All-Math Meeting

https://math.as.uky.edu/undergrad

Department of Mathematics
University of Kentucky

September 28, 2016
# Officers of the Department of Mathematics

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Russell Brown</td>
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</tr>
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</tr>
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</tr>
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<td>Mathskeller Director, POT 937</td>
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</tr>
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<td>Academic Administration Associate, POT 731</td>
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</tr>
</tbody>
</table>
Important Dates

- **September 26–November 23**
  Students are prohibited from changing majors

- **October 27** (Thursday), 5:00 to 6:00pm — THM BS 107
  Eaves Lecture/Year of South India Lecture,
  Speaker: Prof. Ken Ono, Emory University

- **October 31–November 22**
  Priority registration for the 2017 Spring Semester

- **November 30**
  Last day for filing an application for May 2017 undergraduate
  degree online in MyUK

- **December 16**
  End of the Fall semester
  December Commencement (3pm, Rupp Arena)
Math Degrees

Major Degrees

- BA Bachelor of Arts
- BS Bachelor of Sciences

Each has two options:

- Option A: Mathematics
- Option B Mathematical Sciences

- 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
Degree Requirements for BA and BS

- UK Core — 31 credits
- GCCR (Composition and Communication) — 3 credits (Starting Fall 2014)
- College — 25-39 credits (BA); 16-30 credits (BS)
- Math Department — 53 (option A) or 55 (option B) credits
- Electives — 0-9 credits (BS)
Mathematics (B.A.) • 2

**Mathematics - B.A.**

The department offers two programs leading to the B.A. or B.S. degree. Students may major in mathematics by completing the requirements for either (1) Bachelor of Mathematics or Option B: Mathematical Sciences. The mathematics option consists of courses offered solely by the department of mathematics and is intended for those who wish to follow a traditional mathematics career path. The mathematical sciences option consists of courses offered by the departments of computer science, mathematics and statistics, and is intended for those who opt for a career that requires the application of mathematics. The requirements for these programs are outlined below.

Any student earning a Bachelor of Arts (B.A.) degree must complete a minimum of 39 hours at the 300+ level. These hours are generally completed by the major requirements. However, keep this hour requirement in mind as you choose your course work for the requirements in the major. See the complete description of College requirements for a Bachelor of Arts degree in the Arts and Sciences section of the 2016-2017 Undergraduate Bulletin.

**UK Core Requirements**

See the UK Core section of the 2016-2017 Undergraduate Bulletin for the complete UK Core requirements. The courses listed below are (a) recommended by the college, or (b) required by UK Core. Students should work closely with their advisor to complete the UK Core requirements.

| Intellectual Inquiry in Arts and Creativity                      | 3 |
| Intellectual Inquiry in the Humanities                          | 3 |
| Intellectual Inquiry in the Social Sciences                     | 3 |
| Intellectual Inquiry in the Natural, Physical, and Mathematical Sciences | 3 |
| V. Composition and Communication I                             | 3 |
| VI. Composition and Communication II                            | 3 |
| VII. Communication and Citizenship in the USA                   | 3 |
| UK Core hours                                                    | 31 |

**College of Arts and Sciences**

| Graduation Composition and Communication Requirement (GCCCR) | 3 |
| Graduation Composition and Communication Requirement hours (GCCCR) | 3 |
| College Requirements                                           | 14 |
| I. Foreign Language (placement exam recommended)               | 0-14 |
| II. Disciplinary Requirements                                  | 6 |
| a. Natural Science                                             | 6 |
| b. Social Science                                              | 6 |
| c. Humanities                                                  | 3 |
| III. Laboratory of Field Work                                  | 1 |
| IV. Electives                                                   | 3 |
| College Requirement hours                                      | 25-29 |

**OPTION A - Mathematics**

| Premajor Requirements                                           | 11 |
| MA 113 Calculus I                                              | 4 |
| MA 114 Calculus II                                             | 4 |
| MA 116 Calculus II                                             | 4 |
| MA 213 Calculus III                                            | 3 |
| MA 261 Introduction to Number Theory                           | 3 |
| MA 322 Matrix Algebra and its Applications                    | 3 |
| MA 323 Matrix Algebra and Applications                        | 3 |
| MA 432G Methods of Applied Mathematics I                      | 3 |
| MA 481G Differential Equations                                | 3 |
| MA 483G Introduction to Partial Differential Equations         | 3 |
| MA 484G Decision Making Under Uncertainty                     | 6 |
| Major Core hours                                               | 29 |

**OPTION B - Mathematical Sciences**

| Premajor Requirements                                           | 25 |
| MA 137 Calculus I with Life Science Applications               | 4 |
| MA 138 Calculus II with Life Science Applications               | 4 |
| MA 154 Calculus III                                             | 4 |
| MA 159 Calculus III with Life Science Applications              | 4 |
| MA 161 Calculus III with Life Science Applications              | 4 |
| MA 261 Introduction to Number Theory                           | 3 |
| MA 340 Differential Equations                                  | 3 |
| MA 432G Methods of Applied Mathematics I                       | 3 |
| MA 481G Differential Equations                                | 3 |
| MA 483G Introduction to Partial Differential Equations         | 3 |
| MA 484G Decision Making Under Uncertainty                     | 6 |
| Major Core hours                                               | 29 |

**Other Course Work Required for the Major**

**From the Major Department:**

| Choose 10 hours of 300+ level mathematics courses. One of the following sequences, or a substitute approved by the Director of Undergraduate Studies, must be included: MA 371/372, MA 311/312, MA 410/411, MA 415/416, MA/CS 309/310. | 3 |
| MA 351/352, MA 361/362, CS/MA 340/341. At least two of the following must be included: either MA 481G/483G or MA/CS 416G. | 3 |
| MA 432G must be included. | 3 |

**From Outside the Major Department**

| Choose 14 hours outside Mathematics at the 300+ level. Courses are generally chosen from physics, chemistry, biology, logic, statistics, computer science, economics, and engineering. 200+ level courses must be used to satisfy College requirements: all can be counted here. | 14 |
| Other Major hours                                               | 32 |

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University of Kentucky is accredited by the Southern Association of Colleges and Schools Commission on Colleges to award associate, baccalaureate, masters, and doctorate degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097, call 404-679-4500, or online at www.sacscoc.org for questions about the accreditation of University of Kentucky.

For more information on the Mathematics Department, please visit the Math Department's website at https://math.as.uky.edu/undergrad

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2016-2017 Major-Sheets/MS1617/a&s/maa.pdf

https://math.as.uky.edu/undergrad

All-Math Meeting
Mathematics - B.S.

Graduation Composition and Communication Requirement (GCCR)

- MA 391 Mathematics: Composition and Communication

Graduation Composition and Communication Requirement hours (GCCR) ........................................... 3

College Requirements

- MA 113 Calculus I
- MA 114 Calculus II
- CS 115 Introduction to Computer Programming

Other Major hours:................................................................................ 32

- CONTINUED –

Choosing one course from approved list ................................................................... 3

X. Global Dynamics

- MA 113 Calculus I (placement exam recommended) ................................... 0-14

II. Disciplinary Requirements

a. Natural Science .................................................................................. 3
b. Social Science .................................................................................... 3
c. Humanities .......................................................................................... 3

III. Laboratory/Field Work ........................................................................ 1

IV. Electives ............................................................................................... 4

College Requirement hours: ........................................................................... 10-30

OPTION A - Mathematics

Premajor Requirements

- MA 113 Calculus I
- MA 114 Calculus II
- CS 115 Introduction to Computer Programming

Premajor hours: ................................................................................... 11

Major Requirements

- MA 213 Calculus III
- MA 214 Calculus IV
- MA 261 Introduction to Number Theory
- MA 322 Matrix Algebra and its Applications

Major Core hours: ................................................................................... 10

Other Course Work Required for the Major

From the Major Department:

Choose 18 hours from 300-level Mathematics courses. Due to the following sequences, or a substitute approved by the Director of Undergraduate Studies, must be included: MA 317, MA 318, MA 471G, MA 472G, CSMA/CSMMA 499G (or MA/ STA 4170); at least two of the following must be included (they can also count as the sequence of appropriate): MA 351, 352, 361, MA 417G, 418G. May not include MA 322.

From Outside the Major Department

Choose 14 hours outside Mathematics at the 300-level. Courses are generally chosen from physics, chemistry, biology, logic, statistics, computer science, economics, and engineering. 200-level courses used to satisfy College requirements can also be counted here.

Other Major hours: ................................................................................... 32

Mathematics (B.S.) • 2

Other Course Work Required for the Major

From the Major Department:

Choose six hours of acceptable MA courses at the 300 level and above (MA 308 may not be used) ................................................................................... 6

From Outside the Major Department

Note: Upper-level courses chosen from one area outside mathematics. The Director of Undergraduate Studies must approve the supporting program. Courses in the supporting program must be at the 300 level and above. Cross-listed courses may be used for the supporting program provided they are approved by another major department. 

Other Major hours: ................................................................................... 9

Electives

Choose electives to lead to the minimum total of 120 semester hours required for graduation (19

Total Minimum Hours

Required for Degree ................................................................................... 120

Mathematics Cooperative Education

Qualified students majoring in mathematics may participate in the Mathematical Sciences Cooperative Education Program which provides the opportunity for alternating semesters of academic study and full-time employment in business or industry. Guidelines and application forms are available in the Engineering/Math Sciences Co-op Program Office, 720 Roberts Building.

www.uky.edu/registrar/Major-Sheets/MS1617/a&s/mas.pdf

https://math.as.uky.edu/undergrad

All-Math Meeting
Math Major Requirements: Option A

Premajor Requirements (11 credits):
- MA 113, Calculus I
- MA 114, Calculus II
- CS 115, Introduction to Computer Programming

Major Core Requirements (10 credits):
- MA 213, Calculus III
- One of
  - MA 214, Calculus IV
  - MA 261, Introduction to Number Theory
- MA 322, Matrix Algebra and its Applications
18 hours of 300+ level Mathematics courses (other than MA 322)

Must include one of the sequences:

- Topology: MA 351/352
- Algebra: MA 361/362
- Advanced Calculus: MA 471G/MA 472G
- Differential Equations: MA 481G/MA 483G
- Optimization: MA 416G/417G

Must include MA 391 (Composition and Communication) and at least 2 of the following: MA 351, 352, 361, 362, 471G, 472G

14 hours of 300+ level courses outside of Mathematics

Courses used to satisfy College requirements can also be counted here

Electives

Choose electives to lead to the minimum total of 120 hours required for graduation.
Math Major Requirements: Option B

Premajor Requirements (11 credits):
- MA 113 or MA 137, Calculus I with Life Science Applications
- MA 114 or MA 138, Calculus II with Life Science Applications
- CS 115, Introduction to Computer Programming

Major Core Requirements (29 credits):
- CS 215, Introduction to Program Design, Abstraction and Problem Solving
- MA 213, Calculus III
- MA 214, Calculus IV
- MA/STA 320, Introductory Probability
- MA/CS 321, Introduction to Numerical Analysis
- STA 321, Basic Statistical Theory I
- MA 322, Matrix Algebra and its Applications

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All-Math Meeting
Plus a two-semester sequence chosen from the following:

- MA/CS 340 and MA/CS 415G
  Applicable Algebra and Combinatorics and Graph Theory

- MA 432G and MA 433G
  Methods of Applied Mathematics I and Introduction to Complex Variables

- MA 481G and MA 483G
  Differential Equations and Introduction to Partial Differential Equations

- MA/CS 416G I and MA/STA 417G
  Introduction to Optimization and Decision Making Under Uncertainty

From the Math Department (6 credits)

Choose six hours of MA courses at the 300+ level (MA 308 may not be used)

[Comment: The GCCR course MA 391 (Composition and Communication) can be one of these!]

From Outside the Major Department (9 credits)

Nine hour from a supporting program chosen from one area outside mathematics. The DUS must approve the supporting program. Courses in the supporting program must be at the 300+ level. Cross-listed courses may be used for the supporting program provided they are not used to satisfy another major requirement.

Electives

Choose electives to lead to the minimum total of 120 hours required for graduation.
General Advice

Students should select their upper-division coursework based on their goals and interests. Below are some suggestions:

**Preparation for graduate school:**
MA 351, MA 352, MA 361, MA 362, MA 471G, MA 472G

**Secondary education:**
MA 310, MA 320, MA 330, MA 341, MA 361, MA 362

**Mathematics and computer science:**
MA 320, MA 321, MA 340, MA 361, MA 362, MA 415G

**Mathematics and engineering or physical science:**
MA 320, MA 321, MA 361, MA 471G and select from MA 351, MA 362, MA 432G, MA 433G, MA 472G, MA 481G, MA 483G
## Upper Division Courses Offered in Spring 2017

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 261</td>
<td>Introduction to Number Theory</td>
</tr>
<tr>
<td>MA 308</td>
<td>Mathematical Problem Solving for Middle School Teachers</td>
</tr>
<tr>
<td>MA 310</td>
<td>Mathematical Problem Solving for Teachers</td>
</tr>
<tr>
<td>MA 320</td>
<td>Introduction to Probability</td>
</tr>
<tr>
<td>MA 321</td>
<td>Introduction to Numerical Methods</td>
</tr>
<tr>
<td>MA 327</td>
<td>Strategic Decision Making: An Introduction to Game Theory</td>
</tr>
<tr>
<td>MA 330</td>
<td>History of Mathematics</td>
</tr>
<tr>
<td>MA 340</td>
<td>Applicable Algebra</td>
</tr>
<tr>
<td>MA 352</td>
<td>Elementary Topology II</td>
</tr>
<tr>
<td>MA 361</td>
<td>Elementary Modern Algebra I</td>
</tr>
<tr>
<td>MA 362</td>
<td>Elementary Modern Algebra II</td>
</tr>
<tr>
<td>MA 391</td>
<td>Mathematics: Composition and Communication</td>
</tr>
<tr>
<td>MA 417G</td>
<td>Decision Making Under Uncertainty</td>
</tr>
<tr>
<td>MA 471G</td>
<td>Advanced Calculus I</td>
</tr>
<tr>
<td>MA 472G</td>
<td>Advanced Calculus II</td>
</tr>
<tr>
<td>MA 481G</td>
<td>Differential equations I</td>
</tr>
</tbody>
</table>
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 330, MA 341, 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.
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**

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

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<th>Credits</th>
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<tr>
<td>Total Undergraduate Hours</td>
<td>120</td>
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<tr>
<td>Total Undergraduate Hours Toward MA</td>
<td>12</td>
</tr>
<tr>
<td>Total Graduate Hours Toward MA</td>
<td>18</td>
</tr>
<tr>
<td>Total Hours at 600+ from Year 4</td>
<td>6</td>
</tr>
<tr>
<td>Total Hours at 600+ from Year 5</td>
<td>9</td>
</tr>
</tbody>
</table>

[www.as.uky.edu/university-scholars-program](https://www.as.uky.edu/university-scholars-program)

[https://math.as.uky.edu/undergrad](https://math.as.uky.edu/undergrad)

All-Math Meeting
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.

- The 2016-17 faculty advisors are Carolyn Yarnall & Rafael S. González D’León
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 Sathaye’s website: [www.msc.uky.edu/sohum/putnam/index.htm](http://www.msc.uky.edu/sohum/putnam/index.htm)

The group meets on Tuesdays at 3:00 PM in the Mathskeller and discusses problems for about an hour.

If you would like to join, please send an email to: sathaye@uky.edu
Math Movie of the Month

Since Fall 2008, Professors Richard Ehrenborg and Margaret Readdy have organized the Math Movie of the Month (M³) series.

The movie listing for this semester is:

- **The Man Who Knew Infinity** (2015)
  Monday, October 24, 7:15-9:30pm, WT Young Library Auditorium

- **The United States of Mathematics Presidential Debate**
  Friday, November 4, 7:30-8:30pm, CB 118
  A parody of the presidential debates, this film introduces the mathematical field of knot theory and the Euclidean algorithm, all in 45 minutes. Presented by Colin Adams and Thomas Garrity, who previously did The Great pi/e Debate, and moderated by Edward Burger, it is a memorable way to present fascinating mathematics.

- **TBA**
  Friday, December 9, 7:30-8:30 pm, CB 118
Srinivasa Ramanujan—impoverished Hindu college dropout, self-taught in mathematics, introduced himself not only to G.H. Hardy (superstar British mathematician) but to the history of human thought. Ramanujan’s pursuit has led to solutions of ancient mathematical mysteries, breakthroughs in modern physics, and ideas which help power the internet. Tragically, he died at 32 from a misdiagnosed illness, leaving three enigmatic notebooks that drive cutting-edge research to this day.

The speaker will talk about Ramanujan and share exclusive clips from the recent Hollywood film The Man Who Knew Infinity which stars Dev Patel (Ramanujan) and Jeremy Irons (G. H. Hardy).
1729 = 10^3 + 9^3 = 12^3 + 1^3

4104 = 16^3 + 2^3 = 15^3 + 9^3

If \( a^2 + ab + b^2 = 3cd^2 \), then
\[
(a + c^2d)^3 + (bc + d)^3 = (ac + d)^3 + (b + c^2d)^3.
\]

For example, \((a, b, c, d) = (3, 0, 3, 1)\) gives the identity for 1729.
\[4^4 + 6^4 + 8^4 + 9^4 + 14^4 = 15^4\]

\[2^4 + 2^4 + 3^4 + 4^4 + 4^4 = 5^4\]

\[(8s^2 + 40st - 24t^2)^4 + (6s^2 - 44st - 18t^2)^4 + (14s^2 - 4st - 42t^2)^4\]
\[+ (9s^2 + 27t^2)^4 + (4s^2 + 12t^2)^4 = (15s^2 + 45t^2)^4\]

\[(4m^2 - 12n^2)^4 + (3m^2 + 9n^2)^4 + (2m^2 - 12mn - 6n^2)^4\]
\[+ (4m^2 + 12n^2)^4 + (2m^2 + 12mn - 6n^2)^4 = (5m^2 + 15n^2)^4\]

For example, \((s, t) = (1, 0)\) gives the identity for \(15^4\) and \((m, n) = (1, 0)\) gives the identity for \(5^4\).
Assume that \( ad = bc \). Then

\[
64 \left\{ (a + b + c)^6 + (b + c + d)^6 - (c + d + a)^6 - (d + a + b)^6 + (a - d)^6 - (b - c)^6 \right\}
\times \left\{ (a + b + c)^{10} + (b + c + d)^{10} - (c + d + a)^{10} - (d + a + b)^{10} + (a - d)^{10} - (b - c)^{10} \right\}
\]

\[
= 45 \left\{ (a + b + c)^8 + (b + c + d)^8 - (c + d + a)^8 - (d + a + b)^8 + (a - d)^8 - (b - c)^8 \right\}^2
\]
Ramanujan’s Approximation to $\pi$

$$\pi \approx \left( 97 \frac{1}{2} - \frac{1}{11} \right)^{\frac{1}{4}} = 3.14159\,26526\ldots$$

How did Ramanujan find this?

Here is a possible explanation.

$$\pi^4 = 97.409091034002\ldots \approx 97.40909090909\ldots = 97.5 - \frac{1}{11}$$
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 (≈ $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 (≈ $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 (≈ $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 (≈ $500) or (2) groups of students interested in attending conferences in Kentucky, such as the sectional meeting of the Math Association of America (≈ $100/$200). Travel awards will be granted on a competitive basis by the Undergraduate Committee.

https://math.as.uky.edu/undergrad

All-Math Meeting
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 (≈ $1,000) and may help with grading, conducting study sessions, or other activities as determined by the supervising instructor.

- **J.C. Eaves Speakers Series**
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/academy/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
2016 Corrine Elliott, Math & Chemistry
2014 Matthew Fahrbach, CS & Math
2014 Samuel Saarinen, Math
2013 Josiah Hanna, CS & Math

Hon. Mention
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

Hon. Mention
2016 Samuel Saarinen, Math
2015 Matthew Fahrbach, 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. Robert Denomme, Director of the Mathskeller: robert.denomme@uky.edu
MERCER OFFICE VISIT

FRIDAY, OCTOBER 7, 2016

What: Learn about Mercer and our actuarial employment opportunities and network with recent graduates.

Who: Juniors & seniors interested in actuarial consulting

When: 09:30 AM - 1:30 PM - Lunch will be provided

Where: Mercer - Louisville Office
400 W. Market Street Suite 700
Louisville, KY 40202

Attire: Business Casual

Please bring a resume

R.S.V.P. by September 30, 2016
Sarah Sutton
Email: sarah.r.sutton@mercer.com