

# MATHEMATICS

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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 discrete mathematics and continues through linear algebra, abstract algebra, real analysis, topics in mathematics, 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 (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/mathematics/mathematics-ba/>)
- B.A. in Mathematics with Education 5-12 Licensure (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/mathematics/mathematics-ba-education-5-12-licensure/>)
- B.S. in Actuarial Science and Finance (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/actuarial-science-and-finance/>)
- B.S. in Mathematics and Data Science (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/mathematics/mathematics-data-science-bs/>)

## Minor in Mathematics

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

### **MAT 101M • Mathematics for the 21st Century 3 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. *Special*

*Notes:* This course carries cross-credit with MATH 180. *Offered:* Fall, Spring.

### **MAT 102M • Creative Problem Solving 3 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 123M • Precalculus 3 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:* Two years of high school algebra and Satisfactory completion of the Math and Computer Science department placement requirements. *Offered:* Fall, Spring. *Special Notes:* For Placement information, see: <https://www.bethel.edu/undergrad/academics/math-cs/placement-exams>

## Mathematics 2

### **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:* Satisfactory completion of the Math and Computer Science department placement exam or MAT 123M and Satisfactory completion of the Math and Computer Science department placement exam or Equivalent high school or college course(s) and Satisfactory completion of Math and Computer Science department placement exam. Offered: Fall, Spring. Special Notes: For Placement information, see: <https://www.bethel.edu/undergrad/academics/math-cs/placement-exams>

### **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 C- or higher. Offered: Fall, Spring.

### **MAT 201M • Mathematics for Elementary Education 1 3 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.

*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. Placement Required, see: <https://www.bethel.edu/undergrad/academics/math-cs/placement-exams>

### **MAT 202 • Mathematics for Elementary Education 2 3 Credits**

Problem-solving and reasoning strategies; algebraic expressions, equations, and functions; data analysis, statistics, combinations/permutations, and probability; concepts and applications of two- and three-dimensional geometry and measurement.

*Prerequisites:* Grade of C or higher in MAT 201M. 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 3 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 PSY 230M. MAT 207M will not count toward the psychology minor elective credit requirement.

### **MAT 211 • Linear Algebra 3 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 C- or higher or MAT 241 with C- or higher. Offered: Spring.

### **MAT 222 • Differential Equations 3 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 C- or higher. Offered: Spring. Special Notes: MAT 223 is a preferred prerequisite.

**MAT 223 • Multivariable Calculus 3 Credits**

Calculus of parametric curves: arc length, curvature, motion. Calculus of real functions on  $\mathbb{R}^n$ : 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 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 C- or higher. *Special Notes:* Students may not receive credit for both MAT 224 and MAT 222. *Offered:* Fall.

**MAT 241 • Discrete Mathematics 3 Credits**

A collection of topics useful to mathematics and computer science majors. Topics deal mainly with finite collections of mathematical objects (graphs, trees, finite state machines, etc.). Examination of sets, logic, Boolean algebras, proof techniques, algorithm analysis, counting, and recursion.

*Prerequisites:* MAT 124M with C- or higher. *Offered:* Fall, Spring.

**MAT 300 • Numerical Analysis 3 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 C- or higher. *Offered:* Fall, even # years.

**MAT 310 • 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 C- or higher. *Offered:* Spring. *Special Notes:* MAT 241 is a strongly recommended prerequisite.

**MAT 330 • Probability and Statistics 3 Credits**

Discrete and continuous probability spaces, distribution and density functions, random variables, sampling, expectation, estimation, and hypothesis testing.

*Prerequisites:* MAT 125 with C- or higher. *Offered:* Fall.

**MAT 331 • Applied Statistics 3 Credits**

Linear and multilinear regression, Factor analysis, including analysis of variance and experimental design.

*Prerequisites:* MAT 330 with C- or higher or Consent of instructor. *Offered:* Spring, even # years.

**MAT 351 • Modern Geometry 3 Credits**

A survey of informal and formal geometric topics. Investigation of concepts, structure, proof, Euclidean, non-Euclidean, and transformational geometry.

*Prerequisites:* MAT 241 with C- or higher or Consent of instructor. *Offered:* Fall, even # years. *Special Notes:* Designed for students seeking licensure to teach math in grades 5-12.

**MAT 376 • Operations Research 4 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 105 with C- or higher or COS 205 with C- or higher; MAT 211 with C- or higher or MAT 224 with C- or higher. *Offered:* Fall, odd # years.

**MAT 422 • Real Analysis 3 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 C- or higher and MAT 241 with C- or higher. *Offered:* Fall.

**MAT 425 • Topics in Mathematics 3 Credits**

A seminar designed to provide an in-depth experience with a specific field of mathematics. Topics vary and include logic, number theory, dynamical systems, chaos and fractals, complex analysis, partial differential equations and Fourier analysis, intermediate probability and statistics, combinatorics, and topology.

*Corequisites:* MAT 310 with C- or higher or Consent of instructor. *Offered:* Spring, odd # years.

**MAT 499 • Senior Seminar 3 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 330 with C- or higher and one of the following: MAT 310 with C- or higher, MAT 422 with C- or higher. *Offered:* January.