MASTER OF SCIENCE IN APPLIED MATHEMATICS

The Master of Science in Applied Mathematics program at Illinois Tech is a modern graduate program tailored to serve students based on their academic background and future career goals. For students who wish to pursue a doctoral degree in the mathematical sciences, it provides a strong academic foundation that prepares the student for the challenge of Ph.D. coursework and research. For students who wish to pursue careers in industry, Illinois Tech trains students in state-of-the-art advanced mathematical techniques and models that are appealing to future employers. These options are possible due to the remarkably flexible structure of the program that allows students to craft their own coursework to meet their career goals by choosing one of the three options of study:

1. Coursework only option
2. Completing an industry-based project
3. Writing an M.S. thesis

In addition, students can choose a specialization from a wide range of contemporary areas of applied mathematics:

- Computational Statistics for Data Science
- Discrete Computation and Optimization
- Industrial Mathematics
- Quantitative Risk Management
- Stochastic Computation

Students satisfying the requirements of a specialization will have the specialization recognized on official transcripts.

Admission Requirements

The program normally requires a bachelor's degree in mathematics or applied mathematics. Candidates whose degree is in another field (for example, computer science, physics, or engineering) and whose background in mathematics is strong are also eligible for admission and are encouraged to apply. Applicants should have a bachelor's degree from an accredited university with a minimum cumulative GPA of 3.0/4.0. A combined verbal and quantitative GRE examination score of at least 304 and an analytic writing score of at least 2.5 are required. TOEFL scores (if required) should be a minimum of 80/550 (internet-based/paper-based test scores). A professional statement of goals/objectives (two pages) and a curriculum vitae must be submitted. Two letters of recommendation are required. Students must remove deficiencies in essential undergraduate courses that are prerequisites for the degree program, in addition to fulfilling all other degree requirements. Typically, admitted students score at least 156 on the quantitative portion of the GRE; however, meeting the minimum or typical GPA and test score requirements does not guarantee admission.

The Director of Graduate Studies serves as temporary academic adviser for newly admitted graduate students in the master of science programs until an appropriate faculty member is selected as the adviser. Students are responsible for following all departmental procedures, as well as the general requirements of the Graduate College.

Curriculum

Students may transfer up to two classes from a graduate program at another accredited university if the student has not used the classes to satisfy the requirements for a degree at the previous university.

General Program Requirements

1. All students will follow the requirements for core courses as given below.
2. All students will choose one of the following three options:

    a. *Coursework Only Option.* Students must pass the comprehensive exam, consisting of two exams corresponding to the courses MATH 500, MATH 540, MATH 553, MATH 563, and MATH 577, which must be passed at a master's level or above.

    b. *Master's Project Option.* Perform an industrial project for three to five credit hours taken as MATH 594. A project may focus on the applications of existing methodologies or mathematical modeling of a real-life phenomenon, possibly from outside mathematics, including industry sponsored group projects. This option also requires MATH 522 and the completion of a formal specialization.

    c. *M.S. Thesis Option.* M.S. Thesis for five to eight credit hours taken as MATH 591. A thesis should go into substantial depth on a topic or problem from a methodological or mathematical perspective and make a contribution towards the advancement of mathematical understanding of the problem under study.

3. All students will take the colloquium course MATH 593 (zero credit hours) at least one semester.

4. All students will take their remaining credit hours from the elective courses listed below or other courses with the approval of the academic adviser.
5. Students will maintain a GPA of at least 3.0 in their coursework.
6. Students in the coursework only option or thesis option may complete one of the listed specializations, but are not required to do so.

Master of Science in Applied Mathematics (Coursework Only Option)

Requirement	Credits
Minimum Degree Credits	32
Maximum 400-Level Credit	9
Minimum MATH Credit	25

Code	Title		Credit Hours
Core Courses			**(9)** [1]
MATH 577	Computational Mathematics I		3
Select a minimum of six credit hours from the following:			6
MATH 500	Applied Analysis I	3	
or MATH 400	Real Analysis		
MATH 540	Probability [2]	3	
or MATH 475	Probability		
MATH 553	Discrete Applied Mathematics I	3	
or MATH 454	Graph Theory and Applications		
MATH 563	Mathematical Statistics [3]	3	
or MATH 476	Statistics		
Additional Requirements			**(0)**
MATH 593	Seminar in Applied Mathematics		0
Elective Courses			**(23)**
Select 23 credit hours [4]			23
Total Credit Hours			**32**

1. Students in the coursework only option must pass the comprehensive exam, consisting of two exams corresponding to the courses MATH 500, MATH 540, MATH 553, MATH 563, and MATH 577, which must be passed at a master's level or above.
2. MATH 540 or MATH 475 is required for students pursuing specializations in Stochastic Computation, Computational Statistics for Data Science, or Quantitative Risk Management.
3. MATH 563 is required for students pursuing a specialization in Computational Statistics for Data Science.
4. The remaining courses in each student's program are selected in consultation with, and approval of, the Director of Graduate Studies. Students pursuing a specialization should choose approved courses specific to their specialization. See the Specializations tab on this page for more details.

Master of Science in Applied Mathematics (Master's Project Option)

Requirement	Credits
Minimum Degree Credits	32
Maximum 400-Level Credit	9
Minimum MATH Credit	25

Code	Title		Credit Hours
Core Courses			**(9)**
MATH 522	Mathematical Modeling		3
MATH 577	Computational Mathematics I		3
Select a minimum of three credit hours from the following:			3
MATH 500	Applied Analysis I	3	
or MATH 400	Real Analysis		
MATH 540	Probability [1]	3	

or MATH 475	Probability	
MATH 553	Discrete Applied Mathematics I	3
or MATH 454	Graph Theory and Applications	
MATH 563	Mathematical Statistics [2]	3
or MATH 476	Statistics	
Additional Requirements		**(0)**
MATH 593	Seminar in Applied Mathematics	0
Specialization Courses		**(9-15)**
Select 9-15 credit hours from an approved specialization [3, 5]		9-15
Master's Project		**(3-5)**
MATH 594	Professional Master's Project [5]	3-5
or MATH 597	Reading and Special Projects	
Elective Courses		**(3-11)**
Select 3-11 credit hours [4, 5]		3-11

1 MATH 540 or MATH 475 is required for students pursuing specializations in Industrial Mathematics, Stochastic Computation, Computational Statistics for Data Science, or Quantitative Risk Management.
2 MATH 563 is required for students pursuing a specialization in Computational Statistics for Data Science.
3 Students should choose approved courses specific to their specialization. See the Specializations tab on this page for more details.
4 The remaining courses in each student's program are selected in consultation with, and approval of, the Director of Graduate Studies.
5 Variable credit hours should sum up to a minimum 23 credit hours so that students fulfill a minimum 32 credits together with 9 credits of Core Courses.

Master of Science in Applied Mathematics (Thesis Option)

Requirement	Credits
Minimum Degree Credits	32
Maximum 400-Level Credit	9
Minimum MATH Credit	25

Code	Title	Credit Hours
Core Courses		**(9)**
MATH 577	Computational Mathematics I	3
Select six credit hours from the following:		6
MATH 500	Applied Analysis I	3
or MATH 400	Real Analysis	
MATH 540	Probability [1]	3
or MATH 475	Probability	
MATH 553	Discrete Applied Mathematics I	3
or MATH 454	Graph Theory and Applications	
MATH 563	Mathematical Statistics [2]	3
or MATH 476	Statistics	
Additional Requirements		**(0)**
MATH 593	Seminar in Applied Mathematics	0
Elective Courses		**(15-18)**
Select 15-18 credit hours [3, 4]		15-18
Thesis Research		**(5-8)**
MATH 591	Research and Thesis M.S. [4]	5-8

1 MATH 540 or MATH 475 is required for students pursuing specializations in Stochastic Computation, Computational Statistics for Data Science, or Quantitative Risk Management.
2 MATH 563 is required for students pursuing a specialization in Computational Statistics for Data Science.
3 The remaining courses in each student's program are selected in consultation with, and approval of, the Director of Graduate Studies. Students pursuing a specialization should choose approved courses specific to their specialization. See the Specializations tab on this page for more details.

[4] Variable credit hours should sum up to a minimum 23 credit hours so that students fulfill a minimum 32 credits together with 9 credits of Core Courses.

Comprehensive Examination

The comprehensive examination requirement is fulfilled by either (a) passing written tests in two of the five core areas of study at the master of science level; or (b) performing an industrial project (three to five credit hours of MATH 594), satisfying the requirements for one specialization, and taking MATH 522; or (c) a master's thesis (five to eight credit hours of MATH 591) under the supervision of a faculty member.

Specializations

Computational Statistics for Data Science

Code	Title	Credit Hours
Required Courses		**(9)**
MATH 540	Probability [1]	3
or MATH 475	Probability	
MATH 563	Mathematical Statistics [1]	3
MATH 564	Regression	3
Elective Courses		**(0)** [2]
BIOL 550	Bioinformatics	3
CS 579	Online Social Network Analysis	3
CS 583	Probabilistic Graphical Models	3
CS 584	Machine Learning	3
CS 585	Natural Language Processing	3
ECE 566	Machine and Deep Learning	3
MATH 483	Design and Analysis of Experiments	3
MATH 535	Optimization I	3
MATH 542	Stochastic Processes	3
or MATH 481	Introduction to Stochastic Processes	
MATH 546	Introduction to Time Series	3
or MATH 446	Introduction to Time Series	
MATH 561	Algebraic and Geometric Methods in Statistics	3
MATH 565	Monte Carlo Methods	3
MATH 567	Advanced Design of Experiments	3
or MATH 483	Design and Analysis of Experiments	
MATH 569	Statistical Learning	3
MATH 574	Bayesian Computational Statistics	3
MATH 578	Computational Mathematics II	3
MATH 590	Meshfree Methods	3
PHYS 440	Computational Physics	3

[1] MATH 540, MATH 475, and MATH 563 may be used to satisfy both the core degree requirements and specialization requirements.

[2] Students may also select core course options that were not used to satisfy the core course requirement.

Discrete Computation and Optimization

Code	Title	Credit Hours
Required Courses		**(9)**
Select nine credit hours from the following:		9
MATH 530	Applied and Computational Algebra	3
MATH 535	Optimization I	3
MATH 553	Discrete Applied Mathematics I	3
MATH 554	Modern Methods in Discrete Applied Mathematics	3

MATH 569	Statistical Learning	3
Elective Courses		**(0)** [2]
CS 535	Design and Analysis of Algorithms	3
CS 539	Game Theory: Algorithms and Applications	3
CS 579	Online Social Network Analysis	3
CS 583	Probabilistic Graphical Models	3
CS 584	Machine Learning	3
ECE 519	Coding for Reliable Communications	3
ECE 565	Computer Vision and Image Processing	3
MATH 430	Applied Algebra	3
MATH 454	Graph Theory and Applications [1]	3
MATH 542	Stochastic Processes	3
or MATH 481	Introduction to Stochastic Processes	
MATH 546	Introduction to Time Series	3
or MATH 446	Introduction to Time Series	
MATH 561	Algebraic and Geometric Methods in Statistics	3
MATH 563	Mathematical Statistics	3
or MATH 564	Regression	
MATH 565	Monte Carlo Methods	3
MATH 567	Advanced Design of Experiments	3
or MATH 483	Design and Analysis of Experiments	
MATH 574	Bayesian Computational Statistics	3

1 MATH 454 may not be taken if the student has already completed MATH 553.
2 Students may also select core course options that were not used to satisfy the core course requirement.

Industrial Mathematics

Note: The master's project track is required to pursue this specialization.

Code	Title	Credit Hours
Required Courses		**(15)**
MATH 540	Probability [1]	3
or MATH 475	Probability	
MATH 522	Mathematical Modeling [1]	3
SCI 511	Project Management	3
or SCI 522	Public Engagement for Scientists	
MATH 523	Case Studies and Project Design in Applied Mathematics	6
or MATH 592	Internship in Applied Mathematics	
Elective Courses		**(0)** [2]
CS 535	Design and Analysis of Algorithms	3
CS 539	Game Theory: Algorithms and Applications	3
CS 579	Online Social Network Analysis	3
CS 583	Probabilistic Graphical Models	3
CS 584	Machine Learning	3
MATH 430	Applied Algebra	3
MATH 454	Graph Theory and Applications [2]	3
MATH 542	Stochastic Processes	3
or MATH 481	Introduction to Stochastic Processes	
MATH 546	Introduction to Time Series	3
or MATH 446	Introduction to Time Series	
MATH 561	Algebraic and Geometric Methods in Statistics	3
MATH 563	Mathematical Statistics	3
or MATH 564	Regression	

MATH 565	Monte Carlo Methods	3
MATH 567	Advanced Design of Experiments	3
or MATH 483	Design and Analysis of Experiments	
MATH 574	Bayesian Computational Statistics	3

1 MATH 540, MATH 475, and MATH 522 may be used to satisfy both the core degree requirements and specialization requirements.
2 Students may also select core course options that were not used to satisfy the core course requirement.

Quantitative Risk Management

Code	Title	Credit Hours
Required Courses		**(12)**
MATH 540	Probability [1]	3
or MATH 475	Probability	
MATH 542	Stochastic Processes	3
or MATH 543	Stochastic Analysis	
MATH 588	Advanced Quantitative Risk Management	3
MATH 565	Monte Carlo Methods	3
or MATH 582	Mathematical Finance II	
or MATH 584	Mathematical Methods for Algorithmic Trading	
or MATH 587	Theory and Practice of Modeling Risk and Credit Derivatives	
Elective Courses		**(0)** [2]
MATH 543	Stochastic Analysis	3
MATH 544	Stochastic Dynamics	3
or MATH 545	Stochastic Partial Differential Equations	
MATH 546	Introduction to Time Series	3
or MATH 566	Multivariate Analysis	
MATH 563	Mathematical Statistics	3
or MATH 564	Regression	
MATH 569	Statistical Learning	3
MATH 574	Bayesian Computational Statistics	3
MATH 578	Computational Mathematics II	3
MATH 581	Finite Element Method	3
or MATH 589	Numerical Methods for Partial Differential Equations	
or MATH 590	Meshfree Methods	
MATH 586	Theory and Practice of Fixed Income Modeling	3

1 MATH 540 or MATH 475 may be used to satisfy both the core degree requirements and specialization requirements.
2 Students may also select core course options that were not used to satisfy the core course requirement.

Stochastic Computation

Code	Title	Credit Hours
Required Courses		**(12)**
MATH 540	Probability [1]	3
or MATH 475	Probability	
Select nine credit hours from the following:		9
MATH 542	Stochastic Processes	3
or MATH 543	Stochastic Analysis	
MATH 544	Stochastic Dynamics	3
MATH 545	Stochastic Partial Differential Equations	3
MATH 565	Monte Carlo Methods	3
MATH 574	Bayesian Computational Statistics	3
Elective Courses		**(0)** [2]
CS 595	Topics in Computer Science (Advanced Scientific Computing)	3

MATH 522	Mathematical Modeling	3
MATH 530	Applied and Computational Algebra	3
MATH 546	Introduction to Time Series	3
MATH 569	Statistical Learning	3
MATH 573	Reliable Mathematical Software	0
MATH 578	Computational Mathematics II	3
MATH 589	Numerical Methods for Partial Differential Equations	3

[1] MATH 540 or MATH 475 may be used to satisfy both the core degree requirements and specialization requirements.
[2] Students may also select core course options that were not used to satisfy the core course requirement.