Mathematics

The Department of Mathematics offers two master's degrees, one in Mathematics and the other in Statistics, and two doctoral degrees, one in Mathematics and one in Statistics. Areas of study for Mathematics include: algebra, algebraic geometry, real and complex analysis, differential geometry, and topology. The areas of study for Statistics are: mathematical statistics, survival analysis, modeling, statistical computing for massive data, Bayesian regulation, bioinformatics, longitudinal and functional data analysis, statistical computation, asymptotic theory, objective Bayes, bootstrap, post-selection inference, and application of statistics to medicine. Because it is difficult to make up coherent programs for students entering in the middle of the year, students are ordinarily admitted only in the fall.

Graduate students have an opportunity when they first arrive to share common concerns and to become acquainted. One of the most attractive features of our program is the friendly and supportive atmosphere among the graduate students. Advanced courses in the Washington University math department can build on the common background shared by all students. As a result, these courses are richer and nearer to the level of PhD work than typical advanced courses.

Students typically complete the PhD program in five years. A student who comes here with advanced preparation may finish in less time. On the other hand, some students find that it is advisable for them to take preparatory work before attempting the qualifying courses. In special cases, the time schedule may be lengthened accordingly. Students should plan to develop a close relationship with their thesis advisers so that they may have a realistic idea of their progress.

Graduate study in mathematics is not for everyone. Entering students usually find that the time and effort required to succeed goes well beyond anything they encountered as undergraduates. Success requires both ample mathematical ability and the determination to grapple with a subject for many days or weeks until the light of understanding shines through. The experience can be daunting. Those who continue in their studies are largely those for whom the pleasure in attaining that understanding more than compensates for the required effort. For such persons, the life of a mathematician can be richly rewarding.

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Phone: 314-935-6760
Website: http://wumath.wustl.edu/graduate

Faculty

Chair
John E. McCarthy
Spencer T. Olin Professor of Mathematics
PhD, University of California, Berkeley
Analysis; operator theory; one and several complex variables

Directors
Mohan Kumar (http://wumath.wustl.edu/people/kumar_n-mohan)
Director of Graduate Studies; Professor of Mathematics
PhD, Bombay University
Algebraic geometry; commutative algebra

Ron Freiwald (http://wumath.wustl.edu/people/freiwald_ron)
Director of Undergraduate Studies; Professor of Mathematics
PhD, University of Rochester
General topology

Endowed Professor
John E. McCarthy (http://wumath.wustl.edu/people/faculty/professors/mccarthy_john-e)
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Analysis; operator theory; one and several complex variables

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Jefferson M. Gill
Professor, Political Science; Courtesy appointment, Mathematics
PhD, American University

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Several complex variables; geometric analysis

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David Wright
PhD, Columbia University
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Assistant Professors

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Brian E. Blank
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PhD, University of California, Davis
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Assistant Professors

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PhD, Imperial College London
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Geometric numerical analysis, computational mathematics

Michael Wendl (http://wumath.wustl.edu/people/wendl_michael)
Assistant Professor of Genetics, The Genome Institute; courtesy appointment Mathematics Department
PhD, Washington University
Combinatorics, PDEs, probability, and statistical genetics

Professors Emeriti

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PhD, University of Michigan
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PhD, Harvard University
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Differential geometry

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PhD, Purdue University
General topology

Richard Rochberg
PhD, Harvard University
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PhD, California Institute of Technology
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Guido L. Weiss (http://wumath.wustl.edu/people/weiss Guido-l)
PhD, University of Chicago
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Harmonic analysis, differential geometry

William Chauvenet Postdoctoral Lecturers

Michael Hartz  
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Yakov Berchenko-Kogan  
PhD, Massachusetts Institute of Technology

James Pascoe  
NSF Postdoctoral Fellow  
PhD, University of California, San Diego  
Several complex variables

Coordinator Lower Division Teaching

Blake Thornton (http://wumath.wustl.edu/people/thornton_blake)  
Coordinator of Lower Division Teaching, Mathematics Department  
PhD, University of Utah

Program Coordinator

Lisa M. Kuehne (http://wumath.wustl.edu/people/kuehne_lisa)  
Program Coordinator, University College & Center for Advanced Learning  
AM Mathematics, Washington University  
Undergraduate Mathematics Education

Degree Requirements

AM in Mathematics

General requirements: 36 units of course work and an optional thesis. 3 units may be for thesis research. The minimum residence requirement is one full academic year of graduate study. A grade point average of B or better must be maintained in graduate course work.

Optional thesis requirements: To be eligible for the thesis option, a student must maintain a cumulative grade point average of 3.5 or higher in the first 18 units of course work satisfying the program requirements.

Course requirements: There are four basic graduate sequences in pure mathematics:

<table>
<thead>
<tr>
<th>Course Sequence</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 5021 &amp; Math 5022</td>
<td>6</td>
</tr>
<tr>
<td>Math 5031 &amp; Math 5032</td>
<td>6</td>
</tr>
<tr>
<td>Math 5041 &amp; Math 5042</td>
<td>6</td>
</tr>
</tbody>
</table>

AM in Statistics

General requirements: 36 units of course work and a thesis. 6 units may be for thesis research. The minimum residence requirement is one full academic year of graduate study. A grade point average of B or better must be maintained in graduate course work.

Course requirements: The student must take (or have taken) the following six required courses in mathematics or their equivalents:

<table>
<thead>
<tr>
<th>Course Sequence</th>
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</thead>
<tbody>
<tr>
<td>Math 493 &amp; Math 494</td>
<td>6</td>
</tr>
<tr>
<td>or Math 5061 &amp; Math 5062</td>
<td>6</td>
</tr>
<tr>
<td>Math 439</td>
<td>3</td>
</tr>
<tr>
<td>Math 4392</td>
<td>3</td>
</tr>
<tr>
<td>Math 459</td>
<td>3</td>
</tr>
<tr>
<td>Math 475</td>
<td>3</td>
</tr>
</tbody>
</table>

or a suitable substitute elective approved by the department

In the case that an equivalent course has been taken and also proficiency in the course material has been demonstrated, other 400-level and above electives may be substituted in consultation with the adviser. Additional 400-level or higher electives will be chosen by the student in consultation with his or her adviser to make up the 36 units.

PhD in Mathematics

General requirements: Completion of the PhD requires four full years of graduate study, with at least 48 units spent in residence at Washington University. The student must spend at least one academic year as a full-time student; this requirement cannot be met wholly by summer sessions or part-time study. The student may, with departmental permission, transfer part of the graduate units from other universities. A grade point average of B or better is required in graduate course work. Graduate students in

<table>
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<tr>
<td>Math 5051 &amp; Math 5052</td>
<td>6</td>
</tr>
<tr>
<td>Measure Theory and Functional Analysis I &amp; Measure Theory and Functional Analysis II</td>
<td>6</td>
</tr>
</tbody>
</table>

A candidate for the AM in Mathematics must include two of these sequences (12 units) in the required 36 units. The student, in consultation with his or her adviser, selects the remaining 24 units according to the student's interests and needs.

The AM examination: Candidates for the AM degree must pass at least two of the four PhD qualifying exams. Under exceptional circumstances, the graduate committee may allow the student to substitute the PhD qualifying exams mentioned above with a comprehensive examination on the contents of Math 4111 Introduction to Analysis–Math 4121 Introduction to Lebesgue Integration, Math 4171 Topology I–Math 4181 Topology II, and Math 429 Linear Algebra–Math 430 Modern Algebra.
mathematics may ordinarily expect up to five years of support. Continuation of support each year is dependent upon normal progress toward the degree and satisfactory performance of duties.

**Specific course requirements:** The course work must include four basic graduate sequences:

<table>
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<td>Geometry I and Geometry II</td>
<td>6</td>
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<td>Math 5051 &amp; 5052</td>
<td>Measure Theory and Functional Analysis I and Measure Theory and Functional Analysis II</td>
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</tr>
</tbody>
</table>

**Language requirement:** For the PhD, the department requires two of these languages: English, French, German, or Russian. If the student's native language is English, then he or she must demonstrate competence in one of the other three languages by either:

- submitting an undergraduate transcript showing one year of one of these languages passed with a grade of C or better;
- taking a one-semester course in one of these languages while a graduate student at Washington University, and passing with a grade of B or better; or
- passing one of the annual written exams given by the department in mathematical French or German or Russian, as decided by the thesis adviser.

**Qualifying examinations:** The qualifying exam is in two parts; one is a series of four written tests covering a range of topics, and one is an oral exam on two selected topics. The written tests cover the material in the four basic course sequences. Each spring, at the end of each sequence, all students enrolled in the course take a two-hour final exam; this exam usually covers the second half of the sequence. Doctoral candidates take an additional one-hour exam which covers the entire sequence. To pass the qualifying exam in one of the four areas, the student must pass the three-hour combined exam.

**The dissertation and final oral exam:** The student's dissertation is the single most important requirement for the PhD degree. It must be an original contribution to mathematical knowledge and the student's opportunity to conduct significant independent research. Once the department has accepted the dissertation (on the advice of the thesis adviser), the student is required to pass a final oral examination. Part of this procedure is a question/answer period in which the student is expected to "defend" the thesis. For information about preparing the thesis and its abstract, and about the deadlines involved, please consult the following items from the Graduate School: the Forms page (which includes the Doctoral Dissertation Guide). For a sample thesis TeX file and style file, visit the Department of Mathematics website.

**PhD in Statistics**

**Degree Requirements Summary**

Required graduate units, consisting of:

- 24 required course work units total in fundamental topics and exam fields
- 12 elective course work units
- 6 course work units for staffing a walk-in statistical consulting center to be setup by the department
- 4 qualifying exams: 2 in statistics, 2 in mathematics
- Graduate School Teaching Requirement for PhD Students
- Major and minor oral presentation
- Dissertation research, thesis preparation, and defense (30 course work units)

**General requirements:** The PhD in Statistics general requirements mirror the PhD in Mathematics. For a more detailed explanation, please visit the PhD in Statistics webpage.

**Specific course requirements:** The course work must include two basic graduate statistics sequences:

<table>
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<td>Math 439 &amp; 4392</td>
<td>Linear Statistical Models and Advanced Linear Statistical Models</td>
<td>6</td>
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and any two of the following pure math sequences:

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Prerequisites, if needed, are Math 429 Linear Algebra (0 units toward the degree) and Math 233 Calculus III (0 units toward the degree).

**Language requirement:** A student whose native language is not English must demonstrate proficiency in English. The student also is expected to become fluent in spoken English. In particular, any student who expects to gain teaching experience while pursuing a degree will need to do this as soon as possible.
All students are expected to fulfill the language requirement during their first two years of graduate study.

**Qualifying examinations:** The qualifying exam is in two parts. One is a series of four written tests covering a range of topics, and one is an oral exam on two selected topics. The written tests cover the material in the four basic course sequences. Each spring, at the end of each sequence, all students enrolled in the course take a two-hour final exam; this exam usually covers the second half of the sequence. Doctoral candidates take an additional one-hour exam which covers the entire sequence. To pass the qualifying exam in one of the four areas, the student must pass the three-hour combined exam.

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