolled in EDTE 535A, Teaching Practicum I for Blended Math Candidates, are able to implement their lesson as part of the practicum, and have a real context for the full content of the course. 3 hours lecture. (020978)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 449 Modern Algebra 3 Units
Prerequisite: MATH 220, MATH 235, MATH 330W.
Typically Offered: Fall only
Introduction to basic algebraic structures such as groups, ring, and fields. The fundamental concepts of homomorphism, subgroup, normal subgroup and factor group of a group as well as subring, ideal and factor ring of a ring; permutation groups and matrix groups. 3 hours discussion. (005582)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 450 Computational Statistics 3 Units
Prerequisite: MATH 220, MATH 350 or MATH 660. Strongly Recommended: MATH 235 or a similar exposure to Linear Algebra.
Typically Offered: Fall only
Continuation of MATH 350 with a strong focus on computational tools used to fit statistical models. Topics may include Bayesian statistics, Monte Carlo, Markov chain Monte Carlo, optimization expectation-maximization algorithms, matrix decompositions, variational inference, stochastic optimization, and neural networks. This course requires the use of a laptop computer and appropriate software such as R or Python. 3 hours discussion. (005562)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division; Laptop required

MATH 451 Modern Algebra II 3 Units
Prerequisite: MATH 449.
Typically Offered: Spring only odd years
Continuation of MATH 449, topics may include group actions, the Sylow theorems, number fields, finite fields, algebraic extensions, field automorphisms, splitting fields of polynomials, Galois groups, and solvable groups. 3 hours discussion. (021971)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 456 Applied Statistical Methods II 3 Units
Prerequisite: MATH 314 or MATH 315.
Typically Offered: Spring only
Advanced topics in applied statistics including multiple and logistic regression, multivariate methods, multi-level modeling, repeated measures, and others as appropriate. The statistical programming language R is used. Appropriate for biology, agriculture, nutrition, business, psychology, social science and other majors. 3 hours discussion. (005570)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 458 Sampling Methods 3 Units
Prerequisite: MATH 314, MATH 315, or MATH 351 (may be taken concurrently).
Typically Offered: Spring only odd years
The theory and application of survey sampling techniques. Topics include simple random sampling, stratified sampling, systematic sampling, and cluster sampling. Appropriate for mathematics, computer science, psychology, social science, agriculture, biology, and other majors. 3 hours discussion. (005573)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division
MATH 461 Numerical Analysis 3 Units
Prerequisite: MATH 220 or MATH 260; completion of computer literacy requirement.
Typically Offered: Spring only
Approximation; numerical integration; numerical solution of ordinary and partial differential equations; interpolation and extrapolation. 3 hours discussion. (005584)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 465 Introduction to Complex Variables 3 Units
Prerequisite: MATH 220.
Typically Offered: Fall only
Algebra of Complex Numbers, Cauchy-Riemann Equations, the exponential, trigonometric, and logarithmic functions, complex integration and Cauchy integral formula, Taylor and Laurent series, the residue theorem, conformal mapping, and applications. 3 hours discussion. (005577)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 472 Introduction to Chaotic Dynamical Systems 3 Units
Prerequisite: MATH 260. Recommended: MATH 235, MATH 360.
Typically Offered: Fall only odd years
An introduction to the study of non-linear dynamical systems. Both discrete and continuous systems will be studied using classical analysis combined with geometric techniques and computer simulation. Areas of application include fractal geometry, coding theory, fluid turbulence, population fluctuation, and chaotic vibrations of structures and circuits. 3 hours discussion. (005588)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 475 Calculus of Variations 3 Units
Prerequisite: MATH 260, MATH 361 is recommended.
Typically Offered: Fall only even years
Classical problems in the calculus of variations. Euler-Lagrange equations. Isoperimetric problems, Fermat's principle. Lagrangian and Hamiltonian mechanics of particles. Two independent variables. Applications to physics and engineering. 3 hours discussion. (005590)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 480 Mathematical Modeling 3 Units
Prerequisite: MATH 235, MATH 260.
Typically Offered: Spring only
The translation of real world phenomena into mathematical language. Possible applications include population and competing species models, mathematical theories of war, traffic flow, river pollution, water waves and tidal dynamics, probabilistic and simulation models. 3 hours discussion. (005592)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 485 Advanced Topics in Data Science 3 Units
Prerequisite: CSCI 385 or MATH 385; MATH 456 (may be taken concurrently).
Typically Offered: Spring only
Getting connected to current events in Data Science and building an online presence. Ethics of predictive analytics and privacy and open data. Reporting and dissemination of research using interactive dashboards and web-publishing. Introduction to current scalable technologies to handle Big Data. Introduction to advanced statistical analysis and machine learning techniques for Data Science. 3 hours lecture. (021890)
Cross listing(s): CSCI 485
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Upper Division

MATH 490 Data Science Capstone 1-3 Units
Prerequisite: MATH 485, senior standing, approved project, enrollment in the Data Science Certificate Program.
Typically Offered: Fall and spring
Students work independently to provide a service in the form of a data product to a local business, researcher, or community member. Students provide status reports at weekly meetings and present their finished project to a group of peers at the end of the semester in an appropriate venue such as at an undergraduate seminar series or poster symposium. 0 hours supervision. (021898)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Upper Division

MATH 495H Honors Reading Course 3 Units
Prerequisite: Admission to the Department Honors Program, completion of MATH 420W with a grade of B or higher.
Typically Offered: Fall and spring
Directed reading in an advanced topic under the guidance of an Honors thesis supervisor. The course exceeds the usual level of difficulty associated with undergraduate work. It provides the background necessary to write an Honors thesis. 9 hours supervision. (005595)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Upper Division

MATH 497H Honors Reading Course 3 Units
Prerequisite: Admission to the Department Honors Program, enrollment in Honors program.
Typically Offered: Fall and spring
Directed reading in an advanced topic under the guidance of an Honors thesis supervisor. The course exceeds the usual level of difficulty associated with undergraduate work. It provides the background necessary to write an Honors thesis. 9 hours supervision. (005595)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Upper Division

MATH 498 Advanced Topics in Mathematics 1-3 Units
Prerequisite: At least one 300- or 400-level mathematics course appropriate to the subject, faculty permission.
Typically Offered: Fall and spring
This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See the Class Schedule for the specific topic being offered. 3 hours supervision. (005593)
Grade Basis: Graded
Repeatability: You may take this course more than once
Course Attributes: Upper Division

MATH 499 Special Problems 1-3 Units
Prerequisite: Faculty permission.
Typically Offered: Fall and spring
This course is an independent study of special problems offered for 1.0-3.0 units. You must register directly with a supervising faculty member. 3 hours supervision. (005594)
Grade Basis: Credit/No Credit
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Upper Division
MATH 499H Honors Thesis 3 Units
Prerequisite: Completion of MATH 495H with a grade of B or higher, and approval by the department Honors advisor and thesis supervisor of the proposed thesis topic.
Typically Offered: Fall and spring
Preparation of written thesis in mathematics under supervision of Honors thesis advisor. The thesis, based on studies begun in MATH 495H, will require original work beyond that normally required in undergraduate work. Completed written thesis must be approved by the thesis supervisor and Honors advisor. A summary of the thesis will be presented by the student in public lecture. Successful completion of MATH 495H and MATH 499H is one of the requirements for being designated as an Honors graduate in mathematics. 9 hours supervision. (005596)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Upper Division

MATH 500 Data Science Seminar 1 Unit
Typically Offered: Spring only
This seminar explores current and relevant applications and implementations of data science and analytical methods and tools in the field. Seminars include external and student-led presentations and hands-on tutorials. Emphasis is placed on students sharing and receiving feedback on an approved capstone or master's project. Appropriate for seniors and graduate students in relevant programs. 1 hour seminar. (022563)
Grade Basis: ABC/No Credit
Repeatability: You may take this course for a maximum of 4 units
Course Attributes: Upper Division; Laptop required

MATH 589 Field Experience in Statistics and Data Science 3 Units
Prerequisite: MATH 315 or MATH 615, MATH 385 or CSCI 385, or faculty permission.
Typically Offered: Fall and spring
This internship provides an authentic virtual (and in person when available) career experience, emphasizing problem solving, decision-making and remote collaboration skills, along with an understanding of leadership roles in a professional space. In addition to synchronous meetings with the faculty mentor, students work directly with students, staff or faculty in a drop-in consulting environment, and with research project staff at campus and community based organizations to learn about and contribute to the day-to-day operations of these organizations. 3 hours supervision. (022502)
Grade Basis: Graded
Repeatability: You may take this course for a maximum of 9 units
Course Attributes: Upper Division

MATH 608 Data Science for Graduate Studies 3 Units
Prerequisite: Basic programming knowledge, admission to the master's program in Data Science and Analytics or Computer Science, or faculty permission.
Typically Offered: Fall only
This course covers foundational practices of data science emphasizing reproducibility and ethical practices at all stages of the data science lifecycle. Recent advances and seminal works in data science and related fields will be discussed and scientific communication best practices will be addressed. Topics include version control, scientific thinking, web scraping, intermediate data wrangling, data visualization, modeling, prediction, classification, and text analysis in either R or Python. 3 hours discussion. (022535)
Cross listing(s): CSCI 608
Grade Basis: Graduate Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Graduate Division; Laptop required

MATH 610 Topics in Mathematics for Secondary Teachers: Analysis 3 Units
Prerequisite: Admission to the master's program in mathematics education or instructor permission.
Typically Offered: Inquire at department
Through an array of pedagogical strategies, secondary mathematics teachers explore analysis topics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of analysis. 3 hours seminar. (005599)
Grade Basis: Report in Progress: ABC/NC
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Graduate Division

MATH 615 Data Analysis for Graduate Research 3 Units
Prerequisite: MATH 105, MATH 305, MATH 315, or MATH 350.
Typically Offered: Fall only
This course provides a hands-on introduction to using data to rigorously answer research questions. Students practice cleaning and manipulating data, creating data visualizations, and conducting introductory level statistical analysis using real-world data sets that are relevant to their field. Analysis topics include single and two-sample inference, analysis of variance, multiple regression, analysis of co-variance, experimental design, repeated measures, nonparametric procedures, and categorical data analysis. Reproducible research is strongly emphasized through the use of statistical computing software (e.g., SPSS, Stata, SAS, R, Python). Recommended for all majors that use data for research. 3 hours discussion. (005597)
Grade Basis: Graduate Graded
Repeatability: You may take this course for a maximum of 3 units
Course Attributes: Graduate Division

MATH 620 Topics in Mathematics for Secondary Teachers: Geometry 3 Units
Prerequisite: Admission to the master's program in mathematics education or instructor permission.
Typically Offered: Inquire at department
Through an array of pedagogical strategies, secondary mathematics teachers explore geometry appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of geometry. 3 hours seminar. (005602)
Grade Basis: Report in Progress: ABC/NC
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Graduate Division
MATH 630  Topics in Mathematics for Secondary Teachers: Foundations of Mathematics  
3 Units  
**Prerequisite:** Admission to the master's program in mathematics education or instructor permission.  
**Typically Offered:** Inquire at department  
Through an array of pedagogical strategies, secondary mathematics teachers explore the foundations of mathematics topics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of the foundations of mathematics. 3 hours seminar.  
(005601)  
**Grade Basis:** Report in Progress: ABC/NC  
**Repeatability:** You may take this course for a maximum of 6 units  
**Course Attributes:** Graduate Division  

MATH 633  Topics in Mathematics for Secondary Teachers: Number Theory  
3 Units  
**Prerequisite:** Admission to the master's program in mathematics education or instructor permission.  
**Typically Offered:** Inquire at department  
Through an array of pedagogical strategies, secondary mathematics teachers explore number theory appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of number theory. 3 hours seminar.  
(005605)  
**Grade Basis:** Report in Progress: ABC/NC  
**Repeatability:** You may take this course for a maximum of 6 units  
**Course Attributes:** Graduate Division  

MATH 635  Topics in Mathematics for Secondary Teachers: Discrete Mathematics  
3 Units  
**Prerequisite:** Admission to the master's program in mathematics education or instructor permission.  
**Typically Offered:** Inquire at department  
Through an array of pedagogical strategies, secondary mathematics teachers explore discrete mathematics topics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of discrete mathematics. 3 hours seminar.  
(005600)  
**Grade Basis:** Report in Progress: ABC/NC  
**Repeatability:** You may take this course for a maximum of 6 units  
**Course Attributes:** Graduate Division  

MATH 637  Topics in Mathematics for Secondary Teachers: History of Mathematics  
3 Units  
**Prerequisite:** Admission to the master's program in mathematics education or instructor permission.  
**Typically Offered:** Inquire at department  
Through an array of pedagogical strategies, secondary mathematics teachers explore the history of mathematics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of the history of mathematics. 3 hours seminar.  
(005603)  
**Grade Basis:** Report in Progress: ABC/NC  
**Repeatability:** You may take this course for a maximum of 6 units  
**Course Attributes:** Graduate Division  

MATH 640  Topics in Mathematics for Secondary Teachers: Modern Algebra  
3 Units  
**Prerequisite:** Admission to the master's program in mathematics education or instructor permission.  
**Typically Offered:** Inquire at department  
Through an array of pedagogical strategies, secondary mathematics teachers explore modern algebra topics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of modern algebra. 3 hours seminar.  
(005598)  
**Grade Basis:** Report in Progress: ABC/NC  
**Repeatability:** You may take this course for a maximum of 6 units  
**Course Attributes:** Graduate Division  

MATH 650  Topics in Mathematics for Secondary Teachers: Probability and Statistics  
3 Units  
**Prerequisite:** Admission to the master's program in mathematics education or instructor permission.  
**Typically Offered:** Inquire at department  
Through an array of pedagogical strategies, secondary mathematics teachers explore probability and statistics appropriate for the secondary school curriculum. These topics and strategies provide a basis for reflective analysis and deepening knowledge of probability and statistics. 3 hours seminar.  
(005606)  
**Grade Basis:** Report in Progress: ABC/NC  
**Repeatability:** You may take this course for a maximum of 6 units  
**Course Attributes:** Graduate Division  

MATH 651  Probability and Statistics for Data Science  
3 Units  
**Prerequisite:** MATH 121, MATH 615. Recommended: CSCI 485 or MATH 485.  
**Typically Offered:** Fall only  
This course covers simulation, probability theory and distributions, Bayes’ methods, sampling distributions, and point and interval estimation. Also included are maximum likelihood, testing hypotheses, likelihood ratio tests, and multivariable regression theory. The statistical programming language R is used. 3 hours lecture.  
(022569)  
**Grade Basis:** ABC/No Credit  
**Repeatability:** You may take this course for a maximum of 3 units  
**Course Attributes:** Graduate Division; Laptop required  

MATH 660  Topics in Mathematics for Secondary Teachers: Mathematical Modeling  
3 Units  
**Prerequisite:** Admission to the master's program in mathematics education or instructor permission.  
**Typically Offered:** Inquire at department  
Through an array of pedagogical strategies, secondary mathematics teachers explore mathematical modeling appropriate for the secondary school curriculum. These topics and strategies provide a basis for the reflective analysis and deepening knowledge of mathematical modeling. 3 hours seminar.  
(005604)  
**Grade Basis:** Report in Progress: ABC/NC  
**Repeatability:** You may take this course for a maximum of 6 units  
**Course Attributes:** Graduate Division  

MATH 697  Independent Study  
1-3 Units  
**Typically Offered:** Fall and spring  
This course is a graduate-level independent study offered for 1.0-3.0 units. You must register directly with a supervising faculty member. 3 hours supervision.  
(005616)  
**Grade Basis:** Report in Progress: Graded  
**Repeatability:** You may take this course for a maximum of 6 units  
**Course Attributes:** Graduate Division
MATH 698  Grad Advanced Topics in Math  1-3 Units
Typically Offered: Fall and spring
This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See the Class Schedule for the specific topic being offered. 9 hours supervision.  (005615)
Grade Basis: Graduate Graded
Repeatability: You may take this course more than once
Course Attributes: Graduate Division

MATH 699P  Master's Project  1-3 Units
Typically Offered: Fall and spring
This course is offered for 1.0-6.0 units. You must register directly with a supervising faculty member. 9 hours supervision.  (005622)
Grade Basis: Report in Progress: CR/NC
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Graduate Division

MATH 699T  Master's Study  1-3 Units
Typically Offered: Fall and spring
This course is offered for 1.0-6.0 units. You must register directly with a supervising faculty member. 9 hours supervision.  (005620)
Grade Basis: Report in Progress: CR/NC
Repeatability: You may take this course for a maximum of 6 units
Course Attributes: Graduate Division