Mathematics or Applied Mathematics

A degree in mathematics is useful for those seeking careers in teaching, research, the sciences, or business and government. The traditional mathematics major is particularly appropriate if students plan to teach or enter professional school or if they seek an interesting major within the liberal arts. The applied mathematics major is suggested if a student plans a career in actuarial work, industrial mathematics or statistics.

The minor in mathematics consists of 21 units of required course work. Please refer to the Degree Requirements section (p. 1) for more information.

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Website: http://ucollege.wustl.edu/programs/undergraduate/bachelors-math

Degree Requirements

Bachelor of Science in Mathematics or Applied Mathematics

All University College undergraduate students must satisfy the same general-education requirements (http://bulletin.wustl.edu/undergrad/ucollege/bachelors/#degreerequirements).

Required for all mathematics majors: 12 units

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 155</td>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>Math 156</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>Math 255</td>
<td>Calculus III</td>
<td>3</td>
</tr>
<tr>
<td>Math 256</td>
<td>Calculus IV</td>
<td>3</td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

Students in the applied math major are also required to take Math 133 Programming with Python.

Plus an additional 18 units of 300- and 400-level Mathematics courses

Students in the traditional math major are encouraged to take Math 3101 Foundations for Higher Mathematics. This is a day-school course designed to introduce students to the language and conventions of mathematical discourse. University College math majors may enroll in this course at the University College tuition rate. In addition, students should select relevant courses in the social and physical sciences to complement and augment the major.

A sample of available 300- and 400-level courses is given here:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 301</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Math 305</td>
<td>Probability and Statistics</td>
<td>3</td>
</tr>
<tr>
<td>Math 3091</td>
<td>Matrix Algebra</td>
<td>3</td>
</tr>
<tr>
<td>Math 493</td>
<td>Probability</td>
<td>3</td>
</tr>
<tr>
<td>Math 494</td>
<td>Mathematical Statistics</td>
<td>3</td>
</tr>
</tbody>
</table>

The Minor in Mathematics

To earn a minor in mathematics, 21 credits of mathematics courses must be completed, of which at least 9 units must be advanced course work (300 level or above). Suggested course work includes the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 133</td>
<td>Programming with Python</td>
<td>3</td>
</tr>
<tr>
<td>Math 155</td>
<td>Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>Math 156</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>Math 255</td>
<td>Calculus III</td>
<td>3</td>
</tr>
<tr>
<td>Math 256</td>
<td>Calculus IV</td>
<td>3</td>
</tr>
<tr>
<td>Math 305</td>
<td>Probability and Statistics</td>
<td>3</td>
</tr>
<tr>
<td>or Math 205</td>
<td>Applied Statistics</td>
<td></td>
</tr>
<tr>
<td>Math 309</td>
<td>Matrix Algebra</td>
<td>3</td>
</tr>
<tr>
<td>or Math 301</td>
<td>Differential Equations</td>
<td></td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>

Courses


U20 Math 1011 Introduction to Statistics

This course covers basic concepts of statistics, including data collection (sampling and designing experiments), data organization (tables, graphs, frequency distributions, numerical summarization of data), and statistical inference (elementary probability and hypothesis testing). Prerequisite: high school algebra. This course is not equivalent to L24 1011. Credit 3 units.

U20 Math 133 Programming with Python

An introductory course for students with little or no programming experience. Topics include the software development process, documentation, debugging, and testing within the commonly used Python environment. At the end of the course students should be able to write and debug basic programs to display and interpret data using accepted programming conventions and styles.
Beyond standard mathematics, and discover exciting ideas and concepts that are typically not discussed in standard math courses. This course will expose non-math majors to fascinating sides of mathematics that are applied to various fields such as architecture, the social and behavioral sciences, economics, and more. Mathematics plays an important role in society, from engineering to economics, and is used in everyday life. We will explore questions like: What do rabbits, piano keyboards, and pine cones have in common? What are some coincidences not so amazing after all? Why are bar codes and secret codes so interesting? What do the Parthenon and the Fibonacci sequence have to do with each other? How is machine learning used in the real world? We will look at these and other questions from a variety of disciplines, and emphasize the social, behavioral, and natural sciences. We will develop new perspectives about the world. We will look at questions like: What do rabbits, piano keyboards, and pine cones have to do with number systems and prime numbers? What are some uses and misuses of mathematics in everyday life? Why are coincidences not so amazing after all? Prerequisite: proficiency in high school algebra.

Credit 3 units. UColl: OLI

U20 Math 210 The Art of Mathematical Thinking
Mathematics plays an important role in society, from engineering to architecture to the social and behavioral sciences. This course will expose non-math majors to fascinating sides of mathematics that are typically not discussed in standard math courses. Students will learn effective thinking techniques with applications beyond standard mathematics, and discover exciting ideas and concepts.

Credit 3 units.

U20 Math 230 Introduction to Data Science with Python
In this continuation of Programming with Python, students apply their skills to data science examples. The course will start with a brief review of Python and then shift to technical topics such as working with the numerical library NumPy; data manipulation with pandas; and creating graphics with matplotlib, Seaborn and other data visualization libraries. The final project will be an application of machine learning using the scikit-learn library.

Prerequisite: U20 133 or permission of the instructor.

Credit 3 units. UColl: NSC

U20 Math 251 Calculus II
Continuation of U20 155. Vectors in the plane and in space, calculus of vector-valued functions, parametric equations, arc length, polar coordinates, infinite series, Taylor's theorem. Prerequisite: U20 156 or equivalent.

Credit 3 units.

U20 Math 255 Calculus III
Continuation of U20 251. Functions of several variables, partial derivatives, tangent planes, directional derivatives, total differential, multiple integrals, line integrals, and an introduction to elementary differential equations. Prerequisite: U20 255 or equivalent.

Credit 3 units.

U20 Math 256 Calculus IV
Continuation of U20 255. Functions of several variables, partial derivatives, tangent planes, directional derivatives, total differential, multiple integrals, line integrals, and an introduction to elementary differential equations. Prerequisite: U20 255 or equivalent.

Credit 3 units.

U20 Math 3001 Independent Study in Mathematics
Credit 3 units.

U20 Math 301 Differential Equations
First course in differential equations with emphasis on linear equations and their applications. Prerequisite: U20 256 or equivalent.

Credit 3 units.

U20 Math 305 Probability and Statistics
Discrete and continuous random variables, mean and variance, hypothesis testing and confidence limits, nonparametric methods. Students' t-methods, regression, correlation. Prerequisite: U20 156 or consent of department.

Credit 3 units.

U20 Math 309 Linear Algebra I

Credit 3 units.
U20 Math 3091 Matrix Algebra
An introductory course in linear algebra that focuses on Euclidean n-space, matrices and related computations. Topics include: systems of linear equations, row reduction, matrix operations, determinants, linear independence, dimension, rank, change of basis, diagonalization, eigenvalues, eigenvectors, orthogonality, symmetric matrices, least square approximation, quadratic forms. Introduction to abstract vector spaces.
Prerequisite: Math 132.
Credit 3 units. A&S IQ: AN Arch: NSM Art: NSM

U20 Math 3101 Foundations for Higher Mathematics
This course provides an introduction to the rigorous techniques used in more advanced mathematics. Topics include propositional logic, the use of quantifiers, set theory, methods of proof and disproof (counterexamples), and foundations of mathematics. The use of these tools in the construction of number systems and in other areas such as elementary number theory, combinatorial arguments, and elementary proofs in analysis is also covered. Prerequisite: Math 233.
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

U20 Math 400 Independent Study
Credit variable, maximum 3 units.

U20 Math 420 Experimental Design
A first course in the design and analysis of experiments, from the point of view of regression. Factorial, randomized block, split-plot, Latin square, and similar design. Prerequisite: CSE 131 or 200, Math 3200, or permission of instructor.
Same as U20 Math 520
Credit 3 units. Art: NSM

U20 Math 493 Probability
Mathematical theory and application of probability at the advanced undergraduate level; a calculus-based introduction to probability theory. Topics include the computational basics of probability theory, combinatorial methods, conditional probability including Bayes’ theorem, random variables and distributions, expectations and moments, the classical distributions, and the central limit theorem.
Same as U20 Math 593
Credit 3 units.

U20 Math 494 Mathematical Statistics
Theory of estimation, minimum variance and unbiased estimators, maximum likelihood theory, Bayesian estimation, prior and posterior distributions, confidence intervals for general estimators, standard estimators and distributions such as the Student-t and F-distribution from a more advanced viewpoint, hypothesis testing, the Neymann-Pearson Lemma (about best possible tests), linear models, and other topics as time permits.
Prereq: Math 305 and U20 593, or permission of the instructor.
Same as U20 Math 594
Credit 3 units.