



Faculty

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Degrees and Programs

Mathematics, B.S.	133
Biomathematics, B.S.	134
Teaching Credential	135
Mathematics, Minor	135

The *Mathematics Department* provides courses for future mathematicians, teacher education, general education, and programs in other departments. A common goal of each course is that students will develop problem-solving skills based on mathematical reasoning and understanding, not merely rote memorization. Small class sizes promote communication and teamwork opportunities among students and faculty.

Students majoring in mathematics will have experience with mathematical modeling, abstraction, generalization, logical analysis, and mathematical technology. Students may select courses in order to focus on pure mathematics, applied mathematics, mathematics education, or actuarial certification. The major advisor will assist students with the selection of appropriate courses for each area of focus.

The biomathematics major is an attractive way to prepare for medical or dental school. The major provides excellent preparation for graduate study leading to a Master's Degree in Public Health with emphasis in statistical analysis. A growing area of biological research uses sophisticated mathematics to study genetics, population fluctuations, and metabolic functions. This major provides entry to such graduate programs as Biomathematics, Biostatistics, Mathematical Biology, and Biometrics.

Major in Mathematics, B.S.

A minimum of 68 hours (at least 29.5 upper-division hours)

► Required Core Courses (46 hours):

MATH 131+132	Calculus I, II	4+4
MATH 265	Elementary Linear Algebra	4
MATH 267	Multivariable Calculus	5
MATH 269	Elementary Differential Equations	4
MATH 275	Logic and Sets	4
MATH 290	Sophomore Seminar	.5
MATH 331	Theory of Probability & Statistics	4
MATH 351	Introduction to Abstract Algebra I	4
MATH 385	Mathematical Modeling	4
MATH 421	Elementary Real Analysis I	4
MATH 390+490	Seminar + Senior Seminar	.5 + 1

At least one of the following courses: 3

MATH 352	Introduction to Abstract Algebra II (3)
MATH 422	Elementary Real Analysis II (3)

► Required Core Electives (15 hours):

At least 15 hours of additional MATH courses, 15
of which at least 10 hours must be upper-division.

► Required Cognate Courses (7-9 hours):

INFS 115	Intro to Computer Programming	4
At least one of the following courses: 3-5		
CHEM 451	Physical Chemistry (3)	
FIN 341	Finance (5)	
INFS 470	Business Analytics (4)	
PHYS 211	Physics with Calculus (4)	
PHYS 216	Circuit Analysis (4)	
STAT 322	Statistical Methods (3)	

All core and cognate courses should be chosen in consultation with the major advisor. In selecting courses, students are encouraged to consider the recommendations on the next page:

Mathematics

Major in Biomathematics, B.S.

A minimum of 86 hours (29.5 upper-division hours)

► Required Core Courses (68.5 hours):

BIOL 112+111+113	Biological Foundations II, I, III	5+5+5
BIOL 222	Introduction to Research Methods	2
CHEM 111+111L	General Chemistry I + Lab	4+1
CHEM 112+112L	General Chemistry II + Lab	4+1
CHEM 113+113L	General Chemistry III + Lab	4+1
INFS 115	Intro to Computer Programming	4
MATH 131+132	Calculus I, II	4+4
MATH 265	Elementary Linear Algebra	4
MATH 269	Elementary Differential Equations	4
MATH 275	Logic and Sets	4
MATH 290	Sophomore Seminar	.5
MATH 384	Biomathematics	4
MATH 385	Mathematical Modeling	4
MATH 390+490	Seminar + Senior Seminar	.5 + 1
STAT 322	Statistical Methods	3

► Required Core Electives (17 hours):

At least 17 hours from the following courses: 17

(Include at least one MATH course and two BIOL courses)

BIOL 320	Cell and Molecular Biology (4)
BIOL 328	Animal Behavior (4)
BIOL 331	Marine Science (4)
BIOL 338	Field Biology (3)
BIOL 348	Systems Physiology (5)
BIOL 354	Genetics (4)
BIOL 430	Neurobiology (4)
BIOL 469	Immunology (4)
CHEM 371+371L	Organic Chemistry I + Lab (3+1)
CHEM 372+372L	Organic Chemistry II + Lab (3+1)
MATH 331	Theory of Probability & Statistics (4)
MATH 351+352	Intro to Abstract Algebra I, II (4+3)
MATH 421+422	Elementary Real Analysis I, II (4+3)
MATH 425	Complex Analysis (4)
MATH 465	Linear Algebra (4)

Recommended Cognate Courses:

CHEM 373+373L	Organic Chemistry III + Lab (3+1)
CHEM 481	Biochemistry I (4)
PHYS 111+112+113	General Physics I, II, III (4+4+4)
or PHYS 211+12+13	Physics with Calculus I, II, III (4+4+4)

Many of the core and elective courses for this major carry pre-requisites. All courses should be chosen and sequenced in consultation with the major advisor.

Recommended Courses

Pure Mathematics

A focus on pure mathematics can lead to careers in university teaching and research following graduate studies in mathematics and related areas, such as statistics, computer science, and physics.

Recommended courses: MATH 267, MATH 352, MATH 422, MATH 425, and MATH 465.

Applied Mathematics

A focus on applied mathematics is a path to careers in medicine, government, business, and industry following graduate study in such areas as computational biology, operations research, and applied statistics. Recommended courses: STAT 322, INFS 470, a minor or second major in an applied field such as Biology, Business Administration, or Psychology.

Mathematics Education

A focus on mathematics education is a major component in a program of studies leading to the California Teaching Credential in secondary school mathematics. Recommended courses: MATH 341, MATH 354, MATH 385, and MATH 451.

Actuarial Certification

Actuarial certification can lead to careers in the insurance and investment industry, where actuaries use a broad knowledge of statistics, finance, and business. Recommended courses for students interested in preparing for the national examinations for actuarial certification: MATH 267, STAT 322, and INFS 470.

Teaching Credential

Students desiring to enter a program of studies leading to a California teaching credential in mathematics should take the B.S. degree in Mathematics and complete the recommended courses for the Mathematics Education focus. Students will need to pass the mathematics portion of the CSET exam one quarter prior to doing full-time student teaching. Students are invited to discuss the program with their major advisor in the Mathematics Department.

Those who plan to teach on the secondary level should consult with the credential analyst in the Education Department and should become acquainted with the specific requirements for admission to and successful completion of the Teacher Education Program as outlined in the section entitled "Education" in this catalog.

Minor in Mathematics

A minimum of 27 hours (6 upper-division hours)

Take at least 27 hours (6 upper-division) chosen from any non-service MATH courses. STAT 322 may also apply to the minor.

Mathematics

SERVICE COURSES:

(Not applicable to a major or minor in this department)

MATH 095+096 4+4 F, W, S
Basic Algebra I, II

Basic concepts and techniques of algebra for students without recent experience in algebra.

MATH 095 includes integers, algebraic expressions, first degree equations and inequalities, simple rational expressions and proportions, integer exponents, scientific notation, functions, graphs, and solutions of linear equations and systems.

MATH 096 includes factoring, functions, rational and radical expressions, integer exponents and square roots, complex numbers, and solutions of quadratic and rational equations. Prerequisite: MATH 095 or equivalent.

MATH 106 4 F, W, S
College Algebra

Begins with a quick review of basic algebra, including rational exponents and radicals, complex numbers, linear and quadratic equations, and inequalities. Also includes polynomial and rational functions, composition and inverse of functions, exponentials and logarithms, systems of equations, and arithmetic and geometric progressions. Other topics may include further study of polynomials and/or linear programming. Prerequisite: Algebra II or Integrated Math III in secondary school (C- or above) or MATH 096.

MATH 113 2 S
Trigonometry

A study of the six trigonometric functions and their relationships to one another, as well as the study of applications involving these six functions. Included are degree and radian measure, right triangle trigonometry, graphs of the trigonometric functions, inverse trigonometric functions, fundamental identities, addition identities, double-angle and half-angle identities, solutions of trigonometric equations, law of cosines, law of sines, and vector triangles. Prerequisite: MATH 106 or a strong background in algebra.

MATH 130 5 F
Precalculus

Functions and graphs emphasized as tools to prepare the student for calculus. Included are polynomial and rational functions, logarithmic and exponential functions, as well as a thorough treatment of the six trigonometric functions and their inverses. Prerequisite: MATH 106 or a strong background in algebra.

MATH 211+212 3+3 F+W
Foundations of School Mathematics I, II

A two-quarter sequence covering the logic and structure underlying school mathematics. Concepts, procedures, problem-solving and applications at concrete, pictorial, and abstract levels. Must be taken in sequence. Prerequisite: Algebra II or Integrated Math III in secondary school (C- or above) or MATH 096.

MATH 211 includes problem-solving techniques, sets, logic and deductive reasoning, the arithmetic of whole numbers, fractions, decimals, integers, rational and real numbers, ratio and proportion, and percent.

MATH 212 includes geometry, measurement, and basic probability.

LOWER-DIVISION COURSES:

MATH 131+132 4+4 FW, WS
Calculus I, II

A two-quarter standard sequence in single-variable calculus. Must be taken in sequence. Prerequisite: Knowledge of algebra and trigonometry at the level provided by MATH 130 or by MATH 106 and 113.

MATH 131 focuses on differential calculus and its applications. Includes limits, all derivative tools (including transcendental functions), maximizing/minimizing applications, related rates, L'Hospital's rule, and antiderivatives. Graphing calculators and mathematical software tools are used extensively. Offered F, W.

MATH 132 focuses on integral calculus and its applications. Includes the fundamental theorems, general substitutions, integration by parts, applications to geometry and physics, differential equations, growth models, infinite series, and Taylor expansions. Graphing calculators and mathematical software tools are used extensively. Offered W, S.

MATH 265 4 S
Elementary Linear Algebra

Matrix algebra and determinants, applications to solving systems of linear equations, vector spaces, linear transformations, eigenvalues, and eigenvectors. Prerequisite: MATH 131.

MATH 267 5 F
Multivariable Calculus

Vector functions and functions of more than one variable, solid analytic geometry, parametric curves and surfaces, partial derivatives, gradients, multiple integrals, line and surface integrals, divergence, curl, and Stokes' Theorem. Prerequisite: MATH 132. Recommended prerequisite: MATH 265.

Mathematics

MATH 269 **4 W** **Elementary Differential Equations**

Ordinary differential equations balancing analytic techniques, qualitative methods, and basic modeling. Topics include eigenvalue methods for linear systems, Laplace transforms, phase plane, null-clines, equilibria, harmonic oscillator, and population models. Prerequisite: MATH 132. Recommended prerequisite: MATH 265.

MATH 275 **4 S** **Logic and Sets**

A bridge to upper-division mathematics, developing the student's ability to handle abstract concepts and careful proofs. Propositional and predicate logic, various types of proof, algebra of sets and functions, equivalence relations, and countable sets. Prerequisite: MATH 131.

MATH 290 **0.5 W** **Sophomore Seminar**

Preparation of students for successful pursuit of opportunities in mathematics related fields of work and study. Includes an introduction to tools and resources used in mathematical work, CV/résumé writing, major portfolio preparation, and identifying/pursuing internships and research experiences for undergraduates (REUs). Graded S/F.

UPPER-DIVISION COURSES:

MATH 331 **4 F** **Theory of Probability and Statistics**

Theory and applications of probability models, combinatoric problems, random variables, discrete and continuous distributions, expectation, moment generating functions, and central limit theorem. Prerequisites: MATH 132, STAT 222. Odd years.

MATH 341 **4 W** **Geometries**

The development and history of Euclidean geometry, the axiomatic method and various axiom sets for Euclidean geometry, history of the parallel postulate and discovery of non-Euclidean geometry, neutral and hyperbolic geometry, philosophical implications. Prerequisite: MATH 275. Even years.

MATH 351+352 **4+3 F+W** **Introduction to Abstract Algebra I, II**

A two-quarter sequence introducing the basic topics in modern abstract algebra. Must be taken in sequence. Prerequisite: MATH 275. Odd years.

MATH 351 is a basic introduction to groups, rings, integral domains, fields, and isomorphisms. Also included are mappings, equivalence relations, and modular arithmetic.

MATH 352 is a continuation that stresses applications. Topics studied may include polynomials, elementary Galois theory, geometric constructions, algebraic coding, lattices, and Boolean algebras.

MATH 354 **3 F** **Number Theory**

Topics include Diophantine equations, theorems and conjectures about prime numbers, congruences, the theorems of Euler and Fermat, perfect numbers, continued fractions, and Pythagorean triples. Prerequisite: MATH 275. Even years.

MATH 384 **4 S** **Biomathematics**

An introduction to the applications of mathematical methods in the modeling of various biological phenomena. Connections are made between diverse biological examples linked by common mathematical themes. Explorations may be selected from a variety of discrete and continuous ordinary or partial differential equation models. Prerequisites: MATH 269, 275. Recommended prerequisites: MATH 265 and INFS 115. Odd years.

MATH 385 **4 S** **Mathematical Modeling**

Mathematical modeling of problems selected from a variety of applied areas, including industry, biology, business, and the social sciences. Both deterministic and stochastic models are considered, with an emphasis on practical problem-solving. Includes exploration of the computer as a problem-solving tool. Prerequisites: MATH 269, 275. Recommended prerequisites: MATH 265 and INFS 115. Even years.

MATH 390 **.5 S** **Junior Seminar**

Continued preparation of students for successful pursuit of opportunities in mathematics related fields of work and study. Includes mathematics problem solving in a variety of topics and contexts, investigating employment and further education opportunities for (bio) mathematics graduates, CV and résumé updating, continued major portfolio preparation, introduction to professional mathematics organizations/publications/PUC library resources, and identifying topics of interest for further study in senior seminar. Prerequisite: MATH 290. Graded S/F.

MATH 421+422 **4+3 F+W**
Elementary Real Analysis I, II

A two-quarter sequence focusing on the fundamental definitions and theorems underlying single-variable calculus and related topics. Must be taken in sequence. Prerequisites: MATH 132, 275. Even years.

MATH 421 includes the completeness property, limits of sequences and functions, and continuity.

MATH 422 is a continuation that covers derivatives, the Riemann integral, and infinite series.

MATH 425 **4 S**
Complex Analysis

The elements of the theory of analytic functions including Cauchy's theorem, calculus of residues, conformality, and applications. Prerequisites: MATH 267, 275. Even years.

MATH 451 **4 W**
History of Mathematics

A survey of major developments in mathematics from antiquity to modern times. Involves historically relevant problem sets, class discussions, and presentations by students and teacher. Prerequisite: MATH 131. Odd years.

MATH 465 **4 S**
Linear Algebra

A deeper study than given in MATH 265, including Jordan form, inner product spaces, quadratic forms, Hamilton-Cayley theorem, and normal operators. Prerequisites: MATH 265, 351. Odd years.

MATH 485 **1-4 Arranged**
Special Topics in Mathematics

Study of a selected topic not covered elsewhere in the curriculum. Course content varies from year to year, with topics such as Topology, Differential Geometry, Chaos & Fractals, and Formal Logic & Gödel's Theorems. Repeatable for credit under different subtitles.

MATH 490 **1 S**
Senior Seminar

Continued preparation of students for successful pursuit of opportunities in mathematics related fields of work and study. Includes mathematics problem solving in a variety of topics and contexts, continued major portfolio preparation, and an in-depth study of a topic of interest in a field related to mathematics. Prerequisite: MATH 390.

MATH 495 **1-3 Arranged**
Independent Study

Qualified students may, with the approval of the department chair, undertake a directed research problem suited to their background and experience. Repeatable to a maximum of 9 credits.

Statistics

LOWER-DIVISION COURSE:

STAT 222 **4 F, W, S, Su**
Introduction to Statistics

Descriptive statistics, graphical methods, basic concepts of probability, normal probability distributions, central limit theorem, hypothesis tests involving means and proportions, confidence intervals, introduction to correlation and regression, and chi-square testing. Examples from a wide variety of disciplines, including business, the social sciences, and the life sciences, to prepare students with varying backgrounds and interests to become intelligent consumers and users of statistics. Prerequisites: Algebra II or Integrated Math III in secondary school (C- or above) or MATH 096 (D- or above), ENGL 101.

UPPER-DIVISION COURSE:

STAT 322 **3 W**
Statistical Methods

An intermediate course in applied statistics including multiple regression, analysis of variance, and nonparametric methods. Spreadsheets and statistical software are used to perform calculations. Prerequisite: STAT 222.

