

Mathematics

Marketing

See Business Administration

Mass Communication

See Journalism and Mass Communication

Mathematics (MATH)

College of Arts and Sciences, Department of Mathematics
O'Shaughnessy Science Hall (OSS) 201, (651) 962-5520
Kemper (chair), Dayananda, Dokken, Kroschel, Loe, McLean, Rawdon, Rezac, Scholz, Shakiban, Shemyakin, Shvartsman, Stolarska, Van Fleet, Yang, Youn; Tiefenbruck

The Department of Mathematics offers major programs that can satisfy a variety of student interests and careers. Majors in mathematics can prepare themselves for graduate study in mathematics or related areas, for the teaching of mathematics at the secondary school level, for professional school in law or health science, or for the application of mathematics and statistics in science, business, industry and government.

Students majoring in mathematics are encouraged to use elective courses to broaden their background in mathematics or in a related area of special interest. Coursework in biology, chemistry, economics, engineering, finance, geology, physics, psychology and quantitative methods/computer science combines well with a major in mathematics.

Students graduating with a major in mathematics will be able to demonstrate an understanding of the fundamental notions of mathematics, including rigorous proof. They will be able to model and solve real-world problems arising in business and industry. They will be able to effectively communicate, both orally and in writing, mathematical concepts to their peers and to an audience of non-majors. They will be able to learn and apply mathematics on their own through independent study, research and participation in non-class-related lectures.

In all of the department's major programs, a student must successfully complete at least 16 credits in mathematics courses numbered 300 and above at the University of St. Thomas.

In addition to the mathematics programs described below, the department has programs to prepare students for careers in actuarial science or teacher licensure (see Education). A minor in mathematics is available to support majors in many other departments.

Students should see the chair of the Department of Mathematics for advice in selecting courses for a particular purpose. The department offers a number of courses for non-majors to fulfill the mathematics portion of the core curriculum.

Center for Applied Mathematics

Within the Department of Mathematics, the Center for Applied Mathematics (CAM) provides opportunities for students to work on significant mathematical problems of current interest to business, industry, and government. The CAM summer student research program funds a number of student projects each year.

Major in Mathematics

MATH 113 Calculus I (4 credits) (or 108 and 109)
MATH 114 Calculus II (4 credits)
MATH 200 Multi-Variable Calculus (4 credits)
MATH 210 Introduction to Differential Equations and Systems (4 credits)
MATH 240 Linear Algebra (4 credits)
MATH 301 Abstract Algebra I (4 credits)
MATH 317 Real Analysis (4 credits)

Allied requirement

CISC 130 Introduction to Programming and Problem Solving in the Sciences (4 credits) *or* CISC 131 Introduction to Programming and Problem Solving (4 credits)

Note: CISC 130 is recommended for this major

Plus one of the mathematics programs below:

Pure Mathematics Program

MATH 302 Abstract Algebra II (4 credits)
MATH 419 Complex Variables (4 credits)
MATH 420 Topology (4 credits)

Plus:

four credits of courses MATH 300 or higher not already taken

Applied Mathematics Program

MATH 315 Applied Mathematics and Modeling I (4 credits)
MATH 316 Applied Mathematics and Modeling II (4 credits)

Plus eight credits from the following:

- MATH 300 Advanced Differential Equations (4 credits)
- MATH 303 Statistics for the Applied Sciences (4 credits)
- MATH 314 Mathematical Statistics (4 credits)
- MATH 385 Mathematical Methods of Numerical Analysis (4 credits)
- MATH 400 Dynamical Systems and Chaos (4 credits)
- MATH 419 Complex Variables (4 credits)

Statistics Program

- MATH 313 Probability (4 credits)
- MATH 314 Mathematical Statistics (4 credits)
- MATH 333 Applied Statistical Methods: Regression, Time Series, Forecasting (4 credits)
- MATH 385 Mathematical Methods of Numerical Analysis (4 credits)

Plus:

- IDTH 320 Statistics II (4 credits)

Education Program

- MATH 325 Geometry (4 credits)
- MATH 450 Advanced Mathematics: Exploration and Exposition (4 credits)

Plus:

- MATH 313 Probability (4 credits) *and* 314 Mathematical Statistics (4 credits)
- or*
- MATH 303 Statistics for the Applied Sciences *and* any MATH 300+ not already included

Teacher Licensure

- Elementary Education with a Co-major in Science and Mathematics for Elementary Education
 - Elementary Education with a Specialty in Mathematics (5-8)
 - Major in Mathematics with a Co-major in Secondary Education (5-12)
- See Education*

Minor in Mathematics

- MATH 113 Calculus I (4 credits) (or 108-109)
- MATH 114 Calculus II (4 credits)

Plus at least four credits from the following:

- MATH 200 Multi-Variable Calculus (4 credits)
- MATH 210 Introduction to Differential Equations and Systems (4 credits)

Plus:

A minimum of twelve additional credits in courses numbered above 200 (or approved by the department chair)
 A student minoring in mathematics must successfully complete a minimum of 8 credits in mathematics numbered 200 and above at St. Thomas.

MATH 005 Basic Math Skills (0 credit)

This review of arithmetic and elementary algebra is designed to prepare the student to study MATH 100 (Mathematical Sampler) or MATH 101 (Finite Mathematics). The course is designed as a self-directed study experience. The student will have access to textbook explanations and exercises, videos, CD-ROMs and tutors to gain mastery of the material. Appropriate testing is done with the tutors in the Mathematics Resource Center (MaRC). A nominal registration fee is charged. Offered every semester.

MATH 100 Mathematical Sampler (4 credits) (MATH 101)

This survey of basic mathematical concepts includes both modern and historical perspectives. Emphasis is on the development and appreciation of mathematical ideas and their relationship to other disciplines. Topics include, among others: mathematical problem-solving, set theory, graph theory, an introduction to randomness, counting and probability, statistics and data exploration, measurement and symmetry, and recursion. This course fulfills the core-area in mathematics in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum and is also recommended as the first course in mathematics for prospective elementary teachers. Offered every semester.

Prerequisite: A satisfactory score on the mathematics placement exam

NOTE: Students who receive credit for MATH 100 may not receive credit for MATH 101.

MATH 101 Finite Mathematics (4 credits) (MATH 100)

Elementary set theory, linear equations and matrices, linear programming, finite probability, applications primarily in business and the social sciences. This course fulfills the core-area in mathematics in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum. Offered every semester.

Prerequisite: A satisfactory score on the mathematics placement examination

NOTE: Students who receive credit for MATH 101 may not receive credit for MATH 100.

Mathematics

MATH 105 Precalculus (4 credits) (MATH 108, 109)

The real numbers; basic algebra; analytical treatment of the elementary functions emphasizing the exponential, logarithmic and trigonometric functions and their graphs. (This course is intended as preparation for MATH 113 and does not fulfill a general graduation requirement.) Offered occasionally.

Prerequisite: A satisfactory score on the mathematics placement examination

NOTE: Students who receive credit for MATH 105 may not receive credit for MATH 108 or 109.

MATH 108 Calculus with Review I (4 credits) (MATH 105, 111, 113)

The first course of a two-course sequence designed to integrate introductory calculus material with the algebraic and trigonometric topics necessary to support that study. Review topics include: number systems, basic algebra, functions, the Cartesian coordinate system and graphing. Calculus topics include limits, continuity, derivatives for algebraic functions, applications of derivatives and more graphing. This course is intended only for students planning to take 109 and does not satisfy the mathematics requirement in the core curriculum. This course fulfills the second-level Computer Competency requirement in the core curriculum. Offered every semester.

Prerequisite: A satisfactory score on the mathematics placement examination

NOTE: Students who receive credit for MATH 108 may not receive credit for MATH 105, 111, or 113.

MATH 109 Calculus with Review II (4 credits) (MATH 105, 111, 113)

The second course of a two-course sequence designed to integrate introductory calculus material with the algebraic and trigonometric topics necessary to support that study. Review topics include: exponential and logarithmic functions, trigonometric functions and their inverses and associated graphs. Calculus topics include: derivatives of the transcendental functions, applications of those derivatives and an introduction to integration. This course fulfills the core-area in mathematics in the Natural Science and Mathematical and Quantitative Reasoning and the second-level Computer Competency requirements in the core curriculum. Offered every semester.

Prerequisite: a grade of C- or better in MATH 108

NOTE: Students who receive credit for MATH 109 may not receive credit for MATH 105, 111, or 113.

MATH 111 Calculus for Business and Social Science (4 credits) (MATH 108, 109, 113)

An introductory course in calculus with motivation and examples drawn from business and the social sciences whenever possible. Does not include the calculus of trigonometric functions. This course fulfills the core-area in mathematics in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum. Offered every semester.

Prerequisite: a grade of C- or above in MATH 105 or a satisfactory score on the mathematics placement examination. (Four years of high school mathematics, including college algebra, also are recommended as background for this course.) Students intending to continue in calculus are strongly advised to take MATH 113.

NOTE: Students who receive credit for MATH 111 may not receive credit for MATH 108, 109, or 113.

MATH 113 Calculus I (4 credits) (MATH 108, 109, 111)

An introductory course in calculus: limits; derivatives and integrals of algebraic, exponential, logarithmic and trigonometric functions of one real variable; applications primarily in the natural sciences. This course fulfills the core-area in mathematics in the Natural Science and Mathematical and Quantitative Reasoning and the second-level Computer Competency requirements in the core curriculum. Offered every semester.

Prerequisite: a grade of C- or above in MATH 105 or a satisfactory score on the mathematics placement examination. (Four years of high school mathematics, including college algebra and trigonometry, also are recommended as background for this course.)

NOTE: Students who receive credit for MATH 113 may not receive credit for MATH 108, 109, or 111.

MATH 114 Calculus II (4 credits)

Techniques of integration; applications of integration; infinite series; L'Hospital's rule; improper integrals. This course fulfills the second-level Computer Competency requirement and the core-area in mathematics or the third course in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum. Offered every semester.

Prerequisite: a grade of C- or above in MATH 113 or 109 (or 111, with permission of the department chair)

MATH 121 Structures of Elementary Mathematics (4 credits)

An examination of the mathematical underpinnings of the elementary school curriculum with an emphasis on the understanding of mathematical concepts. Topics will include foundations of integer and rational arithmetic, notions of place-value and base, number sense and estimation, functions and their applications, Euclidean geometry, and mathematical problem-solving. This course is recommended as a second course in mathematics for prospective elementary teachers. It also fulfills the core-area in mathematics or the third course in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum. Offered every semester.

Prerequisite: MATH 100 and an EDUC course, or permission of the instructor

MATH 128 Introduction to Discrete Mathematics (4 credits)

A survey of basic discrete mathematical concepts. Topics include: Boolean algebra, logic, analysis of algorithms, mathematical induction and matrices. Focus on applications to computer science. This course fulfills the core-area in mathematics or the third course in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum. Offered spring semester.

Prerequisite: MATH 111 or 113 or 109 (may be taken concurrently with consent of the instructor)

MATH 200 Multi-Variable Calculus (4 credits)

Vector algebra in two and three dimensions, partial derivatives, multiple integrals, line integrals, surface integrals, Green's Theorem, Stoke's Theorem, divergence theorem. This course fulfills the second-level Computer Competency requirement in the core curriculum. Offered every semester.

Prerequisite: a grade of C- or higher in MATH 114

MATH 210 Introduction to Differential Equations and Systems (4 credits)

An introduction to ordinary differential equations (ODEs), with an emphasis on linear differential equations and linear systems, including applications. Topics covered include first-order equations, ODE models in the physical and biological sciences and engineering, numerical methods of solution, higher order linear equations, matrix tools, the role of eigenvalues and eigenvectors, and an introduction to nonlinear equations and systems, including linear approximations and stability analysis. This course fulfills the second-level Computer Competency requirement in the core curriculum. Offered every semester.

Prerequisite: a grade of C- or above in MATH 114

MATH 240 Linear Algebra (4 credits)

An introductory course in linear algebra, beginning with linear equations, matrix algebra and determinants and going on to study vector spaces, orthogonality, eigenvectors and inner products. The course combines theoretical and applied perspectives, including concepts of rigorous proof. Offered every semester.

Prerequisite: A grade of C- or above in MATH 200

MATH 259 Elements of Geometry and Statistics (4 credits)

Intended for elementary education majors who plan a specialization in mathematics for grades 5-8. Includes intermediate concepts in geometry and statistics essential for a middle school teacher of mathematics. Topics will include: axiomatic systems of geometry with emphasis on Books I and VI of Euclid's Elements; an introduction to non-Euclidean geometry; geometric and inductive reasoning, with applications; introduction to geometric probability and the geometric display of data; organization and analysis of data sets; statistical support of decisions, including applications in education; prediction; the role of randomness in both formal and empirical probability. Offered spring semester of odd-numbered years.

Prerequisites: MATH 100 and 121

MATH 295, 296 Topics (2 credits)**MATH 297, 298 Topics (4 credits)**

The subject matter of these courses will vary from year to year, but will not duplicate existing courses. Descriptions of these courses are available in the Searchable Class Schedule on Murphy Online,

<https://banner.stthomas.edu/pls/banner/prod/bwckschd>.

MATH 300 Advanced Differential Equations (4 credits)

A second course in differential equations and their applications. Topics are selected from a continued study of linear differential equations and systems, Laplace transforms, series solution methods, non-linear equations and systems, partial differential equations and other topics chosen by the instructor. Offered spring of odd-numbered years.

Prerequisite: MATH 210

MATH 301 Abstract Algebra I (4 credits)

Properties of sets, relations and mappings; introduction to groups, rings and fields. Offered fall semester.

Prerequisite: MATH 210

MATH 302 Abstract Algebra II (4 credits)

Topics in modern algebra with applications. Includes material selected from the theory of groups, rings, and fields; linear algebra; Boolean algebra and discrete structures. Offered spring semester of odd-numbered years.

Prerequisite: MATH 301

MATH 303 Statistics for the Applied Sciences (4 credits) (MATH 313, 314)

Probability, Estimation, Hypothesis Testing, Analysis of Variance, Regression Analysis, Topics selected from Experimental Design, Statistical Process Control, Non-Parametric Methods, Factor Analysis as time permits. This course fulfills the second-level Computer Competency requirement in the core curriculum. Offered every semester.

Prerequisite: MATH 200

NOTE: Students who receive credit for MATH 303 may not receive credit for MATH 313 or 314.

MATH 313 Probability (4 credits) (MATH 303)

Probability theory in discrete and continuous sample spaces; random variables and distribution functions; moments; the moment-generating function; functions of random variables; law of large numbers; central limit theorem. This course fulfills the second-level Computer Competency requirement in the core curriculum. Offered spring semester.

Prerequisites: MATH 200 (may be taken concurrently with consent of instructor)

NOTE: Students who receive credit for MATH 313 may not receive credit for MATH 303.

Mathematics

MATH 314 Mathematical Statistics (4 credits) (MATH 303)

Populations and random sampling; sampling distributions. Theory of statistical estimation; criteria and methods of point and interval estimation. Theory of testing statistical hypotheses; non-parametric methods. Offered fall semester.

Prerequisite: MATH 240 and 313

NOTE: Students who receive credit for MATH 314 may not receive credit for MATH 303.

MATH 315 Applied Mathematics and Modeling I (4 credits)

This is a topics course in applied mathematics offered through the Center for Applied Mathematics (CAM). Course content will be drawn from areas of applied mathematics, including: mathematical analysis of data, database theory, discrete and continuous modeling, simulation, applied statistics, coding theory, expert systems, neural network analysis, signal processing, optimization theory, and wavelet theory. Students will work in teams on projects of current interest in applied mathematics. Offered fall semester.

Prerequisites: MATH 200 and 210, or permission of instructor

MATH 316 Applied Mathematics and Modeling II (4 credits)

This is a second topics course in applied mathematics offered through the Center for Applied Mathematics (CAM). It does not necessarily require MATH 315 as a prerequisite. Course content will be drawn from the topics listed under MATH 315. Students will work in teams on projects of current interest in applied mathematics. Offered spring semester.

Prerequisites: MATH 114 and 210, or permission of instructor

MATH 317 Real Analysis (4 credits)

Topology of the real numbers. Functions of one real variable. Rigorous development of continuity and uniform continuity; differentiability; uniform convergence. Sequences and series. Offered fall semester.

Prerequisites: MATH 200 and 210

MATH 325 Geometry (4 credits)

Axioms for geometries; geometrical transformations and their invariants; non-Euclidean geometries; additional topics. Offered spring semester of even-numbered years.

Prerequisites: MATH 200

MATH 333 Applied Statistical Methods: Regression, Time Series, Forecasting (4 credits)

Regression and exponential smoothing methods; Stochastic Time Series: auto- and cross-correlation, autoregressive moving average models; application to forecasting. Offered spring semester.

Prerequisites: MATH 303 or 314 or permission of instructor

MATH 385 Mathematical Methods of Numerical Analysis (4 credits)

Rigorous mathematical treatment of standard topics in numerical analysis including solutions to linear and nonlinear systems, interpolation, numerical integration and differentiation, differential equations, and iterative techniques in matrix algebra. This course provides a theoretical foundation for the numerical solution of mathematical problems. Offered fall semester of even-numbered years.

Prerequisites: MATH 210 or permission of instructor

MATH 400 Dynamical Systems and Chaos (4 credits)

An introduction to discrete and continuous dynamical systems and applications with topics including: iterated mappings in one and two dimensions, phase-plane theory, nonlinear differential equations, and chaos. Additional topics will be chosen from among bifurcations, stability, attractors, Lyapunov functions, Julia sets and Mandelbrot sets. Offered spring semester of even-numbered years.

Prerequisite: MATH 210 or 317 or permission of instructor

MATH 419 Complex Variables (4 credits)

Analytic functions; theorems of Cauchy; Laurent series; residue calculus; entire and meromorphic functions; conformal mapping. Offered fall semester of odd-numbered years.

Prerequisite: MATH 317

MATH 420 Topology (4 credits)

Properties of Euclidean spaces; general spaces; mappings; separation properties; connectedness; compactness; metrizable spaces. Offered spring semester of even-numbered years.

Prerequisite: MATH 317

MATH 450 Advanced Mathematics: Exploration and Exposition (4 credits)

This course gives students a sense of the history, applicability and currency of one or more mathematical ideas and serves as a capstone mathematics course for students seeking to teach secondary mathematics. In the course, students make substantial oral and written presentations on topics carefully selected to have a strong relationship to secondary school mathematics. Topics are included from discrete mathematics and from continuous mathematics. Students use publications, e.g. The American Mathematical Monthly, Mathematics Magazine, Mathematical Intelligencer and

Mathematics – Modern and Classical Languages

Scientific American, as well as standard texts, as sources for their work. Offered fall semester.
Prerequisite: one of MATH 301 or 317 with concurrent registration in the other; senior or graduate standing and declared intent to complete secondary licensure in mathematics. Other students having the course prerequisites may be admitted, but it is their responsibility to determine the relationship of this course to their program of study.

MATH 475, 476 Experiential Learning (2 credits)

MATH 477, 478 Experiential Learning (4 credits)

See the description of these courses at the beginning of the “Curricula” section of this catalog.

MATH 483, 484 Seminar (2 credits)

MATH 485, 486 Seminar (4 credits)

See the description of these courses at the beginning of the “Curricula” section of this catalog.

MATH 487, 488 Topics (2 credits)

MATH 489, 490 Topics (4 credits)

The subject matter of these courses will vary from year to year, but will not duplicate existing courses. Descriptions of these courses are available in the Searchable Class Schedule on Murphy Online, <https://banner.stthomas.edu/pls/banner/prod/bwkschd>.

MATH 491, 492 Research (2 credits)

MATH 493, 494 Research (4 credits)

See the description of these courses at the beginning of the “Curricula” section of this catalog.

MATH 495, 496 Individual Study (2 credits)

MATH 497, 498 Individual Study (4 credits)

See the description of these courses at the beginning of the “Curricula” section of this catalog.

Modern and Classical Languages

College of Arts and Sciences, Department of Modern and Classical Languages

O’Shaughnessy Education Center (OEC) 337, (651) 962-5150

Miller, D., (chair); **Arabic** – Khalek; **Classics** – Quartarone; **French** – Dziekowicz (coordinator), Lohse, Shams; **German** – (coordinator rotates), Fullard, Schons; **Irish Gaelic** – Moore; **Japanese** – Dreszen; **Russian** – Grinberg; **Spanish** – (coordinator rotates), Badessich, Chiara, Kroll, Pinto, Raschio, Rey-Montejo, Scham, Tar, Tight

The Department of Modern and Classical Languages offers major and minor concentrations in Classical Languages, French, German, Latin and Spanish, with additional minors in Greek and Japanese. A Russian major and minor and a Japanese major are available through the Associated Colleges of the Twin Cities. Language classes are also available in Arabic and Irish Gaelic. In cooperation with the ACTC, courses also are available in other languages.

The department also offers majors in international business – language intensive (French, German and Spanish) and literary studies (foreign language and English literature).

Students graduating with a major in Classical Languages will have acquired a working vocabulary and a knowledge of the structures of Classical Greek and/or Latin adequate to read the works of Greek and/or Latin authors. They will have gained experience in reading major authors in the languages, and will perceive the relationship between the authors and their cultural context.

Students graduating with a major in French will have a solid understanding of the French language and the ability to use the language effectively in speaking, comprehension, reading, and writing. They will have developed the skills necessary for the study, analysis, and interpretation of a wide range of cultural texts, including literary texts.

Students graduating with a major in German will have acquired a command of the German language for use in academic and/or professional life. They will have become acquainted with the culture of the German-speaking countries and with the role these countries and their culture have historically played and continue to play in the world today.

Students graduating with a major in international business – language intensive will be able to demonstrate a command of the appropriate language for use in business and professional life, will understand the historical and cultural development of the countries of that language, and will understand the business practices and economic structure of those countries.

Students graduating with a major in Spanish will have a solid understanding of the Spanish language and the ability to use the language effectively in speaking, listening, reading, and writing. Additionally, they will have developed 1) the skills necessary for the study, analysis, and interpretation of a wide range of cultural texts, including literary texts; or 2) a foundation in Hispanic linguistics from both a theoretical and an applied perspective.

The department also offers courses for the non-major to fulfill the Language and Culture requirement of the core curriculum.

Teacher Licensure

Elementary Education with a Specialty in World Languages and Cultures (K-8)

World Languages and Cultures (K-12) with a Major in French, German, or Spanish and a Co-major in Secondary Education

See Education