

MARET | UPPER SCHOOL CURRICULUM MATHEMATICS

Requirements: *Completion of the math progression through Precalculus or four years of mathematics*

Chair: *Susan Lenane*

Innovative, exciting, rigorous, and challenging: these are the adjectives that describe a typical Maret mathematics classroom. From our fifth grade program to BC Calculus, students regularly grapple with complex problems, work collaboratively, and present their solutions. While our students practice skills and acquire content, they also learn more than simply how to perform algorithms.

First and foremost, Maret mathematics classes emphasize problem-solving. In every course, students engage with rich and intriguing problems that require them to think creatively, to synthesize ideas, and to learn new ways to approach problems. Teachers regularly teach problem-solving skills and appropriate “habits of mind” that encourage students to enjoy mathematics and that develop the skills and confidence necessary to dive into challenging problems. Throughout the program, students learn how to utilize technological resources appropriately to explore real data, model natural phenomena, and solve complex equations.

Maret has a range of learners, and the mathematics program reflects this fact by providing numerous options. While only completion of Precalculus is required for graduation, nearly all students take four years of mathematics. The department offers regular, advanced, and accelerated courses; placement into one of these sections is made through careful consultation with students, families, and teachers. The program is flexible enough so that students may choose an appropriately challenging schedule from one year to the next. No student is locked into a “track.”

Ultimately, we aspire to nurture in our students an appreciation for the beauty and utility of mathematics and to foster their excitement for the subject.

Intermediate Algebra 1

Intermediate Algebra 1 strengthens and enriches each student’s ability to apply arithmetic and algebraic concepts to new and interesting problems. Students continue to deepen their understanding of functions, and they apply this knowledge to linear and quadratic functions in particular. Students will develop learning strategies, critical thinking skills, and problem solving techniques that yield success in all areas of mathematics. Graphing calculator technology is used as both an investigative and problem solving tool.

Geometry

In Geometry, students learn about the patterns and shapes that form the foundation of our physical world. Students explore two- and three-dimensional shapes as they participate in inquiry-based activities and as they work through novel problems that require a synthesis of ideas. Traditional two-column proof is deemphasized; students are more often asked to make conjectures and prove theorems using algebra and coordinate geometry. As such, students are daily asked to apply and practice the skills they learned in Algebra 1. The course includes units on patterns; points, lines, and angles; triangles; trigonometry; quadrilaterals; other polygons; circles; solids; and non-Euclidean geometry. During the second semester, students in Geometry will participate in a weekly programming class to broaden their development of computational and design-thinking skills. They will gain a basic understanding of how to create a program using Python, test code, and revise projects, which will further develop their problem-solving and critical thinking skills while simultaneously enhancing their understanding of Geometry.

Advanced Geometry

While Advanced Geometry follows the same curriculum as Geometry, the Advanced Geometry student is challenged with more problems that require creativity in thought and a willingness to persevere

when a solution is not immediately apparent. The development of algebraic and geometric problem solving strategies is the focus of the course, and students are challenged to effectively and efficiently communicate as they formally present their work to their peers. The Geometer's Sketchpad software package is used regularly to explore relationships and to tinker with possible solutions to problems. During the second semester, students in Advanced Geometry will participate in a weekly programming class to broaden their development of computational and design-thinking skills. They will gain a basic understanding of how to create a program using Python, test code, and revise projects, which will further develop their problem-solving and critical thinking skills while simultaneously enhancing their understanding of Geometry.

Algebra 2 & Trigonometry

During this year-long course, students explore families of functions—their characteristics, their graphs, and their real world applications. At the same time they review and strengthen their Algebra 1 skills. For example, reviewing operations with rational numbers extends naturally into a study of rational functions, their asymptotes, and their graphs. Students represent functions graphically, numerically, and algebraically, and the graphing calculator facilitates deep exploration. Applications of each function are also examined using hands-on labs, videos, and interactive websites.

Advanced Algebra 2 & Trigonometry

The Advanced Algebra 2 & Trigonometry curriculum focuses on the study of functions. While a variety of types of functions—exponential, polynomial, rational, and trigonometric—are explored, it is the patterns in their behavior that are emphasized. Students in the Advanced course are asked to apply their knowledge to problems that are unique, problems that do not lend themselves to an algorithm. They develop learning strategies, critical thinking skills, and problem solving techniques that are invaluable in a data-driven world.

Accelerated Algebra 2 & Trigonometry

Accelerated Algebra 2 & Trigonometry is a rigorous, enriched study of advanced algebra concepts, skills, and applications. Mastery of the ideas and problem

solving techniques introduced in Algebra 1 is expected. The course content includes an in-depth study of functions— exponential, polynomial, rational, and trigonometric. Students analyze the graphs of functions as visualizations of mathematical models, and they are consistently challenged to stretch their mastery of skills by applying what they have learned to novel situations.

Precalculus

Precalculus builds problem-solving and analytical skills by reinforcing and extending the concepts introduced in Algebra 2 & Trigonometry. Students continue their exploration of families of functions, focusing on the relationships between functions and their inverses. Additionally, the course opens with a study of probability and statistics and concludes with an introduction to the fundamental ideas of calculus. Students in this class also work with Maret Lower School teachers and students in a “Math Buddies” program. Through their service to these younger children, Precalculus students reinforce their own understanding of mathematics concepts by explaining them to others.

Advanced Precalculus

Advanced Precalculus students gain a deep understanding of the fundamental concepts and applications of functions; the core curriculum is the same as that for Precalculus. Strong facility with the problem solving tools and techniques introduced in Algebra 2 & Trigonometry is required, as little review is built into the course. Students build upon this knowledge base and are asked to creatively incorporate algebraic and geometric concepts into solutions to novel problems.

Accelerated Elementary Functions

Accelerated Elementary Functions utilizes a problem-solving format. Students work on challenging multi-step problems which often utilize mathematics from different disciplines such as geometry, trigonometry, and algebra. In addition to the core Precalculus curriculum, students may learn about vectors, parametric equations, and polar coordinates as they explore new ways to convey mathematical ideas. The course emphasizes lively dialogue and conceptual understanding over algorithmic mimicry.

Calculus

This course is designed to introduce students to the fundamental concepts and problem-solving techniques of calculus. Limits and derivatives are explored in depth; this is followed by an introduction to the basic mechanics and applications of integration. A conceptual approach to calculus is employed, and students continuously review prerequisite mathematics and problem solving strategies. At the conclusion of the course, students will be prepared for, but will not place out of, an introductory calculus course in college.

AB Calculus

The ancient Greek philosopher Heraclitus said, “The only constant is change.” In AB Calculus, students learn the basic mathematical methods used to analyze phenomena that change. Through the study of limits, derivatives, integrals, and differential equations, students learn how to model population growth, profit maximization, and dynamic motion and are prepared for the AP Calculus AB exam.

BC Calculus

This course is the equivalent of a full college course of study in single-variable calculus. Students study differentiation and its applications; integration techniques and problems utilizing the integral; differential equations; and infinite sequences and series. They also learn about the history of calculus. Many (but not all) of the topics covered in this class appear on the AP Calculus BC exam, so students may elect to sit for that exam at the end of the course.

Advanced Statistics

In this course, students take an empirical look at the “American dream” by interpreting and producing statistical data. Through published journal articles, short videos, and documentaries that examine theories of inequality and mobility, students explore topics in modern statistics including data displays, regression analysis, hypothesis tests, and survey design. Students will construct and critique arguments based on empirical evidence, learn to use a statistical analysis software program, construct data sets of their own, and apply statistical techniques to produce their own research.

Multivariable Calculus (MSON)

Prerequisite: *Completion of BC Calculus*

The mathematics of three dimensions is the emphasis of this college-level course. Multivariable Calculus will explore the geometry of three-dimensional space, including vector arithmetic. It will also explore three-dimensional surfaces, using the tools of derivatives and integrals expanded into multiple dimensions. A robust unit on differential equations will allow us to review the topics of single-variable calculus. The emphasis throughout the course will be on problem-solving and on real-world applications of the tools we learn in fields such as economics, astronomy, physics, engineering, and medicine.

Advanced Abstract Math (MSON)

Semester Course

Prerequisite: *Completion of Algebra 2 & Trigonometry*

This course will be a student-driven elective for those interested in learning topics outside the standard mathematics curriculum, as well as learning topics already within the curriculum at a deeper level. At the beginning of the course will be a brief unit on proof techniques. After a short time, students will be expected to turn in a list of several mathematical topics about which they would like to learn more. The instructor will then choose from these topics to form a cohesive unit, collecting input from as many students as possible. We will devote the remainder of the semester to studying these topics. Topics from previous semesters include fractal geometry and dimension, Cantor’s set theory, number theory, cryptography, power series, and Fibonacci numbers, to name a few. The only prerequisites for this course are a solid background in algebra and a thirst to satisfy mathematical curiosity. A few times throughout the term, problems will be assigned for homework. At a later class session, the instructor will ask for student volunteers to share their solutions. These solutions will be evaluated in terms of accuracy both in writing and in spoken communication, as both of these skills are of paramount importance to the budding scientist or mathematician.

Advanced Topics in Mathematics Through a Geometry Lens (MSON)

Spring Semester

Prerequisite: *Completion of Algebra 2*

This student-driven course is for those interested in learning topics related to Geometry that are outside the standard mathematics curriculum or explore topics already within the curriculum but at a deeper level. Beginning with Transformational Geometry, the course includes proofs from a new axiom set. Students will choose from a list of suggested topics related to geometry that they would like to explore. The remainder of the course focuses on topics chosen by the TEACHER with student input. Examples include Non-Euclidean Geometry, applications of geometric transformations to other parts of mathematics, and a geometric approach to linear algebra.

Students should be willing to explore unfamiliar mathematics, exhibit an interest in mathematical reasoning and proofs, and display a hefty dose of mathematical curiosity.

Advanced Math Topics: Financial Algebra (MSON)

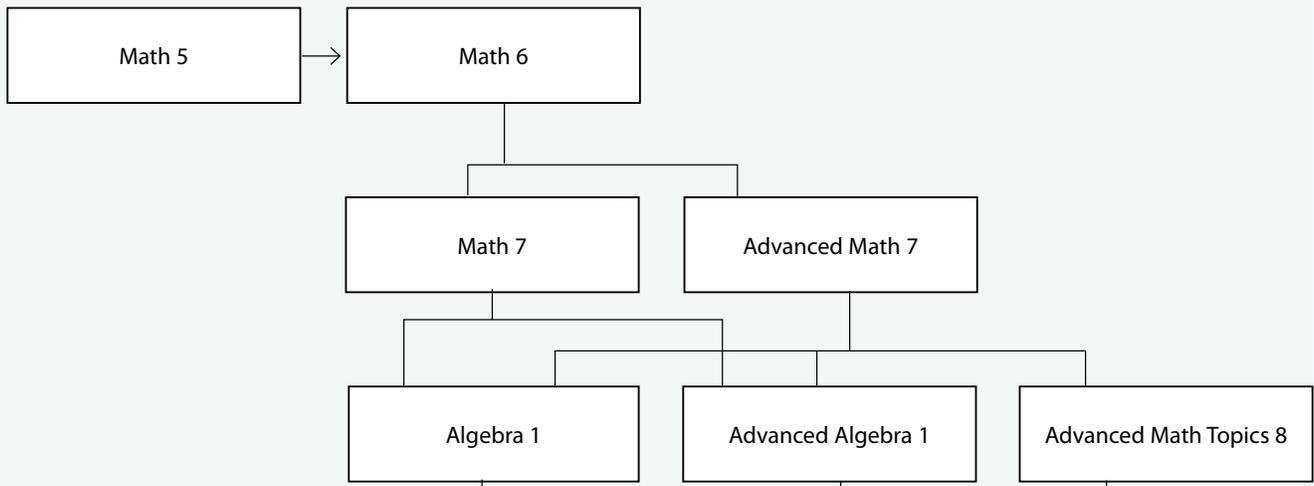
(Spring Semester)

Prerequisite: *Algebra II*

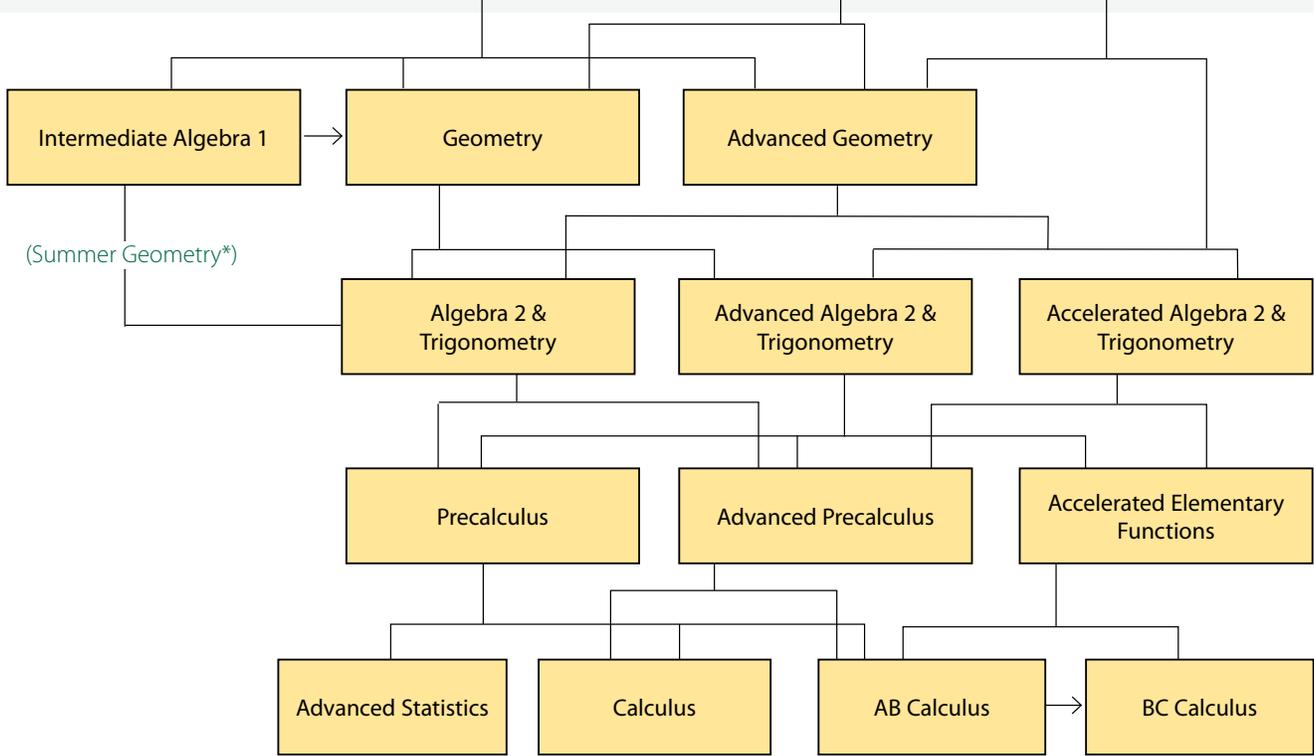
This one-semester course will provide students a mathematical and conceptual framework with which to make important personal financial decisions using algebraic tools. Specifically, the class will investigate i) the time value of money (i.e., interest rates, compounding, saving and borrowing) using exponential functions; and ii) the characteristics and risk/reward tradeoff of different financial instruments/investments, such as stocks, bonds and mutual funds, using algebra, probability and statistics. Other financial algebra topics selected with student input may include financial accounting, depreciation methods and foreign currency exchange. The course will stress use of the TI-83/84 calculator, Excel spreadsheets and iPad apps. Students should be willing to exhibit an interest in mathematical reasoning and display a hefty dose of curiosity about the language and problem solving nature of personal finance.

MIDDLE SCHOOL AND UPPER SCHOOL MATHEMATICS SEQUENCE

Middle School



Upper School



MSON Offerings: Multivariable Calculus, Advanced Abstract Math, Advanced Topics in Mathematics Through a Geometry Lens

Statistics courses are available to seniors. Some students elect to take both a statistics course and a calculus course during senior year.
 *Summer Geometry not offered at Maret. Department approval required.