Mathematics

Department Overview

The Department of Mathematics offers a B.S. degree in mathematics, a B.S. degree in actuarial science and a double major in mathematics and secondary education that includes teaching certification. The objective of the bachelor’s degree program in mathematics is to prepare students for professional careers in a variety of industries and for graduate programs leading to the M.S. and Ph.D. Students also may opt for advanced degrees in education, business administration, law, or medicine.

Professor: David Hecker Ph.D.; Kristopher Tapp Ph.D.; Paul Klingsberg Ph.D.; Rommel Regis Ph.D.; Sam Smith Ph.D.; Tetyana Berezovski Ph.D.
Associate Professor: Rachel Hall Ph.D.
Assistant Professor: Bahaeddine Taoufik Ph.D.; Elaine Terry Ph.D.; Hongjun Ha Ph.D.
Visiting: Greg Manco Ph.D.; Patricia Bobo M.S., A.S.A.
Other Title: John J. Whitaker M.S., F.S.A.

Chair: Kristopher Tapp, Ph.D

Undergraduate Major

- Bachelor of Science in Mathematics (https://academiccatalog.sju.edu/arts-sciences/mathematics/bs-mathematics/)

Undergraduate Minors

- Mathematics (https://academiccatalog.sju.edu/arts-sciences/mathematics/minor-mathematics/)

MAT 101 Mathematical Explorations I (3 credits)
For humanities majors, the course covers set theory and a number of its applications, topics from logic including propositions, truth tables, number systems, and elementary geometry. Other topics may be covered at instructor’s discretion.
Restrictions: Enrollment is limited to PLS/HDC level students.
Attributes: Undergraduate

MAT 102 Mathematical Explorations II (3 credits)
This is a second course for humanities majors. The course covers elementary probability, including independent and dependent events, conditional probability, binomial probability, and certain applications in a wide variety of situations. MAT 101 is not required for MAT 102.
Restrictions: Enrollment is limited to PLS/HDC level students.
Attributes: Undergraduate

MAT 103 Quantitative Appl in Business (3 credits)
Topics in finite mathematics: matrices, solving linear systems, optimization using linear programming, simplex algorithm. Pre-calculus topics: linear, quadratic, exponential, and logarithmic functions and their graphs, mathematical models, and certain applications.
Restrictions: Enrollment is limited to PLS/HDC level students.
Attributes: Undergraduate

MAT 107 Contemporary Topics in Math (3 credits)
This course is designed to enable the student to recognize, understand and apply various mathematical concepts and principles that are the foundation for many things that we take for granted in our everyday lives, such as Voting, Traveling, Finances, Government and the wonders of Nature.
Attributes: Undergraduate

MAT 108 Introduction to Statistics (3 credits)
Introduction to statistics and probability: measures of central tendency, variability, correlation, regression, chance and randomness, random variables, probability distributions, law of large numbers, central limit theorem. Students will be required to use a computer software package to solve various statistical problems. Designed for Social Science majors. Students may NOT receive credit for this course and for MAT 128.
Attributes: Undergraduate

MAT 109 Math Modeling for MS Teachers (3 credits)
Designed for students who will become middle school teachers, this course will explore mathematical topics in the context of building of building models to solve problems. The emphasis will be on using multiple representations to develop mathematical models that describe some phenomena and learning the mathematical techniques necessary for working with the model in order to effectively answer questions about the situation being modeled. Students will interpret results given the context of the model and develop their communication skills for explaining mathematics.
Attributes: Undergraduate

MAT 110 Fundamental Math for Educators (3 credits)
This course is designed to ensure that pre-service educators have a deep understanding of the essential mathematical core standards and competencies required to enter the teaching profession. Students will develop basic mathematical skills, will be able to employ problem solving strategies, will be able to communicate mathematical concepts, and will be able to construct and evaluate mathematical arguments.
Attributes: Undergraduate

MAT 111 The Mathematics of Patterns (3 credits)
This course focuses on mathematics as the science of identifying, understanding and describing patterns. Patterns that occur in nature and empirical studies can be identified and modeled using fundamental ideas such as functions (mathematical rules), probability (long term behavior), exploratory data analysis (statistics) and geometry. Through a series of guided investigations students will master the reasoning used to identify the patterns, the mathematical model used to describe the pattern and the computational techniques necessary to further explore and apply the pattern in new situations. This course is designed specifically for students intending to become elementary or middle school teachers.
Attributes: Undergraduate

MAT 120 The Mathematics of Modeling (3 credits)
Designed for students who will become middle school teachers, this course will explore mathematical topics in the context of building of building models to solve problems. The emphasis will be on using multiple representations to develop mathematical models that describe some phenomena and learning the mathematical techniques necessary for working with the model in order to effectively answer questions about the situation being modeled. Students will interpret results given the context of the model and develop their communication skills for explaining mathematics.
Attributes: Undergraduate

MAT 121 Math Modeling for MS Teachers (3 credits)
This course is designed to ensure that pre-service educators have a deep understanding of the essential mathematical core standards and competencies required to enter the teaching profession. Students will develop basic mathematical skills, will be able to employ problem solving strategies, will be able to communicate mathematical concepts, and will be able to construct and evaluate mathematical arguments.
Attributes: Undergraduate

MAT 123 Differential Calculus (3 credits)
Review of mathematical models using polynomial, rational, exponential and logarithmic functions with business applications. Introduction to differential calculus including limits, rates of change and the derivative, optimization using the derivative. Students may NOT receive credit for both this course and for any of the following courses: MAT 155 or MAT 161.
Attributes: Undergraduate

MAT 161 Further Topics in Math (3 credits)
This course is designed to enable the student to recognize, understand and apply various mathematical concepts and principles that are the foundation for many things that we take for granted in our everyday lives, such as Voting, Traveling, Finances, Government and the wonders of Nature.
Attributes: Undergraduate

Undergraduate Minors

- Mathematics (https://academiccatalog.sju.edu/arts-sciences/mathematics/minor-mathematics/)

MAT 101 Mathematical Explorations I (3 credits)
For humanities majors, the course covers set theory and a number of its applications, topics from logic including propositions, truth tables, number systems, and elementary geometry. Other topics may be covered at instructor’s discretion.
Restrictions: Enrollment is limited to PLS/HDC level students.
Attributes: Undergraduate

MAT 102 Mathematical Explorations II (3 credits)
This is a second course for humanities majors. The course covers elementary probability, including independent and dependent events, conditional probability, binomial probability, and certain applications in a wide variety of situations. MAT 101 is not required for MAT 102.
Restrictions: Enrollment is limited to PLS/HDC level students.
Attributes: Undergraduate

MAT 103 Quantitative Appl in Business (3 credits)
Topics in finite mathematics: matrices, solving linear systems, optimization using linear programming, simplex algorithm. Pre-calculus topics: linear, quadratic, exponential, and logarithmic functions and their graphs, mathematical models, and certain applications.
Restrictions: Enrollment is limited to PLS/HDC level students.
Attributes: Undergraduate

MAT 107 Contemporary Topics in Math (3 credits)
This course is designed to enable the student to recognize, understand and apply various mathematical concepts and principles that are the foundation for many things that we take for granted in our everyday lives, such as Voting, Traveling, Finances, Government and the wonders of Nature.
Attributes: Undergraduate
MAT 128 Applied Statistics (3 credits)
Introduction to statistics and probability: design of a study, measures of central tendency, variability, correlation, regression; probability, random variables, probability distributions, central limit theorem; inferential statistics, hypothesis testing, etc. Students will be required to use a computer software package to solve various statistical problems. Data analysis projects will be assigned. Students may NOT receive credit for both this course and for MAT 118.
Attributes: Undergraduate

MAT 130 Whole Truth about Whole Number (3 credits)
This course involves studying properties of natural numbers and integers. Topics include divisibility, prime numbers, the Euclidean Algorithm and cryptography for putting messages into code.
Prerequisites: Math Placement with a score of BEAUT or Math Placement with a score of MA155 or Math Placement with a score of MA161 or Math Placement with a score of MA162
Attributes: Math Beauty, Undergraduate

MAT 131 Linear Methods (3 credits)
This course studies basic properties and applications of matrices and vectors. Then, matrices and vectors will be used in a variety of applications, including vector geometry, elementary graph theory, solving word problems involving systems of linear equations, least-squares functions, and geometric transformations. The course also covers some topics in basic logic, including logical operators, the conditional, truth tables, quantifiers, and syllogisms. Students in this course will be required to have a graphing calculator that can perform standard matrix operations.
Prerequisites: Math Placement with a score of BEAUT or Math Placement with a score of MA155 or Math Placement with a score of MA161 or Math Placement with a score of MA162
Attributes: Math Beauty, Undergraduate

MAT 132 Math of Games & Politics (3 credits)
This course will focus on both computational and theoretical aspects of probability theory, game theory and social choice theory. Topics include expected value, counting methods and conditional probability, dominant strategies, combinatorial games, Nash equilibria, social dilemmas and, for zero sum games, saddle points and the Minimax theorem. Social choice theory topics include voting methods, weighted voting, fairness criteria and impossibility theorems.
Prerequisites: Math Placement with a score of BEAUT or Math Placement with a score of MA155 or Math Placement with a score of MA161 or Math Placement with a score of MA162
Attributes: Math Beauty, Undergraduate

MAT 133 Math of Games & Politics (3 credits)
This course investigates several beautiful topics within mathematics. Depending on the instructor, these topics might include: prime numbers, the different sizes of infinity, the Platonic solids, the fourth dimension, fractals, chaos, probability, and the math of voting.
Attributes: First-Year Seminar, Undergraduate

MAT 134 Math of Uncertainty:Rules/Prob (3 credits)
This course provides students with an in-depth introduction to probability and its many real-life applications. Students will study counting techniques including permutations, combinations, binomial coefficients, occupancy problems and runs within random orderings and will prove combinatorial identities. Students will study topics in probability including sample spaces, DeMorgan’s Laws, conditional probability, independent events, Bayes Theorem, random variables and expected value. Students will examine many of the classical problems in probability theory including Prisoner’s Dilemma, Gambler’s Ruin and the Birthday Problem as well as lotteries, card games and random walks.
Prerequisites: Math Placement with a score of BEAUT or Math Placement with a score of MA155 or Math Placement with a score of MA161 or Math Placement with a score of MA162
Attributes: Math Beauty, Undergraduate

MAT 135 Sounding Number: Music & Math (3 credits)
Music has many connections to mathematics. The ancient Greeks discovered that chords with pleasing sounds are related to simple ratios of integers. Other connections include equations describing the sounds of musical instruments, the mathematics of digital recording, the use of symmetry in composition, and the systematic exploration of patterns by African and Indian drummers. This course introduces basic concepts in trigonometry, set and group theory, and combinatorics and investigates their applications in the analysis, recording, and composition of music. Along the way, we consider the role of creativity in mathematics and the ways in which mathematics has inspired musicians. The course will involve hands-on laboratory work in audio engineering and music composition.
Prerequisites: Math Placement with a score of BEAUT or Math Placement with a score of MA155 or Math Placement with a score of MA161 or Math Placement with a score of MA162
Attributes: Math Beauty, Undergraduate

MAT 150 First Year Seminar (3 credits)
This course investigates several beautiful topics within mathematics. Depending on the instructor, these topics might include: prime numbers, the different sizes of infinity, the Platonic solids, the fourth dimension, fractals, chaos, probability, and the math of voting.
Attributes: First-Year Seminar, Undergraduate

MAT 155 Fundamentals of Calculus (3 credits)
This course covers the fundamentals of differential calculus (limit, continuity, and the derivative) and introduces the antiderivative and the indefinite integral. In addition, we discuss the historical roots of calculus and the challenges faced in establishing a rigorous logical foundation for its concepts. Students may NOT receive credit for both this course and for any of the following courses: MAT 123 or MAT 161
Prerequisites: MAT 120 or Math Placement with a score of MA162 or Math Placement with a score of MA161 or Math Placement with a score of MA155
Restrictions: Students cannot enroll who have a major in Actuarial Science, Chemistry, Mathematics or Physics.
Attributes: Math Beauty, Undergraduate

MAT 156 Applied Calculus II (3 credits)
This course covers the definite integral, techniques of integration, solving differential equations, power series and Taylor series. Students may NOT receive credit for both this course and for MAT 162.
Prerequisites: MAT 155 or MAT 161
Attributes: Undergraduate
MAT 161 Calculus I (4 credits)
Limits; slopes, rates of change and the derivative; techniques of differentiation; implicit differentiation; derivatives of transcendental functions; related rates; linear approximation; L'Hospital's Rule; the Mean Value Theorem; applications of differentiation (including curve sketching and optimization); introduction to integration; the Fundamental Theorem of Calculus. Students may NOT receive credit for both this course and for any of the following courses: MAT 123 or MAT 155.
Prerequisites: MAT 120 or Math Placement with a score of MA162 or Math Placement with a score of MA161
Attributes: Math Beauty, Undergraduate

MAT 162 Calculus II (4 credits)
Techniques of integration; applications of integration; improper integrals; exponential growth; infinite sequences and series; power series and Taylor series. Students may NOT receive credit for both this course and for MAT 156.
Prerequisites: MAT 161 or Math Placement with a score of MA162
Attributes: Math Beauty, Undergraduate

MAT 170 Special Topics in Mathematics (3 credits)
Topics will vary according to the semester in which the class is offered.
Attributes: Undergraduate

MAT 180 Theory of Numbers (3 credits)
Division Algorithm; Mathematical induction; Euclidean algorithm; fundamental theorem of arithmetic; linear Diophantine equations; modular arithmetic; number theoretic functions; prime numbers; Fermat's last theorem; quadratic residues, primitive roots, Chinese Remainder theorem. This course fulfils the GEP Mathematics requirement and has no prerequisites but is at a slightly more advanced level than courses in the range of MAT 130 - MAT 139.
Attributes: Math Beauty, Undergraduate

MAT 213 Calculus III (4 credits)
Vector geometry in two and three dimensions; polar coordinates; introduction to the calculus of vector-valued functions (velocity, speed, acceleration, curvature, parametric equations); differentiation of functions of several variables (partial derivatives, the differential, chain rules, directional derivatives); applications of differentiation (linear approximation, optimization, the method of Lagrange multipliers); integrals of functions of several variables; applications of integration. Also, if time permits, cylindrical and spherical coordinates; some surface integrals; the Change of Variable theorem.
Prerequisites: MAT 162
Attributes: Math Beauty, Undergraduate

MAT 223 Intro Math of Data Science (3 credits)
This course provides an introduction to basic mathematical topics needed to understand modern areas of applied and theoretical mathematics including the rapidly growing field of data science. It includes elementary set theory and counting techniques, discrete probability, descriptive statistics, simple linear regression, basic inferential statistics, and an introduction to linear algebra. This course will also cover some basic proof techniques in elementary set theory, combinatorics, discrete probability and linear algebra.
Prerequisites: MAT 155 (may be taken concurrently) or MAT 161 (may be taken concurrently) or MAT 180 (may be taken concurrently)
Attributes: Math Beauty, Undergraduate

MAT 225 Fundamental Ideas of Math (3 credits)
An introduction to: (i) the basic ideas used throughout Mathematics—logic, sets, functions, relations, counting principles — and (ii) the fundamental activity of mathematics—proving theorems. Topics include: basic set theory and logic, functions and relations, permutations and combinations, combinatorial proofs, discrete probability, and the Principle of Inclusion-Exclusion. Students may NOT receive credit both for this course and for either of CSC 240 /MED 553.
Prerequisites: MAT 161 or Math Placement with a score of MA162
Attributes: Undergraduate

MAT 226 Introduction to Linear Algebra (4 credits)
Linear systems, vector spaces, dimension, linear transformations, matrices, inner product, orthogonality, characteristic polynomials, diagonalization, eigenvalues, and eigenvectors. Permission of the chair of Mathematics.
Prerequisites: MAT 223 or MAT 225
Attributes: Math Beauty, Undergraduate

MAT 231 The Mathematics of Music (3 credits)
Music has many connections to mathematics. The ancient Greeks discovered that chords with a pleasing sound are related to simple ratios of integers. The mathematics of rhythm has also been studied for centuries—in fact, ancient Indian writers discovered the celebrated Fibonacci sequence in the rhythms of Sanskrit poetry. Other connections between math and music investigated in this course include the equations describing the sounds of musical instruments, the mathematics behind digital recording, the use of symmetry and group theory in composition, the exploration of patterns by African and Indian drummers, the application of chaos theory to modeling the behavior of melodies, and the representation of chords by exotic geometric objects called orbifolds. Along the way, we discuss the role of creativity in mathematics and the ways in which mathematics has inspired musicians. Students with exceptional performance in Calculus I (or AP) and musical training will be admitted on a case-by-case basis as determined by the chair of Mathematics.
Prerequisites: MAT 162 and ART 151
Attributes: Math Beauty, Undergraduate

MAT 232 Chaos, Fractals & Dynamic Syst (3 credits)
Introduction to dynamical systems: one dimensional dynamics; attracting, repelling, periodic and chaotic orbits; bifurcation; dynamics in the complex plane, Julia sets, the Mandelbrot set; two dimensional dynamics. Introduction to fractals: self-similarity, iterated function systems, fractal dimension.
Prerequisites: MAT 156 or MAT 162
Attributes: Math Beauty, Undergraduate

MAT 233 History of Mathematics (3 credits)
Development of mathematical ideas over 2500 years, beginning with Greek geometry and including Euclid, Archimedes, Newton, Euler, Gauss, and Poincare.
Prerequisites: MAT 161 or MAT 155
Attributes: Math Beauty, Undergraduate

MAT 238 Differential Equations (3 credits)
Prerequisites: MAT 213
Attributes: Math Beauty, Undergraduate
MAT 239 Problem Solving (3 credits)
The course is designed to involve students in an active way in the mathematical process by having them participate in the major activity of both pure and applied mathematics: the solving of problems. Problems will be chosen from many areas of mathematics, and an attempt will be made to develop general approaches to and general paradigms for problem solving.
Prerequisites: MAT 223 or MAT 225
Attributes: Math Beauty, Undergraduate

MAT 270 Special Topics in Mathematics (3 credits)
Topics will vary according to the semester in which the class is offered.
Attributes: Undergraduate

MAT 290 Professional Prep Seminar (1 credit)
What can you do with a degree in Mathematics, Computer Science, Information Technology, or Actuarial Science? Do you know how to search for an internship or a job? And, are you ready to apply for a position should the opportunity arise? Have you practiced your elevator pitch? This professional development seminar will enhance students’ knowledge about internships and careers within their major and help them build practical skills through a series of steps and events throughout the semester. This one-credit course meets once a week throughout the semester to provide practical instruction and skills in areas that include internship search and application, resume/cover letter prep, professional communication and networking/interviewing.
Attributes: Undergraduate

MAT 293 Mathematical Symmetry (3 credits)

MAT 311 Numerical Analy & Comp Tech (3 credits)
An introduction to numerical methods for solving a variety of problems. Included will be rootfinding, numerical integration and differentiation, polynomial approximation, systems of equations, ordinary differential equations, and discussion of convergence issues, error analysis and machine arithmetic. Concurrent enrollment in or prior completion of MAT 226 would be beneficial.
Prerequisites: MAT 213
Attributes: Math Beauty, Undergraduate

MAT 313 Mathematical Optimization (3 credits)
The course covers basic ideas in optimization beginning with linear programming, the simplex method and duality and finishes with non-linear optimization and algorithms and conditions leading to a solution of non-linear problems.
Prerequisites: MAT 226
Attributes: Math Beauty, Undergraduate

MAT 316 Operations Research (3 credits)
The course will cover some of the basic models and techniques used in operations research. Topics include: linear programming, the simplex method, duality, network problems, transportation problems, and time permitting, game theory.
Prerequisites: MAT 226
Attributes: Math Beauty, Undergraduate

MAT 321 Probability (3 credits)
The first part of a two-semester sequence, this course includes discrete probability and counting methods, conditional probability and independence, Bayes’ Theorem, discrete and continuous random variables, expectation, variance, moment-generating functions, special probability distributions, joint distributions, marginal and conditional distributions, independent random variables, covariance and correlation, conditional expectations, and distributions of functions of random variables.
Prerequisites: MAT 213 (may be taken concurrently) and (MAT 223 (may be taken concurrently) or MAT 225 (may be taken concurrently))
Attributes: Math Beauty, Undergraduate

MAT 322 Mathematical Statistics (3 credits)
Random samples, sample size, statistics and sampling distributions, the Central Limit Theorem, methods of point estimation including moment matching, percentile matching, maximum likelihood estimation, main properties of point estimators, asymptotic properties of MLE, evaluation of goodness of a point estimator, Rao-Blackwell theorem, UMVUE, interval estimation, hypothesis testing, power of tests, the Neyman-Pearson lemma, regression analysis, analysis of variance, categorical data analysis (Chi-square test). Data analysis projects will be assigned.
Prerequisites: MAT 321
Attributes: Undergraduate

MAT 325 Essentials of Data Science (3 credits)
This course covers the basic topics in data science. It includes descriptive and inferential statistics, introduction to simple and multiple regression, data visualization, and data cleaning or scrubbing. It also includes an introduction to machine learning topics such as decision trees, k-nearest neighbors, neural networks and clustering. The R software or the Python programming language will be used to visualize and analyze datasets.
Prerequisites: MAT 225 or (MAT 128 and MAT 155)
Attributes: Math Beauty, Undergraduate

MAT 332 Geometry (3 credits)
Prerequisites: MAT 155 or MAT 161
Attributes: Math Beauty, Undergraduate

MAT 334 Combinatorics & Graph Theory (3 credits)
Introduction to combinatorics and graph theory and to methods by which each theory is applied to the other. Topics include basic counting formulas; generating functions; the principle of inclusion-exclusion; counting labeled trees (Cayley’s Theorem, Kirchhoff’s Theorem, Prüfer’s Theorem); directed Euler circuits; Pólya-deBruijn theory; Möbius inversion.
Prerequisites: MAT 162
Attributes: Math Beauty, Undergraduate

MAT 336 Logic & Foundations (3 credits)
Cantorian set theory and the crisis in foundations (Cantor’s paradox, Russell’s paradox); the intuitionist challenge and the formalist response; formal logic and meta mathematics (Propositional Calculus, Predicate Calculus, formal number theory); Goedel’s incompleteness theorems of 1931.
Prerequisites: MAT 162
Attributes: Math Beauty, Undergraduate
MAT 370 Special Topics in Mathematics (3 credits)
Topics will vary according to the semester in which the class is offered.
Attributes: Undergraduate

MAT 403 Abstract Algebra (3 credits)
Group theory, including finite groups, subgroups, cyclic groups, permutation groups, group isomorphisms, and cosets; introduction to rings and fields, including integral domains, polynomial rings, unique factorization domains and Euclidean domains.
Prerequisites: MAT 223 or MAT 225
Attributes: Undergraduate

MAT 404 Abstract Algebra II (3 credits)
A more in-depth treatment of rings and fields including integral domains, fields, field extensions, homomorphisms, and the insolvability of the quintic by radicals. Galois theory.
Prerequisites: MAT 403
Attributes: Math Beauty, Undergraduate

MAT 409 Real Analysis (3 credits)
Elementary topology of Euclidean spaces, including open, closed and compact sets; convergence of sequences and series; least upper bound axiom and its equivalents; sequences of functions, pointwise and uniform convergence, continuity, differentiation and integration of sequences.
Prerequisites: MAT 223 or MAT 225
Attributes: Math Beauty, Undergraduate

MAT 410 Complex Analysis (3 credits)
Analytic functions; complex integration; singularities.
Prerequisites: MAT 409
Attributes: Math Beauty, Undergraduate

MAT 415 Differential Geometry (3 credits)
The local and global theory of curves and surfaces in Euclidean space. Topics include Frenet frames, orientation, geodesics, the second fundamental form, and Gauss curvature.
Prerequisites: MAT 226 and MAT 409
Attributes: Math Beauty, Undergraduate

MAT 418 Topology of Point Sets (3 credits)
Open and closed sets, closure and interior, continuity, metric spaces, connectivity, compactness; the Heine-Borel and Bolzano-Weierstrass Theorems. The Classification of Surfaces may also be covered.
Prerequisites: MAT 409
Attributes: Undergraduate

MAT 423 Applied Statistical Methods (3 credits)
Statistical models, design and analysis of experiments, regression, Monte Carlo methods, and other advanced topics in statistics.
Prerequisites: MAT 156 or MAT 162
Attributes: Math Beauty, Undergraduate

MAT 424 Regression and Time Series (3 credits)
The first part of the course covers Generalized Linear Models (GLMs). Topics include exponential family, important link functions, estimations (maximum likelihood estimation, generalized moment matching), diagnostic tests for model validations (graphical methods, chi-square statistics, t and F tests, AIC and BIC, likelihood ratio test), applications of GLMs on real data, prediction and confidence intervals. It also includes penalized regression (ridge and lasso regression, k-nearest neighbors algorithm). The second part of the course covers Time Series Analysis. Topics include an introduction to discrete stochastic processes, random walks, stationary processes, autocorrelation functions, and partial autocorrelation functions, various time series models (exponential smoothing, autoregressive (AR) model, moving average (MA) model, ARMA model), autoregressive conditional heteroskedastic (ARCH) model, generalized ARCH (GARCH) model, variants of GARCH, predictions and their confidence intervals using time series models.
Prerequisites: MAT 322
Attributes: Math Beauty, Undergraduate

MAT 425 Machine Learning/Data Science (3 credits)
This course provides an introduction to the fields of Machine Learning, Data Science and Predictive Analytics. It includes linear regression, logistic regression, nearest neighbor methods, decision trees, neural networks, clustering, principal components analysis, and resampling methods such as cross-validation and bootstrapping. If time permits, it will also include support vector machines, deep learning methods, and machine learning methods for numerical optimization such as genetic and evolutionary algorithms and swarm intelligence algorithms. The R software will be used to apply statistical and machine learning methods to real data sets. Whenever appropriate, the mathematical background of machine learning methods will be covered. Students will be required to work on a final data analysis project and present their findings in class. This course and MAT 424 (Regression and Time Series) together cover the topics in the SOA (Society of Actuaries) exam in SRM (Statistics for Risk Modeling) and provide an intro to the PA (Predictive Analytics) exam. Also, this course and MAT 424 cover several topics in the CAS (Casualty Actuarial Society) exams in MAS (Modern Actuarial Statistics) I and II.
Prerequisites: MAT 223
Attributes: Math Beauty, Undergraduate

MAT 470 Topics in Mathematics (3 credits)
Topics will vary according to the semester in which the class is offered.
Attributes: Undergraduate

MAT 471 Independent Study (3 credits)

MAT 472 Independent Study (3 credits)

MAT 491 Mathematics Internship I (3 credits)
The course goals are: to gain first-hand experience of the daily activities of professionals in mathematics and related fields, to verify an interest in a particular area of mathematics, to develop and hone skills required for mathematical professions, to establish contacts outside the academic community who will facilitate a career in mathematics. An internship journal and an academic paper are also required.

MAT 492 Mathematics Internship II (3 credits)
The course goals are: to gain first-hand experience of the daily activities of professionals in mathematics and related fields, to verify an interest in a particular area of mathematics, to develop and hone skills required for mathematical professions, to establish contacts outside the academic community who will facilitate a career in mathematics. An internship journal and an academic paper are also required.
MAT 493 Independent Research (3 credits)
Students need to complete the application form for independent study (available in the Dean's Office) and have the approval of the department chair and Associate Dean in order to register. Honors Research (6 credits) must be elected in junior year to allow adequate research time. Students need to complete the application form for independent study (available in the Dean's Office) and have the approval of the department chair, Associate Dean and the Honors Program Director in order to register. Honors Students must complete this sequence.
Attributes: Math Beauty, Undergraduate

MAT 494 Independent Research (3 credits)
Students need to complete the application form for independent study (available in the Dean's Office) and have the approval of the department chair and Associate Dean in order to register. Honors Research (6 credits) must be elected in junior year to allow adequate research time. Students need to complete the application form for independent study (available in the Dean's Office) and have the approval of the department chair, Associate Dean and the Honors Program Director in order to register. Honors Students must complete this sequence.
Attributes: Math Beauty, Undergraduate