department NEWS

joe fisher RETIRES by James Osterburg

Joe Wayne Fisher is a native of the small farming community of Polk, Neb. He was salutatorian of his class at Kearney State College, now the University of Nebraska at Kearney, where he earned a teaching degree. He earned his PhD in mathematics in 1968 at the University of Illinois, and came to UC as an associate professor in 1975.

An algebraist, Joe worked on ring theory. He collaborated with UC colleague James Osterburg, and one of his results (with Susan Montgomery of USC) inspired an important open conjecture in the field of Hopf algebras. Some of his most admired work deals with the relationship between local properties of an algebraic structure and global properties of a larger structure. He had four PhD students at UC: Richard Heeg, Chan Huh, Jae Park and Edna Reiter.

Joe's love of teaching naturally led to many years of service as the department's first undergraduate program director (1992-2006). Joe has long been a proponent of reforming the way mathematics is taught. He introduced technology into the classroom, championed innovations such as group (cooperative) learning, emphasized critical thinking and often taught seminar-style.

Joe was also a dedicated member of the UC Chapter of the American Association of University Professors, serving in several positions, including chapter president.

Joe was a wonderful colleague and friend. The department will miss his reliable good humor and experience, as will the many undergraduates who visited his office for advice, help with math or just to chat. We wish Joe and his wife, statistician Amy Fisher (PhD 1993) a happy and healthy retirement.

faculty NEWS

Jim Deddens received the first "Jules Verne 20,000 leagues below the LOD (limit of detection)" award at the EPICOH 2007 (Epidemiology in Occupational Health) meeting in Banff , Canada.

Xiaodong Lin was elected a member of the International Statistics Institute.

Tara Smith is a member of the Advanced Placement Calculus Exam Test Development Committee and a question leader for exam grading.

Shuang Zhang was invited by Field medalist T.S. Yau of Harvard to speak at the International Congress of Chinese Mathematicians (ICCM) last December.

andrew lorent JOINS THE FACULTY

This fall, the department welcomes new assistant professor Andrew Lorent. A British citizen and graduate of University College London, Andrew comes to us following a series of prestigious postdoctoral positions in Europe that have given him the freedom to focus on a variety of fascinating and difficult mathematical problems.

Andrew's interests span geometric measure theory, calculus of variations and applications of calculus of variations in continuum mechanics (mathematical models of solids and fluids) and materials science (phase transitions, crystalline microstructure, etc.).

Geometric measure theory (GMT) originates from the study of lower dimensional objects in a higher dimensional space, not point-wise, as in differential geometry or topology, but from the perspective of measure theory. This leads to a theory that combines measure theory, geometric combinatorics and analysis to prove strikingly strong theorems about objects that initially seem to have little regularity or structure. GMT techniques have proved useful in areas of analysis where it is necessary to take a limit and the limiting object loses much of the regularity of the sequence, to try to regain the regularity lost. GMT has applications in the theory of minimal surfaces, calculus of variations and geometric analysis. The class of theorems Andrew has studied most are the so-called rectifiability and density theorems. These theorems prove very strong characterizations of sets or measures that have local scaling limits.

Calculus of variations is the study of the existence, uniqueness and properties of minimizers of certain energy functionals. For functionals acting on scalar valued functions this theory is very classical; unique minimizers exist and can be found by simple algorithms if and only if the functional is convex. However in many areas of physics, for example elasticity, magnetism and solid-state physics, the energy functional acts on vector valued functions and the classic theory has little to offer. In the last 20 years many groups of mathematicians have worked to develop a non-convex calculus of variations. Andrew has worked on problems related to the energy functionals associated with phrase transition in solids, and on problems related to a functional occurring in micro-magnetics.

A common theme is that nearly all problems studied by Andrew are very concrete and simple to state, and are understandable by anyone with basic graduate level analysis.

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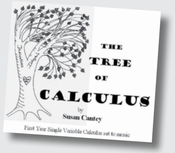
alumni NEWS

Frank B. Thomas (BA 1957), who retired in 1995 from the position of chief information officer at the University of Akron, operates HEITS (Higher Education Information for Technology Services), a company he founded that produces, compiles and sells reports from annual surveys on information technology salaries, budgets, fees and other information useful for managers, covering 204 institutions of higher education. A veteran of the Korean War, Frank completed his undergraduate degree here in 1957 and a PhD in education from the University of Akron in 1983.

Susan McIntyre Cantey (BA 1978, MAT 1983) has taught mathematics at Walnut Hills High School for the last 30 years. Susan taught calculus for UC's (now defunct) Evening College for about 22 years. She is National Board Certified and won a Presidential Award for Excellence in Mathematics Teaching in 1987. Recently, Susan released a CD of 26 calculus songs called "The Tree of Calculus," which is quietly selling to AP teachers across the country and in Canada through CDBaby and iTunes, or in Cincinnati at Everybody's Records in Pleasant Ridge. Some of these songs have been incorporated into videos by her Walnut Hills students and posted on YouTube (type "MrsCantey" in the search box). Susan's songs can be heard at http://cdbaby.com/cd/susancantey5.



Bin Huang (MS 1995) received her PhD in biostatistics from UC in 2002 and is currently research assistant professor at the Center for Epidemiology and Biostatistics (CEB) at Cincinnati Children's Hospital Medical Center. Bin has been mentoring a group of our department's PhD graduate statistics students at the CEB, who are working under her supervision on NIH-funded projects. She was recently approved for affiliated faculty status in the department. Bin is married to Professor Srdjan Stojanovic and the couple has two children.

John Murray (MS 1998) is professor of economics at the University of Toledo. His new book "Origins of American Health Insurance" (Yale University Press, 2007) contains a chapter on the early history of group-health specific actuarial science – an episode in the history of applied math.

Rob Sinn (MS 1998, PhD (interdisciplinary) 2003) was named the North Georgia College & University Alumni Association's 2008 Distinguished Professor. An assistant professor in the NGCSU Mathematics Department, Sinn is involved in professional training for K-12 teachers and directs the school's Summer Honors Program, program for high an academic and leadership school students. His NSF-funded research investigates best practice teaching of introductory statistics courses. He is well-known on campus for a game theory course he introduced for math majors that involves a novel career simulation game. Students get scholarship points for presentations at class conferences and publications in class journals, and then have to parlay their scholarship points into promotions and tenure.

James Poeppelman (BA 2003) writes, "I'm sure the undergrad students are always eager to know where their math skills will take them. Anyway, I'm currently employed by a Fortune 500 company as a systems analyst. I've been in the world of IT for about four years now and have nothing but good things to say about it." He reports he often uses mathematical methods at work, such as multiple regression analysis to analyze key components when optimizing Web marketing strategies and modular arithmetic when outputting query results. In his spare time, he launched the full-scale e-commerce company PrimarySupplements.com (http://www.primarysupplements.com), which retails nutritional products.

the HYPOTENEWS

Undergraduate Research Opportunities Multiply

UC and NKU Team Up to Run a Summer Research Experience for Undergraduates

REU students in NKU's computer science lab exploring cryptosystems with Magma software.

The mathematics departments of the University of Cincinnati and Northern Kentucky University are collaborating to run a Research Experience for Undergraduates (REU), one of 60 REUs in mathematics nationwide. This summer was the first of three summers, funded jointly by the National Science Foundation and the Department of Defense, focusing on mathematical cryptology. Each summer, talented undergraduates mentored by Professor Jintai Ding of UC, Professor Chris Christensen of NKU and two UC graduate students, will attack unsolved problems in cryptology. The program provides travel support, housing on the NKU campus, meals and a stipend for the student participants, as well as funding for each student to participate in one professional conference during the academic year following his or her participation in the REU.

In addition to Zachary Vance from UC and one student from NKU, this summer's participants came from Taylor University, Transylvania University, the University of Michigan, the University of Texas and the University of Wisconsin. John Baena and Daniel Cabarcas were the graduate student mentors for this summer's program.

Participants attacked KeeLoq, a cipher used in many remote key entry systems for automobiles, and SMS4, a cipher used in the Chinese standard for wireless LAN. They also considered improvements to an algebraic attack on the Data Encryption Standard (DES) and explored the polynomials used in the Hidden Field Equations (HFE) multivariate public key cryptosystem. The security of a new version of HFE with smaller degree polynomial but larger field size was explored. (Note: Mathematicians "attack" a cipher when they try to recover all or part of its key.)

The REU ended Aug. 9. It is expected that participants will present their work at conferences during the next academic year. It is hoped that some publishable papers will result from the REU.

First Taft Senior Research Fellow Graduates

Jason Hardin, the first recipient of a Taft Senior Research Fellowship in the Department of Mathematical Sciences, graduated this June. This fall, he is attending graduate school in mathematics at the University of Nebraska.

Jason's Taft senior research project focused on an aspect of what is known as "inverse Galois theory." Given a polynomial over a field, classical Galois theory associates a finite group, the so-called Galois group of the polynomial, to the smallest field extension containing all the roots of that polynomial, in such a way that there is a one-to-one correspondence between subgroups of the Galois group and intermediate fields between the original field and the field containing all the roots. In classical Galois theory, one tries to find the group that corresponds to a given polynomial (or field extension). Inverse Galois theory instead starts with a group, and asks what conditions on a field will guarantee the existence of a field extension corresponding to the given group.

Jason's project considered the question of automatic realizability: when does realizability of one group as a Galois group for some extension of a field imply that a different group also must occur as a Galois group for some other extension of that same field? Jason's project looked at groups containing 64 elements, and he obtained a number of new results on automatic realizability relationships among these groups.

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THE RIGHT ANGLE

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Comments and suggestions are welcome.

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F O L D H E R E

from the EDITOR

Thanks to all of the people who contributed inspiration, ideas, information, articles and news items for this issue of the *Right Angle*. I encourage all readers to become contributors! Please send in your comments, suggestions and items for the Alumni News section; use this form or e-mail me at RightAngle@math.uc.edu.

Joanna Mitro

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Address _____

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Year of graduation _____

Degree _____

Current occupation _____

Professional or personal news (comments/suggestions):

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calling all Alumni

Thanks to All of Our 2007-08 Donors

We thank the following individuals and foundations for their generous donations to the department. These gifts fund scholarships, attract and retain the finest faculty and enrich the experience of our graduate and undergraduate students.

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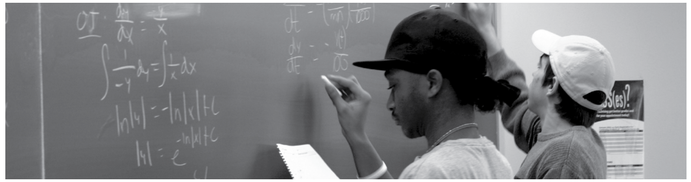
For information on making a gift to the University of Cincinnati, please contact Mike Volan at 513-556-0862, 1-888-556-8889 (toll-free) or mike.volan@uc.edu.

Alumni Shadowing Opportunities

Today's students are eager for real-world, hands-on experience, such as that provided by undergraduate research, internships and co-op programs. Though the department has been very successful in locating internships for statistics graduate students in recent years, comparable opportunities for undergraduates are fewer. "Alumni shadowing" is an alternative to a full-blown internship that still gives students a taste of where a math degree might lead. Please contact the department if you would be willing to talk to an undergraduate about your career, if you work in the area and could invite a student to shadow you for a day or two on-the-job, or would be willing to participate in an alumni panel discussion for our undergraduate majors.



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UNIVERSITY OF Cincinnati

from the HEAD

Dear Friends,

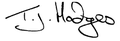
Another exciting year for our department culminated with a new first – a summer Research Experience for Undergraduates in Cryptography funded by the National Science Foundation and hosted jointly by UC and our colleagues at Northern Kentucky University.

Many of you will surely remember Joe Fisher who retired this year. Joe served as undergraduate program director for 14 years and was known for encouraging students to major in mathematics and helping them with questions and concerns. His sense of humor and love of teaching will be greatly missed.

Nages Shanmugalingam was honored with the McMicken Dean's Award for Distinguished Scholarship. Her research in geometric analysis has gained significant international attention and has been supported for many years by the National Science Foundation.

Additionally, the international Great Plains Operator Theory Symposium attracted more than 120 participants from all over the world to campus last June.

My best wishes to you all. Don't forget to write and let us know what you have been doing so we can include it in next year's edition!



Tim Hodges

PS: We learned, as the newsletter was going to print, of the Aug. 10 death of Maita Levine, after a short illness. She was a fine colleague and good friend of the department, and we regret that she is no longer with us to share her wisdom, perspective and joy of life.

mathematics of FINANCIAL RISK MANAGEMENT

Srdjan Stojanovic

Modern mathematical finance has developed to help investors price and manipulate financial contracts such as bonds, options, futures contracts, etc., for the purpose of exploiting risk (to make money) or for controlling risk (to protect against loss). Srdjan Stojanovic's contributions to this field are being discussed and applied by practitioners around the world.

The simplest financial contracts are called bonds – they have a constant (fixed) payoff $V(T) = \$P$ at some set time T in the future. What is the fair price of a bond today? If the short term interest rate $r100\%$ is fixed for the duration of the contract, the bond's price today should equal its "present value," i.e., $V(t) = P\,exp(-r(T-t))$, where t denotes today's date. This sort of financial contract is considered "risk-free" since the price/value of the contract is a non-random function of t.

On the other hand, a tradable security (such as a stock, index fund, etc.), involves risks – random price fluctuations and the possibility of loss. A standard ("log-normal") model for the dynamics of the price $Y(t)$ of a tradable security is given by the stochastic differential equation:

$$dY(t) = Y(t)(a\,dt + v\,dB(t))$$

where a is the appreciation rate, v is the volatility, and $B(t)$ is a standard Brownian motion. Such a tradable security can be bought or sold in the market and can be used to hedge (reduce or cancel out) risks associated with owning a related financial instrument – investors protect themselves against risky investments using a trading strategy that balances the loss in one investment against the gain in another. In this model, the market is "complete," i.e., it is possible to construct perfect hedges for all financial contracts. The famous Black-Scholes pricing theorem exploits this property. One can solve the Black Scholes PDE to give the correct price for the bond described above, as well as for financial contracts with non-constant payoffs $V(T,Y)$ by using the appropriate terminal condition. Complete markets are the subject of Srdjan Stojanovic's book Computational Financial Mathematics using *Mathematica*, hardcover (with CD-ROM), Birkhauser, Boston, 2003.

Complete market models are mathematically very tractable, but perfect hedging is not a realistic assumption. In the real world, future interest rates are neither constant nor known in advance, and moreover they are seldom if ever perfectly correlated to some collection of tradables, so even a simple bond is not necessarily hedgeable. For example, Stojanovic has studied the more realistic market model:

$$dY(t) = Y(t)((a_0 + r(t))\,dt + v\,dB_1(t))$$

$$dr(t) = (q_0 + q_1 r(t))\,dt + w\,dB_2(t),$$

where B_1 and B_2 are correlated Brownian motions, and $q_1 < 0$ (the Vasicek short rate model, where the interest rate is mean-reverting around its long term average $-\,q_0/q_1$ and diffusing with intensity w). Thus we come to the modern problems in financial mathematics: pricing and partial hedging in incomplete markets. Although such problems have been studied since the 1980s, it is only lately that a key component of such pricing was addressed and solved appropriately: the determination of the market price of risk ("risk premium"). Because perfect hedging is not possible, the remaining risks have to be priced according to the investors' *relative risk aversion*: a parameter that can be used in measuring the utility of wealth. This has been the focus of Stojanovic's recent research and the subject of numerous presentations to investment professionals in Chicago, New York and London under the auspices of RISK Magazine Training Institutes and Executive Training Courses for GARP (Global Association of Risk Professionals).

Srdjan is currently at work on a second book that covers risk premium, interest rates, equity and foreign exchange.

This past year the department created a new track in financial mathematics for the master of science degree to prepare students for careers in financial mathematics, financial engineering, and quantitative and computational finance in the banking and investment world. The core courses include Computational Financial Mathematics 1, 2, and 3 (15 MATH 541, 542 and 543), based on Stojanovic's book, and approved courses in finance and economics. More information is available online: **http://math.uc.edu/grad/MS-finmath.html.**