

Graduate Study in Mathematics

2008-2009

$$\iint_{\mathbb{R}^2} \mathbf{K} \mathbf{E} \mathbf{D} \mathbf{G}$$

$$\zeta(2) = \sum_{n=1}^{\infty} \frac{1}{n^2} = \prod_p \left(\frac{1}{1 - \frac{1}{p^2}} \right)$$

$$\mathbb{E} + \mathbb{H}$$



Graduate Study in Mathematics Western Kentucky University

2008-2009

The Department

The Mathematics Department at Western Kentucky University is one of nine departments in the Ogden College of Science and Engineering. The department has a faculty of 40, three-fourths of whom are active in research and have published widely in pure and applied mathematics. The department has also established a strong record of research among graduate and undergraduate students. The department offers the Bachelor of Arts, the Master of Arts, and the Master of Science degrees.

The department has one computer laboratory/classroom containing a total of 25 computer stations equipped with geometric visualization and symbolic manipulation software. All graduate student offices are equipped with computers. The library subscribes to over 50 professional journals in mathematics or mathematics education and has a large collection of mathematics books and monographs.

All faculty and graduate student offices, departmental classrooms, and computer laboratories are located in the Central Wing of the Thompson Complex for the sciences. For more information, see: www.wku.edu/Mathematics

The University

Western Kentucky University enrolls approximately 19,000 undergraduate and graduate students, including more than 1000 minority students and international students from 70 countries. Western Kentucky University is committed to attracting students and faculty who are dedicated to academic excellence. The University offers an inviting, nurturing, and challenging environment that is responsive to the intellectual, social, and cultural needs of a diverse learning community. For more information, see: www.wku.edu

The Community

Located in south-central Kentucky, Bowling Green is a city of 50,000 with a cultural and religious diversity not typically found in communities of its size. Bowling Green has expanding industrial and retail bases and offers many theater and concert opportunities. Numerous restaurants are available and recreational activities are offered at city, state, and national parks, golf courses, and lakes. Nearby attractions include Mammoth Cave National Park and the National Corvette Museum. For more information, <http://www.wku.edu/community.html>

My experience as a graduate student in the mathematics department at WKU was enjoyable as well as challenging. The professors were very knowledgeable, as one would expect, but they were also professional and helpful. My advisors guided me well. As a result, I feel that I have received a solid, well-rounded mathematics education.

Joseph W. Galloway
M.S., 2005

Adjunct Instructor
Elizabethtown Community
and Technical College

Master Degrees in Mathematics

The Department of Mathematics offers the Master of Science (M.S.) degree and the Master of Arts (M.A.) degree. Both degrees have thesis and non-thesis options, and both require 30 hours of graduate-level courses. The M.S. degree is designed for students who wish to obtain a Ph.D. degree, to teach in a community college, or to seek employment in industries needing mathematical or computational expertise. On the other hand, the M.A. is designed for secondary teachers and includes courses that will help them become more knowledgeable about the mathematics they teach in high school while exploring the connections and extensions of that knowledge to college and higher mathematics. The M.A. degree program is offered through online courses.

The Master of Science Program

The M.S. program has two options: the “General” and the “Computational” option. The M.S. General Option requires traditional courses in analysis, algebra, topology, and applied mathematics, and is recommended for students who wish to obtain a Ph.D. degree, plan a teaching career at the community college level, or to seek employment in industry. This option is based to a large extent on traditional course work from applied and pure mathematics. The M.S. Computational Option is designed for students seeking employment in industry with an emphasis on computational mathematics and/or computer science. The option contains a large component of computer science graduate courses and has entry requirements that are tailored to meet the needs of this option. Many high-end positions in industry, financial sector, or government require hands-on mathematical expertise that goes beyond what is provided by a bachelor’s degree and is different in flavor from our “general option”.

The General Option

A. Admission Requirements

1. A GAP score of 3000.
2. Completion of the following undergraduate courses: (a) a calculus sequence through multivariable calculus; (b) linear algebra; (c) discrete mathematics; (d) an applied mathematics course (e.g. differential equations, probability, calculus-based statistics, numerical analysis); (e) abstract algebra.
3. A cumulative grade point average of at least 3.0 (on a 4.0 scale) in at least one of the following: (i) all mathematics courses that are applicable to the undergraduate mathematics major; or (ii) courses specified in (b) through (e) of Item 2 listed above.

Admission may be granted to a student having at most one deficiency in the undergraduate courses listed in Item 2.

B. Academic Requirements

The General Option requires a minimum of 30 hours of graduate-level mathematics courses. The following are required:

- (1) Algebra: MATH 417G Algebraic Systems
 Analysis: MATH 431G Intermediate Analysis I
 Topology: MATH 439G Topology
 If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department graduate advisor.
- (2) An applied Mathematics course selected from MATH 529, 531, 535, 536, 540, 541, 542, 550, 570, STAT 549, or as approved by the Departmental Graduate Committee
- (3) MATH 532
- (4) One of the following two-course sequences: MATH 417G-517, 439G-539, 450G-550, 435G-535, 470G-570, 529-540, 435G-531, 535-536; 405G-406G can be taken by students who have substituted a 500-level course for at least one of the three courses listed in (1).
- (5) The remaining mathematics courses in the student's program must be chosen from MATH 405G, 406G, 415G, 423G, 435G, 450G, 470G, 504, 517, 523, 529, 531, 535, 536, 539, 540, 541, 542, 550, 560, 570, 590 or STAT 549.
- (6) A maximum of 12 hours at the 400G-level may be included in the entire program. Graduate students are required to complete additional problem sets and/or papers to receive graduate credit for these courses, which are also open to undergraduate students.
- (7) Students who choose to write a thesis are required to complete 6 hours of MATH 599 – Thesis Research and Writing and to give an oral defense of the thesis.
- (8) A student may, upon prior approval of the Mathematics Department Graduate Committee, include in his/her program a maximum of 6 hours of coursework from a related field.
- (9) Comprehensive exams are required.

The members of the faculty of WKU's graduate mathematics department are phenomenal. They are enthusiastic about their subjects, and are eager to work with you one-on-one as you assemble your master's thesis. On top of that, the regular course offerings cast a wide net across the various branches of mathematics, and the special topics courses give you the opportunity to work with some of the latest developments in the field. Behind-the-scenes, the town of Bowling Green, KY offers an idyllic, cultured background for your studies, with many opportunities for enlightened recreation.

Jamie Johnson
 M.S., 2004

Software Developer for
 Control Systems Design LLC

Research Tool Requirement. A research tool is required and that entails coursework beyond the 30 hours of mathematics. The research tool must be completed during the first 15 hours of coursework. The purpose of the research tool is to provide a student with tools that make a graduating student more marketable and to assist the student in his/her research. A student who is interested in industry employment should look at options that might make him/her more marketable to potential employers. A student who plans to do a thesis should think about what would be helpful for the thesis.

The research tool can be fulfilled in a variety of ways, some of which are listed below:

- a) Courses in other disciplines. The research tool course should be in disciplines that have a strong relation to mathematics. Examples of such disciplines are computer science, physics or economics among many other disciplines. The level (200/300/400/graduate) of the course needs to be appropriate to the students' background. For example, any graduate or 400 level computer science course will be accepted. However, a student with no prior programming experience can not take such a course and instead could choose a first year undergraduate programming course.
- b) Learning how to use a standard statistical package (such as SAS or SPSS).
- c) A mathematics reading course if the reading course is aimed at exposing the student to research articles in an area of mathematics. A reading course that counts as a research tool is not a special topics course, i.e. the reading can not be based on a single source or have a very narrow focus. It should also not be the continuation of a prior course. The offerings of such reading courses will be limited to exceptional cases. Reading courses should not be used to replace other course offerings of the department that a student could take at the same time.
- d) A foreign language examination (appropriate if this language is useful to the student in his or her research).

The choice of a research tool will be discussed in the graduate committee and must be approved by the Mathematics Department graduate advisor in advance or at the latest at the time when the student fills out the degree program form.

The Computational Mathematics Option

A. Admission Requirements

1. A GAP score of 3000.
2. Completion of the following undergraduate courses: (a) a one year calculus sequence; (b) linear algebra; (c) discrete mathematics (d) a one year sequence of programming courses; (e) A B.A. degree with a major in either Computer Science, Engineering, Mathematics or Physics.
3. A cumulative grade point average of at least 3.0 (on a 4.0 scale) in at least one of the following: (i) all mathematics and computer science courses that are listed in (a) through (d) of Item 2 above; or (ii) all courses in the major listed in (e) of Item 2 above.

Students cannot enter the program if they have a deficiency in the courses listed in Item 2 above.

B. Academic Requirements

The Computational Mathematics Option requires a minimum of 30 hours of graduate-level mathematics and computer science courses. The following are required:

- (1) MATH 405G Numerical Analysis I
MATH 406G Numerical Analysis II
STAT 549 Statistical Methods I
MATH 470G Introduction to Operations Research
CS 549 Algorithms Analysis
- (2) At least two courses from the list below are required:
CS 562 Parallel and Distributed Computing
CS 565 Data Mining Techniques and Tools
CS 595 Advanced Topics in computer science (with permission of advisor, i.e. depending what the topic of the course will be)
- (3) The remaining courses will be chosen from the list below:
MATH 431G Intermediate Analysis I
MATH 541 Graph Theory
MATH 570 Topics in Operations Research
MATH 504 Computer Applications to Problems in Mathematics
MATH 540 Stochastic Processes
MATH 542 Advanced Topics in Discrete Mathematics
MATH 590 Advanced Topics in Mathematics (with permission of advisor, i.e. depending what the topic of the course will be.)
- (4) A maximum of 12 hours at the 400G-level may be included in the entire program. Graduate students are required to complete additional problem sets and/or papers to receive graduate credit for these courses, which are also open to undergraduate students.
- (5) Comprehensive exams are required.
- (6) The research tool requirement is satisfied by the computer science classes.

All students in the M.S. program must have a working knowledge of a high-level programming language or computer algebra system.

The Master of Arts Program

The M.A. degree is designed specifically to accommodate the busy schedules of secondary mathematics teachers. All coursework is offered online so that teachers have flexibility to complete coursework at nontraditional times. Access to the internet is required.

A. Admission Requirements

1. A GAP score of 3000.
2. Secondary teacher certification.

At first, I was skeptical about choosing a smaller university; however, I have never regretted my decision. I found the faculty to be knowledgeable and friendly. Furthermore, since most of the professors knew me personally, they were amicable and helpful, answering questions I had about teaching, research and coursework. The faculty at WKU was more to me than teachers: they were also mentors and friends.

Heather Bjorum
M.S., 2005
Adjunct Instructor
Texas Christian University

3. A bachelors degree in mathematics, or completion of the following undergraduate courses:
- (a) a calculus sequence through multivariable calculus;
 - (b) linear algebra;
 - (c) discrete mathematics;
 - (d) probability or calculus-based statistics;
 - (e) abstract algebra;
 - (f) geometry.

Admission may be granted to a student having at most one deficiency in the undergraduate courses listed in Item 3.

B. Academic Requirements

The M.A. degree requires a minimum of 30 hours of graduate-level courses, including the following:

- (1) Core Mathematics Courses: The student is required to complete at least four of the following list of mathematics courses:
 Math 501 Introduction to Probability and Statistics I
 Math 503 Introduction to Analysis
 Math 511 Secondary Mathematics from an Advanced Perspective I
 { Math 512 Secondary Mathematics from an Advanced Perspective II
 or Math 423G Geometry II
 or Math 523 Topics from Geometry
 Math 514 Modeling and Applications for Secondary Teachers
- (2) Core Education Courses:
 PSY 510 Advanced Ed. Psychology or PSY 511 Psychology of Learning
 SEC 580 The Curriculum
 EDU 544 Classroom Teaching Strategies
 SEC 534 Seminar in Mathematics Education
- (3) Elective courses: Six hours of mathematics courses chosen from those listed above or MATH 405G, 406G, 409G, 415G, 421G, 423G, 429G, 431G, 432G, 435G, 439G, 450G, 470G, 475G, 500, 504, 509, 517, 531, 532, 535, 536, 539, 540, 541, 542, 550, 560, 590, 599.
- (4) A maximum of 9 hours at the 400G level may be included in the entire program. Graduate students are required to complete additional problem sets and/or papers to receive graduate credit for these courses, which are also open to undergraduate students.
- (5) A thesis student is required to complete 6 hours of Math 599-Thesis Research and Writing and to give an oral defense of the thesis.
- (6) Comprehensive exams are required.

Rank II Certification

A student may receive Rank II Certification from the Kentucky Department of Education by earning a Master of Arts in Mathematics. In addition to satisfying the degree requirements, the student must develop and submit a professional portfolio consistent with the Kentucky Experienced Teacher Standards. A teaching component of at least one semester (either in a secondary school or as a graduate teaching assistant) is also required.

Thesis Preparation and Presentation

The department encourages all students who are supported by an assistantship to take the thesis option. Writing a thesis is usually a wonderful and rewarding experience for students. It represents a high point in their academic careers, and is a necessary tool for doctoral dissertation research and writing. Students who choose to write a thesis are required to complete 6 hours of MATH 599 – Thesis Research and Writing and to give an oral defense of the thesis. The following are the policies and guidelines to thesis preparation and presentation:

1. A student should declare his/her a intention to pursue the thesis option no later than the end of the first year of study (or when completing 18 credit hours towards the degree) and select a thesis advisor.
2. The student and the thesis advisor should start the process of finding a topic during the summer or winter break (or after completing 18 hrs of credit towards the degree). This process often will require the student read extensively to become familiar with the necessary background material.
3. During the next full term, the student should select two other faculty members (in consultation with his/her thesis advisor) to serve on her/his thesis committee. The student should write a brief document (no more than one or two pages) outlining the goal and scope of the thesis. This document must be approved by the thesis committee to ensure that the goals are reasonable. This process should be completed by the 12th week of that term. A copy of the final document should be given to the departmental Director of Graduate Studies who will share it with the Graduate Committee.
4. A series of graduate student seminars will be scheduled by the Director of Graduate Studies. A thesis student is expected to give a presentation on the progress of his/her thesis at such a seminar.
5. The student and his/her advisor may decide that the original outline and scope of the thesis can no longer be fulfilled. There could be many reasons for this - unforeseen difficulties in the arguments needed, new results by others, a change of interest by the student. In such a case the student's thesis committee should be consulted. The thesis committee must approve the revised scope of the thesis. During this step, the Director of Graduate Studies should be included in the discussions.

WKU was my first experience in studying abroad and I can say that it was one of the most beautiful experiences to me. All professors in the Math Department are very nice and friendly. This helped me, especially for a person who lived far away from home, feel happy and warm. I just love all of you. I can say that I will always miss "the hill".

Ngoc Nguyen
M.S., 2006
Ph.D. student
Bowling Green State U.

6. Any student writing a thesis must give an oral presentation (called the thesis defense) about his/her thesis to the whole department. It is the thesis advisor's responsibility to schedule the time and location of the thesis defense and send an appropriate announcement to the departmental faculty. The entire thesis committee is expected to attend the thesis defense.
7. Students are encouraged to use L^AT_EX for their thesis. However, the use of other word processors (such as Microsoft Word or Mathematica) is acceptable.
8. The thesis committee should receive a copy of the thesis at least one week prior to the thesis defense. Members of the thesis committee should take the job of proofreading the thesis seriously –it is an important step in the process of ensuring a polished final product.
9. If the thesis advisor realizes during the final semester that the student most likely will miss the deadline for submission of the final product, then it is possible for the student to finish during the next semester. (This can be a summer term if the final term is a spring semester. In this case, the student can still attend the spring graduation, but the degree will have an August date.) If the thesis deadline is to be extended, the thesis advisor must consult with the thesis committee and the Director of Graduate Studies on the new timeline, and determine whether there is additional financial support available for the student. (Such support is unusual and funds are very limited.) The thesis advisor will then put the new timeline in writing and distribute it to the student, the thesis committee, and the Director of Graduate Studies.
10. The decision to accept or reject the student's thesis rests with the thesis committee. The earliest the student would be informed of this decision is at the conclusion of the thesis defense. Should a revised version of the thesis be required, then the final decision will come within a week of its submission to the committee.
11. The thesis should be in the final state before it is sent to the Ogden College Dean's office for proofreading. The proofreading in the Dean's office cannot replace or substitute for the proofreading by the committee and the student.

Comprehensive Exams

A student selecting to write a thesis is required to present an oral defense of the thesis and complete comprehensive written exams based on four courses (normally including one year-long sequence) approved by the departmental Graduate Committee. Non-thesis students must complete comprehensive written exams based on six courses (normally including two year-long sequences) approved by the departmental Graduate Committee. A student can decide for which courses she/he wants to take comprehensive exams subject to the rules outlined for the selected option within our graduate program.

The Graduate Committee has the responsibility for administering the comprehensive exams to the student. Comprehensive exams will usually be scheduled once towards the end of a semester. The responsibilities of the Graduate Committee include the following:

1. Ensure that the sequence of exams given to a student will fulfill the program requirements.
2. Assemble the exams needed. The graduate committee will approach faculty members who have taught a course for which an exam is needed to construct an exam. Any

faculty member who teaches a course with graduate students is expected to draft questions for a comprehensive exam if so asked. The graduate committee has the right to alter an exam to ensure that the exams given to all students are of approximately equal difficulty and length.

3. Set a date and time for the comprehensive exams and administer those exams. The goal will be to administer all comprehensive exams in a given semester at a common date and time.
4. Assume the responsibility for grading the comprehensive exams and deciding whether or not a student has passed. The faculty member who created a particular exam will grade the exam. At least one member of the graduate committee will also grade the exam. (This will ensure an approximate equality in grading standards over the years.) Any decision on pass/fail decision for an exam will be made in consultation with the faculty member who constructed the exam.
5. Inform the student of the outcome of the exams and determine the necessary course of action that needs to be taken if a student fails a part of an exam. If a student fails one or more exams, the Graduate Committee will schedule an oral examination with the student, the faculty members who made out the exams and two members of the Graduate Committee. If a student fails the oral exam, then the student will be required to repeat the comprehensive exams in the next semester.
6. Assume the responsibility for completing the required assessment forms.

Graduate Assistantships

Graduate assistantships are available, on a competitive basis, from the Department of Mathematics. A student will be awarded one of three assistantship levels based on his/her readiness to assume primary teaching responsibility in DMA 096C (Intermediate Algebra) as described below:

Level I assistantship is for a student who has removed all undergraduate deficiencies (if any) and is prepared to assume primary teaching responsibility for a section of the developmental course DMA 096 (Intermediate Algebra). A student may demonstrate eligibility by successfully completing a teacher certification program (including student teaching) as an undergraduate or by serving at least one semester as a student assistant in a section of Math 116 (College Algebra). Holding primary teaching responsibilities for one section of DMA 096 each semester (4 semester hours each semester), a Level I Teaching Assistant will be awarded a stipend of \$12,500 for the academic year.

Level II assistantship is for a student who has removed all undergraduate deficiencies (if any) and will be prepared to assume primary teaching responsibilities for a section of DMA 096 after one semester of supervised service as a student assistant in a section of Math 116. Serving as a student assistant during the first semester and holding primary teaching responsibilities for one section of DMA 096 during the second semester, a Level II Teaching Assistant will be awarded a stipend of \$10,750 for the academic year.

WKU is a very special school for me. That was my first experience in the States. I was scared, nervous and homesick. However, after a while, with the great help and effort of the Faculty and Staff of the Math Department, I wasn't homesick or scared at all. All the graduate courses offered were really good and helpful. All the professors were very supportive and caring. I had such a nice time at WKU.

Asli Gldrdek
M.S., 2005
Ph.D. student
Auburn University

Level III assistantship is for a student who has demonstrated appropriate potential for graduate study in mathematics but has a deficiency that may be removed by a single undergraduate course, or, for another reason, is not adequately prepared to serve as a student assistant in a section of Math 116. During the first semester, such a student will be assigned duties in the department's computer laboratory and/or tutoring laboratory while removing the deficiency and becoming prepared for supervised service in a section of Math 116. A Level III Graduate Assistant will be awarded a stipend of \$9,000 for the academic year.

Graduate assistants are reviewed each semester and may be reappointed at a different level. Competitive summer graduate assistantships up to \$2120 may be available. Students should submit applications for admission to the Graduate School and for assistantships directly to the Graduate School. There is a \$35 application fee. Information on application procedures and forms is available at: <http://www.wku.edu/graduate>.

Tuition and Tuition Supplements

All graduate assistants pay tuition at the resident rate of \$3507 per semester. This rate may change, but the department expects to have funds to cover somewhere between 25-50% of tuition cost.

Non-resident graduate students not on assistantship pay tuition of \$3839 per semester, and international graduate students not on assistantship pay tuition of \$4337 (this is the rate for international students minus a scholarship for full-time, non-resident, international graduate students).

Funds for scholarships to reduce tuition further will assigned on a competitive basis.

Timeline for Applications

In order to get full consideration for an assistantship, the data below should be followed. A person who applies at a later date will only be considered for an assistantship if there are unfilled assistantships.

	<u>Assistantship*</u>	<u>Admission only</u>	
		Foreign Students	U.S. Citizens
For Fall:	March 30*	April 1	August 1
For Spring:	October 15*	September 1	December 15
For Summer:	April 1*	March 1	May 15

*Applications for assistantship must be accompanied or preceded by the application for admission. New students applying for both admission and assistantship must observe the earlier deadline.

Housing is available on campus from \$1495 to \$1725 per semester (\$2243 to \$2588 for a private room), and the community offers a wide range of housing options near campus, as well.

The Graduate Faculty

Ferhan Atici, Associate Professor, Ph.D. University of Nebraska, 1995. Difference equations, differential equations, calculus on time scales.

Melanie Autin, Assistant Professor, Ph.D. University of South Carolina, 2007. Statistics education, generalized additive models, environmental statistics.

James B. Barksdale, Jr., Professor, Ph.D. University of Arkansas, 1969. Functional analysis, normed linear spaces, Banach spaces.

David Benko, Assistant Professor, Ph.D. University of South Florida, 2001. Approximation theory, numerical analysis.

Tilak Bhattacharya, Assistant Professor, Ph.D. Purdue University, 1988. Non-linear PDEs.

Daniel Biles, Professor, Ph.D. Vanderbilt University, 1987. Fundamental theory of differential equations and differential inclusions, in particular existence of solutions and generalized solutions and related topics.

Barry Brunson, Professor, Ph.D. Indiana University, 1982. Probability theory, statistical inference.

Robert Crawford, Professor, Ph.D. Indiana University, 1970. Algebra, geometry, and combinatorics.

Béla Csaba, Assistant Professor, Ph.D. Rutgers The State University of New Jersey, 2000. Graph theory, combinatorics, probabilistic methods, theoretical computer science.

Molly Dunkum, Assistant Professor, Ph.D. University of Kentucky, 2005. Homological algebra.

Constance C. Edwards, Associate Professor, Ph.D. University of Wisconsin, 1975. Mathematics education and curriculum design including content and layout styles for graphing calculator guidebooks.

Claus Ernst, Professor, Ph.D. Florida State University, 1988. Low dimensional geometric topology and knot theory; physical knots and their applications to molecular biology and chemistry.

Jemal Gishe, Assistant Professor, Ph.D. University of South Florida, 2006. Orthogonal polynomials, special functions, symbolic computations.

Peter Hamburger, Professor and Department Head, Ph.D. Eötvös Loránd University, Budapest Hungary, 1971. Combinatorics, topology, and graph theory.

The thing I treasure most about my graduate experience at Western is the sense of community in the math department. There was no unfriendly face, and all my professors were available at any time. The expectance level is also very high, which was appreciated and wanted from a department with such a high level of intelligence.

David High
M.S., 2006

Nezam Iraniparast, Professor, Ph.D. University of California at Davis, 1984. Partial differential equations, and specifically, hyperbolic characteristic initial boundary value problems, which can be described as determining waves from prescribed initial data and the data along the paths of propagation.

Bruce Kessler, Professor and Assistant Dean, Ph.D. Vanderbilt University, 1997. Wavelet theory and its applications to signal processing and pattern recognition, cyberdefense, mathematical modeling.

Dominic Lanphier, Assistant Professor, Ph.D. University of Minnesota, 1999. Number theory, automorphic forms and L-functions, discrete mathematics.

Hope Marchionda, Assistant Professor, Ph.D. Clemson University, 2006. Mathematics education.

David Neal, Professor, Ph.D. University of Florida, 1988. Probability theory, stochastic processes, random walks, statistical inference.

Lan Nguyen, Associate Professor, Ph.D. Ohio University, 2002. Semigroups of operators and Cauchy problems, autonomous and nonautonomous differential equations in abstract spaces.

Attila Pór, Assistant Professor, Ph.D. Eötvös Loránd University, Budapest, Hungary, 2003. Combinatorial geometry, combinatorics, convex geometry.

Jonathan Quiton, Assistant Professor, Ph.D. University of South Carolina, 2007. Parametric and nonparametric methods in survival analysis, applied stochastic processes, statistics education.

Bettina Richmond, Professor, Ph.D. Florida State University, 1985. Algebra, Hopf algebra structure theory.

Tom Richmond, Professor, Ph.D. Washington State University, 1986. General topology, ordered sets, partially ordered topological spaces, compactifications.

Mark Robinson, Professor, Ph.D. University of Kentucky, 1991. Numerical solutions of differential equations.

John Spraker, Professor, Ph.D. Indiana University, 1987. Complex variables, operator theory, and differential equations.

Wanda Weidemann, Professor, Ed.D. Vanderbilt University, 1990. Mathematics education, curriculum development to enhance the content knowledge of both preservice and inservice teachers.

Di Wu, Assistant Professor, Ph.D. Iowa State University, 2006. Computational biology and optimization.

Mathematics Graduate Courses

Up to 12 hours of 400G level mathematics courses may be applied toward the M.S. and up to 9 hours of 400G level mathematics courses may be applied toward the M.A. degree. Graduate students are required to complete additional problem sets and/or papers to receive graduate credit for these courses, which are also open to undergraduate students. Descriptions of the prerequisite courses may be found at <http://www.wku.edu/Mathematics/mathcat.html> #courses.

For a listing of the courses which may be applied to the option of your choice, please refer to the descriptions above.

405G Numerical Analysis I (CS 405G).

3 hours.

Prerequisites: MATH 307 or 310 or 327; and CS 230 or CS 240 or permission of instructor.

Computer arithmetic, roots of equations, polynomial approximation and interpolation, numerical differentiation and integration. Computer solutions of problems will be required.

406G Numerical Analysis II.

3 hours.

Prerequisites: MATH 307, 327 and 331; and either MATH 405 or CS 405.

The solution of linear systems by direct and iterative methods, matrix inversion, the calculation of eigenvalues and eigenvectors of matrices. Initial and boundary value problems in ordinary differential equations. Computer solution of problems will be required.

409G History of Mathematics.

3 hours.

Prerequisite: At least 6 hours of upper division undergraduate mathematics, or permission of instructor.

History of mathematics from ancient times through the development of calculus with emphasis on famous problems. Provides knowledge and appreciation useful in the classroom. Term papers will be required. Not applicable to the M.S. degree in Mathematics.

415G Algebra and Number Theory.

3 hours.

Prerequisite: MATH 315 or 317.

Survey of modern algebra and number theory. Includes number systems, divisibility, congruences, groups and their application to number theory.

417G Algebraic Systems.

3 hours.

Prerequisite: MATH 317.

Theory of groups.

421G Problem Solving for Secondary Teachers.

3 hours.

Prerequisites: MATH 307 and MATH 310; MATH 329 and MATH 323, or permission of instructor.

Utilizes various techniques and technology to solve mathematical problems. Integrates concepts from algebra, geometry, trigonometry, probability, statistics, number theory, discrete mathematics, linear algebra, and calculus. Not applicable to the M.S. degree in Mathematics.



My "time" at WKU has been rewarding both socially and academically. The mathematics department offered an educational experience that forced me to grow in the understanding and application of the basic foundations of theoretical math while simultaneously being exposed to specialized research projects in newly developing fields. The wealth of knowledge I have gained at WKU has more than adequately prepared me for my pursuit of a doctoral degree in statistics at the University of South Carolina.

Chris McMahan
M.S., 2008

Ph.D. student
Univ. of South Carolina

423G Geometry II. 3 hours.

Prerequisite: MATH 323.

An axiomatic development of hyperbolic geometry based on the hyperbolic parallel postulate and the absolute geometry developed in MATH 323, including an emphasis on contrasts with Euclidean geometry.

429G Probability and Statistics II. 3 hours.

Prerequisite: Math 329.

Sampling distributions, statistical inference; point and interval estimation, properties of estimators; hypothesis testing; regression and correlation; analysis of variance; and non-parametric methods.

431G Intermediate Analysis I. 3 hours.

Prerequisite: MATH 317.

Topics chosen from cardinality, limits, continuity, elementary topological concepts, sequences and series, differentiation and integration, elementary functional analysis.

432G Intermediate Analysis II. 3 hours.

Prerequisite: MATH 431.

Continuation of MATH 431.

435G Partial Differential Equations. 3 hours.

Prerequisites: MATH 307, 327, and 331.

Equations of first and second order; elliptic, hyperbolic and parabolic equations of mathematical physics using separation of variables and Fourier series.

439G Topology. 3 hours.

Prerequisite: MATH 317 or permission of instructor.

Topological spaces, mappings, separation axioms, compactness, connectedness, arcwise connectedness, metric spaces.

450G Complex Variables. 3 hours.

Prerequisite: MATH 327.

Complex number plane, analytic functions of a complex variable, integration, power series, calculus of residues, conformal representation, applications of analytic function theory.

470G Introduction to Operations Research. 3 hours.

Prerequisite: MATH 307 and 327 or permission of instructor.

Principles and techniques of operations research including linear programming, integer programming, quality theory, sensitivity analysis, and dynamic programming.

475G Selected Topics in Mathematics. 1 to 3 hours.

Prerequisite: Permission of instructor.

Significant problems and developments of current interest.

Courses numbered 500 and above are for graduate students only.

500 Readings in Mathematics.

1 to 3 hours.

Prerequisite: Undergraduate major in mathematics.
Students read and present papers that have appeared in (or have been accepted by) mathematical journals. Topics covered are determined by areas of interest.

501 Introduction to Probability and Statistics I.

3 hours.

Prerequisite: Permission of instructor.
Interpreting and analyzing univariate and bivariate data; data collection; planning and conducting experiments; probability and sampling distributions; statistical inference. (Not applicable to the M.S. degree in Mathematics.)

502 Introduction to Probability and Statistics II.

3 hours.

Prerequisite: MATH 203 or 329 or 501; or permission of instructor.
Review of linear algebra, Markov chains, decision theory, linear programming and game theory. (Not applicable to the M.S. degree in Mathematics.)

503 Introduction to Analysis.

3 hours.

Examination of selected topics in elementary calculus including sequences, series, limits, continuity, the derivative, and the Riemann integral. Introductory material includes logic, set theory, and functions. (Not applicable to the M.S. degree in Mathematics.)

504 Computer Applications to Problems in Mathematics.

3 hours.

Computer techniques and solutions of problems in mathematics including calculus, applied statistics, simulation, linear programming, game theory and linear algebra.

509 History of Modern Mathematics.

3 hours.

Prerequisite: MATH 227 or permission of instructor.
History and development of mathematics since the 18th century with an emphasis on important problems and famous mathematicians. (Not applicable to the M.S. degree in Mathematics.)

511 Secondary Mathematics from an Advanced Perspective I. 3 hours.

Prerequisite: Mathematics major or minor, or permission of instructor.
Intended for teachers wishing to develop a deeper understanding of underlying concepts of algebra and calculus. Examines links among different fields of mathematics and connections among high school, college, and higher mathematics. (Not applicable to the M.S. degree in Mathematics.)

512 Secondary Mathematics from an Advanced Perspective II. 3 hours.

Prerequisite: Mathematics major or minor, or permission of instructor.
Intended for teachers wishing to develop a deeper understanding of underlying concepts of geometry. Examines relationships among different fields of mathematics and connections among high school, college, and higher mathematics. (Not applicable to the M.S. degree in Mathematics.)



My experience at WKU's Math Department was very enriching. Being an international student, I was at first unsure how things would go. I secretly feared that I might find myself lonely and home-sick. However, it turned out that I had been so wrong! I found the professors not only knowledgeable and challenging, but also very helpful. I found my fellow students not only understanding, but also very friendly. It felt so much like home.

Joseph Kimeu
M.S., 2008

514 Applications and Modeling for Secondary Teachers. 3 hours.

Prerequisite: Mathematics major or minor, or permission of instructor.

Utilizes concepts from many fields of mathematics to explore how high school and college mathematics is used in real world settings. Intended for secondary teachers. (Not applicable to the M.S. degree in Mathematics.)

517 Topics from Algebra. 3 hours.

Prerequisite: MATH 417.

Theory of rings, fields, and vector spaces. Topics include: polynomial rings, principal ideal domains, unique factorization domains, field extensions, Galois theory.

523 Topics from Geometry. 3 hours.

Prerequisite: Undergraduate geometry and permission of instructor.

Geometry of special lines and points, isometrics, similarities, inversion, applications.

529 Applied Probability. 3 hours.

Prerequisites: MATH 431 or MATH 327, and permission of instructor.

Axiomatic development of the theory of probability. Introduction to Markov chains, random variables, distributions, transformations. Limit theorems and various modes of convergence.

531 Advanced Differential Equations. 3 hours.

Prerequisites: MATH 331, 431.

Power series solutions, existence and uniqueness theorems, stability and Liapunov's method, regular singular points, perturbations of periodic solutions.

532 Real Analysis. 3 hours.

Prerequisite: MATH 432.

Function spaces, additive set functions, outer measure; measurable functions, integration.

535 Advanced Applied Mathematics I. 3 hours.

Prerequisites: MATH 331, 431.

Eigenvalue and boundary value problems, orthogonal expansions in function spaces, classical polynomials, Sturm-Liouville theory, Fourier and Laplace transforms.

536 Advanced Applied Mathematics II. 3 hours.

Prerequisite: MATH 535.

Integral equations, calculus of variations, maximization of linear functionals, maximum gradient method.

539 Topology II. 3 hours.

Prerequisite: MATH 439.

Homotopy, homology theory.

540 Stochastic Processes. 3 hours.

Prerequisite: Permission of instructor.

Theory and application of stochastic processes, random walks, Markov chains, Poisson processes; birth and death processes, queues, renewal and branching.

541 Graph Theory. 3 hours.

Prerequisite: Undergraduate major in mathematics or permission of instructor.

Introduction to the basic concepts of graph theory. Topics include Eulerian circuits, Hamiltonian cycles, coloring problems and planar graphs.

542 Advanced Topics in Discrete Mathematics. 3 hours.

Prerequisites: Math 310 and Math 317.

Combinatorics, ordered sets and lattice theory, modeling with difference equations, discrete calculus, dynamic equations on time scales.

STAT 549 Statistical Methods I. 3 hours.

Prerequisite: Permission of instructor.

Principles of applied statistical research. Elements of data collection and experimental design. Parametric and nonparametric methods for analyzing interval, ordinal and categorical data, including confidence intervals and hypothesis testing, single factor ANOVA, simple and multiple linear regression and correlation. Emphasis will be placed on analyzing real data.

550 Complex Analysis. 3 hours.

Prerequisites: MATH 432, 450.

Analytic continuation, conformal mapping, Riemann surfaces, and univalent functions.

560 Functional Analysis. 3 hours.

Prerequisite: MATH 432.

Theory of abstract linear spaces. Topics include: normed vector spaces, inner product spaces, Hilbert spaces, open mapping and closed graph theorems, Banach-Steinhaus theorem, weak and weak-* topologies.

570 Topics in Operations Research. 3 hours.

Prerequisites: MATH 432, 470, or consent of instructor.

Specific area(s) of operations research.

590 Special Topics in Mathematics. 3 hours.

Prerequisite: Permission of instructor.

599 Thesis Research and Writing. 6 hours.**600 Maintaining Matriculation. 1 to 6 hours.**

The program features dedicated advisors who will do everything they can to make earning a Masters degree a pleasant experience while the camaraderie with other graduate students forge a supportive and unforgettable friend base.

Bryan Sandor
M.S., 2008

For More Information. . .

Visit our webpage at www.wku.edu/Mathematics, or contact

Claus Ernst, Director of Graduate Studies

Address: Department of Mathematics
Western Kentucky University
1906 College Heights Blvd. #11078
Bowling Green, KY 42101-1078

e-mail: *claus.ernst@wku.edu*

Phone: (270)-745-6224

Fax: (270)-745-3699

About the Cover

The inset is the on-campus Guthrie Tower. The 125-foot bell tower and plaza is a memorial to freedom and those who gave their lives defending it. The tower honors the memory of Lowell Guthrie's brother, Sgt. 1st Class Robert Guthrie, who was killed in the Korean War, and all those associated with Western who lost their lives in service to this country. The construction was completed in 2002.

The three formulas are among the most celebrated and popularly mathematical formulas. The formula $\int \int_S K ds = 2\pi\chi(S)$ relates the Gauss curvature of a surface S to its Euler characteristic $\chi(S)$. One calculates K using the unit normal for the surface and it is a geometric quantity, while $\chi(S)$ is computed by using triangulations of the surface and is a topological quantity.

The second formula $\zeta(z) = \prod_p \frac{1}{1-p^{-z}}$, $z = x + iy$ is the Riemann zeta function and its relation to the primes p . This formula has a pivotal role to play in number theory, such as in the prime number theorem and in many other very well-known theorems. Incidentally, Euler discovered this formula. An important conjecture about the zeta function is that its nontrivial zeros lie on the critical line $x = 1/2$. A solution of this has implications not only for Mathematics but also for Physics.

The last formula $e^{i\pi} + 1 = 0$ is also due to Euler. This was much admired by the famous physicist Richard Feynman. He called it one of the "most remarkable, almost astounding" formula he had ever seen. This has great application in Quantum Mechanics which rules the subatomic world.

Finally, the Möbius strip is one of the simplest nonorientable surfaces and is also very easy to make. It has only "one side". Any ordinary sheet of paper has two sides and is orientable. Traveling from one side to the other requires one to go around an edge. If one twists the sheet and glues two opposite edges then one of the "sides" is lost. One can go from "one side" to the "other" without going around the "edges".