**MATHEMATICS, 4+1 BS/ APPLIED MATHEMATICS, MS**

**Introduction**
Please click here (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/mathematical-statistical-sciences/) to see Mathematical and Statistical Sciences department information.

This is a unique program where a student can obtain both a BS in Mathematics and MS in Applied Mathematics in five years through a specialized course sequence. The program requires 12 fewer credits than if both degrees were earned separately.

These degree requirements are subject to periodic revision by the academic department, and the College of Liberal Arts and Sciences reserves the right to make exceptions and substitutions as judged necessary in individual cases. Therefore, the College strongly urges students to consult regularly with their major and graduate advisor and CLAS advisor to confirm the best plans of study before finalizing them.

**Program Delivery**
This is an on-campus program.

**Declaring This Major**
Click here (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/#policiestext) to go to information about declaring a major.

**General Requirements**
To earn a degree, students must satisfy all requirements in each of the three areas below, in addition to their individual major requirements.

- CU Denver General Graduation Requirements (http://catalog.ucdenver.edu/cu-denver/undergraduate/graduation/)
- CU Denver Core Curriculum (http://catalog.ucdenver.edu/cu-denver/undergraduate/graduation-undergraduate-core-requirements/)
- College of Liberal Arts & Sciences Graduation Requirements (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/undergraduate/graduationrequirements#graduationrequirements) for information about Academic Policies

**Program Requirements**
While students are completing a BS degree in Mathematics, (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/mathematics-bs/#degrequirementstext) they may also complete some of the requirements for an MS degree in Applied Mathematics (http://catalog.ucdenver.edu/cu-denver/graduate/schools-colleges-departments/college-liberal-arts-sciences/mathematical-statistical-sciences/applied-mathematics-ms/) by participating in the BS/MS program using the following guidelines:

1. The student must apply and be accepted for participation in the BS/MS program prior to completion of the BS degree in consultation with both the undergraduate and graduate advisors. Students must complete a 4+1 intent form to formally declare this program, as they work very closely with undergraduate and graduate advisors to ensure they are on track and completing requirements as necessary.

2. Students should declare their intent to complete this program in their junior or senior year to the Director of the Program in Applied Mathematics after completing MATH 1401 Calculus I, MATH 2411 Calculus II, MATH 2421 Calculus III, MATH 3000 Introduction to Abstract Mathematics, MATH 3191 Applied Linear Algebra, MATH 4310 Introduction to Real Analysis I. A 3.0 grade point average (GPA) is required over all mathematics courses.

3. Students must complete a total of 45 credit hours, including a minimum of 42 MATH credit hours.

4. Students must complete at least 30 upper-division (3000-level and above) credit hours in the major.

5. Students must earn a minimum grade of C- (1.7) in all undergraduate courses that apply to the major and must achieve a minimum cumulative undergraduate major GPA of 2.25. Students must earn a minimum grade of B- (2.7) in all graduate courses and must achieve a minimum cumulative major GPA of 3.0, for all courses that will apply to the MS. Courses taken using P+P/F or S/U grading cannot apply to major and graduate requirements.

6. Students must complete a minimum of 15 upper-division level MATH credit hours and all graduate level credit hours with CU Denver faculty.

7. Students must complete a 4+1 intent form (http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/physics/physics-bs/BMA_form_1_1_.pdf) to formally declare this program, as they work very closely with undergraduate and graduate advisors to ensure they are on track and completing requirements as necessary. Students must apply and be accepted to the Applied Mathematics, MS during the last semester of their undergraduate career. A maximum of 12 credit hours of graduate level courses that are applied to the undergraduate degree will apply to the graduate degree.

8. Students will be advised to take MATH 4320 Introduction to Real Analysis II as an elective for the B.S.

9. In the semester in which the student intends to complete their BS, students must apply for admission into MS degree in Applied Mathematics (http://catalog.ucdenver.edu/cu-denver/graduate/schools-colleges-departments/college-liberal-arts-sciences/mathematical-statistical-sciences/applied-mathematics-ms/). Students must complete either the requirements for the M.S. degree without concentration area or specific coursework requirements in one of the following areas: Applied Probability, Applied Statistics, Discrete Mathematics, Mathematics of Engineering and Science, Numerical Analysis, or Operations Research.

10. The following MATH courses will not count toward a graduate degree: MCKE 5000 Algebraic Patterns and Functions I-MCKE 5009 Math Modeling–Using and Applying Math; MATH 5010 History of Mathematics, MATH 5012 An Advanced Perspective on Number and Operation-MATH 5015 Capstone Course for Secondary Teachers, MATH 5017 Topics in Mathematics for Teachers, MATH 5198 Mathematics for Bioscientists; and MATH 5830 Applied Statistics.
Mathematics course requirements:

**Programming Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Complete one of the following programming requirements:</td>
<td>3-4</td>
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<tr>
<td>MATH 1376</td>
<td>Programming for Data Science</td>
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<tr>
<td>CSCI 1410 &amp; CSCI 1411</td>
<td>Fundamentals of Computing and Fundamentals of Computing Laboratory</td>
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**Mathematics Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Complete all of the following Mathematics courses:</td>
<td>24</td>
</tr>
<tr>
<td>MATH 1401</td>
<td>Calculus I</td>
<td></td>
</tr>
<tr>
<td>MATH 2411</td>
<td>Calculus II</td>
<td></td>
</tr>
<tr>
<td>MATH 2421</td>
<td>Calculus III</td>
<td></td>
</tr>
<tr>
<td>MATH 3000</td>
<td>Introduction to Abstract Mathematics</td>
<td></td>
</tr>
<tr>
<td>MATH 3191</td>
<td>Applied Linear Algebra</td>
<td></td>
</tr>
<tr>
<td>MATH 3310</td>
<td>Introduction to Real Analysis I</td>
<td></td>
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<tr>
<td>MATH 3382</td>
<td>Statistical Theory</td>
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**Electives**

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Complete two approved MATH electives (at least six semester hours) above the 3000 level, excluding MATH 3195, MATH 3511, MATH 3800, MATH 3999, and MATH 4830.</td>
<td>6</td>
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<tr>
<td>MATH 3200</td>
<td>Elementary Differential Equations</td>
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<tr>
<td>MATH 3301</td>
<td>Introduction to Optimization</td>
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<tr>
<td>MATH 3376</td>
<td>Data Wrangling &amp; Visualization</td>
<td></td>
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<tr>
<td>MATH 3440</td>
<td>Introduction to Symbolic Logic</td>
<td></td>
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<tr>
<td>MATH 3810</td>
<td>Introduction to Probability</td>
<td></td>
</tr>
<tr>
<td>MATH 4010</td>
<td>History of Mathematics</td>
<td></td>
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<tr>
<td>MATH 4027</td>
<td>Topics in Mathematics</td>
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<tr>
<td>MATH 4110</td>
<td>Theory of Numbers</td>
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<tr>
<td>MATH 4140</td>
<td>Introduction to Modern Algebra</td>
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<tr>
<td>MATH 4320</td>
<td>Introduction to Real Analysis II</td>
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<tr>
<td>MATH 4337</td>
<td>Intro to Statistical and Machine Learning</td>
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<tr>
<td>MATH 4387</td>
<td>Applied Regression Analysis</td>
<td></td>
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<tr>
<td>MATH 4388</td>
<td>Machine Learning Methods</td>
<td></td>
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<tr>
<td>MATH 4390</td>
<td>Game Theory</td>
<td></td>
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<tr>
<td>MATH 4408</td>
<td>Applied Graph Theory</td>
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<tr>
<td>MATH 4409</td>
<td>Applied Combinatorics</td>
<td></td>
</tr>
<tr>
<td>MATH 4450</td>
<td>Complex Variables</td>
<td></td>
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<tr>
<td>MATH 4650</td>
<td>Numerical Analysis I</td>
<td></td>
</tr>
<tr>
<td>MATH 4660</td>
<td>Numerical Analysis II</td>
<td></td>
</tr>
<tr>
<td>MATH 4733</td>
<td>Partial Differential Equations</td>
<td></td>
</tr>
<tr>
<td>MATH 4792</td>
<td>Probabilistic Modeling</td>
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</table>

**MATH numbered 5000 or above**

Note that these courses taken during the undergraduate career with be used for the B.S. and apply to the 30 hours of course work and satisfy the core requirement for the Applied Mathematics.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Complete the following:</td>
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<tr>
<td>MATH 5779</td>
<td>Math Clinic</td>
<td>12</td>
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<tr>
<td></td>
<td>or MATH 63: Workshop in Statistical Consulting</td>
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<tr>
<td></td>
<td>Complete nine semester hours of MATH numbered 5000 or above from the list below.</td>
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<tr>
<td>MATH 5070</td>
<td>Applied Analysis</td>
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<tr>
<td></td>
<td>or MATH 61: Real Analysis</td>
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<tr>
<td>MATH 5135</td>
<td>Functions of a Complex Variable</td>
<td></td>
</tr>
<tr>
<td>MATH 5310</td>
<td>Probability</td>
<td></td>
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<tr>
<td>MATH 5320</td>
<td>Statistical Inference</td>
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</tr>
<tr>
<td>MATH 5387</td>
<td>Applied Regression Analysis</td>
<td></td>
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<tr>
<td>MATH 5390</td>
<td>Game Theory</td>
<td></td>
</tr>
<tr>
<td>MATH 5490</td>
<td>Network Flows</td>
<td></td>
</tr>
<tr>
<td>MATH 5593</td>
<td>Linear Programming</td>
<td></td>
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<tr>
<td>MATH 5660</td>
<td>Numerical Analysis I</td>
<td></td>
</tr>
<tr>
<td>MATH 5661</td>
<td>Numerical Analysis II</td>
<td></td>
</tr>
<tr>
<td>MATH 5733</td>
<td>Partial Differential Equations</td>
<td></td>
</tr>
<tr>
<td>MATH 5792</td>
<td>Probabilistic Modeling</td>
<td></td>
</tr>
<tr>
<td>MATH 6023</td>
<td>Topics in Discrete Math</td>
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</tr>
<tr>
<td>MATH 6101</td>
<td>Uncertainty Quantification</td>
<td></td>
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<tr>
<td>MATH 6131</td>
<td>Real Analysis</td>
<td></td>
</tr>
<tr>
<td>MATH 6380</td>
<td>Stochastic Processes</td>
<td></td>
</tr>
<tr>
<td>MATH 6384</td>
<td>Spatial Data Analysis</td>
<td></td>
</tr>
<tr>
<td>MATH 6388</td>
<td>Statistical and Machine Learning</td>
<td></td>
</tr>
<tr>
<td>MATH 6404</td>
<td>Applied Graph Theory</td>
<td></td>
</tr>
<tr>
<td>MATH 6595</td>
<td>Nonlinear Programming</td>
<td></td>
</tr>
<tr>
<td>MATH 6653</td>
<td>Introduction to Finite Element Methods</td>
<td></td>
</tr>
<tr>
<td>MATH 6660</td>
<td>Research Methods in Mathematics and Statistics</td>
<td></td>
</tr>
</tbody>
</table>

To learn more about the undergraduate Student Learning Outcomes for this program, please visit our website (https://clas.ucdenver.edu/mathematical-and-statistical-sciences/undergraduate-goals-and-objectives/).

To learn more about the graduate Student Learning Outcomes for this program, please visit our website (https://clas.ucdenver.edu/mathematical-and-statistical-sciences/ms-applied-mathematics-program-goals-objectives/).