Math Undergraduate Program

Alberto Corso, DUS

https://math.as.uky.edu/undergrad
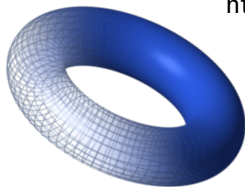
Department of Mathematics
University of Kentucky
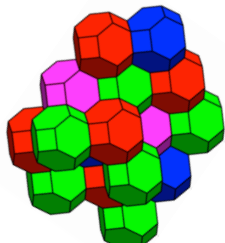
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Math Degrees

Major Degrees
- BA   Bachelor of Arts
- BS   Bachelor of Sciences

▶ Each has 4 tracks:
- Foundations of Mathematics
- Applied Mathematics, Modeling, and Optimizations
- Mathematics of Data, Computation, and Finance
- General Mathematics

▶ Complete a minimum of 120 credit hours and earn a 2.0 cumulative grade point average (GPA)

▶ Mathematics Departmental Honors Requirement: 3.5 cumulative GPA or above

▶ Dean's List Requirement: 3.6 cumulative GPA or above

We also offer a **Minor in Math**

Math Major Requirements

Premajor Requirements (10/11 credits):

- ▶ **MA 113** - Calculus 1 (4 cr) OR
  MA 137 - Calculus 1 with Life Science Applications (4 cr)

- ▶ **MA 114** - Calculus 2 (4 cr) OR
  MA 138 - Calculus 2 with Life Science Applications (4 cr)

- ▶ **CS 115** - Intro to Computer Programming (3 cr) OR
  EGR 102 - Fundamentals of Engineering Computing (2 cr)

Major Core Requirements (7 credits):

- ▶ **MA 213** - Calculus III (4 cr)

- ▶ **MA 322** - Matrix Algebra and Its Applications (3 cr)

GCCR requirement (3 credits):

Foundations of Mathematics

This track trains students in the practice of modern mathematics.

Students in this track learn the core topics of analysis, algebra, and topology, and take elective mathematics courses according to their interests and career goals. Through their coursework, students will gain valuable experience in problem solving as well as the construction and communication of logical arguments – skills valued by industry, government, and academia.

The goal of this track is to prepare students to be competitive for both careers in industries that prize creativity and for graduate programs in mathematics or related fields such as data science, statistics, or applied mathematics.

Foundations of Mathematics

▶ **MA 261** - Introduction to Number Theory

▶ Pick four of the following:

MA 351 - Elementary Topology 1
MA 352 - Elementary Topology 2
MA 361 - Elementary Modern Algebra 1
MA 362 - Elementary Modern Algebra 2
MA 433G - Introduction to Complex Variables
MA 471G - Advanced Calculus 1
MA 472G - Advanced Calculus 2

▶ Complete 6 additional credit hours of MA courses above MA 213, with the exclusion of MA 241 and MA 308, MA 322, and MA 391. Of these 6 credit hours, a maximum of 3 hours can be independent work in mathematics (MA 395).

Applied Mathematics, Modeling, and Optimization

This track provides a broad background in mathematics and its applications, with a focus on mathematical modeling and algorithms used in interdisciplinary settings such as in scheduling and routing problems, network analysis, secure communications, resource allocation, economics, biology, and biomedicine.

Students will learn about fundamental results in probability, game theory, graph theory, mathematical modeling, linear programming, stability analysis, and uncertainty quantification, along with topics in elective mathematics courses that align with students' personal interests and career goals. Students will understand both how mathematical approaches are applied to solve problems and why the underlying mathematical theory is correct.

The goal of this track is to prepare students for a career in pharmaceutical companies or financial institutions, industrial or government research, public policy, security analysis, K-12 and higher education, technical or scientific writing, and more.

Applied Mathematics, Modeling, and Optimization

▶ **MA/STA 320** - Introductory Probability

▶ Pick four of the following:

MA/ECO 327 - Strategic Decision Making:
An Introduction to Game Theory
MA/BIO 337 - Mathematical Modeling in the Life Sciences
MA/CS 340 - Applicable Algebra
MA/CS 415G - Combinatorics and Graph Theory
MA/CS 416G - Introduction to Optimization
MA 432G - Methods of Applied Mathematics 1

▶ Complete 6 additional credit hours of MA courses above MA 213, with the exclusion of MA 241 and MA 308, MA 322, and MA 391. Of these 6 credit hours, a maximum of 3 hours can be independent work in mathematics (MA 395).

Mathematics of Data, Computation, and Finance

This track provides a broad background in computational mathematics, with a focus on developing both mathematical concepts and algorithms that arise in data science and machine learning as well as tools needed to model and analyze a wide range of phenomena in fields where uncertainty plays a role such as finance, physics, engineering, and biology.

Students will learn about fundamental results in computational mathematics, probability, statistics, financial mathematics, and machine learning algorithms along with topics in elective mathematics courses that align with students' personal interests and career goals. Students will understand both how mathematical approaches are applied to solve problems and why the underlying mathematical theory is correct.

The goal of this track is to prepare students for career that focus on data science, computational science, engineering, and finance, whether they are interested in applying mathematics to solve real-world problems or building a mathematical foundation for advanced studies in a related discipline.

Mathematics of Data, Computation, and Finance

- ▶ **MA/STA 320** - Introductory Probability

- ▶ Pick four of the following:

  MA/CS 321 - Introduction to Numerical Methods
  MA 323 - Mathematical Introduction to Data Science
  MA/STA 417G - Decision Making Under Uncertainty
  MA 420G - Introduction to Stochastic Processes
  MA 421G - Mathematical Introduction to Deep Learning
  MA 427G - Financial Mathematics

- ▶ Complete 6 additional credit hours of MA courses above MA 213, with the exclusion of MA 241 and MA 308, MA 322, and MA 391. Of these 6 credit hours, a maximum of 3 hours can be independent work in mathematics (MA 395).

General Mathematics

This is the default option for students who do not declare another track.

▶ Complete 21 credit hours of additional MA courses above MA 213, with the exclusion of MA 241, MA 308, MA 322, and MA 391. Of these 21 credit hours, a maximum of 3 hours can be independent work in mathematics (MA 395). Students pursuing this track must plan their coursework in such a way to be compliant with the prerequisites of MA 391.

Math Minor

21 hours of Math Courses:

▶ ☐ MA 113 or MA 137, Calculus I
☐ MA 114 or MA 138, Calculus II
☐ MA 213, Calculus III
☐ MA 322, Matrix Algebra

▶ 6 additional hours of courses numbered 214 or higher.

Possible choices: MA 214, MA 261, MA 320, MA 321,
MA 323, MA 327, MA 330, MA 337, MA 340, MA 351,
MA 361, or any 400+ level course

To declare a minor, a student must visit the advising center of the
college of their primary major.

Major Programs Related to Math

- ▶ Mathematical Economics
- ▶ Statistics
- ▶ Physics
- ▶ Engineering
- ▶ Computer Science
- ▶ Chemistry
- ▶ STEM Education

Many math majors are double (or even second degree) majors or have interesting minors.

Talk to your advisor about your interests!

Study Abroad

Various options exist for math majors to study abroad, e.g.

- ▶ Budapest Semester in Mathematics
- ▶ Budapest Semester in Mathematics Education
- ▶ UKY-City University of Hong Kong Program

Talk to your advisor about options, check out

http://www.uky.edu/international/students

University Scholars Program (USP): 4+1

▶ The USP offers students the opportunity of integrating their undergraduate and graduate courses of study in a single continuous program culminating in both a baccalaureate and a master's. The total number of hours for the combined program may be as many as 12 less than the total required for the separate degrees.

▶ Application to the program should be submitted at the end of the student's junior year. Applicants should have completed at least 90 credit hours of work toward the bachelor's degree, or be eligible for senior standing in the semester they are admitted to the program.

▶ The master's program should be in the field of the undergraduate major, and the undergraduate grade point average must be at least a 3.50 in the applicant's major field and 3.20 overall.

▶ Students submit the University Scholars Program form, GRE scores and an online application to the Graduate School in their junior year.

▶ Undergraduate tuition rates will be applied to the 12 hours (or less) of graduate level coursework designated for dual credit.

Integrated 4+1 Year BS/MS in Mathematics
Based on BS Option A

Fall	Year 1	Spring	
UK Core CC1	3	UK Core CC2	3
Foreign Language 101	4	Foreign Language 102	4
UK Core QFO (MA 113/MA 193)	5	UK Core QFO (MA 114/MA 194)	5
UK Core HUM	3	CS 115	3
Total Credits	15	Total Credits	15
Fall	**Year 2**	**Spring**	
Foreign Language 201	3	Foreign Language 202	3
UK Core NPM (PHY 231)	4	MA 261: Number Theory or MA 214: Calculus IV	3
UK Core NPM (PHY 241)	1	MA 322: Matrix Algebra	3
MA 213: Calculus III	4	A&S NS (PHY 232: General Physics)	4
UK Core SIR (STA 210)	3	A&S Lab (PHY: 242: Physics Lab II)	1
Total Credits	15	Total Credits	14
Fall	**Year 3**	**Spring**	
MA 361 Abstract Algebra I	3	MA 362 Abstract Algebra II	3
MA 471G Advanced Calculus I	3	MA 472G Advanced Calculus II	3
CS 215: Introduction to program design, abstraction, and problem solving	4	UK Core GDY	3
UK Core ACR	3	MA 391 - GCCR	3
UK Core CCC	3	A&S SS (ECO 201: Principles of Economics)	3
Total Credits	16	Total Credits	15
Fall	**Year 4**	**Spring**	
MA 565 Linear Algebra I	3	MA 614 Enumerative Combinatorics	3
MA 575 Principles of Analysis	3	MA 676 Real Analysis I	3
UK Core CCC	3	UK Core GDY	3
UK Core SSC	3	Elective	3
Elective	3	Elective	3
Total Credits	15	Total Credits	15
Fall	**Year 5**	**Spring**	
MA 561 Abstract Algebra I	3	MA 661 Abstract Algebra II	3
MA 514 Combinatorial Structures	3	MA 671 Complex Analysis I	3
MA 551 Topology I	3	MA 651 Topology II	3
Total Credits	9	Total Credits	9

Degree Requirement Analysis

Math Club

▶ The UK Math Club is open to all undergraduate students with an interest in mathematics and serves as a focus of activities for our majors and a way to draw students to the major.

▶ The group holds several meetings each semester on topics such as an interesting piece of mathematics, information about summer internship or travel opportunities for mathematics students as well as career information.

▶ A list of recent activities is available from the website
http://www.math.uky.edu/~mathclub/
Each event will draw from 20 to 100 students.

▶ The Math Club enables undergraduate students to interact with faculty members and each other in an informal setting.

Math Competitions

▶ Several students at the University of Kentucky take part in regional and national mathematical competitions.

▶ This activity is challenging as well as satisfying, since it lets you test your intellectual power against problems whose solution needs original thought besides textbook routines.

▶ Typically, we participate in the **Virginia Tech competition** (October) and the **Putnam competition** (December).

▶ You may also find a collection of problems and other information on Professor Avinash Satahye's website:
www.msc.uky.edu/sohum/putnam/index.htm

▶ If you would like to join, please send an email to Professor Xuancheng (Fernando) Shao:
xuancheng.shao@uky.edu

The Math Lab at UK

▶ Since Spring 2018 Dr. Chris Manon is running the UK Math Lab (UKML) in order to provide a year-round venue for undergraduates to participate in mathematics research and outreach.

▶ On a typical semester there are a number of research projects dedicated to an unsolved mathematical problem and running under the direction of faculty members from the department.

▶ The Lab is also running visualization projects aimed at a broader non-mathematical audience.

▶ Lab members have a weekly commitment to research and visualization projects in exchange for course credit (MA 398 or MA 399) or, in special circumstances, a stipend.

▶ Each project nominally lasts the length of a summer or a semester, at the end of which project members give a seminar-style research talk on their work.

▶ This experience is typically a good introduction to research outside UK through summer REUs (as described next).

UKML is part of a larger consortium called Geometry Labs United.

REU = Research Experience for Undergraduates

- ▶ REUs are summer programs typically lasting 6-9 weeks
- ▶ They take place all over the USA
- ▶ Specific research topics vary
- ▶ Typical stipend is $2,000 to $4,000, plus extra funds for food, travel, and lodging

Application Information

- ☐ Application deadlines range January-March
- ☐ You will write an essay or two when you apply
- ☐ You will usually need three letters of recommendation from math or science professors who know you reasonably well

Typical Course Prerequisites for REUs

- ▶ MA 113 [MA 137], MA 114 [MA 138], MA 213: Calculus I-III

- ▶ MA 322: Matrix Algebra

  [VERY IMPORTANT, take it as early as possible]

- ▶ CS 115: Computer Programming

- ▶ Experience in upper-division math courses. For example:
  MA 261 (Number Theory)
  MA 361 (Modern Algebra)
  MA 351 (Topology)
  MA 321 (Numerical Methods)
  MA 471G (Advanced Calculus)
  MA 416G (Optimization)

How do I find REUs?

▶ American Mathematical Society REU page
http://www.ams.org/programs/students/undergrad/emp-reu

▶ MathPrograms.org
http://www.mathprograms.org/

Scholarship/Awards Information

The **Sally E. Pence Award** was established in 1963 by Dr. James C. Eaves, the Mathematics chair at the time. The award honors Dr. Sallie Pence, a UK faculty member interested in encouraging prospective teachers of mathematics, and provides recognition to Sophomore or Junior mathematics or secondary math education majors who have expressed their intention of becoming a teacher. Applicants for the award must have a overall standing of 3.0 and a standing in mathematics of 3.3. Application is in the Fall of the Sophomore or Junior year and selected applicants are presented the award at the annual Spring awards ceremony held at the Math House. Students may use the award to join the NCTM.

▶ The **Carolyn S. Bunyan Scholarship** was established in 1992 in memory of her brother C.G. Soward and in honor of her older brother, William C. Soward, her sister Mary A. Soward, and her two nieces, Ann Soward Vance and Erwinna Soward Wright. Mrs. Bunyan received a degree from the University of Wisconsin in 1925 and wanted to encourage outstanding mathematics majors to continue their studies. Application is in the Fall of the Sophomore or Junior year and the selected applicant is presented the award ($\approx$ \$1,500) at the annual Spring awards ceremony held at the Math House.

▶ The **Robert B. Royster Memorial Award** is given to a graduating mathematics senior who is pursuing a career in teaching.

▶ The **J.C. Eaves Endowed Scholarship in Mathematics** was established in 2004 by J.C. Eaves and Mary G. Eaves in memory of Professor J.C. Eaves, former Mathematics chair and Professor at UK until 1967. The scholarship ($\approx$ \$2,500) is intended for students who are graduates of any high school in the Commonwealth of Kentucky (with preference for qualified students from Muhlenberg, Taylor or Adair counties), who are Junior or Senior level Arts and Science students majoring in Mathematics and have at least a 3.0 GPA. Financial need may be a consideration in awarding this scholarship.

▶ The **J.C. Eaves Undergraduate Summer Research Award** provides a stipend ($\approx$ \$3,000) for an undergraduate student to conduct research under a faculty supervisor. Summer research awards will be awarded on a competitive basis by the Undergraduate Committee. Students are asked to submit a research proposal and a supporting letter from their faculty mentor.

▶ The **J.C. Eaves Undergraduate Travel Award** provides support for (1) students who have the opportunity to travel to a national conference to present the results of their undergraduate research projects ($\approx$ \$500) or (2) groups of students interested in attending conferences in Kentucky, such as the sectional meeting of the Math Association of America ($\approx$ \$100/\$200) . Travel awards will be granted on a competitive basis by the Undergraduate Committee.

The J.C. Eaves Undergrad. Excellence Fund in Math

The J.C. Eaves Excellence Fund in Mathematics provides the
Department with flexible, non-endowed funds to conduct a range
of activities to enhance our program for undergraduate
mathematics majors:

- ▶ **Math Club Activities**
- ▶ **J.C. Eaves Undergraduate Summer Research Awards**
- ▶ **J.C. Eaves Undergraduate Travel Awards**
- ▶ **J.C. Eaves Undergraduate Teaching Assistantships**
  provide our undergraduate students with a wider range of teaching opportunities in advanced Math courses.
  This will help to strengthen their understanding of the mathematics studied in these courses. By working
  closely with a faculty member, undergraduate assistants will strengthen their preparation as teachers which
  will be valuable for students heading to graduate school or to secondary school teaching. The typical
  undergraduate assistant will work 5 hours per week throughout a semester ($\approx$ \$1,000) and may help with
  grading, conducting study sessions, or other activities as determined by the supervising instructor.
- ▶ **J.C. Eaves Speakers Series**

UK Office of Nationally Competitive Awards

Math majors often are good candidates for national awards and scholarships such as:

- ▶ Astronaut
- ▶ Goldwater
- ▶ Marshall
- ▶ Fulbright
- ▶ NSF Graduate Fellowships

This office can also assist with REU applications.

http://www.uky.edu/chellgren/competitive-awards

If interested, contact Pat Whitlow, Director: pat.whitlow@uky.edu

- ▶ **Astronaut Scholarship**
  - 2016-17 Corrine Elliott, Math & Chemistry
  - 2015-16 Robert Cass, Math
  - 2014-15 Matthew Fahrbach, CS & Math
  - 2013-14 Josiah Hanna, CS & Math

▶ **Goldwater Scholarship**

Award	2019 Tom Shelton, Physics & Math
	2017 Benjamin Riley, Physics & Math
	2016 Corrine Elliott, Math & Chemistry
	2014 Matthew Fahrbach, CS & Math
	2014 Samuel Saarinen, Math
	2013 Josiah Hanna, CS & Math
Hon. Mention	2018 Angela Wei, ABT & Math
	2015 Robert Cass, Math
	2015 Corrine Elliott, Math
	2012 Josiah Hanna, CS & Math

▶ **NSF Graduate Research Fellowship**

Award	2016 Robert Cass, Math
	2016 Matthew Fahrbach, CS & Math
	2016 Charles Fieseler, Physics & Math
	2015 Tamas Nagy, Chemistry & Math
	2014 Josiah Hanna, CS & Math

Job Opportunities For Math Majors

- ▶ Tutor at Mathskeller
- ▶ Undergraduate Assistant for the Math Department
- ▶ Math Excel Classroom Assistant
- ▶ Tutor at the Study (not Math Department)
- ▶ For requirements and to apply, go to https://ukjobs.uky.edu/ and search for student jobs in the Math Department.
- ▶ You can also inquire with Dr. Jonathan Clark, Director of the Mathskeller: jon.clark@uky.edu