School of Natural Sciences and Mathematics

Department of Mathematical Sciences

Objectives

The Mathematical Sciences Department at The University of Texas at Dallas offers graduate studies in seven specializations namely - Mathematics, Applied Mathematics, Engineering Mathematics, Statistics, Applied Statistics, Data Science and Actuarial Science, and an interdisciplinary degree in Bioinformatics and Computational Biology. The degree programs offer students the opportunity to prepare for careers in these disciplines themselves or in any of the many other fields for which these disciplines offer such indispensable tools. As other sciences develop, problems which require the use of these tools are numerous and pressing.

In addition to a wide range of courses in mathematics, statistics, and actuarial science, the Mathematical Sciences Department offers a unique selection of courses that consider mathematical and computational aspects of engineering, biology and other scientific problems.


The Master of Science degree is also available for those who plan to teach Mathematics or Statistics above the remedial level at a community college or at a college or university. The Master of Science degree is recommended as a minimum, since a doctorate degree is sometimes required.

For information concerning the Master of Arts in Teaching in Mathematics Education, designed for persons who are teaching in grades 6-12, see the Science and Mathematics Education section.

The Doctor of Philosophy degree programs cover two basic areas of concentration: Statistics and Mathematics. They are designed for those who plan to pursue academic, government, financial, actuarial, or industrial careers.

Facilities

The faculty, staff, and students have access to a large network of workstations and servers on campus.

Admission Requirements

The University's general admission requirements are discussed on the Graduate Admission page (catalog.utdallas.edu/2016/graduate/admission).

Specific additional admission requirements for students in degree programs in the Department of
Mathematical Sciences follow. Students lacking undergraduate prerequisites for graduate courses in their area must complete these prerequisites or receive approval from the graduate advisor and the course instructor before registering.

One of the components of a student's academic history which is evaluated when the student is seeking admission to the graduate program is his/her performance on certain standardized tests. Since these tests are designed to indicate only the student's potential for graduate study, they are used in conjunction with other measures of student proficiency, such as GPA (grade point average), etc., in determining the admission status of a potential graduate student. Accordingly, there is no rigid minimum cutoff score for admission to the program. Most applicants admitted to either the MS or PhD programs have GRE scores of at least 143 verbal, 155 quantitative, and 310 combined. However, exceptions are made in some cases when other credentials are especially strong. Higher standards prevail for applicants seeking Teaching Assistantships.

**Master of Science in Mathematics**

*36 semester credit hours minimum*

**Department Faculty**

**Degree Requirements**

The University's general degree requirements are discussed on the [Graduate Policies and Procedures page](catalog.utdallas.edu/2016/graduate/policies/policy).

Students seeking a Master of Science in Mathematics must complete a total of 12 three-semester credit hour courses. In some cases, credit for 3 semester credit hours is approved for good mathematics background. The student may choose a thesis plan or a non-thesis plan. In the thesis plan, the thesis replaces two elective courses with completion of an approved thesis (six thesis semester credit hours). The thesis is directed by a Supervising Professor and must be approved by the Head of the Mathematical Sciences Department.

Each student must earn a 3.0 minimum GPA in the courses listed for the student's program.

*To satisfy the MS degree requirements, we currently offer a choice between four specializations - Mathematics, Applied Mathematics, Engineering Mathematics, and Data Science.*

**Mathematics Specialization (MS)**

- **MATH 5301** Elementary Analysis I (or equivalent)
- **MATH 5302** Elementary Analysis II (or equivalent)
- **MATH 6301** Real Analysis
- **MATH 6302** Functional Analysis I
- **MATH 6303** Theory of Complex Functions I
MATH 6309 Differential Geometry or MATH 6310 Topology
MATH 6311 Abstract Algebra I
MATH 6313 Numerical Analysis
MATH 6315 Ordinary Differential Equations
MATH 6318 Numerical Analysis of Differential Equations

Plus two guided electives.

Applied Mathematics Specialization (MS)

MATH 5301 Elementary Analysis I (or equivalent)
MATH 5302 Elementary Analysis II (or equivalent)
MATH 6303 Theory of Complex Functions I
MATH 6308 Inverse Problems and Applications
MATH 6313 Numerical Analysis
MATH 6315 Ordinary Differential Equations
MATH 6318 Numerical Analysis of Differential Equations
MATH 6319 Principles and Techniques in Applied Mathematics I
MATH 6320 Principles and Techniques in Applied Mathematics II
MATH 6321 Optimization

Plus two guided electives.

Engineering Mathematics Specialization (MS)

MATH 5301 Elementary Analysis I (or equivalent)
MATH 5302 Elementary Analysis II (or equivalent)
MATH 6303 Theory of Complex Functions I
MATH 6305 Mathematics of Signal Processing
MATH 6313 Numerical Analysis
MATH 6315 Ordinary Differential Equations
MATH 6318 Numerical Analysis of Differential Equations
MATH 6319 Principles and Techniques in Applied Mathematics I
MATH 6320 Principles and Techniques in Applied Mathematics II
MATH 6331 Linear Systems and Signals

Plus two guided electives.
Data Science Specialization (MS)

- **CS 5303** Computer Science I
- **CS 5343** Algorithm Analysis and Data Structures
- **CS 6307** Introduction to Big Data Management and Analytics for non-CS Majors
- **CS 6375** Machine Learning
- **MATH 6312** Combinatorics and Graph Theory
- **MATH 6321** Optimization
- **MATH 6340** Numerical Linear Algebra
  or **MATH 6319** Principles and Techniques in Applied Mathematics
- **MATH 6390** Topics in Mathematics (Mathematical Foundations of Data Science)
- **STAT 5390** Topics in Statistics (Probability and Statistics for Data Science and Bioinformatics)
- **STAT 6390** Topics in Statistics (Statistical Machine Learning)

Plus two guided elective.

Other Requirements

Electives must be approved by the assigned graduate advisor. Typically, electives are 6000- and 7000-level Mathematics courses. Courses from other disciplines may also be used upon approval. Substitutions for required courses may be made if approved by the assigned graduate advisor. Instructors may substitute stated prerequisites for students with equivalent experience.

Master of Science in Statistics

*36 semester credit hours minimum*

Department Faculty

Program Objective

The Statistics MS degree curriculum at the University of Texas at Dallas offers a balanced list of applied and theoretical graduate courses in Statistics and attractive electives. During their study, our MS students acquire the necessary skills that make them highly competitive in the modern job market. Our recent graduates are currently employed as statisticians, biostatisticians, quantitative analysts, managers, actuaries, and so on, or they continue into doctoral degree programs.

Degree Requirements

The University's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/now/graduate/policies/policy).
The MS degree in Statistics requires completion of 12 approved graduate courses, for a total of 36 semester credit hours. Among these courses, there will be at least 7 courses in Statistics, including 5 specified ones. The other 5 courses are electives, which may be in Statistics, Mathematics, or another discipline, according to the student's professional interests and career goals. All such decisions are made in consultation with the statistics graduate advisor and are subject to the advisor’s approval.

Some students choose to do research at the MS level under the supervision of one of the professors and to write a thesis. The thesis must be approved by the Head of the Mathematical Sciences Department. Once the research project is completed, the thesis requires a formal defense in front of the thesis committee. A MS thesis project can be counted as 3 or 6 semester credit hours towards the required 36 hours.

Each student must earn a 3.0 minimum GPA in the courses listed for the student's program.

To satisfy the MS degree requirements, we currently offer a choice between three specializations - Statistics and Applied Statistics, and Data Science.

Statistics Specialization (MS)

1. Five Core Courses:
   - STAT 6331 Statistical Inference I
   - STAT 6337 Advanced Statistical Methods I
   - STAT 6338 Advanced Statistical Methods II
   - STAT 6339 Linear Statistical Models
   - STAT 6341 Numerical Linear Algebra and Statistical Computing

2. Two courses selected from different specialization groups:
   - Statistics Specialization Group One
     - STAT 6329 Applied Probability and Stochastic Processes
     - STAT 6343 Experimental Design
     - STAT 7334 Nonparametric and Robust Statistical Methods
   - Statistics Specialization Group Two
     - STAT 6348 Applied Multivariate Analysis
     - STAT 7331 Multivariate Analysis
   - Statistics Specialization Group Three
     - STAT 6347 Applied Time Series Analysis
     - STAT 7338 Time Series Modeling and Filtering

3. Students must choose remaining courses as electives approved by the graduate advisor for Statistics. Up to two of the following prerequisite 5000-level courses may be counted as electives:
MATH 5301 Elementary Analysis I
MATH 5302 Elementary Analysis II
STAT 5351 Probability and Statistics I
STAT 5352 Probability and Statistics II

Applied Statistics Specialization (MS)

1. Five core courses:
   - STAT 5351 Probability and Statistics I
   - STAT 5352 Probability and Statistics II
   - STAT 6337 Advanced Statistical Methods I
   - STAT 6338 Advanced Statistical Methods II
   - STAT 6341 Numerical Linear Algebra and Statistical Computing

2. Two or more courses are selected from the following list:
   - STAT 6329 Applied Probability and Stochastic Processes
   - STAT 6343 Experimental Design
   - STAT 6347 Applied Time Series Analysis
   - STAT 6348 Applied Multivariate Analysis

3. The remaining elective courses can be chosen in Statistics (e.g., STAT 6326 Sampling Theory, STAT 6v99 Statistical Consulting, STAT 6390 Topics in Statistics, etc.) or in other disciplines, and must be approved by the advisor. Many students use this option to build expertise in another subject to enhance their employment opportunities.

Data Science Specialization (MS)

   - CS 5303 Computer Science I
   - CS 5343 Algorithm Analysis and Data Structures
   - CS 6307 Introduction to Big Data Management and Analytics for non-CS Majors
   - CS 6375 Machine Learning
   - MATH 6312 Combinatorics and Graph Theory
   - STAT 5351 Probability and Statistics I
   - STAT 5352 Probability and Statistics II
   - STAT 6337 Advanced Statistical Methods I
   - STAT 6338 Advanced Statistical Methods II
   - STAT 6348 Applied Multivariate Analysis
Topics in Statistics (Statistical Machine Learning)

Plus one guided elective.

Other Requirements

Electives must be approved by the assigned graduate advisor. Courses from other disciplines may also be used upon approval. Substitutions for required courses may be made if approved by the assigned graduate advisor. Instructors may substitute stated prerequisites for students with equivalent experience.

Master of Science in Actuarial Science

36 semester credit hours minimum

Program Objective

The objective of the program is to educate future leaders of the actuarial industry with training in actuarial theory and methods in a wide spectrum of actuarial applications involving probabilistic and statistical models. All students will be prepared to take five actuarial preliminary exams and will take two advanced actuarial classes to prepare for professional accreditation. Furthermore, students who did not take classes required for VEE (Validation of Educational Experience) credits in statistics, finance, and economics will have such opportunity. With this combined knowledge of mathematics particularly of probability, statistics, and decision theory together with knowledge of financial mathematics and insurance, the expected passing of five actuarial exams, and the three required VEE credits, graduates of the program will be able to work as senior actuaries in insurance, consulting, finance, government, and emerging markets.

Course Requirements

The University's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/2016/graduate/policies/policy).

The minimal total required number of classes for graduation is 36 semester credit hours. Among them, 27 semester credit hours of required courses and 9 semester credit hours of electives.

Required Courses: 27 semester credit hours

- STAT 5351 Probability and Statistics I
- STAT 5352 Probability and Statistics II
- ACTS 6301 Theory of Actuarial Models: Life Contingencies
- ACTS 6303 Theory of Actuarial Models: Life Contingencies II
**ACTS 6304** Construction and Evaluation of Actuarial Models I

**ACTS 6305** Construction and Evaluation of Actuarial Models II

**ACTS 6306** Advanced Actuarial Applications

**ACTS 6308** Actuarial Financial Mathematics

Prescribed Elective Courses: 9 semester credit hours

For the prescribed elective courses select three courses from the following:

**STAT 6337** Advanced Statistical Methods I

**STAT 6329** Applied Probability and Stochastic Processes

**STAT 6338** Advanced Statistical Methods II

**STAT 6343** Experimental Design

**STAT 6347** Applied Time Series Analysis

**STAT 7338** Time Series Modeling and Filtering

**STAT 6348** Applied Multivariate Analysis

**STAT 6390** Topics in Statistics-Level 6

**STAT 7334** Nonparametric and Robust Statistical Methods

**MATH 6313** Numerical Analysis

**STAT 6331** Statistical Inference I

**FIN 6301** Financial Management

**FIN 6308** Regulation of Business and Financial Markets

**FIN 6310** Investment Management

**FIN 6314** Fixed Income Securities

**FIN 6360** Options and Future Markets

**FIN 6382** Numerical Methods in Finance

**OPRE 6335** Risk and Decision Analysis

**MECO 6303** Business Economics

**ACCT 6305** Accounting for Managers

**PPPE 6321** Economics for Public Policy

**Preparation for Actuarial Exams**

These classes prepare for the three preliminary actuarial examinations jointly administered by
the Society of Actuaries (SOA), Casualty Actuarial Society (CAS) and the Canadian Institute of Actuaries (CIA):

Exam 1/P: STAT 5351 and STAT 5352
Exam 2/FM: ACTS 6308
Exam 3L/MLC: ACTS 6301
Exam 3F/MFE: ACTS 6302
Exam 4/C: ACTS 6304
Exam 5/FAP: ACTS 6306

Validation by Educational Experience (VEE) Credits

Applied Statistical Methods: STAT 6337 and STAT 6347
Corporate Finance: FIN 6301
Economics: MECO 6303

Master of Science in Bioinformatics and Computational Biology

36 semester credit hours minimum

Mathematics Faculty

Biology Faculty

Program Objective

The Master of Science in Bioinformatics and Computational Biology (BCBM) is offered jointly by the Departments of Mathematical Sciences and Biological Sciences, with the former serving as the administrative unit. The BCBM combines coursework from the disciplines of biology, computer science, and mathematics. It seeks to address the demand for a new breed of scientists who have fundamental understanding in the fields of biology, mathematics, statistics, and computer science. With this interdisciplinary training, these scientists will be well prepared to meet the demand and challenges that have arisen and will continue to develop in the biotechnology arena.

A successful applicant is expected to have a Bachelor’s degree in Mathematics, Biology or another Science/Engineering and must have completed Differential and Integral Calculus courses. One or several of the following courses taken prior to enrollment are desirable: biology courses, a high level programming language, Linear Algebra, and Differential Equations.
Degree Requirements

1. Three introductory electives

The three introductory electives are 5000 level classes with possible prefixes BIOL, CS, MATH and STAT, and are chosen with the consent of the advisor, according to the background, strengths, and interests of a student. For a candidate with a strong and broad background, some introductory electives may be replaced by 6000 level electives.

The list of introductory electives includes:

- **CS 5303** Computer Science I
- **CS 5343** Algorithms Analysis and Data Structures
- **STAT 5352** Probability and Statistics II
- **BIOL 5410** Biochemistry
- **BIOL 5420** Molecular Biology
- **BIOL 5460** Quantitative Biology
- **BIOL 5376** Applied Bioinformatics
- **MATH 5301** Elementary Analysis I
- **MATH 5302** Elementary Analysis II
- **MATH 5390** Topics in Mathematics

2. Four Core courses

- **BIOL 5381** Genomics
- **STAT 5351** Probability and Statistics I
- **MATH 6341** Bioinformatics
- **CS 5333** Discrete Structures or **MATH 6312** Combinatorics and Graph Theory

3. Five advanced electives

The five advanced electives are 6000 or 7000 level classes with possible prefixes BIOL, CS, MATH and STAT, and are chosen according to the interests of a student with the consent of the advisor. Two of the advanced electives could be replaced by 6 hours research followed by a master thesis, according to the general University rules.

The list of advanced electives includes:

- **CS 6360** Database Design
- **MATH 6313** Numerical Analysis
- **MATH 6315** Ordinary Differential Equations
MATH 6324 Applied Dynamical Systems I
MATH 6343 Computational Biology
MATH 6345 Mathematical Methods in Medicine and Biology
MATH 7313 Partial Differential Equations I
BIOL 6385 Computational Biology
STAT 6337 Advanced Statistical Methods I
STAT 6338 Advanced Statistical Methods II
Other courses may also be taken with the advisor's approval.

Doctor of Philosophy in Mathematics
75 semester credit hours minimum beyond the baccalaureate degree

Department Faculty

Degree Requirements

The University's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/2016/graduate/policies/policy).

The Doctor of Philosophy degree program is tailored to the student. The student must arrange a course program with the guidance and approval of the graduate advisor. Adjustments can be made as the student's interests develop and a specific dissertation topic is chosen. A minimum of 75 semester credit hours beyond the bachelor's degree is required.

MATH 6301 Real Analysis
MATH 6302 Functional Analysis I
MATH 6303 Theory of Complex Functions I
MATH 6309 Differential Geometry or MATH 6310 Topology
MATH 6311 Abstract Algebra I
MATH 6313 Numerical Analysis
MATH 6315 Ordinary Differential Equations
MATH 6316 Differential Equations
MATH 6318 Numerical Analysis of Differential Equations
MATH 6319 Principles and Techniques in Applied Mathematics I
MATH 6320 Principles and Techniques in Applied Mathematics II
Electives and Dissertation

An additional 18-24 semester credit hours designed for the student's area of specialization are taken as electives in a degree plan designed by the student and the graduate advisor. This plan is subject to approval by the Department Head. After completion of the first 3 or 4 academic semesters of the course program, the student must pass a PhD Qualifying Examination in order to continue on to the research and dissertation phase of the PhD program. Finally, a dissertation is required and must be approved by the graduate program.

There must be available a dissertation research advisor or group of dissertation advisors willing to supervise and guide the student. A dissertation Supervising Committee should be formed in accordance with the UT Dallas policy memorandum (UTDPP1052).

Doctor of Philosophy in Statistics

75 semester credit hours minimum beyond the baccalaureate degree

Department Faculty

Degree Requirements

The University's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/2016/graduate/policies/policy).

The Doctor of Philosophy degree program is tailored to the student. The student must arrange a course program with the guidance and approval of the graduate advisor. Adjustments can be made as the student's interests develop and a specific dissertation topic is chosen. A minimum of 75 semester credit hours beyond the bachelor's degree is required.

- STAT 6331 Statistical Inference I
- STAT 6332 Statistical Inference II
- STAT 6337 Advanced Statistical Methods I
- STAT 6338 Advanced Statistical Methods II
- STAT 6339 Linear Statistical Models
- STAT 6344 Probability Theory I

Three courses approved by the student's PhD advisor from the following list:

- STAT 7330 Decision Theory and Bayesian Inference
- STAT 7331 Multivariate Analysis
STAT 7334 Nonparametric and Robust Statistics Statistical Methods
STAT 7338 Time Series Modeling and Filtering
STAT 7345 Advanced Probability and Stochastic Processes

Electives and Dissertation

An additional 18-24 semester credit hours designed for the student's area of specialization are taken as electives in a degree plan designed by the student and the graduate advisor. This plan is subject to approval by the Department Head. After completion of the first 3 or 4 academic semesters of the course program, the student must pass a PhD Qualifying Examination in order to continue on to the research and dissertation phase of the PhD program. Finally, a dissertation is required and must be approved by the graduate program. There must be available a dissertation research advisor or group of dissertation advisors willing to supervise and guide the student. A dissertation Supervising Committee should be formed in accordance with the UT Dallas policy memorandum (UTDPP1052).

Research

Within the Mathematical Sciences Department opportunities exist for work and/or research in Applied Mathematics, Engineering Mathematics, Mathematics, and Statistics. The opportunity to take coursework in several of the other University programs also allows the student to prepare for interdisciplinary work. Such coursework must be approved by the assigned graduate advisor.


Some of the broad research areas represented in Statistics are as follows: probability theory, stochastic processes, statistical inference, asymptotic theory, statistical methodology, time series analysis, Bayesian analysis, robust multivariate statistical methods, nonparametric methods, nonparametric curve estimation, sequential analysis, biostatistics, statistical genetics, and bioinformatics.

For a complete list of faculty and their areas of research, visit the Department of Mathematical Sciences Faculty (www.utdallas.edu/nsm/math/faculty).

Graduate Certificate in Data Science: 12 semester credit hours

The Department of Mathematical Sciences, in cooperation with the Department of Computer Science, offers a graduate certificate in Data Science.
Admission Requirements
Students must gain admission to a graduate program at UT Dallas and have the pre-requisites needed to take the certificate courses.

Certificate Requirements
Students must complete the following four courses with a GPA of 3.0 or better.

- CS 6307 Introduction to Big Data Management and Analytics for non-CS Majors
- CS 6375 Machine Learning
- MATH 6312 Combinatorics and Graph Theory
- STAT 6390 Topics in Statistics (Statistical Machine Learning)

1. Exam 1/P
2. Exam 3L/MLC, Part I
3. Exam 3F/MFE
4. Exam 3L/MLC, Part II
5. Exam 4/C, Part I
6. Exam 4/C, Part II
7. Exam 5/FAP
8. Exam 2/FM
9. VEE, Applied Statistical Methods
10. VEE, Corporate Finance
11. VEE, Economics