MATHEMATICS

Department Chair: Anne Sinko

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Math Center Director: Brian Nyholm

The Mathematics Department offers courses to fit the needs of a wide variety of students: the student majoring in mathematics, the student majoring in another field who needs supporting courses in mathematics, and the general liberal arts student.

Since a knowledge of mathematics can be useful in disciplines as diverse as biology, philosophy and economics, the Mathematics Department offers a number of options to students. The major offerings are flexible enough to prepare students for further study in graduate school, for a career in secondary education, for a career as an actuary or data scientist, or for a career in business or industry. A student majoring in another discipline may choose to minor in Mathematics. A major in Elementary Education may choose a minor in Mathematics or the concentration designed especially for elementary teachers. (See the Education Department (https://catalog.csbsju.edu/catalog/academic-departments/education/) listing for more information.)

In addition to the formal courses described below, there are many other opportunities available for students interested in mathematics. An individual learning project on a topic of mutual interest can be designed with the assistance of a faculty member. The department supports students to engage in summer research in mathematics and related mathematical sciences, through a generous stipend program. Opportunities are available to combine the summer research with a Distinguished Thesis. An active student math club and a local chapter of Pi Mu Epsilon (a national honor society for students of mathematics) cooperate with the Mathematics Department to offer a rich program of seminars, films, visiting speakers, career information and social activities. Each spring the department hosts a regional Pi Mu Epsilon conference at which students and faculty from several colleges gather at Saint Benedict's and Saint John's for two days of presentations by students and invited speakers.

Each semester, the Mathematics Department employs students paid on an hourly basis as calculus teaching assistants, course assistants, and tutors. Calculus teaching assistants grade papers and, in consultation with the course instructor, supervise the calculus labs. Those labs, which meet regularly, provide students with additional opportunities to discuss course material and to practice problem-solving skills. Course assistants grade papers for lower division classes other than calculus I and II. Tutors give individual help to students at the Math Center.

Mathematics in the Integrations Curriculum

Mathematics, both as a skill and as a theoretical structure has played a crucial role in modern civilization and the everyday lives of individuals. Therefore, all students will be required to take and pass one course which satisfies the common curriculum requirement in mathematics, and students may opt to take a mathematics course to fulfill the Abstract Structures requirement for the Integrations curriculum. While different courses cover different topics, all courses meeting the requirement stress mathematics as a conceptual discipline and address its contemporary role. These courses will also enable students to understand and appreciate the power and limitations when using mathematical reasoning, its language, and notation to solve a variety of problems from other disciplines and from everyday life. Students enrolled in our courses are actively involved in doing mathematics.

We offer two 2-credit support courses for students who would prefer a review of mathematics. Students who wish to eventually take calculus will take Math 115, and most other students will take Math 111 if they wish to review material.

Majors

- Mathematics Major (https://catalog.csbsju.edu/catalog/academic-departments/mathematics/mathematics-major/)
- Mathematics Major - Secondary Education (https://catalog.csbsju.edu/catalog/academic-departments/mathematics/mathematics-major-secondary-education/)

Minors

- Mathematics Minor (https://catalog.csbsju.edu/catalog/academic-departments/mathematics/mathematics-minor/)

MATH 111 Pre-Statistics and Modeling (2 Credits)
For students who wish to further their mathematical and problem-solving skills, with emphasis on questions relevant to statistics and finite mathematics. Students will: create and interpret data from graphs and tables; understand several representations of quantitative data and articular the connections among them; use and understand mathematical notation; model relationships in data with linear functions and graphs; apply basic counting principles to elementary discrete probability.
Prerequisites: None
Equivalent courses: ACSC 111, COLG 105K

MATH 114 Mathematics Exploration (4 Credits)
A course to enrich the students' liberal arts education by presenting the spirit and some insights of mathematics. The course will emphasize understanding over techniques. Topics will illustrate the nature of contemporary mathematics and the relationship between mathematics and our cultural heritage. Some possible topics include: algorithms, exotic geometries, finance, map coloring, graphs, groups and mathematical modeling
Prerequisites: None
Equivalent courses: HONR 270B
Attributes: Abstract Structures (AS), Thematic Encounter1/2 - Truth, Thematic Encounter1/2-Justice, Thematic Encounter1/2-Movement

MATH 114A Islamic Art: Where Geometry and Culture Meet (4 Credits)
This course combines classroom learning at CSB/SJU during CD mod and ends with an experiential component abroad. A course to enrich the students' liberal arts education by presenting the spirit and some insights of mathematics. The course will emphasize understanding over techniques. Topics will illustrate the nature of contemporary mathematics and the relationship between mathematics and our cultural heritage. Some possible topics include: algorithms, exotic geometries, finance, map coloring, graphs, groups and mathematical modeling.
Prerequisites: (ACT Math with a score of 17 or Quantitative Skills Inventory with a score of 25 or SAT Mathematics with a score of 470 or SAT R Math with a score of 470)

MATH 115 Pre-Calculus Mathematics (2 Credits)
Properties of polynomial, trigonometric, exponential functions. For the student who needs further preparation for calculus. Prerequisites: three years of college preparatory mathematics.
Prerequisites: None
Equivalent courses: MATH 115Z

MATH 118 Essential Calculus (4 Credits)
Preliminary concepts; derivatives, integrals and the concept of limit; application of differentiation and integration; calculus of several variables; exponentials, logarithms and growth problems. Other topics may include differential equations and probability theory.
Prerequisites: (ACT Math with a score of 21 or Math Proficiency - SAT with a score of 530 or Quantitative Skills Inventory with a score of 25 or SAT Mathematics with a score of 530 or SAT R Math with a score of 530)
Equivalent courses: MATH 123
Attributes: Abstract Structures (AS), Thematic Encounter1/2-Movement

MATH 119 Calculus I (4 Credits)
Definition and nature of limits, continuity, derivatives of polynomial, algebraic and trigonometric functions and applications. Definite integrals and application..
Prerequisites: None
Corequisites: MATH 119L
Equivalent courses: MATH 119AC, MATH 119Z
Attributes: Abstract Structures (AS), Thematic Encounter1/2-Movement

MATH 119L Calculus I Lab (0 Credits)
Prerequisites: None
Corequisites: MATH 119

MATH 120 Calculus II (4 Credits)
Continuation of applications of the integral. Infinite series, Taylor's theorem, methods of integration, introduction to functions of several variables. Additional topics may include complex numbers, polar coordinates, parametric equations, approximation methods, differential equations.
Prerequisites: MATH 119 or MATH 119Z or MATH 119AC
Corequisites: MATH 120L
Equivalent courses: MATH 120AC, MATH 120Z
Attributes: Abstract Structures (AS), Thematic Encounter1/2-Movement

MATH 120L Math II Lab (0 Credits)
Prerequisites: None
Corequisites: MATH 120

MATH 121 Fundamentals of Mathematics I (4 Credits)
Basic concepts of sets, numeration, structure of number systems, arithmetic and algebraic operations, problem solving, and other topics to prepare students for elementary school mathematics teaching.
Prerequisites: None
Restrictions: Enrollment is limited to students with a major in Elementary Education.
Attributes: Abstract Structures (AS)

MATH 122 Finite Mathematics (4 Credits)
Mathematics for students in the life, social and management sciences. Topics chosen from symbolic logic, set theory, combinatorial analysis, probability, linear equations, vectors, matrices, mathematics of finance, linear programming, Markov chains and matrix games.
Prerequisites: (ACT Math with a score of 21 or Quantitative Skills Inventory with a score of 25 or SAT Mathematics with a score of 530 or SAT R Math with a score of 530 or Stats & Modeling QSI with a score of 17 or MATH 111)

MATH 124 Probability and Statistical Inference (4 Credits)
Graphs and charts, mean, median and other measures of location. Terminology and rules of elementary probability; normal distribution, random sampling, estimation of mean, standard deviation and proportions, correlation and regression, confidence intervals, tests of hypotheses.
Prerequisites: None
Equivalent courses: HONR 260A, MATH 124AC
Attributes: Abstract Structures (AS), Quantitative Reasoning (QR), Thematic Encounter1/2 - Truth

MATH 125 Discrete Mathematical Modeling (4 Credits)
This course is an introduction to mathematical modeling based on the use of elementary functions to describe and explore real-world phenomena and data. Linear, exponential. Logarithmic and polynomial function models are examined closely and are applied to real-world data in course assignments. Students will study three main areas of modeling: optimization, dynamical systems and probability theory using discrete models and methods. Examples of topics covered may include Linear Programming, Population Growth, Mathematics of Finance, Regression (linear and non-linear), Probability distributions, and Markov Chains.
Prerequisites: None
Attributes: Abstract Structures (AS), Quantitative Reasoning (QR), Thematic Encounter1/2 - Truth

MATH 127 Number Systems (1 Credits)
Topics to include sets, functions, other number bases, elementary number theory, rational and irrational numbers and problem solving strategies related to these topics. Intended for Elementary Education majors. who have completed Math 118, Math 119 or the equivalent, with a grade of C or better.
Prerequisites: MATH 118 or MATH 119 or MATH 119Z
Restrictions: Enrollment is limited to students with a major in Elementary Education.

MATH 180 Fundamentals of Mathematics II (4 Credits)
Continuation of 121. Probability and statistics, geometry, discrete mathematics including combinatorics and graph theory, and other topics to prepare students for middle school mathematics teaching.
Prerequisites: MATH 121
Attributes: Abstract Structures (AS), Thematic Encounter1/2 - Truth

MATH 220 Calculus III (4 Credits)
Multivariable calculus. Partial derivatives and multiple integrals. Green's, Stokes, and divergence theorems. Fourier series and transforms.
Prerequisites: MATH 120

MATH 239 Linear Algebra (4 Credits)
Systems of linear equations, matrices and matrix operations, vector spaces, subspaces, linear independence, basis and dimension, linear transformations, eigenvalues and eigenvectors, inner products, elementary proofs appropriate to o the course content, and selected applications.
Prerequisites: MATH 119 or MATH 119Z or MATH 120
Attributes: Abstract Structures (AS)

MATH 271 Individual Learning Project (1-4 Credits)
Supervised reading or research at the lower-division level. Permission of department chair required. Consult department for applicability towards major requirements. Not available to first-year students.
Prerequisites: None

MATH 279A Mathematical Problem Solving (4 Credits)
This course will focus on techniques that will help you solve mathematics problems you have never seen before. The focus will be on heuristics and strategies, rather than new mathematical ideas.
Prerequisites: You must take INTG 100 or 205 prior to taking a Thematic Focus Course. You must take a Cultural and Social Difference: Identity (CI) course prior to or at the same time as Thematic Focus Courses.
Attributes: Abstract Structures (AS), Experiential Engagement (EX), Thematic Focus - Truth

MATH 304 Foundations and Structures of Mathematics (4 Credits)
The basic theme of this course is mathematical thinking and writing. Emphasis will be placed on formulating and writing proofs. The course will cover topics in the following areas: logic, sets, relations, functions, counting, graph theory, infinite sets, algebraic structures and the real number system. Additional topics as time permits.
Prerequisites: MATH 119 or MATH 119Z
Equivalent courses: MATH 241
Attributes: Abstract Structures (AS), Thematic Encounter3 - Truth

MATH 305 Multivariable Calculus (4 Credits)
Topics selected from Geometry of Rn, differentiation in Rn, vector-valued functions, optimization, multiple integrals, line and surface integrals, vector analysis and introduction to differential forms. Fall.
Prerequisites: MATH 239

MATH 306 Differential Equations and Linear Algebra (4 Credits)
The concept of a solution, tangent fields, the existence and uniqueness theorem and its implication, elementary solution techniques, and series and numerical solutions to differential equations. Also linear equations, and systems, matrices, and matrix operations, eigenvalues, and eigenvectors.
Prerequisites: MATH 120

MATH 307 History of Mathematics (1-4 Credits)
Advanced level independent guided readings, discussions and written projects on the history of mathematics.
Prerequisites: None

MATH 315 Applied Optimization (4 Credits)
Topics selected from: linear programming, duality theory, dynamic and integer programming, graph-theoretic methods, stochastic processes, queuing theory, simulation, non-linear programming, PERT/CPM. Applications to social and natural sciences and business. Students will solve problems that involve real-world data.
Prerequisites: MATH 239 or MATH 306

MATH 318 Applied Statistical Models (4 Credits)
The relationships among variables in real data sets will be explored through the theory and application of linear models. The focus of the course will be on building such models, assessing their adequacy, and drawing conclusions. Statistical computing programs will be used to analyze the data. Spring in even years.
Prerequisites: MATH 239 or MATH 306

MATH 322 Graph Theory (4 Credits)
Basic graph theory including trees, planarity, and vertex colorings. Additional topics at the discretion of the instructor. Recommended MATH 239 or 304 prior to enrollment. Spring in odd years.
Prerequisites: MATH 239 or MATH 279A or MATH 306

MATH 331 Algebraic Structures I (4 Credits)
Definitions and basic properties of sets and relations, groups, rings, ideals, integral domains, fields, algebras and applications. Spring and fall in even years.
Prerequisites: (MATH 306 or MATH 239) and (MATH 304)
Restrictions: Students with the 2026-2027 Registration Cohort attribute may not enroll.

MATH 332 Algebraic Structures II (4 Credits)
Continuation of 331, additional topics in Algebra such as: Sylow theorems, coding theory, free groups, Euclidean rings, extension fields, Galois theory, categories, functors, tensor products.
Prerequisites: MATH 331

MATH 333 Geometry I (4 Credits)
Foundations of geometry, study of axiom systems for finite geometries and Euclidean geometry, topics in synthetic geometry; introduction to hyperbolic and other geometries. Geometric transformation theory and classification of geometries by transformation groups.
Prerequisites: MATH 239 or MATH 306
Attributes: Thematic Encounter3 - Truth

MATH 335 Coding Theory and Cryptography (4 Credits)
This course studies mathematical concepts underlying two pillars of modern information security: coding theory and cryptography. Both theoretical and practical aspects of those mathematical concepts will be addressed. Topics may include finite fields, error-correcting and error-detecting, linear codes, cyclic codes, probabilistic algorithms, Diffie-Hellmann schemes, RSA and elliptic curve schemes, post-quantum cryptography.
Prerequisites: MATH 239 or MATH 306 or CSCI 239

MATH 337 Differential Equations (4 Credits)
The concept of a solution, tangent fields, the existence and uniqueness theorem and its implications, elementary solution techniques, series and numerical solutions, linear equations and systems, Laplace transforms, applications. Spring.
Prerequisites: MATH 239
Attributes: Abstract Structures (AS), Thematic Encounter3 - Movement

MATH 338 Numerical Methods (4 Credits)
Numerical algorithms and error estimations, solutions of linear and nonlinear equations and systems, numerical solutions of differential equations, numerical integration, interpolation and approximation techniques, matrix methods and power series calculations.
Prerequisites: MATH 239 or MATH 306

MATH 339 Mathematical Modeling (4 Credits)
Mathematical modeling is the art of finding mathematical descriptions of real-world phenomena, with the goal of attaining a deeper understanding of those phenomena. The mathematical tools will vary according to the application. This course will cover both continuous and discrete mathematical models. Applications will be drawn from a variety of fields, such as population dynamics, economics, and physical sciences. Fall in odd years.
Prerequisites: MATH 239 or CSCI 239 or MATH 306

MATH 340A Mathematical Modelling in Biology (4 Credits)
Traditional approaches to mathematical modelling in biology have relied primarily on differential equations models. However, new approaches have and are being developed that rely instead on discrete methods, such as those coming from graph theory, polynomial manipulation and elementary linear algebra. For example, gene regulatory networks have been successfully modelled using Boolean logic. The spread of tick-borne diseases and methods of control have been well described using agent-based models. Graph theoretic models have been used to explore aspects of neuronal network connectivity. This course will survey a variety of discrete modelling approaches, including Boolean models, polynomial dynamical systems, graph theory, agent based modelling, and hidden Markov models. Emphasis will be on examples and applications, which will be drawn from various areas of biology, including problems in gene regulation, population dynamics and neuroscience. The necessary mathematical background will be included in the course.
Prerequisites: MATH 239
Equivalent courses: BIOL 373L

MATH 340C A Mathematician's Guide to Music (4 Credits)
What's so special about sine waves and to what extent can sound be broken into sine waves? Why does the modern scale have twelve notes and are there other (mathematical) possibilities? How does a violin produce sound, and why is it so different from the way a clarinet or a drum produces sounds? We will answer these and other questions regarding the connections between music and mathematics. Topics will include, but are not limited to, Fourier analysis, consonance and dissonance, modeling different types of instruments, scales, temperaments, and symmetry in music.
Prerequisites: MATH 239

MATH 340D History of Geometry & Algebra (4 Credits)
Geometric and algebraic thinking have been at the heart of mathematics throughout its 4000 year history. While other courses mention what previous mathematicians accomplished, they too rarely consider how those mathematicians approached the mathematics. We will delve into translations of original mathematical texts, seeking to understand how mathematics developed. Some past insights turned out to be dead ends, some needed centuries to bear fruit. Our sources will range from problems found in Babylonian clay tablets to Archimedes' elegant proofs on to Descartes' fusion of algebra and geometry and beyond, with many stops on the way. An historical approach can provide insight to all mathematics majors and will especially benefit future high school teachers.
Prerequisites: MATH 239 or MATH 239Z

MATH 340E Knot Theory (4 Credits)
One of the better jokes about Knot theory is that students enjoy it because it's "not theory"! But if it's "not theory" what is it? Knot theory is a relatively new branch of mathematics with historical roots reaching back to the late nineteenth century. The main project of Knot Theory is to devise mathematical tests for distinguishing one knot from another. Investigators in knot theory use ideas and techniques from several important branches of mathematics--primarily topology, algebra and combinatorics--to get some insight into the fundamental classification problem. In this course our first task will be to devise a careful definition of a knot; the rest of the course will be devoted to learning about various properties of knots and practicing the various mathematical techniques which are used to describe and distinguish them. Toward the end of the course we'll take time to learn about some of the current applications of knot theory in biology, chemistry and physics.
Prerequisites: MATH 239 or MATH 239Z

MATH 340G A Study of the Game Lights Out (4 Credits)
The game LIGHTS OUT! is played on a 5 × 5 square grid of buttons; each button may be on or off. Given an initial configuration of buttons that are on, the object of the game is to turn all the lights out. Pressing a button changes the on/off state of the button pressed and of all its vertical and horizontal neighbors. In this course, we will explore topics in graph theory and linear algebra to help us investigate the game applied to graph families such as paths, cycles, and complete graphs before looking at the game applied to Cartesian Product graphs. Finally, we will explore a graph family that the game has never been applied to.
Prerequisites: MATH 239

MATH 340H PICMath (4 Credits)
Students will work in groups on a problem from the industrial, government, or non-profit sector. Contact instructor regarding prerequisites and enrollment.
Prerequisites: MATH 239

MATH 343 Analysis I (4 Credits)
Set theory, real numbers, topology of Cartesian spaces, Heine-Borel Theorem, sequences, series, convergence, continuity, differentiation, integration. Spring and fall in odd years.
Prerequisites: (MATH 120 or MATH 120Z) and MATH 304
Restrictions: Students with the 2025-2026 Registration Cohort or 2026-2027 Registration Cohort attributes may not enroll.

MATH 344 Analysis II (4 Credits)
Topics selected from the following: mapping theorems and extremum problems, Riemann-Stieltjes integral, main theorems of integral calculus, point set topology, Lebesque integral, functions defined by integrals, convergence theorems.
Prerequisites: None

MATH 345 Mathematical Statistics I (4 Credits)
Probability spaces, random variables, statistics and sampling distributions, statistical hypotheses and decision theory, statistical inference, estimation. Offered Fall.
Prerequisites: MATH 120 or MATH 120Z

MATH 346 Mathematical Statistics II (4 Credits)
Topics selected from the following: sampling, order statistics, Monte Carlo methods, asymptotic efficiencies, maximum likelihood techniques, inference, multivariate normal, analysis of variance, regression, correlation. Spring in odd years.
Prerequisites: MATH 345

MATH 348 Complex Variables (4 Credits)
Topics will generally include properties of complex numbers; complex functions and their derivatives; analyticity; Cauchy's Theorem and related results; series representations of functions; contour integration and the theory of residues. Additional topics at the discretion of the instructor. Spring in even years.
Prerequisites: MATH 120 or MATH 120Z

MATH 349 Financial Mathematics (4 Credits)
An introduction to mathematical and numerical models used to price financial securities and make risk estimates. Topics include time value of money, annuities and cash flows, loans, bonds, general cash flows and portfolios, immunization, derivatives, options, swaps, and hedging and investment strategies. It is a course for students interested in understanding how mathematical models are used in financial and actuarial work.
Prerequisites: (MATH 120 or MATH 120Z) and (MATH 239 or MATH 306)

MATH 357 Game Theory (4 Credits)
This course is the mathematical study of games. We will consider two types of games in this course: combinatorial and strategic interaction. Examples of combinatorial games are chess, Go, tic-tac-toe, and Nim, whereas the standard example of a strategic interaction is the prisoner's dilemma. Much of the focus will be determining the best strategy for a game, and then providing an explanation about why that strategy is, in fact, the best.
Prerequisites: MATH 279

MATH 370 SCSU/SABRO COURSES (1-4 Credits)
Prerequisites: None

MATH 371 Individual Learning Project (1-4 Credits)
Supervised reading or research at the upper-division level. Permission of department chair and completion and/or concurrent registration of 12 credits within the department required. Consult department for applicability towards major requirements. Not available to first-year students.
Prerequisites: None

MATH 395 Mathematics Capstone (2 Credits)
Critical analysis of readings or topics and/or an in-depth investigation leading to a project. The course will be structured as a seminar. The instructor will select the subject matter. Students will present and discuss the material of the course, and complete regular assignments (short papers or problem sets).
Prerequisites: MATH 239 and (MATH 241 or MATH 304)

MATH 397 Internship (1-16 Credits)
Completed Application for Internship Form REQUIRED. See Internship Office Web Page.
Prerequisites: None
Attributes: Experiential Engagement (EX)