MATHEMATICS

The majors in Mathematics (https://www.bethel.edu/undergrad/academics/math-cs/) prepare students for a variety of careers through a balance of theoretical and practical coursework. Theoretical study begins with an introduction to proofs and continues through linear algebra, abstract algebra, real analysis, complex analysis, combinatorics, graph theory, and senior seminar. Problem-solving and mathematical modeling skills are honed through the calculus sequence of courses, differential equations, probability and statistics, numerical analysis, and operations research. Practical computing skills are developed by using advanced software in many courses and through introductory programming courses. Students who wish to teach mathematics in grades 5-12 may also include coursework designed specifically to satisfy state licensure requirements. Additional coursework and advising are available for students preparing for graduate school or for math-oriented careers such as data science and actuarial science.

Advanced Placement: The Math and Computer Science department (https://www.bethel.edu/undergrad/academics/math-cs/) requires a score of 4 or better on the AB AP exam, or 3 or better on the BC AP exam, or less than 3 with a subscore of 4-5 on the BC AP exam in order for the exam to be used to fulfill course requirements in the majors and minors it offers. Students with a score of 3 will receive elective credit or receive credit toward General Education requirements. Students should consult the department chair with questions on AP exams and requirements for majors.

Majors in Mathematics

- B.A. in Mathematics (https://catalog.bethel.edu/arts-sciences/academic-programs-departments/mathematics/mathematics-ba/)
- B.A. in Mathematics with Education 5-12 Licensure (https://catalog.bethel.edu/arts-sciences/academic-programs-departments/mathematics/mathematics-ba-education-5-12-licensure/)
- B.S. in Actuarial Science and Finance (https://catalog.bethel.edu/arts-sciences/academic-programs-departments/actuarial-science-and-finance/)
- B.S. in Mathematics and Data Science (https://catalog.bethel.edu/arts-sciences/academic-programs-departments/mathematics/mathematics-data-science-bs/)

Minor in Mathematics

- Mathematics (https://catalog.bethel.edu/arts-sciences/academic-programs-departments/mathematics/mathematics-minor/)

Endorsement in Mathematics

- Complex Number Methods (https://catalog.bethel.edu/arts-sciences/academic-programs-departments/endorsements/complex-number-methods/)

MAT 101M • Mathematics for the 21st Century 4 Credits
Mathematical ideas that a liberally educated person should be familiar with in order to function well in a technological society.
Prerequisites: Two years of high school algebra, including logarithms and exponential functions. Offered: Fall, Spring. Special Notes: This course carries cross-credit with MATH 180.

MAT 102M • Creative Problem Solving 4 Credits
Learn to use creative thinking and intuition to gain confidence in understanding and solving some intriguing problems in mathematics.
Prerequisites: High school algebra and geometry. Offered: January.

MAT 121M • Precalculus 4 Credits
Mathematics topics required for MAT 124M or further study in the natural sciences. Equations and inequalities; graphs of functions and relations; polynomial, rational, exponential, logarithmic functions; trigonometric functions, identities, equations, and applications.
Prerequisites: A course in Geometry; Two years of high school algebra. Offered: Spring.

MAT 122 • Calculus 1 Corequisite 2 Credits
Concepts, strategies, and skills necessary to succeed in MAT 124M.
Prerequisites: Placement at MAT 122 or higher on the Math and Computer Science department placement exam; MAT 121M or equivalent high school or college course(s). Offered: Fall. Special Notes: Designed to give increased support to students concurrently taking MAT 124M.

MAT 124M • Calculus 1 4 Credits
A mathematical foundation for future college courses and beyond. Introduces the concepts and methods of the derivative and the integral, demonstrating how they are applied in real-world modeling situations. Topics are examined graphically, numerically, and algebraically, including using a symbolic computer algebra system to aid with understanding.
Prerequisites: Placement at MAT 124M on the Math and Computer Science department placement exam; MAT 121M, concurrent enrollment in MAT 122, or equivalent high school or college course(s). Offered: Fall, Spring.

MAT 125 • Calculus 2 4 Credits
A continuation of the equipping of students with tools for effective problem solving. Study of integration, sequences and series, and introduction to differential equations and approximation techniques. Each topic is approached from several viewpoints (graphical, numerical, algebraic) to involve students with different learning styles.
Prerequisites: MAT 124M with a C- or higher. Offered: Fall, Spring.

MAT 201M • Mathematics for Elementary Education 1 4 Credits
Introduction to problem solving; patterns and sequences; systems of numeration; sets and logic; concepts, operations, and algorithms for each subset of the real numbers; elementary number theory; concepts and applications of ratios, proportions, and percents; data analysis, statistics, combinations/permutations, and probability.
Prerequisites: Major in elementary education; minimum ACT mathematics score of 24, minimum SAT mathematics score of 580 or satisfactory completion of Bethel's online Math for Elementary Education prep course; 15 college-level credits completed. Offered: Fall, Spring. Special Notes: MAT 201M may not be used to fulfill the requirements for a major or minor in mathematics.

MAT 202 • Mathematics for Elementary Education 2 2 Credits
Problem-solving and reasoning strategies; algebraic expressions, equations, and functions; concepts and applications of two- and three-dimensional geometry and measurement.
Prerequisites: MAT 201M with a C or higher. Offered: Fall, Spring. Special Notes: MAT 202 may not be used to fulfill the requirements for a major or minor in mathematics.

MAT 207M • Statistical Analysis 4 Credits
Descriptive and inferential statistics. Specific topics include discrete probability spaces, random variables, distributions, normal distribution, estimation, hypothesis testing, linear regression, correlation analysis. Possible additional topics include: analysis of variance, goodness-of-fit, and contingency tables. Applications to business, economics, and science.
Offered: Fall, January, Spring. Special Notes: Students may not receive credit for both MAT 207M and BUS 201M or PSY 230M. MAT 207M will not count toward the psychology minor elective credit requirement.

MAT 211 • Linear Algebra 4 Credits
Linear systems, matrices, vectors and vector spaces, linear transformations, inner products, norms, eigenvalues and eigenvectors, orthogonality, and applications. A foundation for many areas of study in mathematics, computer science, engineering, and science.
Prerequisites: MAT 125 with a C- or higher or MAT 242 with a C- or higher. Offered: Fall.

MAT 222 • Differential Equations 4 Credits
Analytic solution methods for ordinary differential equations, including special methods for first- and second-order systems, and transformation methods. Analysis of systems of differential equations using linear algebra and qualitative phase plane techniques.
Prerequisites: MAT 125 with a C- or higher. Offered: Spring. Special Notes: Students may not receive credit for both MAT 222 and MAT 224.

MAT 223 • Multivariable Calculus 4 Credits
Calculus of parametric curves: arc length, curvature, motion. Calculus of real functions on R^n: partial and directional derivatives, multiple integration, optimization techniques (including Lagrange multipliers). Calculus of vector fields: curl, divergence, line and surface integrals, and fundamental theorems.
Prerequisites: MAT 125 with a C- or higher. Offered: Fall, Spring.

MAT 224 • Differential Equations with Linear Algebra 4 Credits
A synthesis of discrete and continuous dynamical systems (difference equations and differential equations) using linear algebra. Standard symbolic, numerical, and qualitative solution methods for differential equations along with relevant computations and theoretical concepts from linear algebra, including: matrix operations, vector spaces, basis, dimension, change of basis, eigenvalues, and diagonalization.
Prerequisites: MAT 125 with a C- or higher. Special Notes: Students may not receive credit for both MAT 224 and MAT 222. Offered: Fall.

MAT 242 • Introduction to Proofs 2 Credits
An introduction to mathematical reasoning skills with a focus on proof techniques such as direct and indirect proof, proof by contradiction, and mathematical induction. Also includes examination of sets, logic, and elementary number theory. Emphasis on mathematical communication.
Prerequisites: MAT 124M with a C- or higher. Offered: Fall, Spring.

MAT 248 • Mathematics of Computer Science 4 Credits
Covers a set of topics necessary to computer science majors, including algorithm analysis, relations, counting, graphs, trees, and finite probability theory.
Prerequisites: COS 110 with a C- or higher or COS 111 with a C- or higher; MAT 242 with a C- or higher. Offered: Spring.

MAT 299 • Careers in Mathematics and Computer Science Seminar 0 Credit
Explores careers in mathematics and computer science through a selection of videos, lectures, tours, or guest speakers. Activities may include developing practical professional skills such as writing resumes and cover letters, accumulating connections and experience, and techniques for interviewing.
Prerequisites: MAT 124M with a C- or higher. Offered: Fall.

MAT 300 • Numerical Analysis 2 Credits
A study of accuracy, efficiency, and robustness of algorithms for numerical approximations of roots, fixed points, functions (interpolation), integration, and solutions of ordinary differential equations. Other topics may include numerical linear algebra.
Prerequisites: MAT 125 with a C- or higher. Offered: Spring, odd # years.

MAT 309 • Financial Mathematics 3 Credits
Topics and problem-solving practice for the actuarial exam in financial mathematics. Theory of interest topics include: time value of money, annuities, cash flows, amortized loans, bonds, portfolios, and immunization. Financial economics topics include: derivatives, options, forwards and futures, swaps, hedging, and investment strategies.
Prerequisites: MAT 125 with a C- or higher. Offered: Fall, even # years.

MAT 322 • Complex Analysis 4 Credits
Extends the concepts of calculus and analysis to the complex setting. Topics include complex numbers, analytic functions, elementary functions, differentiation, integration, series, residues, and poles.
Prerequisites: MAT 125 with a C- or higher. Offered: Spring, odd # years. Special Notes: MAT 223 and MAT 242 are strongly recommended prerequisites.

MAT 330 • Probability and Statistics 3 Credits
Basic axiomatic probability, conditional probability and Bayes' Theorem, discrete and continuous random variables and their distributions, moment generating functions, multivariate random variables and transformations, stochastic processes, sampling distributions and estimators, confidence intervals, hypothesis testing, and an introduction to simple linear regression. Applications to actuarial science, data science, and engineering.
Prerequisites: MAT 125 with a C- or higher. Offered: Fall.

MAT 331 • Advanced Probability and Statistics 3 Credits
Review of probability and statistics, with more depth. Other topics may include: convolution, advanced estimation and hypothesis testing theory and applications, likelihood ratio test, Neyman-Pearson Lemma, best tests, Bayesian estimation, linear and multilinear regression, factor analysis, including analysis of variance and experimental design, chi-square test, and quality control.
Prerequisites: MAT 330 with a C- or higher. Offered: Spring, even # years.

MAT 376 • Operations Research 3 Credits
Mathematical techniques used in systems analysis, including linear programming, simulation techniques, and other topics such as transportation models, integer programming, and network analysis.
Prerequisites: COS 110 with a C- or higher or COS 111 with a C- or higher; MAT 211 with a C- or higher or MAT 224 with a C- or higher. Offered: Fall, odd # years.

MAT 410 • Abstract Algebra 4 Credits
Study of groups, rings, fields, and applications of these algebraic structures from a firm axiomatic foundation with a strong emphasis on properly written proofs.
Prerequisites: MAT 211 with a C- or higher and MAT 242 with a C- or higher. Offered: Spring.

MAT 422 • Real Analysis 4 Credits
Elementary set theory, properties of real numbers, functions of real variables, sequences, series, differentiation, Riemann integration, and introduction to topological concepts.
Prerequisites: MAT 223 with a C- or higher and MAT 242 with a C- or higher. Offered: Fall.

MAT 441 • Combinatorics and Graph Theory 4 Credits
Combinatorics: permutations, combinations, multinomial coefficients, and generating functions. Graph theory: graphs, connectivity, Eulerian tours, trees, matchings, planarity, and chromatic number.
Prerequisites: MAT 242 with a C- or higher. Offered: Fall, odd # years.

MAT 451 • Modern Geometry 4 Credits
An exploration of informal and formal geometric topics using dynamic mathematics software. Investigation of concepts, structure, proof, Euclidean, non-Euclidean, and transformational geometry.
Prerequisites: MAT 242 with a C- or higher. Offered: Fall, even # years.

MAT 490 • Topics in Mathematics 4 Credits
An in-depth study of a specific field of mathematics.
Prerequisites: MAT 211 with a C- or higher and MAT 242 with a C- or higher. Offered: Occasionally.

MAT 499 • Senior Seminar 2 Credits
A short history of mathematics' major transition points, overview of foundations of mathematics, axiomatic structures, and philosophies of mathematics in relation to Christian faith.
Prerequisites: MAT 410 with a C- or higher or MAT 422 with a C- or higher; Senior standing. Offered: January.