New Coordinates: French Hall West

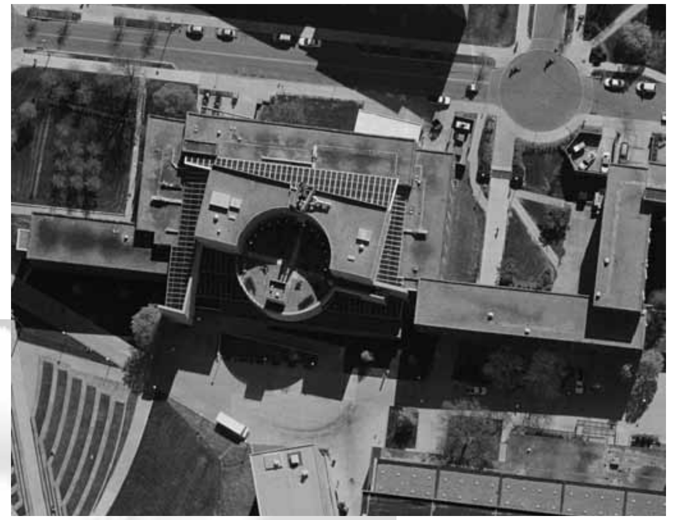
The Department of Mathematical Sciences is relocating from the Old Chemistry Building to French Hall West, as part of a series of moves that consolidated the College of Applied Science with the College of Engineering. The move will be accomplished in two stages this summer and fall. The main departmental office and staff will be on the fourth floor, with faculty and graduate students on the fourth and fifth floors. The Math Learning Center moves to new quarters on the second floor.

French Hall is a small but geometrically striking building that sits across from an arm of the new Campus Recreation Center and faces the Sigma Sigma Commons. To the north is the largest open space on campus, the six acre "Campus Green." To the east is the new Jefferson Residence Hall Complex, with both Dabney and Daniels Residence Halls nearby. The building is comprised of two sections: the original French Hall, which was built to be a dormitory, and an addition completed in 1996 to house University College. The addition was placed in the rectangular open space created by the U shape of the original building, a long rectangular brick structure with two shorter arms. DAAP Architecture Professor William Wesley Taylor, AIA (now at Howard University) worked with the firm of Wagner and Associates to design the addition. Taylor was inspired by the non-traditional students of University College, whom he refers to as "everyday heroes," and the lively activity ("students and dogs") on the grassy space the addition eventually occupied. He sought a creative expression to resolve the tension between the university's vision of a "background" building and the University College faculty and administration's desire for a strong presence on campus.

The front entrance of French Hall West.

The resulting design, executed primarily in concrete with large glass skylights, broke the brick-and-mortar mold of the nearby dormitories and Armory Fieldhouse. It was designed to contrast with campus buildings in other ways, too. Instead of a narrow, traditional doorway entrance (that Taylor believes tells students, "shape yourself to fit"), the entrance is wide and airy, opening into a glass vestibule that leads to the second floor "public space," softening the division between inside and outside.

The space intended for events and celebrations in this structure is located outside, on a circular plaza overlooking the entrance and the public space inside. This plaza is backed by a semicircular wall lined with windows and an arc of spherical lamps at its base. The wall rises to a slotted parapet (hiding equipment on the roof) stamped with square concrete panels that echo the windows below.



Aerial view (courtesy of University Architects)

The lamps, both on the plaza and inside the building, are supported by oversized metal arms that that form a v-shaped trough when viewed head-on. Taylor explains that one of his original ideas (though never executed) was for the arms of the lamps lining the plaza to collect rainwater that would be directed to a garden planted there.

Interior "streets"

Inside, Taylor designed the second floor entry level to create interior "streets," lighted by skylights and flanked by the same spherical light fixtures used on the plaza. Pedestrians inside French Hall on this level have the sensation of walking around the perimeter of the new building, which seems to be connected to the original building only by overhead bridges and the skylights above. The skylights have been described as creating a "zipper" between the new addition and the original building behind it. Taylor likes the indeterminacy of the zipper image: is it opening or closing?

The central circular core of the building may distract the casual viewer from one of the subtle but distinctive features of the building: rotation. Taylor treated the circular core like an axis around which the addition sits, and then rotated the building around this axis. Physically, this turns the building toward open space in the landscape, and symbolically, it acknowledges the way education alters students' lives and careers. He stated that he also planned for this feature to enable the building to "transform itself" as one approaches or moves away – appearing orthogonal from a distance but revealing its rotation from close up.

For mathematicians, a natural question is, "What is the angle of rotation?" Taylor replied that when the plans were drawn up, the angle was measured precisely, based on Taylor's physical positioning of the two buildings ("turned as far as possible to make the interior street work"), but he no longer has a record of that measurement. Perhaps one of us will make that measurement from inside, gazing up at the lines formed by the skylights, walking along the interior streets of the department's new home.

Accomplished Newcomers Join Statistics Group

We welcome two outstanding young statisticians who join the department as assistant professors this fall: Emily L. Kang and Xia Wang. Both come to us from postdoctoral positions. Kang spent two years as a Postdoctoral Fellow with the Statistical and Applied Mathematical Sciences Institute (SAMSI) and at North Carolina State University; Wang spent two years as a Postdoctoral Fellow at the National Institute of Statistical Sciences (NISS). Below they describe their research interests. Both are involved in developing statistical models, so the article starts with Kang's introduction to modeling in statistics.

The key in statistical science is the proper blending of models and data. Data by themselves usually do not tell us much about our world: How do we know the data are signal as opposed to noise? How should we compare/combine data from two or more sources? On the other hand, models (theories and methodologies) by themselves often cannot provide the best descriptions of our world: What can be said about the uncertainties in model assumptions, parameters, or interactions between processes? The power of statistics is that it provides frameworks to blend data and models for scientific inferences in optimal but maybe not unique ways.

Emily Kang

Emily L. Kang completed her PhD in statistics at The Ohio State University in December 2009 under direction of Professor Noel Cressie. Her primary research is in the area of hierarchical statistical modeling in environmental and climate sciences, spatial statistics and spatio-temporal statistics, as well as Bayesian and empirical Bayesian methodology for complex systems. Hierarchical models account for multiple levels of uncertainty in a model. For instance, the model parameters may themselves be given a model. Hierarchical models enable statisticians to separate and quantify uncertainties in the data, in the process and in the parameters. In particular, these powerful models allow statisticians to (1) partition the effects of measurement error and variability at scales below the resolution of data, conditioned on the process at some other scales; (2) model the spatial state in a spatio-temporal process at a given time in terms of its dynamical relationship with the spatial states at previous times; and (3) incorporate parameters that are dependent on other sources of data or other processes.

With the advances in remote sensing technology, data at larger and larger numbers of spatial locations (i.e., finer spatial resolution) are obtained through time, and can quickly lead to overwhelmingly large or even massive datasets. Although a hierarchical statistical framework provides the structure to tackle those large datasets in scientific fields such as environment and climate, traditional techniques developed for small or moderate-sized datasets simply do not translate to modern massive datasets. This necessitates innovative approaches towards analysis and algorithms. For example, "kriging," a classical statistical method widely applied in earth and environmental sciences to estimate values at locations that have not been sampled, becomes computationally infeasible when the number of observations n is too large, since solving the kriging equations involves the inversion of the $n \times n$ covariance matrix. In Kang's research, she developed a fixed-rank Spatial Random Effects (SRE) model where the spatial dependence is captured through a properly selected set of r ($r \ll n$) multi-resolution basis functions. Then the kriging computation can be carried out exactly and is linearly scalable in terms of the number of observations. Kang also investigated the fully Bayesian inference of the SRE model, where the uncertainties from parameters are incorporated coherently. She has also made extensions for spatio-temporal processes and developed a Spatio-Temporal Random Effects model, through which spatio-temporal datasets can be efficiently analyzed in real-time.

In the physical world, many physical/biological processes involve variability over space and time. In the book "Statistics for Spatio-Temporal Data," authors Cressie and Wikle quote Charles Lamb to summarize statisticians' work in spatial and spatio-temporal statistics, "nothing puzzles me more than time and space; and yet nothing troubles me less..." Of course, statisticians, such as Kang, are greatly enjoying resolving those puzzles.

Xia Wang earned PhDs in both statistics and economics at the University of Connecticut. At NISS, she continued her work on Bayesian modeling of categorical data. Her research was applied in the fields of social sciences, environmental and ecological sciences, and proteomics.

Wang's dissertation deals with the statistical analysis of categorical data (for example, binary responses, such as "adopters" and "non-adopters" of some new technology, coded as 0 and 1). A generalized form of regression analysis is used to investigate the relationship between the discrete response variables of interest and a set of explanatory variables. In this setting, one assumes that some function $g = g(\mu)$ of the mean of the response variable is linearly related to

Xia Wang

the explanatory variables. The function g is called the "link function." It is critical to choose link functions in a regression model to accurately reveal the information hidden in the data. Working with Dr. Dipak K. Dey, Wang established and evaluated a new family of generalized link functions based on the generalized extreme value (GEV) distribution from Bayesian statistics, aiming to bridge some gaps between the available approaches and the complication in real-world data which is often skewed (as when there is a significant imbalance between the observed numbers of zeros and ones in the data). The GEV links provide improved and more flexible skewed link regression models than the existing links. The resulting method has very broad applications to categorical data from social sciences as well as environmental and ecological sciences.

During her tenure at NISS, Wang worked as part of the National Cancer Institute-funded proteomics technologies project with another type of categorical data: counts. Spectral counts are typically used to quantify protein abundance in a biological sample analyzed by liquid chromatography-mass spectrometry system (LC-MS). There are several challenges inherent to LC-MS spectral counting in biomarker discovery: few replicates, sparse counts, large number of proteins and unreliable variance estimation. Wang proposed using Bayesian hierarchical methods to model and to analyze these data. The Bayesian framework also naturally allows incorporating prior information, which is of special importance in scientific applications. In the biomarker discovery study, a three-component mixture prior is employed, corresponding to the three possible states of any proteins: up-regulated, no-change and down-regulated. It is shown that the proposed model can more efficiently and accurately detect potential biomarkers.

For her future research, Wang plans to continue exploring many interesting and challenging problems arising in the field of proteomics. She enjoys working collaboratively with researchers from many different disciplines, pointing out that "new science problems, data structures, and requests for new models bring new challenges and fresh thinking on statistical methodology and modeling techniques."

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from the EDITOR

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the HYPOTENEWS

Putnam 2010 Success

The William Lowell Putnam Mathematical Competition is considered to be the most challenging university-level mathematics competition in the world. Participants attempt 12 questions in two sessions (morning and afternoon) of three hours each on the first Saturday in December. The questions require only college-level mathematics to understand but enormous mathematical creativity to solve. Each question is graded out of ten points giving a total possible score of 120 points. The median score is usually between 2 and 3 out of 120! Winners of the Putnam competition include many prominent mathematicians of which three have won the Fields Medal and two the Nobel Prize.

Last fall, the department's Putnam Exam team had one of their best performances in many years. The team gained a ranking of 77 out of the 446 teams competing, putting them in the top 20% overall. This year's team consisted of **Zachary Vance**, **Michael Richardson** and **Jon Massey**. Vance, in particular, put in an impressive performance scoring in the top 10% of the 4,296 participants. This year's team winners were CalTech in first place, with MIT and Harvard taking second and third. Yu Deng of MIT was the top ranked individual.

The competition is designed to stimulate a healthy rivalry in mathematical studies in the colleges and universities of the United States and Canada. It is held under the auspices of the Mathematical Association of America (MAA), which publishes the problems and solutions from each exam every year in the American Mathematical Monthly (usually in the following October or November issue). Curious readers can find a directory of problems (with one or more solutions for each) at ***http://amc.maa.org/a-activities/a7-problems/putnamindex.shtml***.

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UNIVERSITY OF Cincinnati

from the HEAD

Shuang Zhang

Dear Alumni and Friends,

The past academic year was extremely challenging and busy for the department. Nevertheless, the department has accomplished a couple of notable achievements.

We signed an agreement with Capital Normal University in Beijing, whose programs in mathematics and statistics are highly ranked among Chinese peers, to jointly train math undergraduates in a "2+2 program." In short, these self-supported Chinese students will be educated for two years in Beijing and then transfer to the department for their junior and senior years. We anticipate more such agreements in the coming years.

Our increased efforts in recruiting graduate students paid off: 20 new PhD students and about 30 master's students have been admitted. This success boosts our ever successful masters program in statistics, and enlarges our PhD program.

A new committee is working with colleagues in the College of Engineering and Applied Sciences to find ways to strengthen the math education of undergraduate students in the calculus sequence. In the coming autumn quarter, we will be teaching a dramatically increased number of students in calculus.

As senior faculty start planning to retire in the near future, the department is on the move with replacements by new junior faculty members. For example, two new tenure-track faculty members in statistics, Emily Kang and Xia Wang, are joining us this year, and we will be recruiting two new faculty members this coming year. With the infusion of new faculty and the transition to semesters in 2012, the department will be following a new strategic plan to build and concentrate research strength and use our combined talents to effectively fulfill the departmental missions in research, teaching and service.

Best wishes,

Shuang Zhang
Professor and Head

faculty NEWS

Artwork from the conference flyer honoring Kenneth Meyer.

Professor Emeritus **Kenneth Meyer** was honored this spring on the occasion of his 75th birthday with an international conference, "Hamiltonian Dynamics and Celestial Mechanics. To honour Professor Kenneth Meyer in his 75th year," held in Castro-Urdiales, Spain, held May 30-June 3, 2011. The major themes of the meeting were those pioneered or further developed by Meyer throughout his career: bifurcations, normal forms and averaging, reduction of Hamiltonian systems with symmetry, and various topics related to the N body problem in celestial mechanics. Further topics at the meeting included symplectic geometry, celestial mechanics in curved spaces, variational methods, invariant manifolds, homoclinic tangles and quasiperiodic solutions in Hamiltonian systems. Lectures were held on the top floor of the International Center for Mathematical Meetings overlooking the Bay of Biscay on the northern Spanish coast just west of Bilbao. Attendees included **Scott Dumas** and former department members **Dieter Schmidt** and **Chris McCord**. Dumas reported that directly above the lecture hall was a clerestory, initially hidden by a movable screen in the roof, through which came the occasional cries of seagulls and the sounds of late spring storms along the coast.

Don French, **Sokkyung Lim**, and **Benjamin Vaughn** are part of an interdisciplinary team that won a University Research Council Interdisciplinary Grant for their project "Pathogen Persistence Mediated by Biofilms in Urban Water Distribution Systems and River Networks." They will be working with researchers from the College of Medicine and the College of Engineering and Applied Science. The intent of this granting program is to bring faculty together from across the university to work on an interdisciplinary research project that will result in applications to federal granting agencies.

Chuck Groetsch

Emeritus professor **Chuck Groetsch** is one of ten mathematicians elected Fellows of the American Association for the Advancement of Science (AAAS) in 2010. The AAAS Council elects to fellowship members whose "efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished." Groetsch was elected in recognition of his "distinguished contributions of the application of mathematics to science, particularly in the areas of inverse or ill-posed problems, approximation theory and mathematical modeling." Two special issues of the Journal of Integral Equations and Applications (Vol. 22, Nos. 2, 3) were dedicated in Groetsch's honor citing his "fundamental contributions to the field of inverse problems," and the "high regard for his contributions to the world of mathematics." Groetsch holds the Traubert Chair in Science and Mathematics at the Citadel (The Military College of South Carolina).

The inaugural **Ohio River Analysis Meeting** was held January 29-30, 2011 on the University of Cincinnati campus. The Ohio River Analysis Meeting is a joint project of the University of Cincinnati Department of Mathematical Sciences and the University of Kentucky Department of Mathematics organized by **Michael Goldberg** and **Leonid Slavin** of UC, with Changyou Wang of the University of Kentucky. It is made possible by additional generous support from the University of Cincinnati and the National Science Foundation.

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