School of Natural Sciences and Mathematics

Department of Mathematical Sciences

Objectives

The Mathematical Sciences Department at The University of Texas at Dallas offers graduate study in six specializations: Actuarial Science, Applied Mathematics, Engineering Mathematics, Mathematics, Statistics, 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 are 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 and statistics, 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 programs are designed for persons seeking specializations in Applied Mathematics, Engineering Mathematics, Mathematics, Statistics, or Actuarial Science, or Bioinformatics and Computational Biology.

The Master of Science degree is available also 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 an earned doctorate 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 Applied 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/2015/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 Actuarial Science

36 semester credit hours minimum

Department Faculty

Professors: Larry P. Ammann, Sam Efromovich
Clinical Professors: Ronald D. Dearing, Natalia Humphreys
Clinical Assistant Professor: Wenyi (Roy) Lu
Senior Lecturer: Yuly Koshevnik

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/2015/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 I¹
STAT 5352 Probability and Statistics II¹
ACTS 6301 Theory of Actuarial Models: Life Contingencies I²
ACTS 6302 Theory of Actuarial Models: Financial Economics³
ACTS 6303 Theory of Actuarial Models: Life Contingencies II⁴
ACTS 6304 Construction and Evaluation of Actuarial Models I⁵
ACTS 6305 Construction and Evaluation of Actuarial Models II⁶
ACTS 6306 Advanced Actuarial Applications⁷
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 Mathematics

36 semester credit hours minimum

Department Faculty

Professors: Larry P. Ammann, Zalman I. Balanov, Vladimir Dragovic, Sam Efromovich, M. Ali Hooshyar, Wieslaw Krawcewicz, Susan E. Minkoff, L. Felipe Pereira, Dmitry Rachinskiy, Viswanath Ramakrishna, Robert Serfling, Janos Turi, John Zweck
Professors Emeritus: Patrick Odell, Ivor Robinson, John W. Van Ness
Clinical Professors: Natalia Humphreys
Associate Professors: Swati Biswas, Yan Cao, Pankaj K. Choudhary, Mieczyslaw K. Dabkowski, Yulia Gel
Assistant Professors: Mohammad Akbar, Maxim Arnold, Bhargab Chattopadhyay, Min Chen, Tobias Hagge, Qingwen Hu, Frank Konietschke, Yifei Lou, Oleg Makarenkov, Tomoki Oshawa, Qiongxia (Joanne) Song, Anh Tran
Affiliated Faculty: Hervé Abdi, Titu Andreescu, Alain Bensoussan, Raimund J. Ober, John J. Wiorkowski
Adjunct Faculty from the Research for Mathematics of the Mexican Council and Technology: Jose Gomez-Larranaga, Adolfo (Sanchez) Valenzuela

Program Objective

The University's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/2015/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.

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 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 6308 Inverse Problems and Applications
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 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
MATH 6305 Mathematics of Signal Processing
Plus two guided electives.

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 6313 Numerical Analysis
MATH 6315 Ordinary Differential Equations
MATH 6318 Numerical Analysis of Differential Equations
MATH 6301 Real Analysis
MATH 6302 Functional Analysis I
MATH 6311  Abstract Algebra I
MATH 6309  Differential Geometry or  MATH 6310  Topology
Plus two guided electives.

Statistics Specialization (MS)

1. Students seeking a Master of Science in Mathematics with a specialization in Statistics must complete the following 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

Other Requirements
Electives must be approved by the assigned graduate advisor. Typically, electives are 6000- and 7000-level Mathematics or Statistics 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 Bioinformatics and Computational Biology

36 semester credit hours minimum

Department Faculty

Associate Professors: Swati Biswas, Yan Cao
Assistant Professor: Min Chen
Affiliated Faculty: Zhenyu Xuan, Hyuntae Yoo, Michael Qiwei Zhang

Program Objective

The Master of Science in Bioinformatics and Computational Biology (BCBM) is offered jointly by the Departments of Mathematical Sciences and Biological Sciences. This program will combine coursework from the disciplines of biology, computer science, and mathematics. The BCBM program seeks to answer the demand for a new breed of scientist who has 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.

Complete information about the Master of Science in Bioinformatics and Computational Biology Program is available at catalog.utdallas.edu/2015/graduate/programs/nsm/bioinformatics-and-computational-biology.

Doctor of Philosophy in Mathematics

75 semester credit hours minimum beyond the baccalaureate degree

Department Faculty

Professors Emeritus: Patrick Odell, Ivor Robinson, John W. Van Ness
Clinical Professors: Natalia Humphreys
Associate Professors: Swati Biswas, Yan Cao, Pankaj K. Choudhary, Mieczyslaw K. Dabkowski, Yulia Gel
Assistant Professors: Mohammad Akbar, Maxim Arnold, Bhargab Chattopadhyay, Min Chen, Tobias Hagge, Qingwen Hu, Frank Konietschke, Yifei Lou, Oleg Makarenkov, Tomoki Oshawa, Qiongxia (Joanne) Song, Anh Tran
Senior Lecturers: Diana Cogan, Malgorzata Dabkowska, Anatoly Eydelzon, Manjula Foley, Bentley T. Garrett, Yuly Koshevnik, David L. Lewis, Brady McCary, Jigarkumar Patel, William M. Scott, Paul Stanford
Affiliated Faculty: Hervé Abdi, Titu Andreescu, Alain Bensoussan, Raimund J. Ober, John J. Wiorkowski
Adjunct Faculty from the Research for Mathematics of the Mexican Council and
Program Objective

The University's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/2015/graduate/policies/policy). Each 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.

Applied Mathematics Specialization (PhD)

- **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
- **MATH 7313** Partial Differential Equations I
- **MATH 7319** Functional Analysis II

Statistics Specialization (PhD)

- **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 for Applied Mathematics and 18-24 semester credit hours for Statistics 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. Areas of specialization include, for example:

**Applied Mathematics:**

applied analysis, biomathematics, differential equations, relativity, scattering theory, systems theory, signal processing.

**Statistics:**

statistical inference, applied statistics, biostatistics, statistical computing, probability, stochastic processes, time series analysis, multivariate analysis, nonparametric and robust statistics, asymptotic theory.

Other specializations are possible, including interdisciplinary topics. 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](https://catalog.utdallas.edu/2015/graduate/programs/nsm/mathematics)). The dissertation may be in Applied Mathematics or in Statistics exclusively, or it may include considerable work in an area of application.

**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.

Special topics within the Applied Mathematics research area include functional analysis, operator theory, differential and integral equations, optimization, numerical analysis, system theory and control with application in material and molecular sciences, inverse problems with applications in geosciences and medical sciences, relativistic cosmology, differential geometry, applications of topology to biology, mathematical logic, quantum computation and mathematical and computational biology with applications in cardiovascular physiology, neurobiology and cell biology.

Special topics within the Statistics research area include: probability theory, applied probability, stochastic processes, mathematical statistics, statistical inference, asymptotic theory, time series analysis, Bayesian analysis, robust multivariate statistical methods,
robust linear models, robust and nonparametric methods, nonparametric curve estimation, sequential analysis, statistical computing, remote sensing, change-point problems, and spatial statistics

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

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

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