Mathematics

at Arcadia University

Global Perspectives…Personal Attention…Real-World Integrative Learning Experiences

Faculty

Professors
- Dr. Louis M. Friedler (Chair)
- Dr. Carlos E. Ortiz
- Dr. Edward F. Wolff

Associate Professor
- Dr. Yanxia Jia (Computer Science Program Director)
- Dr. Xizhong Zheng

Assistant Professor
- Dr. Richard J. Arras

Adjunct Professors
- Richard Clancy
- Dr. Zaneta Chapman, Assistant Professor of Business
- Dr. Marion Cohen
- Joie Dugan
- William Gingrich
- Dr. Mohammed Khalil
- Lawrence Lee
- Cathrine Magee
- Robert Osifchin
- Francis Prendergast
- Madhu Puri
- Elaine M. Rodgers
- Jonathan Shina

Director of Developmental Mathematics
- Renee Starr

Degrees

Bachelor of Arts in Mathematics
- Actuarial Science Concentration

Bachelor of Science in Mathematics
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Minors

- Elementary Mathematics Education
- Mathematics
- Statistics

Option

- Secondary Education Certification

Pathways to Study Abroad in Mathematics

Majors in the Computer Science and Mathematics Department are strongly encouraged to take full advantage of the study abroad opportunities that Arcadia University offers. In recent years, students have studied at universities in England, Ireland, Scotland, Australia, and Italy. All benefited greatly from their experiences.

Students who plan to study abroad should meet with their advisers as soon as possible to discuss their options. This is especially true given that several of the Department's upper-level courses are taught on an alternating year basis. Therefore, the best semesters to study abroad might differ from year to year. Several courses are part of sequences, and students are advised to take those entire sequences at Arcadia.

Many majors elect not to take any math or computing courses during the semester abroad, instead choosing humanities and social science courses that fulfill Undergraduate Curriculum requirements. These latter courses are more apt to help students gain a rich knowledge and appreciation of the culture of the country in which they are studying.

Visit the University's Web site for Pathways to Study Abroad (www.arcadia.edu/pathways). Since it is important that students plan ahead for study abroad, they should consult with their advisers as soon as possible and make their intentions known to the Department Chair and the Associate Dean of International Affairs.

About the B.A. and B.S. in Mathematics

- Preparation for positions in statistics, applied mathematics, and financial analysis in business, government, or industry
- Preparation for graduate school in mathematics, statistics, mathematics education, or actuarial science
- Preparation for secondary teaching

- Preparation for the first two exams of the Society of Actuaries and Casualty Actuarial Society
- Opportunities to study abroad at some of the top universities around the world

Arcadia University's Mathematics programs are designed to help students to develop problem-solving skills as well as the theoretical insight needed both for applications and graduate study. Courses use state-of-the-art technology, including graphing calculators, computer algebra systems such as Maple, Geometer's Sketchpad, and statistical software such as SAS and SPSS.

The curriculum allows students to specialize in Actuarial Science, Secondary Education, or pure math.

Recent graduates are actuaries, secondary teachers, biostatisticians, statistical programmers, financial analysts, and graduate students in mathematics, statistics, and engineering. They have found positions with companies such as Boeing, Towers-Perrin, and AON Consulting. Students have continued their educations at universities such as Columbia, Wisconsin, Rutgers, George Mason, Delaware, and Villanova.

Arcadia also offers a concentration in Actuarial Science as an option within the Mathematics major. Students may prepare for the first two exams of the Society of Actuaries and Casualty Actuarial Society. A highlight of the program is the special Actuarial Seminar. Students are introduced to the principles of risk management and develop the problem-solving skills necessary to be successful on the first exam.

Bachelor of Arts in Mathematics

The Bachelor of Arts degree program prepares students for teaching mathematics at the elementary and secondary school level and for jobs in industry and business. It can serve as a second major for students specializing in other fields.

Bachelor of Science in Mathematics

The Bachelor of Science degree program involves a deeper investigation of both mathematics and applied sciences and prepares students for graduate study, teaching and work in programming and research. Career options include business, government, industry, teaching positions at all levels from elementary through university, and actuarial science positions.

Actuarial Science Concentration (Bachelor of Arts or Bachelor of Science)

For many years, Arcadia University's Computer Science and Mathematics Department has prepared students to pursue careers as actuaries—the highly paid insurance professionals who use mathematics to quantitatively assess risk. The Department's actuarial science concentration is a program within the mathematics major. The program is administered by Dr. Louis Friedler, an Associate of the Society of Actuaries, and by Dr. Edward Wolff, a statistician with many years experience preparing students for actuarial careers.

To advance within the field of actuarial science, individuals must pass a series of exams administered by the Society of Actuaries and the Casualty Actuarial Society. These exams reflect the importance of both mathematics and business to this career. Arcadia University's actuarial concentration offers courses covering the material for the first two of these exams.

Exam 1/ Exam P:	Probability
Exam 2/ Exam MF:	Mathematical Finance

The Department also offers Validation by Education Experience (VEE) actuarial credit in Applied Statistics, Finance, and Economics in cooperation with Arcadia's Business Department. Details are available on the department's Web page: http://gargoyle.arcadia.edu/mathcs .

Minor in Elementary Mathematics Education

The minor in Elementary Mathematics Education is designed for students majoring in Elementary Education who want to enhance their understanding of mathematics and so meet Pennsylvania certification requirements. This minor is not open to Mathematics majors.

Minor in Mathematics

The minor in Mathematics is designed to give students majoring in other fields the minimum number of Mathematics courses necessary to

do fundamental mathematical analysis required for positions in the sciences and social sciences.

Minor in Statistics

The minor in Statistics provides the necessary background to do statistical analysis in professional or academic settings involving the collection and study of data. This minor is not open to Mathematics majors.

Requirements for the B.A. and B.S. in Mathematics

(38-60 credits as listed below, with Undergraduate Curriculum requirements and electives to total 128 credits)

Common Curriculum for both degree programs

(26-28 credits as listed below)

1. Four courses in Mathematics
   - MA 201, 202, 203 Calculus I, II, III
   - MA 221 Linear Algebra

2. The following course:
   - CS 201 Problem-Solving with Programming and Algorithms I

3. MA 490 Mathematics Capstone (1 credit) plus completion of a Capstone project linked to one of the following three courses: MA 330, MA 343, MA 352.

Additional Requirements

For the Bachelor of Arts (B.A.) in Mathematics
(12 credits as listed below)

1. Two courses in Mathematics chosen from the following:
   - MA 302 Introduction to Analysis
   - MA 322 Abstract Algebra I
   - MA 341 Probability

2. Two Mathematics elective at the 300 level

For the Bachelor of Science (B.S) in Mathematics
(32 credits as listed below)

1. Three courses in Mathematics
   - MA 302 Introduction to Analysis
   - MA 322 Abstract Algebra I
   - MA 341 Probability

2. Three Mathematics electives at the 300 level
3. The following courses:
   - PH 211, 212 Conceptual Physics I, II

Requirements for the Actuarial Science Concentration

(with the Bachelor of Arts or Bachelor of Science)

1. Required courses
   - MA 201, 202, 203 Calculus I, II, III
   - MA 221 Linear Algebra
   - MA 288 Actuarial Seminar
   - MA 341 Probability
   - MA 342 Mathematical Statistics I
   - MA 343 Mathematical Statistics II
   - MA 361 The Mathematical Theory of Interest
   - MA 362 Derivatives Markets

2. Required cognate courses (Students must satisfy the requirements for either the Bachelor of Arts or the Bachelor of Science)
   - BA 201 Financial Accounting
   - BA 380 Principles of Finance
   - BA 382 Investments
   - EC 210 Principles of Macroeconomics
   - EC 211 Principles of Microeconomics
   - CS 201 Problem-Solving with Algorithms and Programming I

3. Recommended course
   - CS 104 Computer as a Tool

Requirements for the Minor in Elementary Mathematics Education

(19–20 credits as listed below)

Students who minor in Elementary Mathematics Education may not also minor in Mathematics or Statistics.

At least three of the courses listed below must be taken on Arcadia's campus.

1. The following course:
   MA 201 Calculus I

2. Any mathematical methods course taught by Arcadia University's Department of Education

3. At least three of the following courses:
   MA 117 Mathematical Concepts I
   MA 118 Mathematical Concepts II
   MA 141 Elementary Statistics
   MA 202 Calculus II
   MA 203 Calculus III
   MA 220 Linear Algebra
   MA 230 Discrete Mathematics

Requirements for the Minor in Mathematics

(19–20 credits as listed below)

Students who minor in both Mathematics and Statistics can only apply MA 201, 202, 203 toward both minors.

1. Four courses in Mathematics
   MA 201, 202, 203 Calculus I, II, III
   MA 221 Linear Algebra

2. One course chosen from the following:
   MA 302 Introduction to Analysis
   MA 322 Abstract Algebra I
   MA 341 Probability

Requirements for the Minor in Statistics

(24 credits as listed below)
Students who minor in both Mathematics and Statistics can only apply MA 201, 202, 203 toward both minors.

1. Three courses in Mathematics
   MA 201, 202, 203 Calculus I, II, III

2. Three courses in probability and statistics from the following:
   MA 141 Elementary Statistics
   MA 242 Intermediate Methods in Statistics
   MA 341 Probability
   MA 342, 343 Mathematical Statistics I, II

Mathematics Courses (MA)

095
Pre-Algebra (Math Skills)
(0 credits; Fall)

This course helps students to prepare for MA 100 through formal instruction and self-paced computer tutorial. Basic mathematical skills will be covered. Topics include operations on whole numbers, fractions, decimals, percents, ratios, proportions, signed numbers, areas of geometric figures, and an introduction to the solution of linear equations.

100
Elementary/Intermediate Algebra
(2 credits; Fall, Spring)

This course is an introduction to the fundamental concepts and processes of Elementary and Intermediate Algebra, with an emphasis on problem-solving. This course is geared both to the individual needing a review of algebra and those attempting to overcome math anxiety. Topics include operations with signed numbers, solving and graphing equations and inequalities, operations with polynomials, factoring, radicals, exponents, and quadratic equations.
Prerequisite: MA 095 or placement exam

110
Pre-Calculus Mathematics
(4 credits, day; Fall, Spring)
(3 credits, evening; Spring)

This course is an introduction to basic mathematical ideas and techniques centered on the function concepts. Includes relations and functions in general, algebraic functions, trigonometric functions, exponential and logarithmic functions.
Prerequisite: MA 100 or placement exam.

117
Mathematical Concepts I
(4 credits; Fall)

This course is an introduction to mathematical reasoning and problem solving. The course emphasizes writing, individual and group investigations, and the use of relevant technology. Content focuses on number theory, college geometry, and the concept of infinity.
Prerequisite: MA 100 or placement exam; open to all majors except Mathematics and Computer Science.

118
Mathematical Concepts II
(4 credits; Spring)

This course is a continuation of MA 117. Further development of mathematical reasoning and

problem solving. The course emphasizes writing, individual and group investigations, and the use of relevant technology. Content focuses on geometry, probability, and data analysis.
Prerequisite: MA 117.

141
Elementary Statistics
(4 credits, day; Fall, Spring)
(3 credits; evening, Fall, Spring, Summer)

Introduction to basic statistical techniques and their applications to the sciences, social sciences and business administration. Includes the collection and presentation of data, measures of central tendency and variability, probability, sampling distributions, confidence intervals, hypothesis testing, correlation and regression, and introduction to analysis of variance. Students learn to use common computer packages in statistics.
Prerequisite: MA 100 or placement exam.

145
Quantitative Models for Decision Making (Finite Math)
(3 credits; Fall, Spring)

Study of applications of mathematical functions, linear equations, linear inequalities, and matrix algebra to solve business decision-making problems utilizing computer-based spreadsheets.
Prerequisite: MA 100 or placement exam.

201
Calculus I
(4 credits; Fall, Spring)

Introduction to basic calculus. Presents limits, continuity, the derivative, the definite and indefinite integral, applications.
Prerequisite: MA 110 or placement exam.

202
Calculus II
(4 credits; Fall, Spring)

Continuation of MA 201. Investigates further techniques of one-variable calculus, including techniques of integration, and infinite series.
Prerequisite: MA 201.

203
Calculus III
(4 credits; Fall)

Continuation of MA 202. Includes multi-variable calculus and applications.
Prerequisite: MA 202

207
Applied Calculus I
(3 credits)

Introduction to the concepts and notations of the calculus of one variable. Includes limits, continuity, the derivative, the definite and indefinite integral. Emphasizes applications to business and economics.
Prerequisite: MA 110 or placement exam; or permission of the instructor. Not regularly offered.

208
Applied Calculus II
(3 credits)

Continuation of MA 207. Develops the topics covered in the first semester. Also introduces differential equations. **Prerequisite**: MA 207 or 201. Not regularly offered .

221
Linear Algebra
(4 credits, day; Fall)

Intensive study of linear algebra. Includes essentials of finite-dimensional vector-spaces, linear transformation, matrix algebra, systems of linear equations, and determinants.
Prerequisite: MA 201 or permission of the Chair.

230
Discrete Structures
(3 credits, evening; Fall)

Introduction to discrete mathematical structures with applications in computer science. Includes basic set algebra, functions, Boolean algebra, propositional logic, graph theory and trees.
Prerequisite: MA 100 or placement exam.

242
Intermediate Methods in Statistics
(4 credits; Spring)

In-depth examination of statistical concepts. Includes multiple correlation and regression, analysis of variance, non-parametric statistics, and sampling designs. Provides experience in working with computer packages in statistics**.**
Prerequisites: MA 141 or permission of the instructor.

288
Actuarial Seminar
(4 credits; Spring odd years)

The purpose of this course is to develop knowledge of the fundamental tools for assessing risk. The application of these tools to problems encountered in actuarial science is emphasized. A thorough command of calculus and probability topics is assumed. Students will learn the basics of risk management and risk theory. Students completing this course will be prepared for Exam P/Exam 1 of the Society of Actuaries/ Casuaty Actuarial Society.
Prerequisites: MA 203 and MA 341.

302
Introduction to Analysis
(4 credits; Spring odd years)

An introduction to the language, fundamental concepts and standard theorems of real analysis. **Prerequisites**: MA 203 and MA 221. Also a 2.0 major GPA is required. However, a 2.20 major GPA is strongly recommended.

315
Theory of Computation
(3 credits)

An introduction to the theoretical basis of computing. Topics include: a review of graph theory; network models; grammars, languages and automata; Turing machines; computability. **Prerequisites**: CS 201 and either MA 230 or MA 322 or MA 302.

322
Abstract Algebra I
(3 credits; Spring even years. Summer odd years.)

Introduction to groups. Emphasizes developments leading to factor groups and group homomorphisms. Includes introductory study of rings and fields.
Prerequisite: MA 221. Also a 2.0 major GPA is required. However, a 2.20 major GPA is strongly recommended.

330
Graph Theory and Combinatorics
(4 credits; Fall, odd years.

Graph theory topics include planar graphs, Euler and Hamiltonian circuits, graph coloring, trees, depth-first and breadth-first search, network algorithms. Combinatorial topics include arrangements and selections, generating functions, recurrence relations, pigeon-hole principle, and inclusion-exclusion. Course covers applications to computer science and business and also material of interest to mathematics/ secondary education majors. MA 330 may be used to satisfy the Computer Science MA 230 requirement.
Prerequisite: MA 221, 203.

331
Modern College Geometry
(4 credits; Spring)

Examination of selected topics from Euclidean and non-Euclidean geometry and projective geometry. Will introduce current software.
Prerequisite: MA 202; or permission of the instructor.

332
Topics in Geometry
Not regularly scheduled. **Prerequisite**: MA 202; or permission of the instructor.

341
Probability
(4 credits; Fall)

Study of combinatorics, discrete and continuous random variables of one and two dimensions, expectations, commonly used probability models, and normal approximation.
Co-requisite: MA 203

342
Mathematical Statistics I
(4 credits; Spring)

Study of sampling theory, sampling distribution, confidence intervals, hypothesis testing, linear regression and related topics.
Prerequisite: MA 341.

343
Mathematical Statistics II
(4 credits; Fall even years)

Continuation of MA 342. Includes regression models, time series, analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA). Employs the SAS programming language.
Prerequisite: MA 342.

352
Differential Equations
(4 credits; Spring)

In-depth examination of theory and methods of solution of differential equations. Includes computer utilization and applications.
Prerequisite: MA 203.

356
Numerical Analysis
(4 credits)

Mathematical analysis of interpolation procedures, polynomial approximations, numerical differentiation and integration. Includes their applications to computers.
Not regularly scheduled.
Prerequisites: MA 203 and CS 201

361
The Mathematical Theory of Interest
(4 credits; Spring even years)

This course uses a problem-solving approach to introduce students to the mathematical theory and practice of interest. Much of the class time will be spent solving problems similar in scope and level of difficulty to those in the actuarial exam on Mathematical Finance. The course will cover the measurement of interest; equations of value; annuities, yield rates, amortization schedules and sinking funds; bonds and other securities; and recent, practical applications.
Prerequisite: MA 202.

362
Derivatives Markets
(2 credits, Spring even years)

An introduction to the mathematics and finance necessary to understand financial derivatives.
Co-requisite: MA 361 Mathematical Theory of Interest

389
Independent Study
Individualized study in a selected area. Suggested topics include real variable (construction of the real numbers, metric spaces, properties of Reimann and Lebesque integrals), topology (introduction to the theory of topological spaces), advanced topics in graph and theory.
Prerequisites: senior standing and permission of the Chair.

490
Mathematics Capstone
(1 credit)
Mathematics majors must complete a substantial research project to satisfy Arcadia University's Capstone requirement.
Prerequisites: Students must also register concurrently for MA 330, MA 342, or MA 352. Junior or Senior standing required or permission of the Department Chair. Also, a 2.0 major GPA is required and a 2.2 major GPA is highly recommended.