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# Notices

## of the American Mathematical Society

October 2009 Volume 56, Number 9



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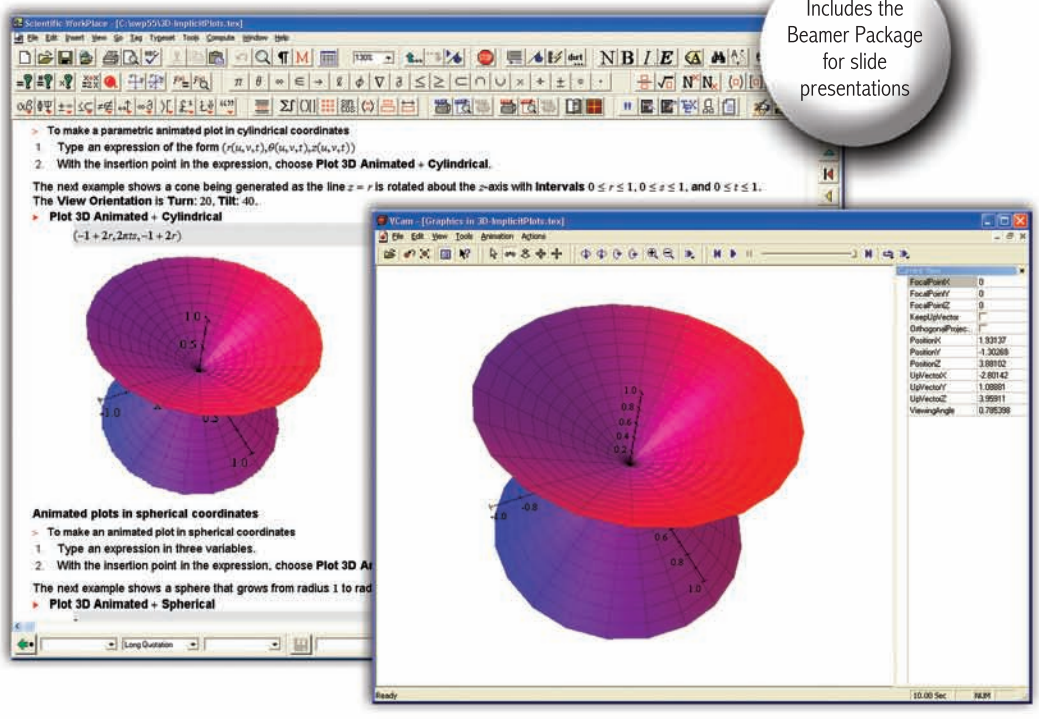


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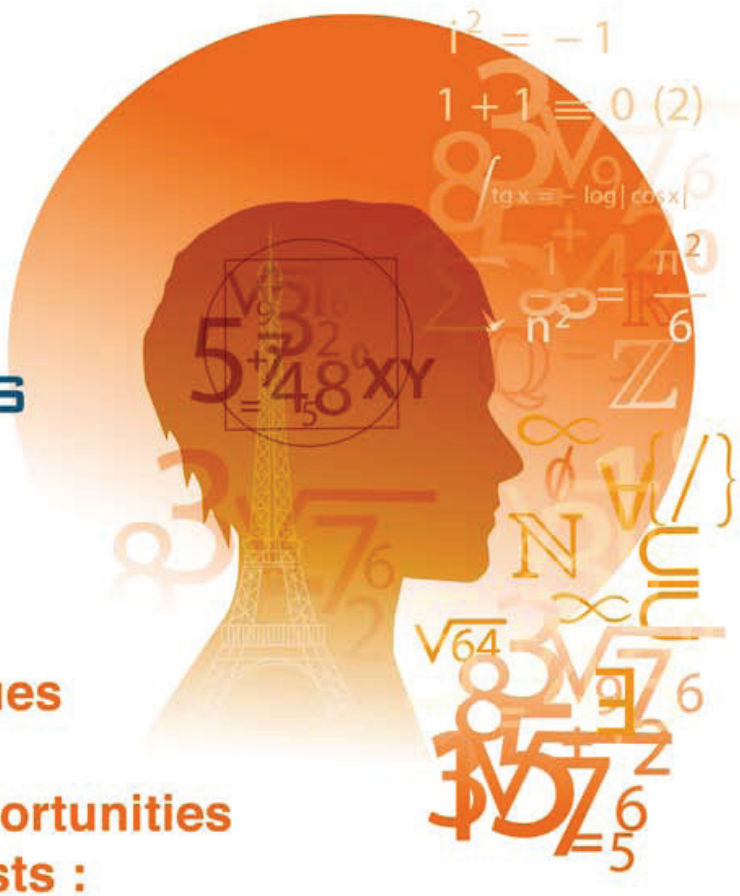

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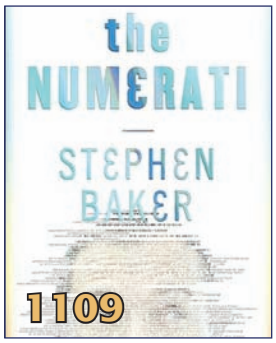


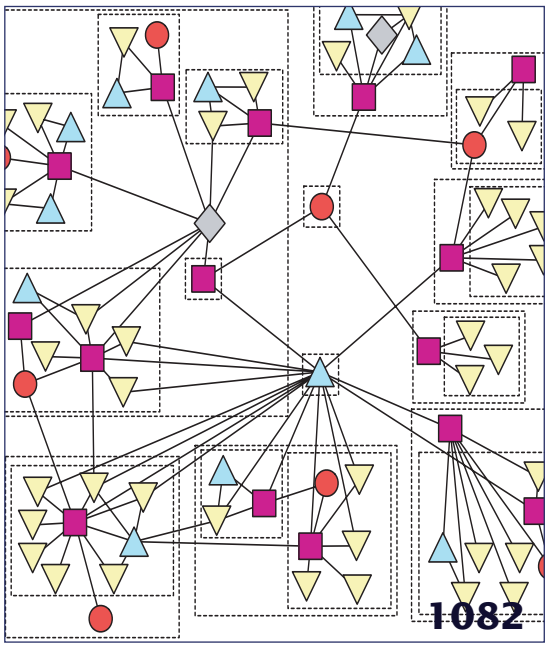


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Legal Commentary

# Accommodations of Learning Disabilities in Mathematics Courses

*Kathleen Ambruso Acker, Mary W. Gray, and Behzad Jalali*

The requirement of the No Child Left Behind Act (NCLB) [27] that measures of academic progress be disaggregated by groups has renewed focus on the issue of accommodating students with disabilities. Although NCLB does not apply to postsecondary education, over the past fifteen years there has been a substantial increase in the attention directed to learning disabilities in this arena. In particular, questions have been raised by institutions of higher education as well as by testing bodies such as the College Board as to whether some recommended accommodations accomplish the purpose for which they were intended and whether they are fair to other students. However, aside from discussions in law reviews, little attention has been focused on whether the accommodations are legally required in a higher-educational setting. We address the legal framework, focusing on what constitutes a disability from a legal point of view and the nature and appropriateness of accommodations, noting where mathematics courses have been affected. Lastly, we will review suggestions for best practices in accommodating learning disabilities in the mathematics classroom in the light of legal requirements.

## Legal Framework

Two federal laws affect college-level instruction: the Rehabilitation Act, Section 504 [39], which prohibits discrimination on the basis of disability by entities receiving federal funds, and the Americans with Disabilities Act (ADA) [2], which broadens the prohibition of discrimination by requiring that all services and places of public accommodation, including colleges and universities, be accessible to those with disabilities. As a result of several Supreme Court decisions narrowing the scope of protection, the ADA was amended, with changes effective from January 1, 2009. The Rehabilitation Act was also amended to conform. Some state laws may impose additional requirements, but we deal only with the federal context. The Office of Civil Rights of the U.S. Department of Education (OCR) issues letters of interpretation in response to both complaints and inquiries concerning disability laws.[1] These are intended to provide guidance; although they do not have the force of law, they are given substantial deference by courts should litigation develop.

Both the ADA and the Rehabilitation Act are broadly applicable to many aspects of higher education, but this paper concentrates on colleges and universities and to a lesser extent on testing bodies such as the College Board, the National Board of Medical Examiners, and various state boards of bar examiners.

The ADA (as amended) states that:

The term "disability" means, with respect to an individual—

(A) a physical or mental impairment that substantially limits one or more major life activities of such individual;

(B) a record of such impairment; or

(C) being regarded as having such an impairment.[2]

Focusing for the most part on (A), this paper primarily examines what constitutes a legal disability in the learning disability context and what accommodations may be required.

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[1] *See, e.g., OCR re Golden Gate University (CA) (9 NDR 182), July 10, 1996.*

[2] *42 U.S.C.S §§12101 et seq. (2009).*

To begin, the statutory definition of "substantially limited" is not particularly helpful in that it equates "substantially limited" to the term "materially restricted" without further explanation or clarification. However, the amendments of 2009 do define disability more broadly than courts had done in the recent past. The amended ADA states that "major life activities include, but are not limited to, caring for oneself, performing manual tasks, seeing, hearing, eating, sleeping, walking, standing, lifting, bending, speaking, breathing, learning, reading, concentrating, thinking, communicating and working." [2]

The standards of measurement of impairment are also altered by the amendments, which specifically state that whether one is impaired should be judged without respect to any amelioration. Thus, for example, one whose diabetes is controlled by medication would still be considered disabled for the purposes of protection under the ADA.[3] Whether the impairment must be in comparison to the average person's ability or to that of a person of similar skills and training has been an issue. For example, should a mathematics graduate student's reading ability be compared to that of an average member of the general public or to that of other mathematics graduate students? The courts have generally adopted an average person standard.[4]

"Learning disabilities" are generally defined to be specific difficulties in learning when the student is generally of average or above-average intelligence [47]; that is, the student's performance on some aspect of learning is substantially below what would be expected at a given age and IQ. Exactly what this means has been the subject of much controversy, not to mention litigation, but for the purpose of discussion we accept this characterization. Note also that Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD) are conditions that some label learning disabilities and others denominate as a separate category of disability that may be eligible for accommodation. For the purposes of this paper both conditions are considered learning disabilities. Learning disabilities affect education at all levels and in all subjects; in particular, dyscalculia, dyslexia, ADD, and ADHD create difficulties for students to understand and apply mathematics appropriately.

Under the ADA and the Rehabilitation Act, any "otherwise qualified" disabled person is entitled to "reasonable" accommodations in order to provide access to education. As might be expected, what "otherwise qualified" and "reasonable" mean has been the subject of much litigation. However, more basic is whether a "learning disability" is a disability for purposes of either act. If not, postsecondary accommodations are not legally mandated, although, of course, a college or university may choose to offer them. It is also important to understand that in order for an adverse action (such as dismissal from a program) to violate the ADA or Rehabilitation Act, there must be a causal connection between it and the disability or perceived disability [4]. For example, many court decisions have noted that a student's failure or dismissal resulting from an inability to meet academic standards even with reasonable accommodations does not constitute discrimination on the basis of a disability.

There are some who contend that "learning disability is merely a subjective social construct that is inherently tied to underlying politics," and indeed there is some disagreement about how learning disabilities are characterized [21], [47]. There has been some movement away from the traditional "discrepancy" measurement of learning disability to one that assesses the struggling student's response to high-quality general education instruction or focuses on an absolute low level of achievement. Such a standard would shift from individual identification to a rulelike process that would not have a "bright" child who performs at a mediocre level classified as learning disabled. More important, however, for the present discussion is the tendency of the courts to declare that under some circumstances "learning disabilities" may not be disabilities for the purpose of the ADA and the Rehabilitation Act and the effect the amendments to the ADA might have on this trend.

## Higher Education vs. K–12 Requirements

In the college setting many difficulties result from failures to distinguish what might have been required at the K–12 level and what is required in the postsecondary context under a different legal framework [26]. Students in K–12 education are protected under the Individuals with Disabilities Education Act (IDEA) [19], whose provisions are designed to guarantee successful outcomes for the disabled, whereas the Rehabilitation Act and the ADA are focused on guaranteeing access. Thus, in K–12 education students with disabilities are entitled to an Individualized Education Program (IEP) developed jointly by their teachers and special education professionals and in consultation with their parents. The goal of an IEP is to assure that the student has a chance to achieve academically in an education setting commensurate with his abilities. The proportion of children classified as learning disabled in the K–12 system has grown enormously in the past several decades, as evidenced by the fact that one in eleven college freshmen self-identify as having a disability, over 50 percent of which are described as "learning disabilities", an increase by as much as threefold over the past

[3] *However, under the 2009 amendments one whose vision is corrected merely by ordinary eyeglasses or contact lenses is not considered disabled.*

[4] *See, e.g., Singh [44].*

twenty years [41]. As a result, IEP beneficiaries have come to expect similar accommodations in college and indeed on licensing exams such as those required for students seeking to become physicians or lawyers. There has been a great deal of litigation about the sufficiency of school districts' individualized plans and also a great deal of controversy about learning disability classification being "affirmative action" for the middle class, as parents and students seek accommodations to secure advantages for their children [23], [42].

At the K–12 level, schools have the responsibility to identify students' disabilities as well as to work cooperatively to develop appropriate accommodations. At the postsecondary level it is up to students to make a focused request to the appropriate administrative office to receive accommodations for their disabilities and to provide appropriate documentation supporting such requests for accommodations [6].

Institutions of higher learning are also constrained by the Health Insurance Portability and Accountability Act of 1996 (HIPAA),[5] which specifically prohibits medical information to be included as part of an educational record, and the Family Education Rights and Privacy Act (FERPA), an act designed to protect the privacy of a student's educational records. "Educational records" as defined by FERPA are records "(1) directly related to a student; and (2) maintained by an educational agency or institution or by a party acting for the agency or institution."[6] Furthermore, the definition explicitly excludes inclusion of records made by physicians, psychiatrists, or psychologists. In other words, records from specialists who diagnose and treat learning disabilities cannot be included as part of the student's education records. Thus, even if the institution requires documentation from specialists to substantiate a student's request for accommodation, this information cannot be shared directly with faculty members. To facilitate open discourse between faculty and students learning to be self-advocating, administrations at many postsecondary schools provide students with appropriately documented learning disabilities a letter detailing what accommodations the student needs. Thus, schools do not contact faculty on behalf of the students, and it is the responsibility of the student to disclose to faculty, on an as-needed basis, the need for accommodations.

## Major Life Activity

A fundamental question, one which has not always been addressed by the courts and hardly at all by colleges and universities, is to what extent a documented learning disability might limit an activity and whether that activity is a major life activity.

A key Supreme Court case, Sutton v. United Air Lines [45], involved twin sisters who applied to be pilots. Although they were severely nearsighted, corrected by glasses their vision was 20-20; nonetheless, they were denied employment based on their eyesight. The Supreme Court decided that with the accommodation of glasses they were not disabled and hence were not entitled to the protection of antidiscrimination legislation. This opened the door to a series of decisions greatly limiting the scope of disability protections, an outcome that the 2009 amendments were enacted to reverse. Nonetheless, ultimately the amendments would most likely not have assisted the sisters, because the airline could very likely justify the requirement for 20-20 uncorrected vision as business related by citing what might happen in an emergency situation to the glasses or lenses on which a pilot was relying.[7]

The Supreme Court further limited the scope of the ADA and the Rehabilitation Act in Toyota v. Williams [46] when it overturned a lower court decision that had found that a woman who was unable to perform specific tasks in one job was entitled to reassignment to another job that she was able to carry out successfully. The court said that the specific set of tasks was not a major life activity and hence her limitation in performing them was not covered by the ADA. This is the sort of result that the amendments to the ADA seek to reverse.

Until the Sutton and Toyota cases the courts had generally assumed that the plaintiff was disabled and then examined whether or not there had been discrimination on the basis of that disability, in particular whether reasonable accommodations had been made (see, e.g., [31], [52]). Subsequently the courts have engaged in detailed individual assessments of whether a "major life activity" was implicated and, if so, whether it was "substantially limited". This is likely to continue under the amended statute, albeit under relaxed standards [37].

Applying this back to an educational setting, we see that there are many cases that examine accommodations where the courts have declared that the fact that the examinees have done as well as they have by getting into college, law school, or medical school with accommodations demonstrates that they are not disabled. One example is the case of McGuiness v. University of New Mexico School of Medicine [25]. Essentially McGuiness had completed several degrees, including a bachelor of science in chemistry and biology as well as a doctorate in psychology, prior to entering medical school. Throughout his educational experience McGuiness

[5] *Public Law 104-191, 104th Congress.*

[6] *20 U.S.C. section §1232g.*

[7] *In any case, the sisters would not have been considered disabled and thus entitled to protection if only ordinary glasses were needed to correct their vision to 20-20.*

worked through anxiety in taking chemistry and mathematics classes without accommodations. However, his medical school grades did not meet the standards set by the medical school. The courts determined that his inability to satisfy medical school requirements did not substantially limit the broader life activity of "working", as it excluded him only from certain limited types of jobs. Furthermore, the court held that his claim of anxiety did not meet the definition of disability under either the ADA standard or the Rehabilitation Act.

In a licensing exam case at the district court level, Price v. National Board of Medical Examiners [35], the "learning" involved was declared to be a "major life activity", but since the plaintiff's prior academic record, achieved without accommodation, was above average, the court held that Price was not disabled and hence not entitled to protection. Whether these cases would have been decided differently under the 2009 amendments is not entirely clear, but it would appear that they would not have been, since neither of the plaintiffs would have met the broadened definition of disability.

Although the amended ADA leaves open the ability of the courts to find that those who have achieved an advanced level without accommodation are not disabled and hence not entitled to the particular accommodation they might now seek, it augurs a different outcome for those who have achieved their current status with accommodations. In particular, they cannot now be deemed not disabled because the ameliorating effects of accommodations have reduced or eliminated any impairment they might otherwise experience. In other words, they are entitled to continued assistance in the form of appropriate accommodations, but it may be questionable whether the impairment they face without accommodations constitutes a limitation in a major life activity.

The underlying issue not directly addressed by the ADA amendments is, as noted above, whether when deciding that a person is impaired, should the comparison be with the average person or with a group of peers (e.g., other students in the same academic program) [4], [35], [44]. Anyone who has progressed to taking a bar exam or even being admitted to college, for example, might on the basis of that achievement be held to be not impaired in the major life activity of "learning" or of "working" since most jobs certainly do not require passing a bar exam and many do not require a postsecondary education. Thus a student could be able without assistance to perform at the level of an "average person" and hence not be considered legally disabled, but not be successful in a program for law students, medical students, or other professionals.

In the case of Singh v. George Washington University (GWU) [44], Carolyn Singh was dismissed from George Washington's medical school due to poor academic progress, primarily on timed multiple-choice exams. Singh's suit against GWU asserted that they did not accommodate her claimed learning disability. After a complicated pair of rulings in the lower court, the appellate court remanded the case for consideration of whether Singh was legally disabled, mandating the "average person" rather than other medical students as the appropriate standard for comparison. It also found that test taking is not in and of itself a major life activity but rather a component of "learning", so that the determination of impairment should be with regard to the totality of "learning".

## Otherwise Qualified

The concept of "otherwise qualified" is intertwined in a complicated way with the notion of "reasonableness" of accommodations. Although others have attempted to identify gaps in existing law and to consider them in the context of real-world implementation by educators and test administrators [41], we confine our discussion to the existing situation and what may develop under the newly amended ADA and Rehabilitation Act.

A person with a disability who can perform the "essential functions" of a job or meet the requirements for services with "reasonable accommodations" can be considered "otherwise qualified". Therefore, if students are unable to make satisfactory progress with reasonable accommodations, it would appear that they are not otherwise qualified, the case of a blind person seeking employment as a bus driver being an extreme example. As noted above, there are many cases involving medical students who do well with or without accommodations until they reach the clinical stage of their training. Then, in spite of repeated accommodations having to do with stretched-out scheduling of clinical rotations, repeated attempts at exams, special supervision and other adjustments to their program, they are unable to achieve a standard acceptable to their institutions. In Falcone v. University of Minnesota [11, p. 160] the court said "the University is not required to tailor a program in which Falcone could graduate with a medical degree without establishing the ability to care for patients." Similarly, in Powell v. National Board of Medical Examiners and the University of Connecticut [34], the court determined that the plaintiff was not entitled to the protection of the ADA, as even with many accommodations she could not do the required clinical rotations.

In a relatively early lower court case, Pandazides v. Virginia Board of Education [29], the court said that an accommodation must not "fundamentally alter the measurement of the skills or knowledge the examination is intended to test." The outcome of Falchenberg v. New York State Department of Education [10] was similar. Falchenberg had received multiple accommodations concerning time requirements and a reader and a scribe on

an exam required for employment as a New York State teacher; however, Falchenberg, a dyslexic, was required to spell and punctuate correctly on her own. Falchenberg felt that this stipulation did not amount to a reasonable accommodation for her disability. Since proper grammar and spelling were integral components of the exam,[8] the court found that Falchenberg was looking for an accommodation that would fundamentally alter the purpose of the exam and thus ruled in favor of the Department of Education. In other words, even with reasonable accommodations there was no way Falchenberg could be considered otherwise qualified.

## Appropriate Accommodations

If a student is not "disabled" under the terms of the law, academic judgment as to what is an "appropriate accommodation" may not have legal significance. However, under the amended ADA, courts are more likely, but not certain, to classify a traditional "learning disability" as a legal disability. Moreover, universities may choose to offer accommodations to those with learning disabilities despite the question of legal obligation. As stated earlier, OCR's stance on treatment of disabled students is given deference should litigation develop.

The test for reasonableness of requested accommodations rests either on whether the accommodation was administratively or financially burdensome or on whether it required a fundamental alteration in an educational program. The issue of administrative or financial burden has arisen in part because, unlike at the K–12 level, where the school system is responsible for providing sufficient services to ensure an appropriate education, in higher education the student assumes responsibility. It is generally the case that postsecondary students must provide documentation by professionals at their own cost. This potentially creates a barrier for low-income but undiagnosed learning-disabled students who struggle to achieve academically. In addition, learning-disabled students often bear the cost burden of private tutors, although many schools provide free tutoring support for all students by way of open labs.

In determining whether a requested accommodation is reasonable, the totality of circumstances must be considered [53]. Administrative or financial burdens may also arise concerning such accommodations as adjustments in exam schedules, provisions for conducting an oral exam, and developing alternative exam forms. Generally, however, the question of the burden has not been as significant as has whether the proposed accommodation would alter the course or the program to the extent that it is unrecognizable. Thus the key to the determination of the appropriateness of an accommodation is usually whether the requested accommodation requires a fundamental alteration in an academic program or lowers standards, in which case the accommodation is not required.[9]

A case often cited as validating the accommodation of learning-disabled students, Guckenberger v. Boston University [17], is worth examining. The provost of the university became concerned about the substantial increase in the number of learning-disabled students receiving accommodations, some of which he felt were inappropriate. After some intemperate remarks from the provost characterizing learning-disabled students as slackers and instituting a requirement for revalidation of documentation of learning disabilities under new standards, a suit was filed by students seeking accommodations, asking for, among other things, a waiver of any courses in mathematics and foreign languages required for graduation.

Although few examples of requests for waiver of the mathematics requirement and no documentation of the waiver being granted were presented, the mathematics department had agreed to allow students to choose an alternative course to meet the requirement. Among the possible substitutes listed were Anthropology of Money, Economics of Less Developed Regions, and Introduction to Environmental Science. Instead of a foreign language students were permitted to take such courses as African Colonial History and Arts of Japan. The court held that the plaintiffs had failed to present scientific evidence that any learning disability was sufficiently severe to preclude sufficient proficiency with appropriate accommodations short of substitution of courses. In the case of the foreign language requirement the court opined that no course in English could substitute fully for the foreign language requirement but that the university had not established the essentiality of such a requirement in the degree program at issue. The actual result of the case was to remove the authority to decide on accommodations from the provost, to modify the documentation of disabilities requirements, and to establish a faculty committee to study the issue of whether eliminating the foreign language requirement would constitute an undesirable alteration in the academic program leading to a degree in the Boston University College of Liberal Arts.[10]

The Boston University case highlights the significance of careful consideration by a university

[8] *Courts have generally held that academic judgments about academic requirements should be granted substantial deference [34], [38].*

[9] *In a case that achieved much publicity, the Supreme Court decided that allowing a disabled golfer to use a cart did not alter the fundamental nature of the competition nor was it unfair to other competitors, as it preserved fatigue as a component of the game [33].*

[10] *The committee later decided that it would and the requirement was retained and not subject to waiver. However, the point made was that a decision as to graduation requirements required a process of academic deliberation.*

as to what accommodations are reasonable. In response to a complaint at another institution, the Office of Civil Rights reviewed the situation of a woman with severe dyscalculia who enrolled in a mathematics course that had been required by her choice of major. Despite using all services available to her through the college, she failed the course. She then petitioned the college to take a course substitution (an option unavailable to her) or to waive the mathematics requirement. The petition was denied and the student was told to retake the course. An investigation by OCR found that the college did not consider the course substitution as a possibility because their policy on course substitutions was undeveloped and in general course substitutions were not granted. OCR determined that this lack of consideration for this sort of academic adjustment was a violation of ADA. They also found that the school did not present evidence why the mathematics class was an essential requirement of the course of study, nor was there evidence of a collegiate dialogue debating whether granting the course substitution would then be considered a fundamental alteration of the program of study. OCR also noted, "Absolute rules against any particular form of academic adjustment or accommodation are disfavored by the law."[11] The view of the OCR, if not necessarily of the courts, may indicate that more flexibility may be required of an institution at the undergraduate level than in graduate programs, particularly medicine, where the stakes of lowered standards may be greater.

For the learning disabled, the most common accommodation requested is increased time for exams, although provision of a note taker, access to a faculty member's lecture notes, oral instead of written examinations, audio or video recordings of lectures, adjustments in course loads, extension of deadlines, and an isolated place in which to take exams are also commonly prescribed. A more unusual accommodation at American University was the rescheduling of a special section of a mathematics class for learning-disabled students to 11:10 a.m. rather than the "early" hour of 9:55.[12]

In many universities, determination of what constitutes an "appropriate accommodation" is done exclusively by special education professionals in an office of disability services or similar unit.[13] While such experts have a role to play in, for example, dealing with the issue of documentation and matching accommodations to amelioration of a disability, it is not clear whether those outside the discipline in question should decide whether a requested accommodation might require a fundamental alteration in a course or program or create unfairness. For example, the University of California statement on Practices for the Documentation and Accommodation of Students with Learning Disabilities states in part:

> It is the responsibility of a Learning Disabilities Specialist, the Program Director, or other staff member designated by the Director to determine appropriate accommodations and services. This determination will be made after interviewing the student and reviewing the information furnished by the diagnosing professional(s).[14]

No mention is made of consultation with the instructors. Since privacy requirements may preclude making clear to instructors why students need accommodation, it may be difficult to formulate accommodations that ameliorate the disability without fundamentally altering the course.

Nonetheless, often accommodations are presented to the instructor of a course without consultation either as to the administrative burden or the alteration in the fundamental nature of the course or program. However, were either of these effects found to result from the proposed accommodations, the accommodations would unlikely be deemed reasonable by the courts. In general there has been great reluctance from courts to decide academic issues such as whether the nature of a course has been altered [8], [53]. Courts have been clear that an institution need not lower its standards as it defines them in order to accommodate disabilities [10], [52]. For example, the Betts court [4] noted that teachers do not have to grant accommodation requests that in their opinion substantially alter the fundamental aspects of the coursework.

Whether the academic freedom of an instructor to determine how to conduct a course absent a showing of a fundamental alteration of the course or lowering of standards trumps the requirement to make accommodations has not been tested in the courts. In a situation involving a mathematics course at the University of California, Berkeley, the Department of Education's Office of Civil Rights declared that an instructor's academic freedom claim did not supersede the ADA's requirement to make reasonable accommodations.[15] A subsequently filed suit was settled before going to trial.

Traditionally, when working with a student who has academic difficulties, regardless of the origin,

[11] http://www.galvin-group.com/dspsresources/assets/CA_OCR_Letter_Mt_San_Antonio.pdf *(accessed 02/15/2009).*

[12] http://www.american.edu/american/registrar/schedule.cfm *(accessed 03/10/2009).*

[13] *In the Boston University case, however, apparently the mathematics department had been consulted by those in learning services about the accommodations to be offered.*

[14] http://dsp.berkeley.edu/learningdisability.html *(accessed 03/09/2009).*

[15] *OCR re Golden Gate University (CA) (9 NDR 182), July 10, 1996.*

most faculty members strive to do what is best for the students in the professional judgment of the faculty member. When presented a list of accommodations from the administration accompanied by mandates to follow, some faculty feel alienated from the process, as well as experiencing a diminished sense of academic freedom [20], [40] and a concern for fairness to other students.

## Are Accommodations Fair?

A discussion of the fairness of an accommodation for a learning-disabled student begins by looking at how it may affect other students [21], [22], [42].[16] As noted, a common accommodation is granting students additional time to work on exams. Time might not be considered a skill that a test is intended to measure but rather as incidental to the form the test takes, so that extending time does not significantly alter the academic requirement. But can quick thinking be fundamental? Some cases have found that it may be essential in making a medical diagnosis.[17] In the medical school context courts have been very clear that certain accommodations may so impede a student's training as to endanger future patients. Although the seriousness or immediacy of harm may be less in other situations, the argument of the necessity of the quickness of judgment can be compelling. In fact, courts have generally deferred to academic judgments about whether certain accommodations are "reasonable" as they did in the Falchenberg case described above. However, if time is not an essential element of the test taking, should not all students be permitted extra time?

Some students require use of technology to complete an exam. For example, a student who may have difficulty with physical transcription may be granted the use of a computer to complete an essay for an exam. In the context of a mathematics course, one could ask whether allowing those diagnosed as having a learning disability to use a calculator when other students are not permitted to do so is fair. Would the use of a calculator alter the skill a test is intended to measure? Are the accommodated students as well qualified as those who have met the requirements without accommodations? And who decides these issues—a learning service office, the relevant department, the course instructor, or the school administration? The Office of Civil Rights conducted an investigation after a student complained of alleged discrimination when prevented from using a calculator during the mathematics placement exam despite being diagnosed with dyscalculia. This resulted in the vice chancellor of the system reminding college presidents that calculators were indeed allowed for all mathematics examinations, placement or otherwise, provided the student was appropriately classified as learning disabled.[18] However, whether this was a considered academic judgment or not is unclear. What might happen should a student without a documented learning disability challenge the differential treatment is also not clear.

As an "appropriate accommodation" some students request video and/or audio taping of the course lecture. This presents two challenges for consideration. First, if a student records the class, who protects the privacy of the other students in the class? Consider then the student who does not feel comfortable participating in a class where recording occurs. In essence, is it fair to "accommodate" one student while unintentionally discriminating against another? Currently no cases of record to date have dealt with this issue. Parkland College policy regarding audio-taped lectures, like that of many institutions, gives the professor permission to tell the class that recording will be occurring but does not prescribe how to deal with objections to such a policy.[19] Second, faculty members have long maintained copyrighted ownership of course materials unless otherwise specified by contract with their associated academic institution. Tapes would be included under course materials protected by copyright law.[20] Again, as is common practice, Parkland College policy allows the instructor to ask the student to sign a taping agreement noting copyright and requiring permission of the instructor for derivative dissemination. California State University at San Bernadino provides each student requesting accommodation a handbook that specifically states that audio tapes must be disposed of at the end of the semester.[21] Wallace Community College informs students that they cannot share tapes with nonstudents, agencies, or media, but they do have the option of donating the tapes back to Disability Support Services.[22] However, little in-depth attention has been given to intellectual property rights in general when considering accommodation requests.

There have been arguments made that the use of standardized examinations is per se discriminatory.[23] As long as they are not the only criterion for success, their use generally has been

[16] *Fuchs and Fuchs [14] have discussed this in a K–12 context.*

[17] *See, e.g., Wong [51].*

[18] `http://www.baruch.cuny.edu/counsel/documents/BM-2-92.pdf` *(accessed 03/10/2009).*

[19] `http://www.parkland.edu/ods/handbook/AudioTapedLectures.pdf` *(accessed 03/10/2009).*

[20] `http://www.copyright.gov/circs/circ1.pdf` *(accessed 02/14/2009).*

[21] `http://enrollment.csusb.edu/~ssd/Documents/Faculty%20Handbook%20-%20Accessible.pdf` *(accessed 03/10/2009).*

[22] `http://www.wallace.edu/student_resources/dss/policies.php` *(accessed 03/10/2009).*

upheld. Ninety percent of those receiving accommodations on standardized tests have been diagnosed with learning disabilities rather than other disabilities such as physical limitations [41]. Is the fairness problem resolved by "flagging" exams taken under accommodations or courses in which exam modifications or other accommodations were made? It used to be the case that SATs were so flagged, and LSATs and medical school exams still are [41]. Obviously, flagging identifies a person as disabled and could result in discrimination.[24] On the other hand, in the absence of flagging, it could be argued that inaccurate pictures of qualifications are presented,[25] which may prove to be unfair to the accommodated students if they are unable to carry out academic programs or jobs for which they have allegedly qualified, as well as being unfair to their competitors.

It could also be said that "rewarding" disabilities creates an incentive for people to define themselves as disabled, thus constituting a moral hazard [23]. Even if not a moral hazard, do the accommodations unfairly ameliorate a disability? Given that the diagnostic regimen required to establish a learning disability at the collegiate level can be expensive, does that mean that students from lower-income families are unfairly disadvantaged? Should there be the possibility for all students to be tested at the university's cost? Or should anyone who wants accommodations get them? There are many features of higher education that disadvantage low-income students; is this another to be lived with, or should there be expanded legal protection for students who might potentially benefit from a diagnosis they cannot afford to obtain? Beyond the question of whether accommodations might constitute alterations in the fundamental nature of a program, we can ask, do the accommodations really address the disability? For example, is more time for mathematics exams really needed to accommodate slowness in reading, given the limited amount of reading normally required in mathematics exams?[26] If a student has difficulty writing, more time may directly ameliorate the limitation. However, there is also anecdotal evidence that excessive time for an exam may in fact be detrimental if eventual fatigue causes students to alter work that was earlier correctly completed.

Consider the following: if a course would be fundamentally altered by an accommodation, then the accommodation is not appropriate. Students routinely transfer credits from one institution to another. Is it possible that upon review some of the credits would not be transferrable because the student received accommodations that, if provided by the second institution, would have fundamentally altered the second institution's course?

## Learning Disabilities and Mathematics

Among examples of learning disabilities are some which are mathematics specific, such as dyscalculia, and others that impact the ability to learn mathematics, such as dyslexia. Dyscalculia is an umbrella term used to describe a collection of challenges students encounter when solving mathematics problems. For example, some students lack number sense, others cannot interpret graphs, and yet others cannot solve problems that rely on sequencing or algorithms for their solution; i.e., they can't solve an equation for $x$ [49]. The degree to which students have one or more of these deficiencies varies. Dyslexic students may have issues reading word problems and number transposition, and since math can be considered a language, decoding of characters may become problematic [43].

Above we note that often in higher education instructors are told to accommodate without necessarily being given specific information as to why an accommodation might be necessary or being consulted as to whether it might fundamentally alter the course requirements. This is unfortunate, particularly for mathematics instructors. Teachers who have knowledge about learning styles and how their students learn may be able to adapt their instruction without compromising the standards of the course, so that students can construct mathematical knowledge for themselves in spite of disabilities [13], [32]. In fact, many "accommodations" are simply techniques that may enhance the learning of all students: supplemental notes, online access to classroom material, audio or video recordings available for replaying as required, access to tutors, ample in-person and/or virtual office hours.

Calculator use in the mathematics classroom, as we have already noted above, is not always left up to the instructor, but perhaps an instructor might dictate the type of calculator to be used and still appropriately accommodate learning-disabled students. Mathematics is cumulative by nature. One has to learn to count before adding or subtracting. One has to understand the order of operations before learning to solve equations. Basic calcula-

[23] *The National Collegiate Athletics Association has rules regarding minimum SAT scores for eligibility for participation in college athletics and for scholarships. They also require a certain number of acceptable high school courses, with courses designated as special education not qualifying unless they can be certified as equivalent to regular courses. Clearly this provides scope for controversy (see e.g., [5], [36]).*

[24] *The ADA prohibits discrimination on the basis of perceived disability, whether or not the person is actually disabled.*

[25] *It has been shown, for example, that accommodated SAT scores overpredict first-year college GPAs [37].*

[26] *If an exam consists primarily of word problems, dyslexia or other difficulties in reading may indeed be a disability.*

tors perform the four fundamental operations of addition, subtraction, multiplication, and division; but advances in technology have created calculators that will solve equations, simultaneously graph and create tables of data for functions, and even generate statistical analysis. It could be the case that a learning-disabled student cannot keep track of sequential steps necessary to solve the problem on paper, but that same student can program a calculator to find the answer. Should we expect students to understand fundamentals such as finding the least common denominator of two fractions, a skill they should have developed before college, or should we be more interested in how the students use the answer found by the calculator to solve the problem? Does this "fundamentally alter" a course? Is this fair to the other students in the class, who may not have been allowed to use any technological help? In light of the outcomes related above, how can this issue best be addressed?

From cases above, it is clear that speed of judgment can be an indicator of qualifications for a program or profession. But does mathematics need to be done quickly? We might ask whether an untimed or extended-time mathematics test really measures the skills or knowledge the exam is intended to measure. When does a mathematics student or a mathematician have to think or calculate quickly?

Research on best practices on teaching K–12 students with learning disabilities in math is available. A meta-analysis from the Center on Instruction in Portsmouth, New Hampshire, listed several pedagogical techniques, including problem-specific step-by-step explicit instruction for finding a solution, student verbalization of steps employed during problem solving, visual representation of math concepts presented in conjunction with traditional problem-solving techniques, and a wide array of examples, to name a few [16]. At the collegiate level the classroom pace is faster, more material is covered, and generalized approaches to solving a problem tend to be presented. With in-class examples to guide them, students are expected to go and explore the concepts outside of class independently. It may be the case that the majority of these techniques can be best applied while working with individual students outside the classroom.[27]

Ideally, the expertise in learning disabilities of a specialist ought to be combined with the subject matter knowledge of a classroom instructor in order to best serve all students. If the use of a calculator is mandated by a learning disabilities professional on placement exams, might that mask an inability to deal with fractions that will later pose a handicap if the student is placed at a higher level than might be mandated were the calculator not used? More fundamentally, is an inability to do well in a college mathematics course without accommodations a disability for purposes of the ADA? Could the "average person" do better? If not everyone is guaranteed a university education that requires a college mathematics course, should a university nonetheless seek to accommodate students with difficulties not legally classifiable as disabilities, especially if the accommodation disadvantages other students?

[27] *Some institutions establish a special section of required courses specially designed for learning-disabled students, the purpose being to assure maximum assistance without altering the nature of the course or disadvantaging other students.* `http://www.american.edu/american/registrar/schedule.cfm` *(accessed 3/10/2009).*

## Conclusion

Instructors faced with requests or demands for accommodations for the learning disabled should not necessarily passively comply. Although they cannot make judgments as to whether the accommodations may be legally required, faculty can and should ask whether the proposed accommodations are actually reasonable and appropriate. Do the accommodations ameliorate the disability, do they fundamentally alter the course or program requirements or lower the academic standards, and are they fair to other students?

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References continued on page 1163.

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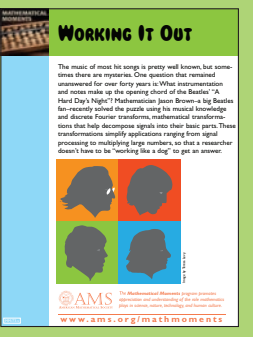



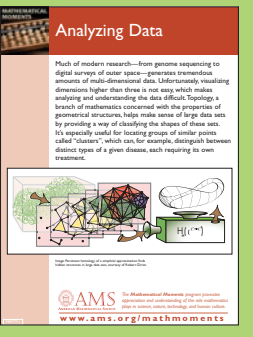


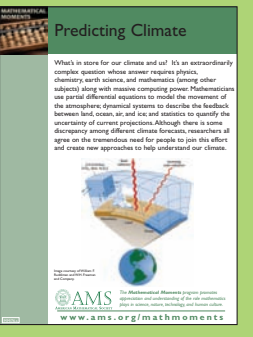


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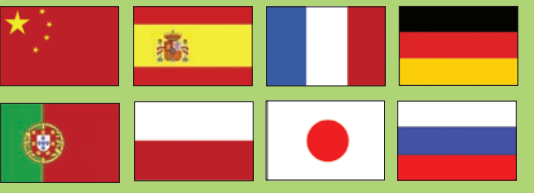

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# Communities in Networks

*Mason A. Porter, Jukka-Pekka Onnela, and Peter J. Mucha*

## Introduction: Networks and Communities

*"But although, as a matter of history, statistical mechanics owes its origin to investigations in thermodynamics, it seems eminently worthy of an independent development, both on account of the elegance and simplicity of its principles, and because it yields new results and places old truths in a new light in departments quite outside of thermodynamics."*

*— Josiah Willard Gibbs,*
Elementary Principles in Statistical Mechanics,
*1902 [47]*

From an abstract perspective, the term *network* is used as a synonym for a mathematical *graph*. However, to scientists across a variety of fields, this label means so much more [13, 20, 44, 83, 88, 120, 124]. In sociology, each *node* (or vertex) of a network represents an *agent*, and a pair of nodes can be connected by a *link* (or edge) that signifies some social interaction or tie between them (see Figure 1 for an example). Each node has a *degree* given by the number of edges connected to it and a *strength* given by the total weight of those edges. Graphs can represent either man-made or natural constructs, such as the World Wide Web or neuronal synaptic networks in the brain. Agents in such networked systems are like particles in traditional statistical mechanics that we all know and (presumably) love, and the structure of interactions between agents reflects the microscopic rules that govern their behavior. The simplest types of links are binary pairwise connections, in which one only cares about the presence or absence of a tie. However, in many situations, links can also be assigned a direction and a (positive or negative) weight to designate different interaction strengths.

Traditional statistical physics is concerned with the dynamics of ensembles of interacting and noninteracting particles. Rather than tracking the motion of all of the particles simultaneously, which is an impossible task due to their tremendous number, one averages (in some appropriate manner) the microscopic rules that govern the dynamics of individual particles to make precise statements of macroscopic observables such as temperature and density [112]. It is also sometimes possible to make comments about intermediate (*mesoscopic*) structures, which lie between the microscopic and macroscopic worlds; they are large enough that it is reasonable to discuss their collective properties but small enough so that those properties are obtained through averaging over smaller numbers of constituent items. One can similarly take a collection of interacting agents, such as the nodes of a network, with some set of microscopic interaction rules and attempt to derive the resulting mesoscopic and macroscopic structures.

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*Peter J. Mucha, Carolina Center for Interdisciplinary Applied Mathematics, Department of Mathematics, University of North Carolina, and Institute for Advanced Materials, Nanoscience and Technology, University of North Carolina. His email address is* mucha@unc.edu.

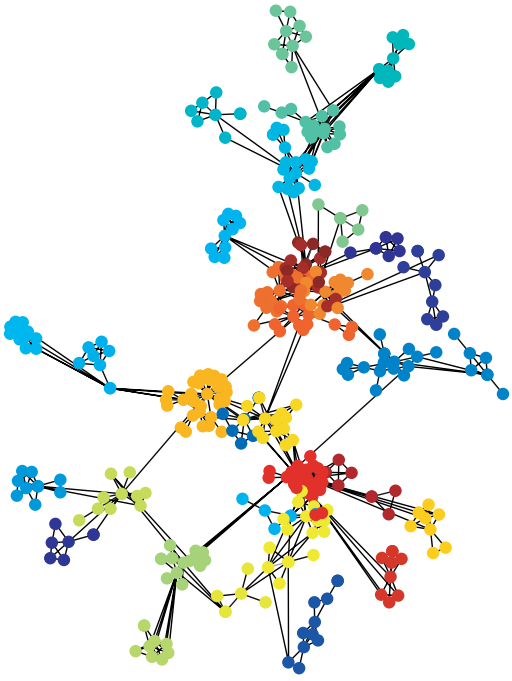

**Figure 1. The largest connected component of a network of network scientists. This network was constructed based on the coauthorship of papers listed in two well-known review articles [13,83] and a small number of additional papers that were added manually [86]. Each node is colored according to community membership, which was determined using a leading-eigenvector spectral method followed by Kernighan-Lin node-swapping steps [64,86,107]. To determine community placement, we used the Fruchterman-Reingold graph visualization [45], a force-directed layout method that is related to maximizing a quality function known as "modularity" [92]. To apply this method, we treated the communities as if they were themselves the nodes of a (significantly smaller) network with connections rescaled by inter-community links. We then used the Kamada-Kawaii spring-embedding graph visualization algorithm [62] to place the nodes of each individual community (ignoring inter-community links) and then to rotate and flip the communities for optimal placement (including inter-community links). See the main text for further details on some of the ideas in this caption. (We gratefully acknowledge Amanda Traud for preparing this figure.)**

One mesoscopic structure, called a *community*, consists of a group of nodes that are relatively densely connected to each other but sparsely connected to other dense groups in the network [39]. We illustrate this idea in Figure 2 using a well-known benchmark network from the sociology literature [131].

The existence of social communities is intuitively clear, and the grouping patterns of humans have been studied for a long time in both sociology [25,44,79] and social anthropology [66,113]. For example, Stuart Rice clustered data by hand to investigate political blocs in the 1920s [106], and George Homans illustrated the usefulness of rearranging the rows and columns of data matrices to reveal their underlying structure in 1950 [60]. Robert Weiss and Eugene Jacobson performed (using organizational data) what might have been the first analysis of network community structure in 1955 [126], and Herbert Simon espoused surprisingly modern views on community structure and complex systems in general in the 1960s [117]. Social communities are ubiquitous, arising in the flocking of animals and in social organizations in every type of human society: groups of hunter-gatherers, feudal structures, royal families, political and business organizations, families, villages, cities, states, nations, continents, and even virtual communities such as Facebook groups [39,88]. Indeed, the concept of community is one of everyday familiarity. We are all connected to relatives, friends, colleagues, and acquaintances who are in turn connected to each other in groups of different sizes and cohesions. The goals of studying social communities have aligned unknowingly with the statistical physics paradigm. As sociologist Mark Granovetter wrote in his seminal 1973 paper [51] on weak ties, "Large-scale statistical, as well as qualitative, studies offer a good deal of insight into such macro phenomena as social mobility, community organization, and political structure... But how interaction in small groups aggregates to form large-scale patterns eludes us in most cases."

Sociologists recognized early that they needed powerful mathematical tools and large-scale data manipulation to address this challenging problem. An important step was taken in 2002, when Michelle Girvan and Mark Newman brought graph-partitioning problems to the broader attention of the statistical physics and mathematics communities [48]. Suddenly, community detection in networks became hip among physicists and applied mathematicians all over the world, and numerous new methods were developed to try to attack this problem. The amount of research in this area has become massive over the past seven years (with new discussions or algorithms posted on the arXiv preprint server almost every day), and the study of what has become known

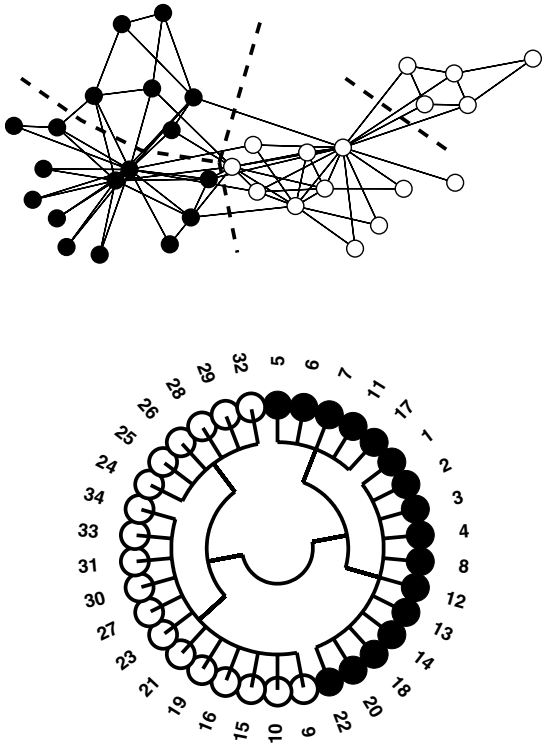


**Figure 2. (Top) The Zachary Karate Club network [131], visualized using the Fruchterman-Reingold method [45]. Nodes are colored black or white depending on their later club affiliation (after a disagreement prompted the organization's breakup). The dashed lines separate different communities, which were determined using a leading-eigenvector spectral maximization of modularity [86] with subsequent Kernighan-Lin node-swapping steps (see the discussion in the main text). (Bottom) Polar coordinate dendrogram representing the results of applying this community-detection algorithm to the network. Nodes are grouped into the communities indicated in the top panel. One can see the initial split of the network into two groups (identical to the actual membership of the new clubs) by moving outward from the center of the ring. Moving farther outward culminates in the final partition of the network into four communities.**

as community structure is now one of the most prominent areas of network science [26, 39, 110].

Although a rigorous notion of community structure remains elusive, one can clarify some issues through the notions of *modules* and *hierarchies*. In general, a network's community structure encompasses a potentially complicated set of hierarchical and modular components [39, 48, 117]. In this context, the term module is typically used to refer to a single cluster of nodes. Given a network that has been partitioned into nonoverlapping modules in some fashion (although some methods also allow for overlapping communities), one can continue dividing each module in an iterative fashion until each node is in its own singleton community. This hierarchical partitioning process can then be represented by a tree, or *dendrogram* (see Figure 2). Such processes can yield a hierarchy of nested modules (see Figure 3), or a collection of modules at one mesoscopic level might be obtained in an algorithm independently from those at another level. However obtained, the *community structure* of a network refers to the set of graph partitions obtained at each "reasonable" step of such procedures. Note that community structure investigations rely implicitly on using connected network components. (We will assume such connectedness in our discussion of community-detection algorithms below.) Community detection can be applied individually to separate components of networks that are not connected.

Many real-world networks possess a natural hierarchy. For example, the committee assignment network of the U.S. House of Representatives includes the House floor, groups of committees, committees, groups of subcommittees within larger committees, and individual subcommittees [100, 101]. As shown in Figure 4, different House committees are resolved into distinct modules within this network. At a different hierarchical level, small groups of committees belong to larger but less densely connected modules. To give an example closer to home, let's consider the departmental organization at a university and suppose that the network in Figure 3 represents collaborations among professors. (It actually represents grassland species interactions [23].) At one level of inspection, everybody in the mathematics department might show up in one community, such as the large one in the upper left. Zooming in, however, reveals smaller communities that might represent the department's subfields.

Although network community structure is almost always fairly complicated, several forms of it have nonetheless been observed and shown to be insightful in applications. The structures of communities and between communities are important for the demographic identification of network components and the function of dynamical processes that operate on networks (such as the spread of opinions and diseases) [39]. A community in a social network might indicate a circle of friends, a community in the World Wide Web might indicate a group of pages on closely related topics, and a community in a cellular or genetic network might be related to a functional module. In some

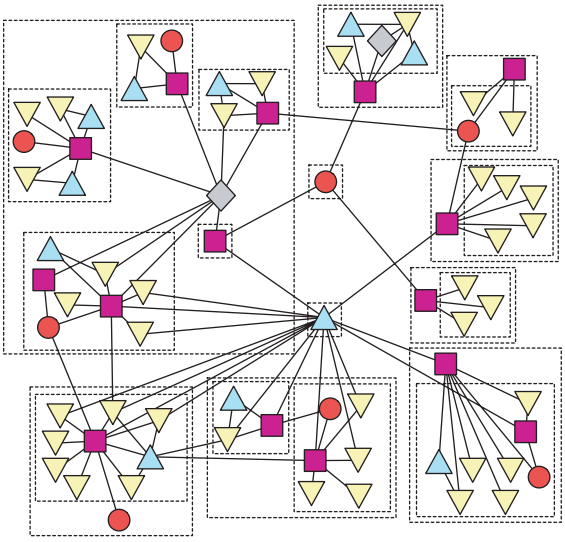

**Figure 3. A network with both hierarchical and modular structure. This image, courtesy of Aaron Clauset, is an adaptation of a figure from [23].**

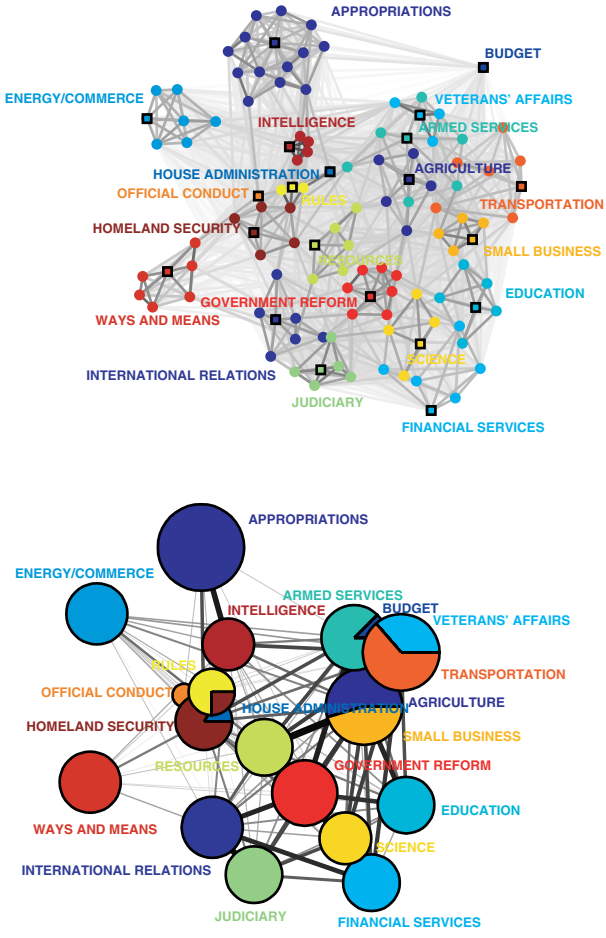


**Figure 4. (Top) The network of committees (squares) and subcommittees (circles) in the 108th U.S. House of Representatives (2003–04), color-coded by the parent standing and select committees and visualized using the Kamada-Kawai method [62]. The darkness of each weighted edge between committees/subcommittees indicates how strongly they are connected. Observe that subcommittees of the same parent committee are closely connected to each other. (Bottom) Coarse-grained plot of the communities in this network. Here one can see some close connections between different committees, such as Veterans Affairs/ Transportation and Rules/Homeland Security.**

cases, a network can contain several identical replicas of small communities known as motifs [75]. Consider a transcription network that controls gene expression in bacteria or yeast. The nodes represent genes or operons, and the edges represent direct transcriptional regulation. A simple motif called a "feed-forward loop" has been shown both theoretically and experimentally to perform signal-processing tasks such as pulse generation. Naturally, the situation becomes much more complicated in the case of people (doesn't it always?). However, monitoring electronically recorded behavioral data, such as mobile phone calls, allows one to study underlying social structures [49, 95]. Although these pairwise interactions (phone calls) are short in duration, they are able to uncover social groups that are persistent over time [97]. One interesting empirical finding, hypothesized by Granovetter [51], is that links within communities tend to be strong and links between them tend to be weak [95]. This structural configuration has important consequences for information flow in social systems [95] and thus affects how the underlying network channels the circulation of social and cultural resources. (See below for additional discussion.)

With methods and algorithms drawn from statistical physics, computer science, discrete mathematics, nonlinear dynamics, sociology, and other subjects, the investigation of network community structure (and more general forms of data clustering) has captured the attention of a diverse group of scientists [39, 54, 88, 110]. This breadth of interest has arisen partly because the development of community-detection methods is an inherently interdisciplinary endeavor and partly because interpreting the structure of a community and its function often requires application-specific knowledge. In fact, one aspect that makes the problem of detecting communities so challenging is that the preferred formulation of communities is often domain-specific. Moreover, after choosing a formulation, one still has to construct the desired

communities by solving an optimization problem that is known to be NP-complete in at least one family of formulations [17]. This has necessitated the adaptation of classical computational-optimization heuristics and the development of new ones.

## A Simple Example

To set the stage for our survey of community-detection algorithms below, consider the ubiquitous but illustrative example of the Zachary Karate Club, in which an internal dispute led to the schism of a karate club into two smaller clubs [131]. We show a visualization of the friendships between members of the original club in Figure 2. When the club split in two, its members chose preferentially to be in the one with most of their friends. Sociologist Wayne Zachary, who was already studying the club's friendships when the schism occurred, realized that he might have been able to predict the split in advance. This makes the Zachary Karate Club a useful benchmark for community-detection algorithms, as one expects any algorithmically produced division of the network into communities to include groups that are similar to the actual memberships of the two smaller clubs.

In Figure 2, we show the communities that we obtained using a spectral-partitioning optimization of a *quality function* known as *modularity* [86]. (This method is described below.) Keeping in mind the hierarchical organization that often occurs as part of network community structure, we visualize the identified divisions using a polar coordinate dendrogram and enumerate the network's nodes around its exterior. Each distinct radius of the dendrogram corresponds to a partition of the original graph into multiple groups. That is, the community assignments at a selected level of the dendrogram are indicated by a radial cut in the bottom panel of Figure 2; one keeps only connections (of nodes to groups) that occur outside this cut. The success of the community identification is apparent in the Zachary Karate Club example, as the two main branches in the dendrogram reflect the actual memberships of the new clubs.

As shown in Figure 2, this community-detection method subsequently splits each of the two main branches. Hence, we see that the Zachary Karate Club network has a natural hierarchy of decompositions: a coarse pair of communities that correspond precisely to the observed membership split and a finer partition into four communities. In larger networks, for which algorithmic methods of investigation are especially important, the presence of multiple such partitions indicates network structures at different mesoscopic resolution levels. At each level, one can easily compare the set of communities with identifying characteristics of the nodes (e.g., the post-split Zachary Karate Club memberships) by drawing a pie chart for each community, indicating the composition of node characteristics in that community, and showing the strength of inter-community connections as ties between the pies (as in Figure 4 for Congressional committees).

## Identifying Communities

Intuitively, a community is a cohesive group of nodes that are connected "more densely" to each other than to the nodes in other communities. The differences between many community-detection methods ultimately come down to the precise definition of "more densely" and the algorithmic heuristic employed to identify such sets. As different scientific fields have different needs, it is not surprising that a wide variety of community-detection methods have been developed to serve those needs [39]. These differing needs have also resulted in the deployment of different real and computer-generated benchmark networks to test community-finding algorithms [39, 70]. A 2005 review article [26] compared the performance of several of the (then-)available methods in terms of both computation time and output. A thorough, more recent discussion is available in [39].

Rather than attempting a similar comparison using every available algorithm, our aim is instead to expose a larger readership to many of the most popular methods (as well as a few of our personal favorites), while contrasting their different perspectives and revealing a few important (and sometimes surprising) similarities. Although we will highlight an extensive suite of techniques in our survey below, there are of course numerous other methods—including ones based on maximum likelihood [23], mathematical programming [1], block modeling [105, 127], link partitioning [2, 33], inference [56, 91], latent space clustering [55], and more—that we unfortunately neglect here because of space considerations. Many of them are discussed in other review articles [26, 39, 110].

### Traditional Clustering Techniques

The idea of organizing data by coarse graining according to common features is a very old one [39, 119]. The original computational attempts to find clusters of similar objects are rooted in statistics and data mining. Important methods include *partitional clustering* techniques such as *k*-means clustering, *neural network clustering* techniques such as self-organizing maps, and *multidimensional scaling* (MDS) techniques such as singular value decomposition (SVD) and principal component analysis (PCA) [46]. For example, MDS algorithms of various levels of sophistication have proven to be amazingly successful at finding clusters of similar data points in myriad

applications, such as voting patterns of legislators and Supreme Court justices [99–101, 118]. Such techniques start with a matrix that indicates similarities (e.g., a tabulation of how every legislator voted on every bill) and return a coordinate matrix that minimizes an appropriate loss function. In the U.S. Congress, this allows one to see that the most important dimensions correspond to the liberal-conservative axis ("partisanship") and how well a given legislator plays with others ("bipartisanship"). During periods of heightened racial tension, such analyses have also revealed a third dimension corresponding to the division between North and South [99].

Another prominent set of classical techniques to detect cohesive groups in graphs are hierarchical clustering algorithms such as the *linkage clustering* methods used in phylogenetic biology [46, 61]. One starts with the complete set of $N$ individual nodes in a weighted network, represented by an *adjacency matrix* $A$ whose elements (links) $A_{ij}$ indicate how closely nodes $i$ and $j$ are related to each other. For the purpose of our presentation, we will only consider undirected networks, which implies that $A$ is symmetric (a few algorithms can also handle directed networks [39, 53, 72]). Linkage clustering is an example of an *agglomerative* method, as it starts from individual nodes and ultimately connects the entire graph. The nodes are conjoined sequentially into larger clusters, starting with the pair with maximal $A_{ij}$ (i.e., the most strongly connected pair). At each step, one recomputes the similarities between the new cluster and each of the old clusters and again joins the two maximally similar clusters, and one continues iteratively until all clusters with nonzero similarity are connected. Different linkage clustering methods utilize different measures of the similarity between clusters. For instance, in *single linkage clustering*, the similarity of two clusters $X$ and $Y$ is defined as the greatest similarity between any pair of nodes $x \in X$ and $y \in Y$. Joining nodes using single linkage clustering essentially mirrors Joseph Kruskal's algorithm for computing minimum spanning trees (MSTs) [31, 50]. With clustering, however, the order of cluster formation is important and can be represented as a dendrogram, whose depths indicate the steps at which two clusters have been combined. More sophisticated techniques that build on these ideas are discussed in [46].

There are also a few classical *divisive* techniques, in which one starts with the full graph and breaks it up to find communities [39, 46, 110]. (As with agglomerative techniques, one can visualize the results using dendrograms.) The most prominent examples are spectral methods, which we discuss in detail below. New data clustering methods, which are applicable both to networks and to more general data structures, continue to be developed very actively [46, 110]. Scientists studying community detection and those studying data clustering are obviously looking at the same coin. The two fields are advancing in parallel, and there are numerous deep connections between them (including, we suspect, far more than are already known).

### The Kernighan-Lin Algorithm

An algorithm from computer science, which can be combined with other methods, was proposed by Brian Kernighan and Shen Lin (KL) in 1970 in their study of how to partition electric circuits into boards so that the nodes in different boards can be linked to each other using the fewest number of connections [64]. To do this, they maximized a quality function $\tilde{Q}$ that relates the number of edges inside each group of nodes to the number between different groups. Starting with an initial partition of a graph into two groups of predefined size, KL steps swap subsets containing equal numbers of vertices between the two groups. To reduce the chance of getting stuck at a local maximum, the KL method permits swaps that decrease $\tilde{Q}$. After a specified number of swaps, one keeps the partition with maximal $\tilde{Q}$ to use as the initial condition for a new set of KL steps. When the number and sizes of communities are not specified, a natural generalization of the KL method is to move a single node at a time [12, 86, 87, 107]. Unsurprisingly, the partitions of networks into communities that are obtained using the KL algorithm depend strongly on one's initial partition and, therefore, it is best used as a supplement to high-quality partitions obtained using other methods [39, 86, 87]. In typical situations, both the KL swaps and the other method would seek to optimize the same $\tilde{Q}$.

### Centrality-Based Community Detection

Michelle Girvan and Mark Newman generated a great deal of attention in mathematics and statistical physics for network community structure in [48] when they devised a community-finding algorithm based on the sociological notion of *betweenness centrality* [4, 42, 124]. An edge has high betweenness if it lies on a large number of short paths between vertices. (Note that betweenness can also be defined for nodes.) If one starts at a node and wants to go to some other node in the network, it is clear that some edges will experience a lot more traffic than others. The betweenness of an edge quantifies such traffic by considering strictly shortest paths (*geodesic betweenness*) or densities of random walks (*random walk betweenness*) [85] between each pair of nodes and taking into account all possible pairs. One can identify communities through a process of ranking all of the edges based on their betweenness, removing the edge with the largest value, and recalculating

betweenness for the remaining edges. The recalculation step is important because the removal of an edge can cause a previously low-traffic edge to have much higher traffic. An iterative implementation of these steps gives a divisive algorithm for detecting community structure, as it deconstructs the initial graph into progressively smaller connected chunks until one obtains a set of isolated nodes.

Betweenness-based methods have been generalized to use network components other than edges, to bipartite networks [100], and to use other sociological notions of centrality [39]. Note, however, that although centrality-based community detection is intuitively appealing, it can be too slow for many large networks (unless they are very sparse), and it tends to give relatively poor results for dense networks.

### *k*-Clique Percolation and Other Local Methods

The method of *k-clique percolation* [97] is based on the concept of a *k-clique*, which is a complete subgraph of $k$ nodes that are connected with all $k(k-1)/2$ possible links. The method relies on the observation that communities seem to consist of several small cliques that share many of their nodes with other cliques in the same community. A *k-clique community* is then defined as the union of all "adjacent" $k$-cliques, which by definition share $k-1$ nodes. One can also think about "rolling" a $k$-clique template from any $k$-clique in the graph to any adjacent $k$-clique by relocating one of its nodes and keeping the other $k-1$ nodes fixed [28]. A community, defined through the percolation of such a template, then consists of the union of all subgraphs that can be fully explored by rolling a $k$-clique template. As $k$ becomes larger, the notion of a community becomes more stringent. Values of $k = 3, \ldots, 6$ tend to be most appropriate because larger values become unwieldy. The special case of $k = 2$ reduces to bond (link) percolation and $k = 1$ reduces to site (node) percolation.

The $k$-clique percolation algorithm is an example of a *local* community-finding method. One obtains a network's global community structure by considering the ensemble of communities obtained by looping over all of its $k$-cliques. Some nodes might not belong to any community (because they are never part of any clique), and others can belong to several communities (if they are located at the interface between two or more communities). The nested nature of communities is recovered by considering different values of $k$, although $k$-clique percolation can be too rigid because focusing on cliques typically causes one to overlook other dense modules that aren't quite as well connected. On the other hand, the advantage of $k$-clique percolation and other local methods is that they have to date provided some of the most successful ways to consider community overlap.

Allowing the detection of network communities that overlap is especially appealing in the social sciences, as people belong simultaneously to several communities (constructed via colleagues, family, hobbies, etc.) [78,79]. Purely agglomerative or divisive techniques do not allow communities to overlap, so it is important to consider local methods as well. Several such methods have now been developed [2, 7, 8, 14, 22, 28, 33, 39, 74, 114, 129], including one that enables the consideration of overlapping communities at multiple resolution levels [69]. We believe that further development of global clustering algorithms that take community overlap explicitly into account is essential to complement the insights from these local approaches.

### Modularity Optimization

One of the most popular quality functions is *modularity*, which attempts to measure how well a given partition of a network compartmentalizes its communities [84, 86, 87, 89, 90]. The problem of optimizing modularity is equivalent to an instance of the famous MAX-CUT problem [86], so it is not surprising that it has been proven to be NP-complete [17]. There are now numerous community-finding algorithms that try to optimize modularity or similarly constructed quality functions in various ways [6, 12, 26, 39]. In the original definition of modularity, an unweighted and undirected network that has been partitioned into communities has modularity [84, 90]

$$Q = \sum_i (e_{ii} - b_i^2), \tag{1}$$

where $e_{ij}$ denotes the fraction of ends of edges in group $i$ for which the other end of the edge lies in group $j$, and $b_i = \sum_j e_{ij}$ is the fraction of all ends of edges that lie in group $i$. Modularity is closely related to the Freeman segregation index [43]; a key difference is that $Q = 0$ when all nodes are assigned to the same community, which enforces the existence of a nontrivial partition with $Q > 0$. Modularity explicitly takes degree heterogeneity into account, as it measures the difference between the total fraction of edges that fall within groups versus the fraction one would expect if edges were placed at random (respecting vertex degrees).[1] Thus, high values of $Q$ indicate network partitions in which more of the edges fall within groups than expected by chance (under a specified null model, as discussed further below). This, in turn, has been

[1] *Interest in degree heterogeneity exploded in the late 1990s with the sudden wealth of empirical data and the seemingly ubiquitous manifestation of heavy-tailed degree distributions such as power laws [3, 83].*

found to be a good indicator of functional network divisions in many cases [86, 87].

For weighted networks, one counts the sums of the weights of edges instead of the number of edges, so heavily weighted edges contribute more than lightly weighted ones. Both $e_{ij}$ and $b_i$ are thus straightforwardly generalized, and then the modularity is again calculated from (1). The meaning of modularity remains essentially the same: It measures when a particular division of the network has more edge weight within groups than one would expect by chance.

Quality functions such as modularity provide precise measures of how to count the total strength of connections within communities versus those between communities [87, 89]. Modularity is a scaled *assortativity* measure based on whether high-strength edges are more or less likely to be adjacent to other high-strength edges [84, 89, 90]. Because communities are supposed to have high edge density relative to other parts of the graph, a high-modularity partition tends to have high edge-strength assortativity by construction. More generally, assortativity notions can be used to partition a graph into groups according to any characteristic by examining whether nodes are more likely (in *assortative* graphs) or less likely (in *disassortative* graphs) to be connected to nodes of the same type [83].

Interestingly, maximizing modularity is closely related to the energy models of pairwise attraction, such as the Fruchterman-Reingold method, that are commonly used for graph visualization [92]. While this isn't necessarily surprising given the clusters that one can typically observe with good graph visualization tools, this recent insight does suggest that such tools may also help lead to the development of better community-detection methods. Conversely, the analysis and construction of algorithms to find network communities might help lead to better graph-visualization techniques.

It is typically impossible computationally to sample a desired quality function by exhaustively enumerating the nonpolynomial number of possible partitions of a network into communities [17]. A number of different methods have thus been proposed to balance the typical quality of their identified optima with the computational costs. Some methods, such as the greedy algorithms in [24, 84], are fast heuristics intended to be applied to networks with millions of nodes or more. Other methods—such as spectral partitioning [86, 87] (discussed below), refined greedy algorithms [111], simulated annealing [52], extremal optimization [30], and others [93]—provide more sophisticated but slower means to identify high-modularity partitions.[2] We discuss the spectral partitioning method below, in part because of its interesting reformulation of the modularity scalar as a matrix, but we note that other algorithmic choices might be superior in many situations. We believe that there is considerable value in having multiple computational heuristics available, as this provides greater flexibility to compare and contrast the identified communities.

Importantly, many modularity-maximization techniques are easy to generalize for use with other related quality functions because it is far from clear that modularity is the best function to optimize. For example, modularity has a known *resolution limit* (see below) that might cause one to miss important communities [38]. A few alternatives to modularity have been considered [6, 39, 57, 69, 121], and it is ultimately desirable to optimize a quality function that includes not only information about the network structure but also other information (such as node characteristics or relevant time-dependence) that would allow one to incorporate functionality directly [116]. Such consideration of additional information is one of the most important open issues in community detection [88, 122].

### Spectral Partitioning

The method of spectral partitioning arose most prominently in the development of algorithms for parallel computation [35, 102]. In traditional spectral partitioning, network properties are related to the spectrum of the graph's Laplacian matrix $L$, which has components $L_{ij} = k_i\delta(i,j) - A_{ij}$, where $k_i$ is the degree of node $i$ (or, in a weighted network, its strength), and $\delta(i,j)$ is the Kronecker delta (i.e., $\delta(i,j) = 1$ if $i = j$ and 0 otherwise).

The simplest such method starts by splitting a network into two components. One then applies two-group partitioning recursively to the smaller networks one obtains as long as it is desirable to do so. (One can also partition networks into more than two groups during each step [21, 29, 86, 107].) For a single partitioning step, one defines an index vector $s$ whose components take the value $+1$ if they belong to group 1 and $-1$ if they belong to group 2. The total edge weight between the two groups of nodes can then be expressed as $R = \frac{1}{4}s^T Ls$. The "best" partition of the network seemingly results from choosing $s$ to minimize $R$ (called the "cut size") and hence the total strength of inter-group edges. (Recall the max-flow min-cut theorem, which states that the minimum cut between any two vertices of a graph—that is, the minimum set of edges whose deletion places the

[2] *As we have discussed, one can also supplement any of these methods with KL swapping steps [12, 64, 86, 87, 93, 107].*

two vertices in disconnected components of the graph—carries the maximum flow between the two vertices [32,37].) Unfortunately, this minimization is easily accomplished by choosing the trivial (and useless) partition of a single group containing every node. The most common solution to this situation is to fix the sizes of the two groups in advance and incorporate this information in the partitioning procedure (as described in, e.g., [86]). This solution is perfectly reasonable for some applications, such as load balancing in parallel computing. However, this approach is neither appropriate nor realistic for community detection in most other contexts because one typically does not know the number or sizes of communities in advance, so choosing arbitrary sizes at the outset precludes attacking the main problem of interest.

Fortunately, one can use the idea of modularity to obtain spectral partitioning algorithms that are appropriate for a broader class of problems [87] (see also the earlier publication [29] and a spiritually similar approach based on peer influences in the sociology literature [77]). By reformulating the scalar quantity of modularity in terms of a *modularity matrix* $B$, with components

$$B_{ij} = A_{ij} - P_{ij}\,, \tag{2}$$

spectral partitioning can be directly applied [87] as a means of heuristically optimizing the modularity

$$Q = \frac{1}{2W}\sum_{i,j} B_{ij}\delta(C_i, C_j)\,, \tag{3}$$

where $\delta(C_i, C_j)$ indicates that the $B_{ij}$ components are only summed over cases in which nodes $i$ and $j$ are assigned to the same community. The factor $W = \frac{1}{2}\sum_{ij} A_{ij}$ is the total edge strength in the network (equal to the total number of edges for unweighted networks), where $k_i$ denotes the strength of node $i$. In (2), $P_{ij}$ denotes the components of a *null model* matrix, which specifies the relative value of intra-community edges in assessing when communities are tightly connected [9, 86]. In general, one is free to specify any reasonable null model. The most popular choice, proposed by Newman and Girvan [86,87,89,90], is

$$P_{ij} = \frac{k_i k_j}{2W}\,. \tag{4}$$

This recovers the definition of modularity in (1), specified in terms of edge-weight deviations from a network chosen randomly from the set of all graphs with the same expected strength distribution as the actual network. This null model is closely related to the configuration model [76], which (as with Erdös-Renyi random graphs) yields networks that aren't expected to have a natural hierarchy [76, 83, 90]. The difference is that (4) is conditioned on the expected degree (or strength) sequence, whereas the configuration model is conditioned on the actual observed sequence.

In spectral partitioning, one can use as many eigenvectors of $B$ as there are positive eigenvalues, but it is effective (and simplest) to recursively subdivide a network using only the "leading eigenvector" $v$, which is paired with the largest positive eigenvalue of $B$. One can then separate the network into two communities according to the signs $s_i = \mathrm{sgn}(v_i)$. The magnitude of $v_i$ indicates the strength to which the $i$th node belongs to its assigned community [86]. For $v_i = 0$, one can assign node $i$ to a community based on which choice produces the higher modularity, changing $s_i = 0$ to $+1$ or $-1$ as appropriate. The modularity of the resulting two-group partition of the network is $Q = \frac{1}{4W}s^T B s$. After this bipartition, one then repeats the partitioning procedure for each graph component, keeping track of the fact that they are actually part of a larger network. One continues recursively until the modularity can no longer be increased with additional subdivisions [86, 87]. The final network partition gives the community structure at a specific resolution level (e.g., committees in the U.S. House of Representatives committee assignment network). This method can be generalized by considering different quality functions [39, 107], allowing steps that decrease global quality in order to further subdivide the communities [107, 133], using more eigenvectors [107, 123], or including a resolution parameter [6, 104] that allows one to examine the network's community structure at different mesoscopic scales.

### The Potts Method

Particles that possess a magnetic moment are often called *spins* [112, 130]. Such spins interact with other spins either *ferromagnetically* (they seek to align) or *antiferromagnetically* (they seek to have different orientations). A *spin glass* is a system that encompasses both disorder and competing ferromagnetic and antiferromagnetic interactions. This leads to a very large number of metastable spin configurations separated by energy barriers with long, glass-like characteristic relaxation times [36, 130]. An important recent insight, inspired by earlier work on data clustering based on the physical properties of an inhomogeneous ferromagnetic model [11], is that optimizing modularity is mathematically equivalent to minimizing the energy (i.e., finding the ground state of the Hamiltonian) of an infinite-range $q$-state Potts model [103, 104].

In a $q$-state Potts spin glass, each spin can be in one of $q$ states. The interaction energy between spins $i$ and $j$ is given by $-J_{ij}$ if the spins are in the same state and zero if they are not [104, 130]. The Hamiltonian of the system is given by the sum

over all of the pairwise interaction energies:

$$H(\{\sigma\}) = -\sum_{ij} J_{ij}\delta(\sigma_i, \sigma_j)\,, \tag{5}$$

where $\sigma_l$ indicates the state of spin $l$ and $\{\sigma\}$ denotes the configuration of spins (i.e., the state of each of the system's $N$ spins). There are a total of $q^N$ such configurations.

We map the problem of minimizing (5) to a network community-detection problem by assigning a spin to each node and letting $q = N$. In this language, one adds the interaction energy $-J_{ij}$ if and only if nodes $i$ and $j$ are placed in the same community. Two nodes that are connected by an edge interact ferromagnetically ($J_{ij} > 0$) when the weight of the edge is greater than expected (given a specific null model) and interact antiferromagnetically ($J_{ij} < 0$) when it is less than expected. If $J_{ij} = 0$, spins $i$ and $j$ do not interact with each other. Hence, two nodes want to be in the same community if they interact ferromagnetically and in different ones if they interact antiferromagnetically. One cannot in general find any arrangement of spins (i.e., any partition of a graph into communities) that simultaneously minimizes all of the pairwise interaction energies. Regardless of this inability to satisfy all of the bonds simultaneously, a phenomenon termed "frustration" [36], one can still try to minimize $H$ globally to find the ground state of the system. The choice of interaction matrix elements given by

$$J_{ij} = \frac{A_{ij} - P_{ij}}{W} \tag{6}$$

implies that $H = -Q$ and recovers modularity maximization [104]. (Division by $W$ is a normalization and does not affect the optimization algorithms.) Alternative interaction models can also be used to partition networks (see, e.g., [57]).

### Resolution Parameters

In 2007, Santo Fortunato and Marc Barthélemy demonstrated, using both real and computer-generated networks, that modularity suffers from a resolution limit in its original formulation [38], as it misses communities that are smaller than a certain threshold size that depends on the size of the network and the extent of interconnectedness of its communities. Communities smaller than the threshold tend to be merged into larger communities, thereby missing important structures. We have seen this in our own work on the U.S. House committee assignment network, as detecting communities by maximizing modularity can group multiple standing committees (with their subcommittees) into a single community [100].

One way to address this resolution limit is to incorporate an explicit *resolution parameter* directly into equations like (6) to obtain [104]

$$J_{ij} = \frac{A_{ij} - \lambda P_{ij}}{W}\,. \tag{7}$$

One can alternatively incorporate a resolution parameter into $A_{ij}$ or elsewhere in the definition of a quality function (see, e.g., [6]). This allows one to zoom in and out in order to find communities of different sizes and thereby explore both the modular and the hierarchical structures of a graph. Fixing $\lambda$ in (7) corresponds to setting the scale at which one is examining the network: Larger values of $\lambda$ yield smaller communities (and vice versa). Resolution parameters have now been incorporated (both explicitly and implicitly) into several methods that use modularity [12, 104], other quality functions [6, 69], and other perspectives [8, 97].

Although introducing a resolution parameter using equations like (7) seems *ad hoc* at first, it can yield very interesting insights. For example, $J_{ij} = (A_{ij} - \lambda)/W$ gives a uniform null model in which a given fixed average edge weight occurs between each node. This can be useful for correlation and similarity networks, such as those produced from matrices of yea and nay votes. Nodes $i$ and $j$ want to be in the same community if and only if they voted the same way more than some threshold fraction of times that is specified by the value of $\lambda$.

Even more exciting, one can relate resolution parameters to the time scales of dynamical processes unfolding on a network [27, 68, 98, 108]. Just as we can learn about the behavior of a dynamical system by studying the structural properties of the network on which it is occurring, we can also learn about the network's structural properties by studying the behavior of a given dynamical process. This suggests the intuitive result that the choice of quality function should also be guided by the nature of the dynamical process of interest. In addition to revealing that resolution parameters arise naturally, this perspective shows that the Potts method arises as a special case of placing a continuous time random walk with Poisson-distributed steps on a network [27]. Freezing the dynamics at a particular point in time yields the modularity-maximizing partition. Freezing at earlier times yields smaller communities (because the random walker hasn't explored as much of the graph), and waiting until later times results in larger communities. The $t \to \infty$ limit reproduces the partitioning from Miroslav Fiedler's original spectral method [35].

## Applications

Armed with the above ideas and algorithms, we turn to selected demonstrations of their efficacy. The increasing rapidity of developments in network community detection has resulted in part

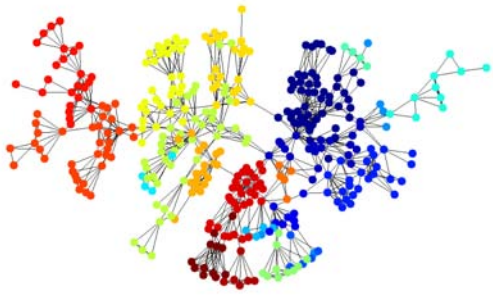

**Figure 5. The largest connected component (379 nodes) of the network of network scientists (1,589 total nodes), determined by coauthorship of papers listed in two well-known review articles [13,83] and a small number of papers added manually [86]. Each of the nodes in the network, which we depict using a Kamada-Kawai visualization [62], is colored according to its community assignment using the leading-eigenvector spectral method [86].**

from the ever-increasing abundance of data sets (and the ability to extract them, with user cleverness). This newfound wealth—which includes large, time-dependent data sets—has, in turn, arisen from the massive amount of information that is now routinely collected on websites and by communication companies, governmental agencies, and others. Electronic databases now provide detailed records of human activity patterns, offering novel avenues to map and explore the structure of social, communication, and collaboration networks. Biologists also have extensive data on numerous systems that can be cast into network form and which beg for additional quantitative analyses.

Because of space limitations, we restrict our discussion to five example applications in which community detection has played a prominent role: scientific coauthorship, mobile phone communication, online social networking sites, biological systems, and legislatures. We make no attempt to be exhaustive for any of these examples; we merely survey research (both by others and by ourselves) that we particularly like.

### Scientific Collaboration Networks

We know from the obsessive computation of Erdös numbers that scientists can be quite narcissistic. (If you want any further evidence, just take a look at the selection of topics and citations in this section.) In this spirit, we use scientific coauthorship networks as our first example.

A bipartite (two-mode) coauthorship network—with scientists linked to papers that they authored or coauthored—can be defined by letting $\delta_i^p = 1$ if scientist $i$ was a coauthor on paper $p$ and 0 otherwise. Such a network was collected and examined from different databases of research papers in [80–82]. To represent the collaboration strength between scientists $i$ and $j$, one can define

$$A_{ij} = \sum_p \frac{\delta_i^p \delta_j^p}{n_p - 1} \tag{8}$$

as the components of a weighted unipartite (one-mode) network, where $n_p$ is the number of authors of paper $p$ and the sum runs over multiple-author papers only. Applying betweenness-based community detection to a network derived from Santa Fe Institute working papers using (8) yields communities that correspond to different disciplines [48]. The statistical physics community can then be further subdivided into three smaller modules that are each centered around the research interests of one dominant member. Similar results have been found using various community-finding algorithms and numerous coauthorship networks, such as the network of network scientists [86] (see Figures 1 and 5), which has become one of the standard benchmark examples in community-detection papers.

### Mobile Phone Networks

Several recent papers have attempted to uncover the large-scale characteristics of communication and social networks using mobile phone data sets [49, 95, 96]. Like many of the coauthorship data sets studied recently [96], mobile phone networks are longitudinal (time-dependent). However, in contrast to the ties in the coauthorship networks above, links in phone networks arise from instant communication events and capture relationships as they happen. This means that at any given instant, the network consists of the collection of ties connecting the people who are currently having a phone conversation. To probe longer-term social structures, one needs to aggregate the data over a time window.

In 2007 one research group used a society-wide communication network containing the mobile phone interaction patterns of millions of individuals in an anonymous European country to explore the relationship of microscopic, mesoscopic, and macroscopic network structures to the strength of ties between individuals on a societal level [95]. They obtained very interesting insights into Mark Granovetter's famous *weak tie hypothesis*, which states that the relative overlap of the friendship circles of two individuals increases with the strength

of the tie connecting them [51]. At the mesoscopic level, this leads to a structure in which individuals within communities tend to be linked via strong ties, whereas communities tend to be connected to other communities via weak ties. Because of this coupling between link strength and function, the weak ties are responsible for the structural integrity of the communication network: It is robust to the removal of the strong ties but breaks up if the weak ties are removed (see Figure 6). In fact, one can even show that the removal of weak ties leads to a (phase) transition from a regime in which the network remains globally connected to one in which the network essentially consists of insular communities. However, there is no phase transition if the strong ties are removed, so the network remains globally connected. The location of the transition also suggests a natural quantitative demarcation between weak and strong ties. This mesoscopic organization of social networks has important consequences for the flow of information. If one assumes that every tie (regardless of strength) is equally efficient in transferring information, one recovers the classical result of Granovetter that weak ties are mostly responsible for information diffusion [51]. However, if one assumes that the rate of information transfer is proportional to the strength of the tie, then neither weak nor strong ties are as effective as intermediate ties for information diffusion [95].

To help develop methods that can be applied to time-dependent networks, another research group has recently applied $k$-clique percolation to a large mobile phone data set to investigate community formation, evolution, and destruction [96]. They found that large communities persist longer if they are capable of dynamically altering their membership (suggesting that an ability to change the group composition results in better adaptability), whereas small groups last longer if they stay virtually unchanged. We've all seen examples of such dynamics in real life: A mathematics department at a university will last a long time and will still be identified as fundamentally the same community even though its membership can change quite drastically over time. On the other hand, an individual research group might rely on only one or two of its members for its existence.

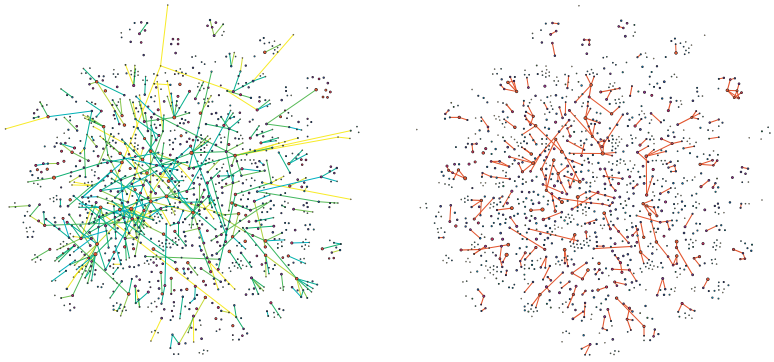

**Figure 6. (Left) A sample of a mobile phone network studied in [94,95]. After the strong ties have been removed, the network still retains its global connectivity. (Right) Removal of weak ties leads, through a phase transition, to a disintegration of the network. (Figure adapted from [94].)**

### Online Social Networks

Social networking sites (SNSs) have become a pervasive part of everyday life. They allow users to construct a public or semi-public online profile within a bounded system, articulate a list of other users (called "friends") with whom they share a connection, and view and traverse their network of connections [16, 122]. Since their introduction, SNSs such as Facebook, LinkedIn, MySpace, and hundreds of others have collectively attracted over one billion users [128]. People have integrated SNSs into their daily lives, using them to communicate with friends, send emails, solicit opinions or votes, organize events, spread ideas, find jobs, and more.

The emergence of SNSs has also revolutionized the availability of quantitative social and demographic data, which has in turn transformed the study of social networks [16]. This has obviously been a big deal for social scientists (see [73] for an excellent recent example), but numerous mathematicians, computer scientists, physicists, and more have also had a lot of fun with this new wealth of data. This has included investigations of attachment mechanisms to determine how SNS network structure might develop [67], the formation of friends, allies, and nemeses [18, 59], and much more [16, 122].

In a recent paper [122], we used anonymous Facebook data from September 2005 to compare the friendship networks of several American universities. This data yields networks in which each node represents a person and each edge represents a self-identified, reciprocal online friendship. The institutions we considered ranged from small technical universities such as Caltech (1,089 nodes) to large state universities such as the University of Oklahoma (about 24,000 nodes). Our data also includes limited demographic information for each user: gender, high school, class year, major, and dormitory residence. Using permutation tests, we developed tools that allow one to quantitatively compare different network partitions, which can be obtained from any desired method—including, in particular, community-detection algorithms and user demographics. This enables one to investigate the demographic organization of different universities and compare the results of different community-detection algorithms. We found, for

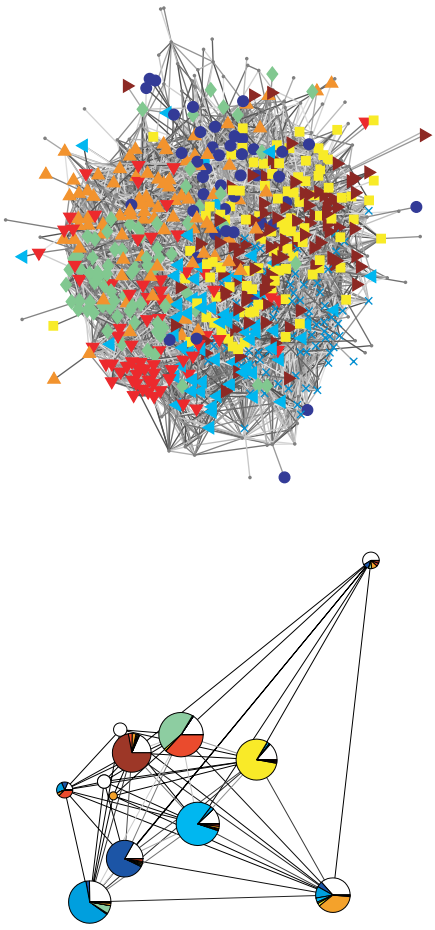

**Figure 7. (Top) Caltech friendship network based on Facebook data from September 2005 using the Fruchterman-Reingold visualization method [45]. The colors (and shapes) correspond to self-identified House (dormitory) affiliation. (Bottom) Communities in the Caltech network. We obtained this community structure, which accurately matches the Caltech House structure, using a slight modification of Newman's leading-eigenvector algorithm [86] and subsequent KL node-swapping steps [107,122,133]. It also gives some indication of the most probable House affiliations of the people in white, who did not identify their House [122].**

example, that communities at Princeton, Georgetown, and the University of North Carolina at Chapel Hill are organized predominantly by class year, whereas those at Caltech are based almost exclusively on House (dormitory) affiliation. As we illustrate in Figure 7, community structure can also be used to make simple yet intelligent guesses about withheld user characteristics. Naturally, this opens up significant privacy issues when data is not fully anonymous.

### Biological Networks

One of the paramount goals of studying biological networks is to determine the principles governing their evolution. It is hoped that finding important network structures might give some insights into the mechanisms (and, ideally, the natural design principles) that control the flow of biological information. Thus, it is unsurprising that clustering methods form a core part of bioinformatics [15,63], and there is simply no way to do justice to this vast literature here. Accordingly, we only present a couple of our favorite examples.

In 2002 Ron Milo et al. investigated a plethora of directed networks to develop the idea of miniature communities known as *motifs* [75], which are used to describe patterns of nodes and edges that occur significantly more prevalently than expected in a network. Motifs can be interpreted as basic building blocks of complex networks, perhaps representing small functional modules that arose via evolutionary mechanisms. The simplest motifs—triangles (3-cliques), in which three nodes are all mutually interconnected—have long been studied in social networks [44,124]. The amazing discovery of Milo et al. is that different types of motifs are, in fact, prevalent universally in many different types of networks. Among the omnipresent motifs they observed are 3-chains in ecological networks (in which a prey node is connected by a directed edge to a predator node, which is in turn connected by a directed edge to another predator); diamonds in ecological networks, neural networks, and logic chips; feed-forward loops in gene regulation networks, neural networks, and logic chips; triangles in the World Wide Web; and more.

Numerous scientists have built on this foundation of motifs, and several investigations have provided fascinating connections between motifs and larger mesoscopic structures. For example, one team investigated three-node and four-node motifs in an integrated *Saccharomyces cerevisiae* network, which they constructed using information from protein interactions, genetic interactions, transcriptional regulation, sequence homology, and expression correlation [132]. Their primary finding was that most motifs form larger "network themes" of recurring interconnection patterns that incorporate multiple motif occurrences. They were also able to tie some of these mesoscopic themes to specific biological phenomena, such as a pair of protein complexes with many genetic interactions between them. The notion of motifs has also recently been used to develop generalizations of graph modularity [5].

One can imagine constructing a course-grained network consisting of interconnected network

themes. For example, in a seminal 2005 paper, Roger Guimerà and Luís Amaral used communities to try to construct a "functional cartography" of biological networks in order to employ nodes and modules with known roles to try to obtain interesting insights on nodes and modules with unknown functionality [52]. To understand their perspective, consider the prototypical maps of countries in which important cities are marked by special symbols, other cities are marked with dots, and smaller towns are not shown. In the network context, there is a one-to-one correspondence between markers and communities, and the symbols are determined according to structural and/or functional roles. The connections between communities are analogous to major highways. In fact, our coloring of community ties according to the demographic composition of their nodes (see Figures 4 and 7) was originally inspired by [52].

To illustrate their idea, Guimerà and Amaral considered the metabolic networks of twelve different organisms. They started by detecting communities by maximizing modularity using simulated annealing and then (following a suggestion from social scientist Brian Uzzi) calculated appropriate properties of each node to determine their role in their assigned community. After finding communities, they calculated for each node $i$ the *within-module degree*, given by the number of its edges that connect to other nodes in the same community, and a *participation ratio* $P_i$, which measures the extent to which links are distributed among all network communities. Guimerà and Amaral then interpreted the role of each node based on its location in the plane determined by $P_i$ and the $z$-score $z_i$ of the within-module degree. They thereby found that "non-hub connector nodes" (which have low $z_i$ and moderately high $P_i$, indicating a preferential connectivity to a subset of the network's communities) are systematically more conserved across species than "provincial hubs" (which have high $z_i$ and low $P_i$). This appears to be related to the role of non-hub connectors in describing the global structure of fluxes between different network modules. Importantly, one can follow a similar procedure using other measures, such as betweenness centrality [34], as the essential insight—which, we stress, *was borrowed from ideas in the social sciences*—is to calculate network quantities relative to community assignment.

### Legislative Networks

Advances in network science have also begun to uncover the ways in which social relationships shape political outcomes [40, 41, 101]. In this section, we describe our own work on legislative networks [100, 101, 125, 133], in which community detection has played a central role.

Consider a bipartite graph that is constructed using Representatives and their committee and subcommittee (henceforth called simply "committee") assignments during a single two-year term of the U.S. House of Representatives. Each edge represents a committee assignment and connects a Representative to a committee. We project each such network onto a weighted unipartite graph of committees (see Figure 4), in which the nodes are now committees and the value of each edge gives the normalized connection strength between two committees. By computing the community structure of these networks and analyzing legislator ideology, we investigated correlations between the political and organizational structure of House committees. This revealed close ties between the House Rules Committee and the Select Committee on Homeland Security in the 107th (2001–02) and 108th (2003–04) Congresses that broke the established procedures for determining the composition of select committees [100, 101]. (Figure 4 shows the 108th Congress.) We also showed that the modularity of good network partitions increased following the 1994 elections, in which the Republican party earned majority status in the House for the first time in more than forty years.

Studying networks constructed from legislation cosponsorship can help uncover social connections between politicians, as legislators who work together closely on pieces of legislation are likely to have friendly (or at least cordial) relations. Computing centrality measures in these networks gives a who's who list of American politics, as it reveals important players like Bob Dole [R-KA], John McCain [R-AZ], and Ted Kennedy [D-MA] [40]. The longitudinal study of community structure in Congressional legislation cosponsorship [133] and roll-call voting [125] networks shows that graph modularity can be used to study partisan polarization and political party realignments. This reveals patterns suggesting that political parties were not the most significant communities in Congress for certain periods of U.S. history and that the 1994 party-changing elections *followed* a rise in partisan polarization rather than themselves leading to an abrupt polarization in America.

## Summary and Outlook

With origins in sociology, computer science, statistics, and other disciplines, the study of network communities is in some respects quite old. Nevertheless, it has experienced incredible growth since the seminal 2002 paper [48] that brought greater attention to the problem, particularly among statistical physicists [39]. In this survey, we have highlighted an extensive suite of techniques, and there are numerous other methods that we simply

haven't had space to discuss (see the review articles [26, 39, 110] for more information on many of them). Despite this wealth of technical advances, much work remains. As Mark Newman recently wrote [88], "The development of methods for finding communities within networks is a thriving sub-area of the field, with an enormous number of different techniques under development. Methods for understanding what the communities mean after you find them are, by contrast, still quite primitive, and much needs to be done if we are to gain real knowledge from the output of our computer programs." One of our primary purposes in writing this article is as a "call to arms" for the mathematics community to be a part of this exciting endeavor. Accordingly, we close our discussion with additional comments about important unresolved issues.

The remarkable advances of the past few years have been driven largely by a massive influx of data. Many of the fascinating networks that have been constructed using such data are enormous (with millions of nodes or more). Given that optimization procedures, such as maximizing graph modularity, have been proven to be NP-complete [17], much of the research drive has been to formulate fast methods that still find a reasonable community structure. Some of the existing algorithms scale well enough to be used on large networks, whereas others must be restricted to smaller ones. The wealth of data has also led to an increasing prevalence (and, we hope, cognizance) of privacy issues. However, although the study of network communities has become so prominent, this research area has serious flaws from both theoretical and applied perspectives: There are almost no theorems, and few methods have been developed to use or even validate the communities that we find.

We hope that some of the mathematically-minded *Notices* readers will be sufficiently excited by network community detection to contribute by developing new methods that address important graph features and make existing techniques more rigorous. When analyzing networks constructed from real-world data, the best practice right now is to use several of the available computationally tractable algorithms and trust only those structures that are similar across multiple methods in order to be confident that they are properties of the actual data rather than byproducts of the algorithms used to produce them. Numerous heuristics and analytical arguments are available, but there aren't any theorems, and even the notion of community structure is itself based on the methodology selected to compute it. There also appear to be deep but uncharacterized connections between methods that have been developed in different fields [39, 110]. Additionally, it would be wonderful if there were a clearer understanding of which notions of community and which community-detection methods might be especially appropriate for networks with specific properties and for networks belonging to a specific domain.

At the same time, the problem of how to validate and use communities once they are identified is almost completely open. Fortunately, recent work offers some hope, as new methods have been developed to infer the existence of missing edges from network data [23] and relate the composition of communities to intelligent guesses about the demographic characteristics of nodes [122]. (As with social networks more generally, sociologists have already been considering these issues for a long time [19, 44]. What we need are techniques that allow us to do this even more effectively.) In [23], Aaron Clauset, Cris Moore, and Mark Newman drew on the insight that real-world networks should not be expected to have a unique community structure (despite the output produced by almost all of the available methods) and formulated a new *hierarchical random graph model* to develop a method for inferring hierarchical structure from network data. (A different hierarchical random graph model was formulated for community detection in [109].) Their method, which shows excellent promise for future development, allowed them to make accurate predictions about missing connections in partially known networks. In our own work on Facebook networks [122], we used permutation tests to advance methods for the quantitative comparison of network partitions. Because one can obtain such partitions either from algorithmic community-detection methods or by hand (from external demographics or other properties), this provides a mechanism to compare the results of different community-finding algorithms and to try to infer node characteristics given partial demographic information.

It is also important to develop community-detection techniques that can be applied to more complicated types of graphs. As we saw in our discussion of legislative and coauthorship networks, collaboration networks have a bipartite structure. However, there has been seemingly only limited work thus far on community finding that works directly on bipartite networks rather than on their unipartite projections [10, 53, 71, 100]. Even fewer community-detection methods are able to handle directed networks (whose adjacency matrices are asymmetric) [53, 72] or signed networks (whose connections might be construed as "attracting" or "repelling") [121]. Moreover, agents in social networks are typically connected in several different manners—for example, Representatives can be connected using voting similarities, common committee assignments, common financial contributors, and more—but there are presently very

few algorithms that can be applied to such multiplex situations without constructing individual graphs for each category, and further development will likely require the application of ideas from multilinear algebra [65, 115]. It would also be desirable to detect communities in hypergraphs and to be able to consider connections between agents that are given by interval ranges rather than precise values. Finally, to be able to study interactions between dynamical processes on networks and the structural dynamics of networks themselves (e.g., if somebody spends a day at home with the flu, the network structure in the workplace is different than usual that day), a lot more work is needed on both overlap between communities and on the community structure of time-dependent and parameter-dependent networks. Analyzing time- and parameter-dependent networks currently relies on *ad hoc* amalgamation of different snapshots rather than on a systematic approach, so it is necessary to develop community-detection methods that incorporate the network structure at multiple times (or parameter values) simultaneously [58, 96, 116]. More generally, this will also have important ramifications for studies of clustering in correlated time series.

We stress that research on network communities has focused on using exclusively structural information (i.e., node connectivity and link weights) to deduce *structural communities* as imperfect proxies for *functional communities* [39, 116, 122]. While this seems to be sufficient for some applications [39], in most situations it is not at all clear that structural communities actually map well to the organization of actors in social networks, functions in biological networks, etc. Hence, it is necessary to develop tools for the detection of functional communities that, whenever possible, incorporate node characteristics and other available information along with the network's structural information. The elephant in the literature is simply elucidated with just one question: *Now that we have all these ways of detecting communities, what do we do with them?*

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# Transitioning to Careers in Higher Education

# Reflections from Recent Ph.D.s in Mathematics Education

*Robert Reys, Dana Cox, Shannon Dingman, and Jill Newton*

Each year a new group of doctoral students complete their Ph.D.s in mathematics and mathematics education, and many of them begin a career in higher education. While Ph.D.s in mathematics going into higher education will enter an academic home in mathematics departments, Ph.D.s in mathematics education may have their tenure homes in mathematics departments or in colleges/schools of education. Research shows that over one-half of the new Ph.D.s in mathematics education take an appointment in a mathematics department [1,2].

Golde and Walker [3] have argued the need to monitor the progress of new Ph.D.s in their positions in higher education and use this information to strengthen doctoral preparation. Important aspects to be monitored are the challenges that lie ahead for these new Ph.D.s as they begin careers in higher education. Some of these challenges, such as quickly becoming familiar with institutional program requirements, being able to offer competent advisement to students where different course titles/numbers are involved, teaching new courses, and expectations for early evidence of scholarly productivity, have been articulated elsewhere [4, 5, 6].

The current study was completed in order to learn more about the types of work expected from new graduates in mathematics education and the challenges they face in their new positions in higher education. This study was also designed to examine ways their early experiences might be used to reshape and improve doctoral programs in mathematics education and thereby benefit future doctoral students with aspirations for entering careers in higher education. All fourteen recent graduates invited to participate in the study responded to the request. These students earned Ph.D.s in mathematics education from Michigan State University, University of Missouri, or Western Michigan University and have taken positions in institutions of higher education during the last three years. Each of these students was associated with the Center for the Study of Mathematics Curriculum supported by the National Science Foundation as one of the Centers for Learning and Teaching (`http://www.mathcurriculumcenter.org/`).

The survey asked these new mathematics educators to describe their current positions, the

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challenges they have been facing, and the support they have received from their institution. They were also asked to reflect on the interview process as well as their current position, and to offer advice to present and future doctoral students considering a career in higher education.

## About the New Faculty Members

These fourteen recent graduates took their new jobs in thirteen different states. Four of them completed a mathematics education doctoral program in a mathematics department. The other ten were in mathematics education programs in colleges of education. Ten of the fourteen new faculty members were employed by institutions that award doctorates in mathematics education, and four were employed in institutions awarding bachelor's or master's degrees. Thirteen were employed in public institutions. A mathematics department was the academic home of eight new faculty members, while six worked in colleges/departments of education, including one that had a joint appointment in education and mathematics.

## Teaching, Research, Service

The new faculty described their positions in predictable ways. In most positions they were expected to engage in some combination of research, teaching, and service, typically a 40-40-20 allocation of their time. Some found themselves

**Table 1. Titles of courses taught during first-year appointment in colleges/schools of education**

| Course Title | Credit Hours |
|---|---|
| Mathematics in Elementary School | 3 |
| Mathematics for Elementary Teachers I | 3 |
| Mathematics for Elementary Teachers II | 3 |
| Teaching Mathematics in the Middle School and High School | 3 |
| Teaching Mathematics in Secondary School | 3 |
| Mathematics Methods for Early Childhood (PreK–4) | 3 |
| Integrated Teaching: Mathematics Methods for Elementary Teachers | 3 |
| Theory of Mathematics and Science Instruction | 3 |
| Mathematics Curriculum (graduate course credit) | 3 |

**Table 2. Titles of courses taught during first-year appointment in departments of mathematics**

| Course Title | Credit Hours |
|---|---|
| Intermediate Algebra | 3 |
| Introduction to the Foundations of Mathematics I | 3 |
| Mathematical Reasoning | 3 |
| Survey of Mathematical Structures II | 3 |
| Pre-calculus for Middle and High School Mathematics Teachers | 4 |
| Business Calculus | 3 |
| Fundamentals of Calculus | 3 |
| Algebraic Reasoning for Elementary Teachers | 4 |
| Mathematics for Elementary Teachers I | 3 |
| Mathematics for Elementary Teaching | 4 |
| Number Theory for Elementary and Middle School Mathematics Teachers | 4 |
| Foundations of Middle School Mathematics | 3 |
| Mathematics for Middle Grade Teachers II | 3 |
| Geometry for Middle Grade Teachers | 3 |
| Methods for Teaching Mathematics K–8 | 3 |

incorporated into established working groups of faculty members, while others were the sole mathematics educator in their institutions. Some were immediately involved in externally funded projects, while others were encouraged to begin exploring ways of obtaining external funds. The positions held a wide range of opportunities for research, teaching, and service.

In terms of research, this meant that some were stepping into a research agenda "already in progress" and for others, this meant freedom to determine their own agendas—which may or may not include collaborative projects. Only one respondent replied that they had not yet set a research agenda. Internal research support took different forms, including mini-grants, travel support, reduced teaching or service loads, and even encouragement to take mini-sabbaticals pretenure.

With respect to teaching, the new faculty taught a wide array of course offerings. Tables 1 and 2 show the range of course titles these new faculty members reported teaching during the 2008–09 academic year. It is worth noting that Tables 1 and 2 also show that some methods courses are taught in mathematics departments (e.g., Methods for Teaching Mathematics K–8) and some mathematics content courses are taught in education (e.g., Mathematics for Elementary Teachers I and II). From the course titles, it is not possible to differentiate the range of topics that is addressed in these courses. However, given the variety of course titles shown in Tables 1 and 2, it is safe to say that regardless of whether their academic home is in education or in a mathematics department, new graduates in mathematics education need to be ready to teach a wide range of courses.

Tables 1 and 2 also show the number of credit hours for each course. The teaching loads were similar in colleges/schools of education and mathematics departments: typically the teaching load was two to three courses each semester. Every faculty member had multiple course preparations, and nearly everyone reported they were teaching courses new to them. Consequently, they spent a large amount of time preparing for and teaching their classes. They also reported that examining homework assignments and developing/grading tests was requiring much more time than they had anticipated.

In several institutions, the teaching load was twelve semester hours for the year, and, depending on the courses taught, this load could be reached by teaching four 3-semester-hour courses, or three 4-credit-hour courses. While the total hours of teaching are identical, these options may result in different workloads.

In terms of service, some new graduates had opportunities to engage immediately with school/university partnerships, including lab schools and funded professional development projects. There were also differences in advising responsibilities and in terms of assigned committee work. Many reported having reduced service loads in the first year to encourage research productivity, and they expected these responsibilities to grow in subsequent years.

## Learning from the Experience of These New Faculty Members

The new faculty members were asked to address a set of common questions:

- What was your biggest adjustment taking a faculty position?
- What advice would you give to current doctoral students in the program?
- What is your advice about pursuing a job?
- If you were interviewing for a job again, what questions would you ask?

A review of their responses suggests they experienced similar challenges that were independent of their academic homes. Whether they were teaching in mathematics departments or colleges/schools of education, many of the same issues and challenges were identified, and their answers often offered very similar ideas. Therefore, the following discussion pools their responses[1] and highlights key issues that were identified.

### What Was Your Biggest Adjustment Taking a Faculty Position?

The challenges noted by the respondents fell into the following three broad categories.

*Learning the system(s).* Learning the system involved two different types of activity: meeting people and getting to know particular programs and courses. Meeting people in new departments, colleges, and universities is a time-consuming yet significant task, particularly as new Ph.D.s learn about the relationship of their own work to the ongoing work being done at their new institution. Understanding alternative course numbering systems, getting to know what courses are offered and required by different programs of study, and finding out how major and minor programs fit within the broader educational goal of the university are also challenging, particularly if new Ph.D.s are asked to take on advising responsibilities in their first year. The importance of gaining and understanding this knowledge was cogently expressed by one new faculty member who said, "I have to make sure that I give accurate information to people who need to student teach or graduate."

Ph.D.s in mathematics education have the added challenge of learning about the local and state K–12 systems. Standards for K–12 mathematics education vary significantly by state [7]. Taking a position across state lines means that new Ph.D.s must adapt quickly as they are introduced to

[1] *Responses provided here are not necessarily exact quotes, but they do reflect the nature of the feedback from these new faculty members.*

local districts and teachers, particularly if they are joining professional development or research programs already in progress, or if they have aspirations of initiating programs in K–12 schools.

*Teaching.* Respondents indicated that teaching has been a nice change from having research as the sole focus in their doctoral program. With this new change came new challenges. Several respondents indicated that teaching college students is very different from teaching middle or high school students (most of the fourteen graduates had previously taught in K–12 schools). They remarked that they had less control over the study habits of college students than in their K–12 experience. One graduate said, "I had to figure out how to give my students assignments that involved a significant amount of formative feedback without being overwhelmed by grading." Since teaching evaluations are regularly done in all courses and are entered into the annual review, it puts added stress on these new faculty members to make the adjustments to college teaching quickly.

*Time Management and Prioritizing.* A common response from the new faculty was that time management was a continuing challenge. One graduate remarked, "I have a lot of freedom in what I do and when I do it. Yet I must juggle teaching, writing, committees, and service." This freedom is different from what most experienced in graduate programs. "I was happy to follow the lead of the faculty [as a doctoral student] as they set priorities for my work. Now I am on my own in choosing which avenues to pursue, and it has been a necessary challenge to say 'no' to some opportunities and 'yes' to others."

While they are negotiating the short-term balance between time for research, teaching, and service, most of the new Ph.D.s are also responsible for developing a long-term research agenda. While it is an essential foundation for academic productivity, respondents indicated that long-range planning was relegated to the back burner given the immediate pressures associated with teaching. This is not surprising considering that teaching is evaluated more immediately than research.

**What Advice Would You Give to Current Doctoral Students as They Continue Their Programs?**

The recent graduates were asked to provide advice to current doctoral students regarding what they could do now in their program of study to best capitalize on the opportunities provided to them. Below are four key pieces of advice gleaned from the new faculty.

*Take advantage of opportunities in research and teaching.* Respondents suggested that new doctoral students look for opportunities to get involved with mentors and research projects. "Take full advantage of the opportunities to work closely with faculty members engaged in research. Even if the work is outside of the expectations of your position, work on projects that are of interest to you or that give you opportunities to pick up new skills." Pointing to the variety of courses mathematics education Ph.D.s are asked to teach, they suggested developing a portfolio of diverse teaching experiences. "Teaching a few different courses (both content and methods courses for teachers) helped a lot for preparing for my teaching at my new job." Another said, "Learn to teach an elementary mathematics content and methods course. Every job out there (nearly so) is going to have you teach one."

*Work hard and engage in scholarly writing.* Along with taking advantage of the proximity of research opportunities, respondents suggested developing good writing habits early and writing as much as possible. "Try to publish an article and make a presentation in the first couple of years of your doctoral program. It gives you valuable experience and it strengthens your vita—which you should already be starting to work on. Even when your proposals are not successful, you learn some do's and don'ts that will help you in the future." They also advised that finding time for writing in the first year of a position is difficult, even without a dissertation to finish. As one new faculty advised, "Don't leave ABD if you can help it."

*Network with others and be open to mentoring.* Some of the new faculty advised developing both personal and professional relationships with young faculty and other graduate students, particularly those with similar research interests. These relationships provide both support and often unforeseen opportunities for research collaboration down the road. Respondents advised, "Don't be shy. Don't be afraid to ask senior faculty members for help and advice." In their own experience, there is much to be learned from faculty members about teaching: "Pay attention to how faculty members deal with their students as you may encounter similar situations." This also goes for research: "Learn from faculty about how the process of grant writing, data collection, etc., works." In developing relationships with faculty, advice included looking beyond home institutions. "Make a list of your 'dream-team' group of researchers with whom you'd like to connect, and work toward developing those relationships." Similarly, developing relationships with graduate students from other campuses can lead to helpful dissertation support and even peer-editing partnerships.

*Develop a tool kit of resources.* In addition to cultivating the resource of professional relationships, respondents valued having a well-organized tool kit of resources to help hit the ground running in their new positions. For teaching, they recommended that new students "gather materials and course information (e.g., syllabi, books, DVDs, curriculum materials, videos, URLs, and lesson plans) so they have something to start with when

designing or developing their own classes." As for research, they iterated that the main goal is to keep all that has been read, written, and discussed in graduate school in a useful and well-organized database. They recommend leveraging technology such as Delicious (http://delicious.com), Zotero (http://zotero.com), Endnote (http://www.endnote.com/), and Refworks (http://refworks.com) for saving, maintaining, categorizing, and noting useful resources.

**What Is Your Advice to Current Doctoral Students about Pursuing a Job in Higher Education?**

In addition to advising current doctoral students about their present experiences, the new faculty provided advice regarding the current students' future transition to the professoriate. Below are several pieces of advice the new faculty members offered.

*Prepare your vita.* Your vita provides a thumbnail sketch of your academic history and work experience. Start it early and keep it current so you can provide a copy on request. Ask experienced faculty members to review your vita and offer suggestions. Several new faculty members reported they have already been asked for a copy of their vita to attach to a proposal that was being prepared. One commented, "I needed to include my vita on an internal travel request for funds. Parts of my vita are also posted on the departmental website, and I am supposed to keep it updated."

*Find a place that is a good fit for you.* Learn about the institutions to which you are applying. In order to ensure a "good fit", seek answers to questions such as, "Is this position a new or replacement position? If it is a replacement, why did the person leave?" Understand and compare your qualifications to the job requirements. Be realistic in what you are, what you know, and what you can do. Do you want to be an active researcher? Are you interested in pursuing scholarly activity via publications? Are you most interested in teaching? Carefully consider your own limits for stress and pressure. One new faculty member commented, "Do what makes you happy, not what gives you the most status or what you think others expect of you. This is your life and your job."

*Choose an institution that offers a productive working environment.* Common among the graduates was the importance of feeling valued and supported in their new employment. As one respondent said, "Finding a place where you feel like there are people that you would really enjoy working with is critical. If you can't be supported in ways that help you do the work you want to do, don't go there."

*Keep ties with your alma mater.* The new graduates urged current doctoral students to keep avenues open with their professors and research collaborators. These faculty members know you well. They are proud of their graduates and want them to be successful in their new positions. Respondents cited the value of keeping connected to former faculty members as they initiated their careers: "Don't be afraid to ask them for advice and help as you prepare for and begin your career in higher education."

*Face reality.* Many respondents alluded to the dramatic change that has confronted them. Their status changed with their new job, going from graduate student to an assistant professor. This transition has now moved them from the top of one heap to the bottom of another (assistant professor). One new graduate summarized the situation as, "I am now the new kid on the block, and the clock is ticking as I begin my path toward tenure!"

**If You Were Interviewing for Another Job, What Question Would You Be Sure to Ask?**

Finally, the new faculty members were asked to examine their experiences in searching for employment and provide questions they would want to ask in future interviews. Below are several categories of questions offered by these recent graduates.

*What are my job expectations?* Some new faculty offered questions related to the expectations of their new position. Examples of these types of questions included: "What is the mentoring process for new faculty members?" "What is the advising load?" "What are the specific expectations for service?" "Is summer school teaching required?" "What are the summer school pay options?" "How often is it [summer school teaching] available?" "Are there expectations to be a faculty advisor to student groups? If so, which groups, and what does this entail?" Those who proposed these questions recommended seeking as much specific information as could be obtained. One new faculty said that in her interviewing experience, although she asked about the teaching load, specific expectations for service, and if pressure exists to secure external funds, she did not ask about advising, and was subsequently surprised to learn that she would be advising sixty undergraduates.

*What is the culture of the department?* Several new faculty members suggested further inquiries into the philosophy and vision of the department as it relates to mathematics education and their professional development. Examples of these questions include: "What does it mean when someone says, 'Mathematicians and mathematics education professors at this institution get along really well'?" "What is the likelihood of hiring additional mathematics educators at this institution?" "What is the start-up package to support research and professional growth of new faculty members?"

*What are the research interests of the other mathematics education faculty?* Several new faculty posed questions related to how they would fit in with other faculty in the department. Examples of these types of questions included: "What are the

research interests of other members of the department?" "How do these interests mesh with my own interests?" "Are these individuals actively involved in research, or are they merely 'interested'?" "Will my research agenda be valued?"

*Why, exactly, do you want to hire me?* New faculty suggested learning exactly why they were offered a position at a particular institution. These faculty wanted to know, "Why me over other candidates?" "What is it that you see me offering that would benefit your program?" These questions were necessitated by their experiences during their first year, where it seemed that "lots of people or groups in the department 'want a piece of me'." The new faculty in these positions recommended that new hires find a clear vision for the purpose of their position.

**Closing**

As evidenced by the reports from these new faculty members, there are a considerable number of important experiences doctoral students in mathematics education need as part of their graduate work in order to be prepared for their future career in higher education. From research to service opportunities, from teaching to other day-to-day tasks, the role of a new professor can be exhilarating, fulfilling, and overwhelming all at once. It is therefore vitally important that those preparing future faculty as well as those who are hiring freshman faculty are cognizant of these issues in order to assist these individuals in making this difficult transition.

For over a decade there has been a severe shortage of doctorates in mathematics education [1,2]. Given this shortage and recruitment costs, it is important for institutions of higher education to not only recruit high-quality candidates that fit their institution, but once candidates have been recruited, the institutions need to support new hires in order to help them be productive and become contributing members of the faculty. It is expensive for institutions, both in terms of financial and human resources, to advertise for positions, organize search committees, review applications, conduct preliminary interviews, verify recommendations, and bring candidates to campus, as well as provide competitive salaries and start-up packages. Therefore, it is imperative that institutions do everything possible to assist and support new faculty members in learning the tricks of their new trade and in becoming successful in their new careers.

New hires in institutions of higher education have valuable experiences that can be useful to institutions planning to search for and retain new faculty members as well as current doctoral students who are preparing for careers in higher education. It is our hope that this discussion provides information useful to both groups, so that when each new faculty member is brought on board he or she will prove to be a good match with a particular institution of higher education. With strong support, faculty members will then be launched on successful careers, and departments/colleges will have acquired a valuable new faculty member who will make positive contributions to the work of the institution for many years to come.

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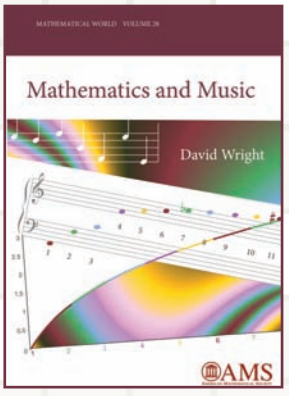


## Mathematics and Music

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**David Wright**, *Washington University, St. Louis, MO*

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# Emmy Noether: The Mother of Modern Algebra

*Reviewed by Benno Artmann*

**Emmy Noether: The Mother of Modern Algebra**
*M. B. W. Tent*
*A. K. Peters, 2008*
*US$29.00, 200 pages*
*ISBN-13:978-1568814308*

The catalogue of the Library of Congress classifies this book as juvenile literature, and in this respect it may serve its intentions well. Beyond that, a person not familiar with Emmy Noether's (1882–1935) life and the academic and political situations in Germany in the years between 1900 and 1935 may profit from the general picture the book provides of these times, even though it may sometimes not be easy to distinguish between facts and fiction.

The chapters of the book are: I, Childhood; II, Studying at the University; III, The Young Scholar; IV, Emmy Noether at Her Prime Time in Göttingen; and V, Exile.

The book is not an historical work in the academic sense. By contrast, and in agreement with her intentions, the author creates a lively picture more in the sense of a novel—letting various actors talk in direct speech, as well as providing as many anecdotes as she could get hold of and inventing stories that in her opinion fit into the general picture. That way, her young readership will appreciate the story and, in addition, along the way will get a vague impression of the mathematical accomplishments of Emmy Noether. In particular, the story of the "Noether Boys" at the Mathematical Institute in Göttingen 1925–1932 makes agreeable reading and provides a lovely picture of her group of students in those years.

Clearly, one cannot expect any specific information about Noether's mathematical work.

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The author has to be content with rather general information about "abstract algebra" and has to reduce the few absolutely necessary mathematical definitions to the capabilities of advanced high school students, as in the case of an "ideal" on page 89.

One thing, however, that could easily be corrected is to be found on pages 105–106. Here the author reports that the students were "shuffling their feet loudly" when the professor entered the classroom and did so again in appreciation at the end of the lecture. Just the opposite is right, as the reviewer remembers from his own student days: One *stamped* the feet at the beginning and end, but *shuffling* the feet was a sign of extreme displeasure during or at the end of the hour.

Well, let us stamp our feet at the end of the book!

No—there is something more useful to be mentioned: On pages 161–168 are to be found several memorial quotations from Hermann Weyl, P. S. Alexandroff, B. L. van der Waerden, and A. Einstein about the life and work of Emmy Noether. These may be very useful for anybody who wants to add a few biographical remarks when teaching Noether's concepts in a course on algebra.

WHAT IS . . .

# Stanley Depth?

*M. R. Pournaki, S. A. Seyed Fakhari, M. Tousi, and S. Yassemi*

## History and Background

Richard P. Stanley is well known for his fundamental and important contributions to combinatorics and its relationship to algebra and geometry, in particular in the theory of simplicial complexes. Two kinds of simplicial complexes play central roles in combinatorics: partitionable complexes and Cohen-Macaulay complexes. Stanley posed a central conjecture relating these two notions: Are all Cohen-Macaulay simplicial complexes partitionable? In a 1982 *Inventiones Mathematicae* paper [4], Stanley defined what is now called the Stanley depth of a graded module over a graded commutative ring. Stanley depth is a geometric invariant of a module that, by a conjecture of Stanley, relates to an algebraic invariant of the module, called simply the *depth*. It is shown in [2] that this conjecture implies his conjecture about partitionable Cohen-Macaulay simplicial complexes. Our aim here is to introduce the notion of the Stanley depth.

Let $\mathbb{K}$ be a field and $S = \mathbb{K}[x_1, \ldots, x_n]$ the $\mathbb{K}$-algebra of polynomials over $\mathbb{K}$ in $n$ indeterminates $x_1, \ldots, x_n$. We may write $\mathbf{x} = \{x_1, \ldots, x_n\}$ and denote $S$ by $\mathbb{K}[\mathbf{x}]$ for convenience. A *monomial* in $S$ is a product $\mathbf{x}^{\mathbf{a}} = x_1^{a_1} \ldots x_n^{a_n}$ for a vector $\mathbf{a} = (a_1, \ldots, a_n) \in \omega^n$ of nonnegative integers. The set of all monomials in $S$, denoted by $\mathrm{Mon}(S)$, forms a $\mathbb{K}$-basis of $S$.

A *monomial ideal* $I$ of $S$ is an ideal generated by monomials in $S$, so that there exists a subset $A \subseteq \mathrm{Mon}(S)$ with $I = \langle \mathbf{x}^{\mathbf{a}} \mid \mathbf{x}^{\mathbf{a}} \in A \rangle$. The Hilbert basis theorem now implies that there exists a finite subset $B \subseteq A$ such that $I = \langle \mathbf{x}^{\mathbf{b}} \mid \mathbf{x}^{\mathbf{b}} \in B \rangle$. Therefore, every monomial ideal $I$ of $S$ may be written in the form $I = \langle \mathbf{x}^{\mathbf{a}_1}, \ldots, \mathbf{x}^{\mathbf{a}_\ell} \rangle$, where $\mathbf{x}^{\mathbf{a}_1}, \ldots, \mathbf{x}^{\mathbf{a}_\ell} \in \mathrm{Mon}(S)$. Monomial ideals are the most manageable among all types of ideals due to their simple structure.

Clearly, every monomial ideal $I$ in $S$ is a $\mathbb{K}$-subspace of $S$. The monomials in $I$ form a $\mathbb{K}$-basis of $I$. Let us characterize monomials that lie in a given monomial ideal. In order to do this, fix a monomial ideal $I = \langle \mathbf{x}^{\mathbf{a}_1}, \ldots, \mathbf{x}^{\mathbf{a}_\ell} \rangle$ in $S$. Then a monomial $\mathbf{x}^{\mathbf{b}}$ lies in $I$ if and only if there exists $t$ with $1 \leq t \leq \ell$ such that $\mathbf{x}^{\mathbf{a}_t} \mid \mathbf{x}^{\mathbf{b}}$. This is equivalent to $\mathbf{x}^{\mathbf{b}} = \mathbf{x}^{\mathbf{a}_t}\mathbf{x}^{\mathbf{c}}$ or $\mathbf{b} = \mathbf{a}_t + \mathbf{c}$, for some $\mathbf{c} \in \omega^n$. Thus, the set $\bigcup_{t=1}^{\ell} (\mathbf{a}_t + \omega^n)$, which is a set of lattice points in $\omega^n$, consists of the exponents of all monomials in $I$. For example, the set of all monomials in the ideal $I = \langle x_1x_2^2, x_1^2x_2 \rangle$ of $S = \mathbb{K}[x_1, x_2]$ is $\{\mathbf{x}^{\mathbf{b}} \mid \mathbf{b} \in (1,2) + \omega^2\} \cup \{\mathbf{x}^{\mathbf{b}} \mid \mathbf{b} \in (2,1) + \omega^2\}$. The exponents of these monomials have been shown in Figure 1 by the blue points.

## Stanley Depth

Let $\mathbf{x}^{\mathbf{a}}$ be a monomial in $S = \mathbb{K}[\mathbf{x}]$ and fix it. The $\mathbb{K}$-subspace of $S$ whose basis consists of all monomials $\mathbf{x}^{\mathbf{a}}\mathbf{u}$, where $\mathbf{u}$ is a monomial in $\mathbb{K}[\mathbf{z}]$, $\mathbf{z} \subseteq \mathbf{x}$, is called a *Stanley space* of dimension $|\mathbf{z}|$ and is denoted by $\mathbf{x}^{\mathbf{a}}\mathbb{K}[\mathbf{z}]$. Here $|\mathbf{z}|$ denotes the number of elements of $\mathbf{z}$. For example, if $S = \mathbb{K}[x_1, x_2]$, then $x_1^2x_2\mathbb{K}$, $x_1^3x_2\mathbb{K}[x_1]$, $x_1x_2^2\mathbb{K}[x_2]$ and $x_1^2x_2^2\mathbb{K}[x_1, x_2]$ are all Stanley spaces with dimensions 0, 1, 1 and 2, respectively. In Figure 2, the red, orange and blue points consist of the exponents of all monomials in $x_1^3x_2\mathbb{K}[x_1]$, $x_1x_2^2\mathbb{K}[x_2]$ and $x_1^2x_2^2\mathbb{K}[x_1, x_2]$,

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respectively. Also $x_1^2x_2\mathbb{K}$ consists of only one monomial, namely $x_1^2x_2$. We draw the exponent of this monomial by a violet point in Figure 2.

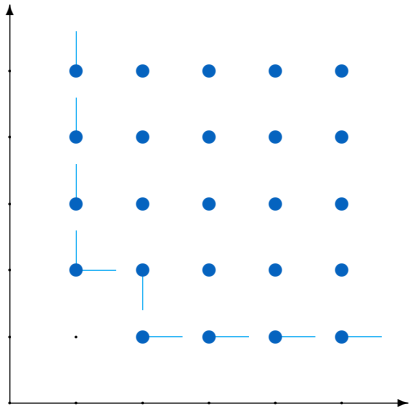


**Figure 1. The blue points mark the exponents of all monomials belonging to the ideal $I = \langle x_1x_2^2, x_1^2x_2\rangle$ of $S = \mathbb{K}[x_1, x_2]$.**

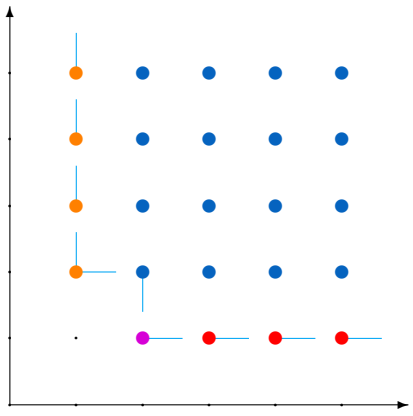


**Figure 2. The violet, red, orange and blue points consist of the exponents of all monomials which belong to $x_1^2x_2\mathbb{K}$, $x_1^3x_2\mathbb{K}[x_1]$, $x_1x_2^2\mathbb{K}[x_2]$ and $x_1^2x_2^2\mathbb{K}[x_1, x_2]$, respectively.**

Let $I$ be a fixed monomial ideal of $S = \mathbb{K}[\mathbf{x}]$. A decomposition $\mathcal{D}$ of $I$ as a finite direct sum of Stanley spaces is called a *Stanley decomposition* of $I$. It is known that there exists at least one Stanley decomposition of $I$. For example,

$$\mathcal{D}_1 : I = x_1^2x_2\mathbb{K} \oplus x_1^3x_2\mathbb{K}[x_1] \oplus x_1x_2^2\mathbb{K}[x_2] \oplus x_1^2x_2^2\mathbb{K}[x_1, x_2]$$

is a Stanley decomposition for $I = \langle x_1x_2^2, x_1^2x_2\rangle$ in $S = \mathbb{K}[x_1, x_2]$. The two other Stanley decompositions of $I$ may be written as follows:

$$\mathcal{D}_2 : I = x_1^2x_2\mathbb{K} \oplus x_1^3x_2\mathbb{K} \oplus x_1^4x_2\mathbb{K}[x_1] \oplus x_1x_2^2\mathbb{K}[x_2] \oplus x_1^2x_2^2\mathbb{K}[x_1, x_2],$$

$$\mathcal{D}_3 : I = x_1x_2^2\mathbb{K}[x_2] \oplus x_1^2x_2\mathbb{K}[x_1, x_2].$$

For a given Stanley decomposition $\mathcal{D}$ of $I$, the minimum dimension of a Stanley space in $\mathcal{D}$ is called the *Stanley depth* of $\mathcal{D}$ and is denoted by $\operatorname{sdepth}(\mathcal{D})$. Therefore, in the above example we have $\operatorname{sdepth}(\mathcal{D}_1) = 0$, $\operatorname{sdepth}(\mathcal{D}_2) = 0$ and $\operatorname{sdepth}(\mathcal{D}_3) = 1$.

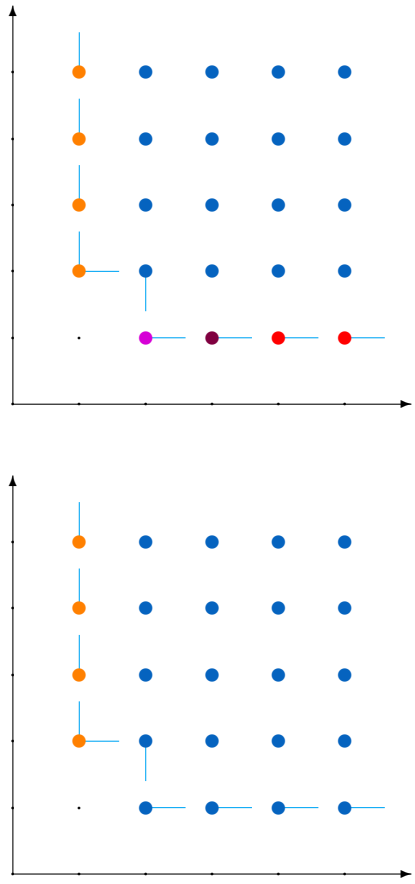


**Figure 3. The upper figure demonstrates the Stanley decomposition $\mathcal{D}_2$, while the one on the bottom corresponds to $\mathcal{D}_3$.**

Finally, the *Stanley depth* of $I$ is defined to be

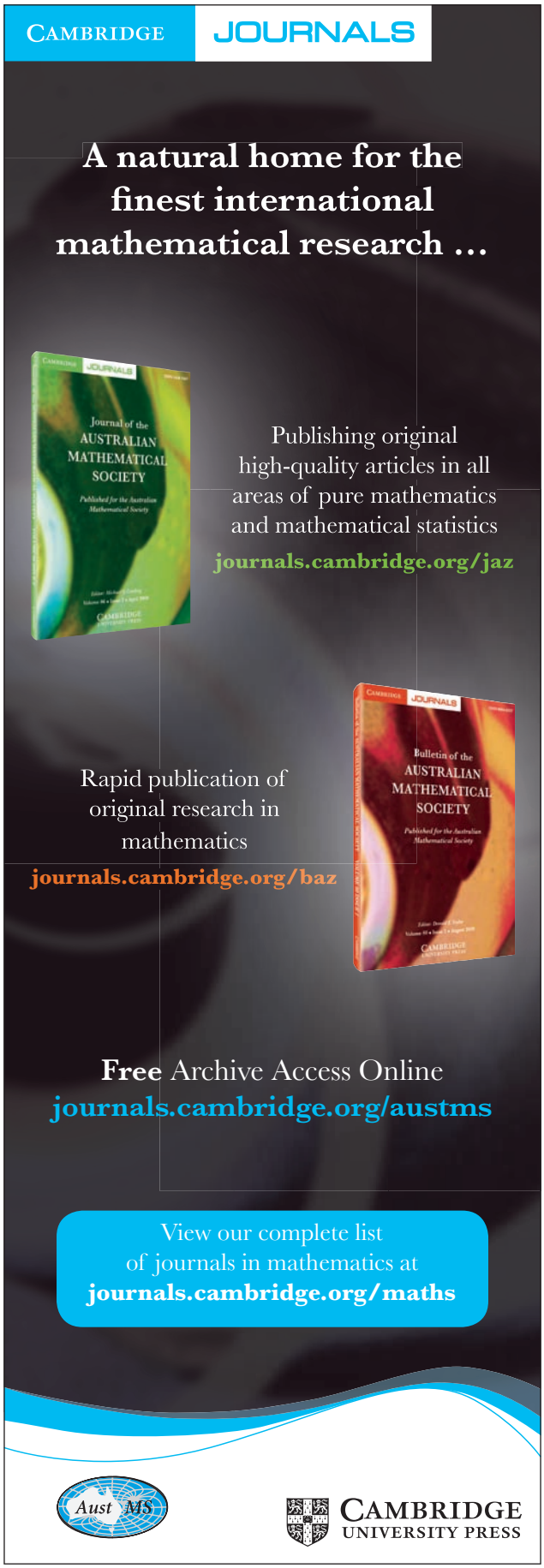
$$\operatorname{sdepth}(I) := \max\{\operatorname{sdepth}(\mathcal{D}) \mid \mathcal{D} \text{ is a Stanley decomposition of } I\}.$$

Thus, in the above example, $\operatorname{sdepth}(I)$ is at least equal to one. One may easily show that, indeed, $\operatorname{sdepth}(I) = 1$.

If $I^c$ denotes the $\mathbb{K}$-subspace of $S = \mathbb{K}[\mathbf{x}]$ generated by all monomials of $S$ which do not belong to $I$, then we may define a Stanley decomposition as well as the Stanley depth of $I^c$. The Stanley depth of $I^c$ is denoted by $\operatorname{sdepth}(S/I)$, instead of $\operatorname{sdepth}(I^c)$, since, as $\mathbb{K}$-subspaces, $S = I \oplus I^c$ and, hence, $S/I \cong I^c$. For example,

$$\mathcal{D} : I^c = x_1x_2\mathbb{K} \oplus \mathbb{K}[x_1] \oplus x_2\mathbb{K}[x_2]$$

is a Stanley decomposition of $I^c$ for $I = \langle x_1x_2^2, x_1^2x_2\rangle$ in $S = \mathbb{K}[x_1, x_2]$. Here we have $\operatorname{sdepth}(\mathcal{D}) = 0$ and one may easily show that $\operatorname{sdepth}(S/I) = 0$.




Stanley [4] defined what is now called the *Stanley depth* of a $\mathbb{Z}^n$-graded module $M$ over the ring $S$. Note that if $M$ is of the form $I$ or $S/I$, where $I$ is a monomial ideal, then this latter notion coincides with the Stanley depth defined above. In general, no algorithm for the computation of the Stanley depth is known. However, in the particular case when $M$ is of the form $I/J$, where $J \subseteq I$ are monomial ideals of $S$, such an algorithm was given by Herzog, Vladoiu, and Zheng (see [3]). They describe how to compute the Stanley depth in this case. Undoubtedly, this is one of the most important contributions to the theory so far. It provides the only method known to compute the Stanley depth and, for example, it was used to compute the Stanley depth for a complete intersection ideal. It is known that the Stanley depth of the monomial ideal $I = \langle x_1^{a_1}, \dots, x_m^{a_m} \rangle$ in the ring $S = \mathbb{K}[x_1, \dots, x_n]$ is equal to $n - m + \lceil m/2 \rceil$.

The depth of a module is one of its important algebraic invariants. For a $\mathbb{Z}^n$-graded module $M$ over the ring $S$, the *depth* of $M$, denoted by $\operatorname{depth}(M)$, is the supremum of the lengths $\ell$ of all sequences $a_1, \dots, a_\ell$ of $\mathbb{Z}$-homogenous elements of the ideal $\langle x_1, \dots, x_n \rangle$, for which $M \neq \langle a_1, \dots, a_\ell \rangle M$ and $a_i$ is not a zero divisor of $M/\langle a_1, \dots, a_{i-1} \rangle M$, for $i = 1, \dots, \ell$. Stanley conjectured that $\operatorname{depth}(M) \leq \operatorname{sdepth}(M)$ holds for every nonzero finitely generated $\mathbb{Z}^n$-graded module $M$ over $S$. Certain cases of the *Stanley conjecture* have been proven, for example, for monomial ideals generated by square free monomials of $S = \mathbb{K}[x_1, \dots, x_n]$ where $n \leq 5$. The question is still largely open with a huge amount of active research behind it. For further reading we refer to [1], [2] and [3].

## Acknowledgments

The authors would like to thank Professor Jürgen Herzog and Professor Rahim Zaare-Nahandi for reading this note and encouraging us to publish it.

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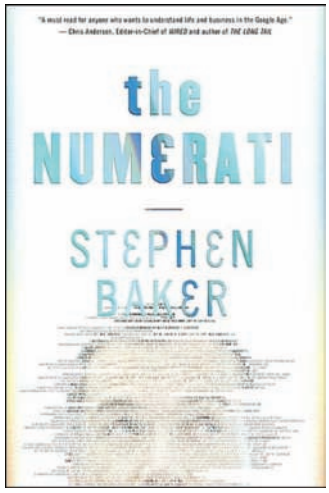
# The Numerati

*Reviewed by Jeffrey Shallit*




**The Numerati**
*Stephen Baker*
*Houghton Mifflin Co., 2008*
*US$26.00, 256 pages*
*ISBN-13: 978-0618784608*

Is it possible for a nonmathematician to write both accurately and entertainingly about a mathematical topic while still conveying something nontrivial about the mathematics? The answer is yes, but good examples are rare. Constance Reid did the trick with her book about Hilbert, and, to a lesser extent, with her book about Courant, but she had the advantage of having Julia Robinson for a sister. And of course Martin Gardner, who had little formal mathematical training, wrote the "Mathematical Games" column of *Scientific American* for many years, and introduced the beauty of mathematics to many young readers, including this reviewer.

Stephen Baker, the author of *The Numerati*, is, unfortunately, no Martin Gardner. By *numerati* (the word apparently first appeared in a 1990 review of a British art exhibit, written by Doron Swade) Baker means the kind of people who, were they working in the financial industry, would be called "quants": people with very strong mathematical and computer skills who can analyze real-world problems. While "quants" study financial markets and build mathematical models, Baker's *numerati* analyze large volumes of data collected electronically, in order to make predictions about human behavior in a variety of spheres: voting, employment, consumption, crime, illness, blogging, and marriage. Each of these activities gets a chapter devoted to it, in which Baker interviews several people who analyze the relevant data and try to come up with marketable conclusions. "[T]hese mathematicians and computer scientists," Baker intones sternly, "are in a position to rule the information of our lives."

In a book whose subject is data, equations, and mathematical models, Baker is surprisingly shy about presenting any actual mathematics. Or perhaps it is not so surprising. Steven Hawking once wrote, "Someone told me that each equation I included in the book would halve the sales. I therefore resolved not to have any equations at all. In the end, however, I did put in one equation, Einstein's famous equation $E = mc^2$. I hope that this will not scare off half of my potential readers." [2] Baker has taken Hawking one equation further.

Baker's approach is almost entirely anecdotal. All told, he interviews about two dozen of the *numerati*, ranging from IBM's Samer Takriti to Yahoo's head of research, Prabhakar Raghavan, and asks them some not-very-revealing questions. We learn very little about their personalities and even less about what it is they do on a day-to-day basis.

Some of the anecdotes are, admittedly, interesting. I particularly enjoyed the plan to "put a wireless computer on half a million cows in Kansas"; with the data collected, researchers hope to determine what behavior patterns of cows are correlated with higher-quality meat. But some are not so interesting. Baker opens with a puzzle: why do people who rent romantic movies online also tend to click on an ad for rental cars, much more than the average user? The answer, when it comes, is not that surprising: lovers of romantic movies were attracted by the ads that promoted weekend "escapes".

There is very little in *The Numerati* to interest the professional or amateur mathematician; this is the kind of book that a business executive

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might buy in an airport bookstore, hoping to learn something about mathematical modeling and the Internet—but I imagine even the business executive will find insufficient novelty in Baker's modest survey. There's just not enough detail provided to tell the reader very much about the main subject: the models and algorithms that extract meaning from large volumes of data.

As an example, consider this passage: "If one of Raghavan's scientists gives an imprecise computer command while trawling through Yahoo's data, he can send the company's servers whirring madly through the noise for days on end. But a timely tweak in these instructions can speed up the hunt by a factor of 30,000. That reduces a 24-hour process to about three seconds. His point is that people with the right smarts can summon meaning from the nearly bottomless sea of data. It's not easy, but they can find us there."

Reading this, I can only wonder, what is an "imprecise computer command"? Does the passage concern a new breakthrough at Yahoo in search optimization, or something obvious that every undergraduate computer science student learns, such as binary search? Baker just doesn't give enough detail to decide.

Baker emphasizes that the volume of data collected by the *numerati* requires new techniques, but he doesn't really explain why. It would have been nice to read something along these lines: if we are working with small data sets, with hundreds or thousands of items, we can afford to use algorithms that run in linear, $O(n \log n)$, or even quadratic time. But, as my colleague Alex López-Ortiz has noted [3], when you are dealing with $2^{30}$ or even $2^{40}$ data points, the log factor is the difference between a query that completes in a second and one that completes in half a minute.

Too often Baker relies on clichés. Over and over, we are told that the goal of the *numerati* is to "turn us into dizzying combinations of numbers" (p. 13), to "turn IBM's workers into numbers" (p. 20), and that they will view people as "boiled down to numbers" (p. 23) or "represented as a series of numbers" (p. 35). Of these, only the last is accurate. Sometimes, though, Baker says we are actually equations: "each of us [is] represented by scores of equations" (p. 42); "I had ... no clue as to what kind of equation I would become" (p. 99). This, even metaphorically, seems incorrect. People might be represented by numbers, and their relationships might be governed by equations, but it makes little sense to claim that an individual's attributes are represented by an equation.

Although most of his account is accurate—as far as it goes—Baker does get some of the history wrong. He claims, for example, that "Google's breakthrough, which transformed a simple search engine into a media giant, was the discovery that our queries—the words we type when we hunt for Web pages—are of immense value to advertisers". This is incorrect. The site `Goto.com` allowed advertisers to bid on search results as early as February 1998, two years before Google did so. Google's original noteworthy accomplishment—and the one that made it the search engine of choice—was its new algorithm, called PageRank, for deciding what Web pages provide good matches for a query.

PageRank represented the Web as a directed graph. Nodes are pages, and there's a directed edge from page $A$ to page $B$ if $A$ links to $B$. In its simplest form, PageRank assigned a weight $W$ to the edge $(A, B)$ with

$$W = \frac{\text{number of links from } B \text{ to } A}{\text{total number of pages that } B \text{ links to}}.$$

The resulting square matrix, called the "link matrix", is column stochastic and has an eigenvalue of 1. The associated eigenvector, if it is unique and suitably normalized, gives the "rank" or importance of each page. (There is now more actual mathematics in this review than in all 244 pages of Baker's book.) To make this idea work well in practice, we need uniqueness of the eigenvector and a fast way to calculate it, so the mathematical story doesn't end here. But even in its infancy, PageRank helped Google give much better results than other search engines—so good that Google's home page cockily offers an option labeled "I'm Feeling Lucky", where only a single search result, the top one, is revealed—that it quickly became the search engine of choice. Although Google's search engine has since moved far past PageRank, a mathematically savvy writer could have easily summarized these elementary ideas, or at least referred to the paper of Bryan and Leise [1].

Even when a simple geometric diagram would have enlightened the reader, Baker refuses to provide it. In talking with Mark Steitz, a Democratic consultant, he describes a "simplex triangle" that represents voters in an election. Each voter is represented by a point with two coordinates that represent (a) the likelihood of favoring one party over another and (b) the likelihood of actually going to the polls in any election. "Steitz draws a vertical line up the triangle, a so-called isoquant. Each voter along this line is of equal value, he says." Although I imagine every reader of this review could produce the diagram Steitz has in mind, one picture here would be worth more than a hundred words.

In the chapter on politics, Baker discusses the difficulty of obtaining good data on who people are likely to vote for. Because of this, "proxies" are used; if you bought a Volvo and shop at Trader Joe's, you might be more likely to vote for a Democrat than someone who's an NRA member and drives a pickup truck. Geographical proxies can be good predictors, too, but Baker's account

is superficial compared to others, such as Michael Weiss's *The Clustering of America* [5].

The contrast between this book and some related ones published recently is startling. For example, Emanuel Derman's *My Life as a Quant* [4] is a memoir of the author's career as a physicist, computer programmer, and financial wizard. Along the way, Derman provides portraits of Tsung-Dao Lee, the physicist who co-discovered the asymmetry of the weak interaction with C. N. Yang, and Fischer Black, co-creator of the Black-Scholes equation for the value of an option. Here is Derman on T. D. Lee:

> ... every speaker felt compelled to focus on him; as they spoke, their eyes fixated only on him, and he let no statement he did not fully agree with pass him by. No matter who lectured at the seminar, T. D. concentrated intensely on their argument, and interrupted at the first instant something was not satisfactory. At times he broke in on the initial sentence of the talk, refusing to let a speaker proceed until the point was clarified. Sometimes clarification never came; I once witnessed the humiliation of a visting postdoc who was forced to defend the first sentence he uttered for the entire hour and a half allowed for his seminar.

Derman's writing is witty, insightful, and moving; his prose is eloquent, and accurately captures the joys and sorrows of doing research. Derman's book is not filled with equations, either, but he uses diagrams effectively to make his points, and describes, in a clear if nontechnical way, some of the ideas that excited him in physics and finance. As someone who has actually worked in mathematics, physics, and finance, Derman writes with an authority and insight that Baker cannot approach.

Very little of *The Numerati* is devoted to an analysis of the ethical and privacy concerns that data collection raises. Although Baker briefly discusses one way of hiding from the *numerati*—an initiative called Attention Trust—he says almost nothing about technologies for cryptography and anonymity. Modern cryptography, which is strongly mathematically based, offers us the hope that many of our transactions can take place veiled from the prying eyes of the *numerati*. And anonymous Web-surfing, based (for example) on technology from `anonymizer.com` or the Tor project, can prevent data collectors from linking online behavior with the specific person who is doing the surfing.

Ultimately, I did not find *The Numerati* a very satisfying account of its subject. I wanted more insight—something that Baker, with his nonmathematical background, could not provide. Perhaps I am unfair in criticizing Stephen Baker for not writing the book I would have wanted to read. The problem is, I don't think he wrote the book that most people would have wanted to read.

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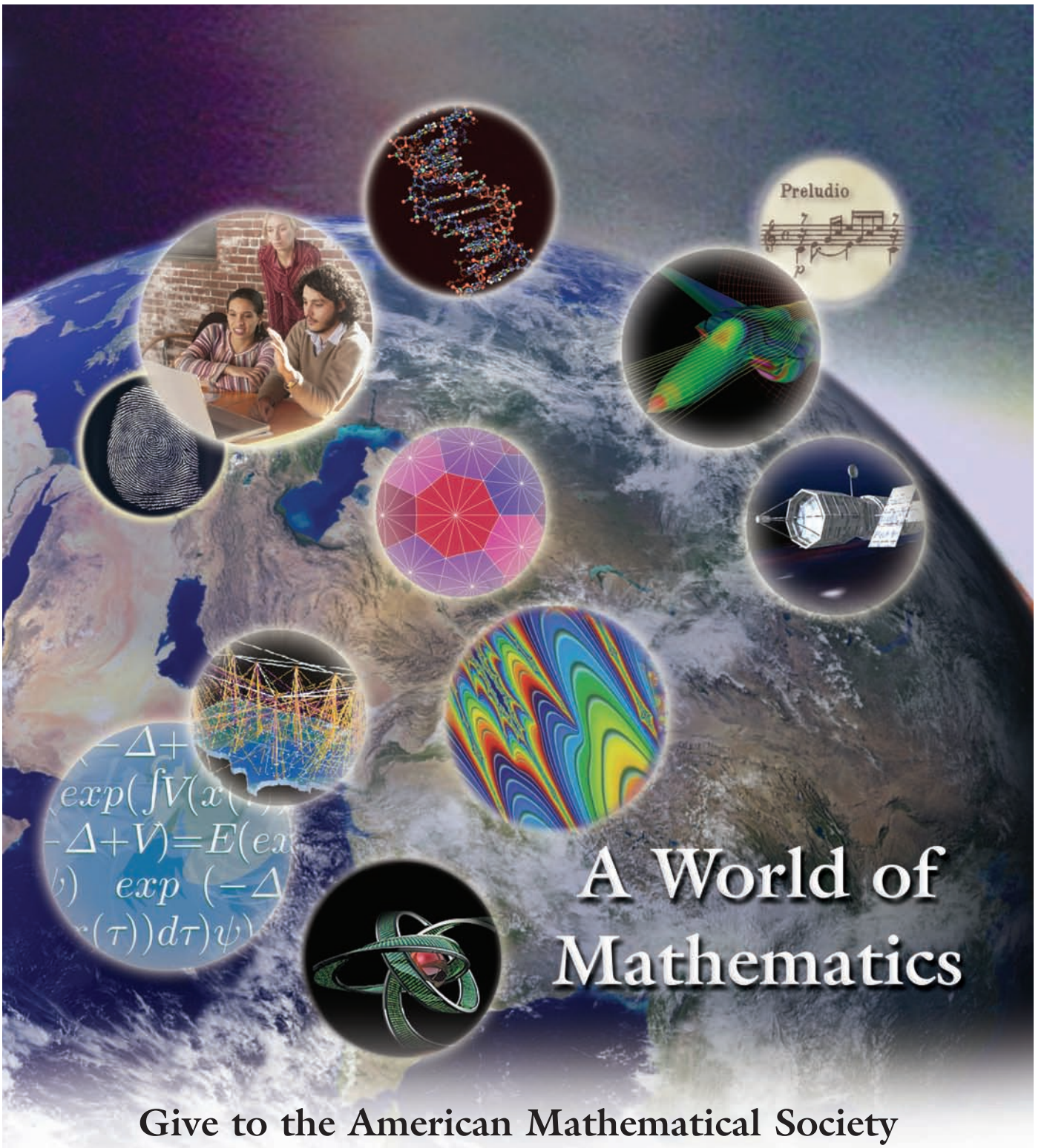


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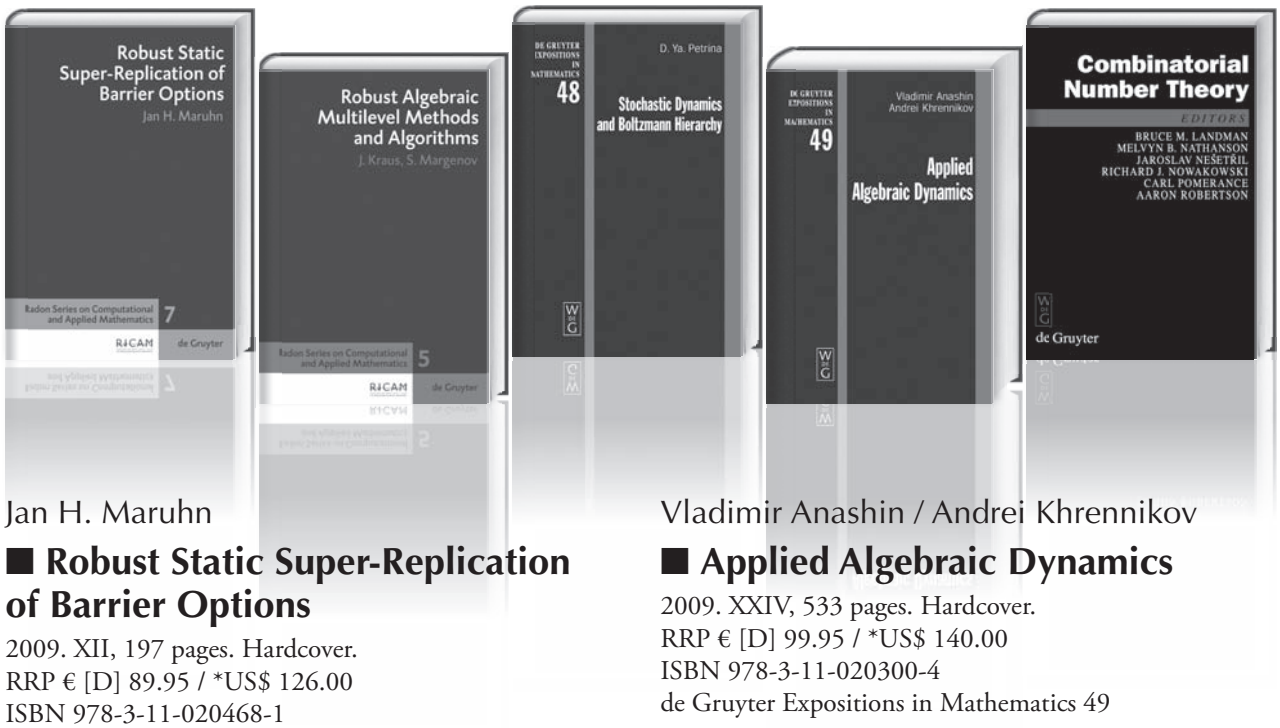


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# Revisiting the Question of Diversity: Faculties and Ph.D. Programs

*H. G. Grundman*

The question is starting to feel old, yet with each repetition, it becomes even more perplexing. As we as mathematicians wonder how our schools, our students, our research, and even our jobs will fare in the downturned economy, we also can hardly avoid wondering: how can the United States have its first African American president and its third female secretary of state while our tenured mathematics faculty members are still overwhelmingly white and male?

From a CBMS survey in 2005, the full-time (tenure-track and non-tenure-track) faculty of mathematics departments awarding Ph.D. degrees are approximately 80% white and 82% male. The lack of diversity is even more striking when contrasted with the national undergraduate student population, which has been growing more and more diverse. As a result, notes Shirley Malcom of AAAS, mathematics faculty are looking less and less like the student bodies that they are teaching [6].

As many of us recall, there were some real changes in the 1960s and 1970s. A number of impressive women and minority mathematicians joined research faculties, breaking the metaphorical glass ceiling.

Karen Uhlenbeck [7], of the University of Texas, Austin, started what is now the Institute for Advanced Study's Women and Mathematics Program after, in the 1990's, she realized that she had been part of a wave of women mathematicians, but that it was a wave that was never followed by another. Many of her peers who held the distinction of being the first women to hold tenure in their departments were also the last. And, somehow, that remains the case today: as these women approach retirement age, they are still the youngest women in their departments. The progress that had been made back when they were hired was not the leading edge of a sea-change that many had hoped for and even expected.

Uhlenbeck blames the lack of sustained change on many things, including her own complacency—she and her peers were doing their work, as were other mathematicians over the years. This leads us to the obvious question: what's wrong with doing our jobs? Nothing, of course! But any of us who take part in hiring and in educating students need to accept that doing our jobs includes examining our policies and practices and fixing anything that is broken. In particular, we need to change those aspects that are contributing to the lack of diversity in our faculty and in the Ph.D.s we graduate.

## A National Forum

One recent attempt to address these issues was a workshop held at the Mathematical Sciences Research Institute (MSRI) in November 2008: *Promoting Diversity at the Graduate Level in Mathematics: A National Forum*, organized by, among others, Sylvia Bozeman of Spelman College and Rhonda Hughes of Bryn Mawr College, the creators of EDGE (Enhancing Diversity in Graduate Education, `http://www.edgeforwomen.org/`). The goal of the three-day conference was to stimulate, identify, and disseminate successful models that improve retention of underrepresented groups in graduate programs in mathematics [3]. (For the purposes of the conference, these groups were

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identified as women, African Americans, Latinos, Native Americans, and Asian Pacific Islanders.) Although the focus was on graduate education, there was also discussion concerning faculty diversity: how policies and practices regarding hiring, particularly those at research universities, have often acted to preserve the nearly homogeneous faculty that has become the norm—and how these practices might be changed.

The first day was devoted to graduate students: listening to them, learning from them, and asking them to propose new models for successful graduate programs. Part of the hope of the organizers was that these students could then go back and assist their departments in changing their departmental structures, policies, and practices. The remaining two days were for faculty from doctoral degree awarding departments and so-called *supplier departments* (those with a history of sending minority students to mathematics graduate school). Together these faculty worked to identify successful existing models, to evaluate and build on the ideas the students had generated the first day, and to develop plans for specific implementations within the attendees' departments.

As noted by Malcom [6], evidence that we're losing critical talent on the education system pathway—from bachelor's degree to doctorate—is in great abundance. For example, in 2004, women earned 46% of B.S. degrees in mathematics and statistics, but women earned only 28.1% of the Ph.D. degrees in these subjects [6]. Although, of course, looking at these different degrees in one given year doesn't describe what actually happened to the students who received B.S. degrees in that year, looking across years makes little difference: in 1994, women earned 47% of B.S. degrees in mathematics, while in 2000, women earned 27% of the mathematics Ph.D. degrees [4]. Similar patterns are seen in data for African American, Hispanic, and American Indian students [6], though with such low numbers, extensive analysis is more difficult.

The MSRI workshop was a packed three days of presentations, panel discussions, and working group sessions. Obviously, this article can provide at most a glimpse into the workshop, providing only a small fraction of the information and ideas examined. Luckily, most of the workshop was videotaped and can be viewed on the Internet [1]. For more statistics on women and minorities in mathematics presented at the workshop, as well as for more sources, see [4, 5, 6].

## Research on Education

Abbe H. Herzig, of the University of Albany, does research on equity and social justice in mathematics and science education at all levels. Recently, she has been more specifically studying women and students of color in the post-graduate mathematical sciences. Needless to say, her research was of great interest to the conference participants.

She began by noting that most studies of the "underparticipation of women and students of color" in mathematics have focused on the K–12 level. The good news is that this research has led to some interventions that have helped to greatly diminish performance and participation differences between gender groups and among various minority groups. The bad news, says Herzig, is that much of this research used a "deficit model", which says that there's something lacking with girls and minorities, something that needs to be fixed.

Making changes in mathematics participation at more advanced levels is more difficult, partly because of beliefs about the nature of mathematics, beliefs that this is a meritocracy in which measures of success are objective, that all one needs is talent and determination. Without entering into this debate, we might want to question just why it is that one should need "determination" and whether or not many graduate programs require more determination on the part of students from underrepresented groups. As observed by Karen Uhlenbeck [7], for the most part, women are not failing out of math graduate school, they are dropping out.

Herzig's work has led her to promote what she calls the "apprentice metaphor" for mathematics education. Just as in apprenticeships historically, mathematics graduate students need to learn to do mathematics, to learn what mathematicians do, and to learn who they are as mathematicians. They need to learn not only the basic craft, but also how to think like, act like, and feel like a mathematician.

Mathematics education has been mostly about the first: the content of mathematics. Slowly, over time, undergraduate mathematics education has moved towards teaching more about the practice of mathematics: problem solving, writing and presenting mathematics, the basics of doing research, etc. At the graduate level, however, the standard model is very far from that of an apprenticeship, with students normally expected to find their own ways, at least until they get to the research phase. Even then the training is almost always narrowly focused on completing the dissertation, with little or no regard for other aspects of what it means to be a mathematician. Herzig also stressed the importance that students, like apprentices, be able to take part in authentic mathematical activities, not just course work, early in their graduate training.

Interestingly, research shows that at the doctoral level, feeling a part of the community is an important indicator of persistence and that students who have had a strong sense of community

as an undergraduate, or even a good REU experience, are more likely to succeed. Herzig explained these findings and noted their consistency with the theories that building students' senses of belonging in mathematics is critical for an equitable K–12 education.

Herzig discussed numerous obstacles to completing a Ph.D. in mathematics, noting additional ones for many women and minorities: having a lack of role models, facing discrimination in finding mentors, being marginalized, confronting blatantly sexist and racist behavior, and constantly having to prove their worth. Each of these can threaten the needed sense of community and belonging. She also discussed some possible ways to work towards eliminating many obstacles: fostering community among the students, initiating a program of meaningful faculty mentoring, establishing policies allowing for flexible scheduling and for full lives, providing positive role models, and practicing zero tolerance for discriminatory behavior, among others. She noted that many of these practices have been found to improve retention of *all* graduate students, not just women and minorities.

Herzig also reported on a 2006 workshop at the American Institute for Mathematics (AIM), "Finding and Keeping Graduate Students in the Mathematical Sciences". She reported on the plethora of ideas and suggestions for both faculty and students generated at this conference. (See [4].)

## Research on Intelligence

For many participants of the MSRI workshop, a high point came on the final day with a presentation by Joshua Aronson [2] of New York University. Aronson has done extensive research on the social and psychological influences on academic achievement. His talk focused on the effect on minorities and women of *stereotype threat:* the added stress that results from an individual's awareness that he or she may be about to confirm a negative stereotype.

Aronson's data generated a lot of excitement because it clearly contradicts many basic assumptions about intelligence and academic performance. To see these contradictions, it is not necessary to agree with all of his theories and explanations (to which this article could not possibly do justice), nor to believe that stereotype threat even exists. The experiments are well designed and carefully controlled—and the results are striking.

Aronson gave the commonly used operational definition of intelligence: that which IQ scores measure, is indicated by performance in school, by verbal fluency, by scores on other standardized tests, etc. He noted that in the past, the prevailing theory was that an individual's intelligence is mostly, if not completely, determined at birth and that this theory is now falling apart.

Rather than taking the expected path into the nature versus nurture debate, Aronson focused on the situations in which intelligence is measured. He argued that this is not simply a case of measuring some static quality of the brain, but is more of a transaction. Whether the subject is being tested or interviewed, the process of measuring is creating a psychological situation. This fact makes it obvious that the results can be affected by many things that we don't usually think of as intelligence.

Okay, so this isn't exactly news to anyone in academics. We know that test scores can be affected by various things. We also know that women and minorities do not perform as highly as men do on many standardized tests and have heard a variety of explanations for this. Aronson listed many of the common explanations, some of them credible, some of them basically disproven. He then noted that these explanations, taken as a group (doing a careful regression analysis), cannot account for a performance gap of the size observed.

This led Aronson to develop the theory of stereotype threat. According to the theory, the awareness of a stereotype implying that the subject is less intelligent and so will do comparatively poorly on a test acts to increase the subject's stress level, leading to a lower test score.

Aronson tested his theories with various groups of subjects and a variety of academic tests. He discovered that simply telling minority students that the goal of the experiment was to study the psychology of achievement and test-taking, that the intelligence of individuals was not being measured, resulted in much higher test scores than those of the minority students who had been told that the goal was to test each individual's intelligence.

In a related experiment, one group was asked to fill out a demographic survey, including a question about race, at the beginning of a test. In this group, the white subjects did about twice as well as the African Americans. Another group took the same test without the survey (but with a question about race at the end of the test). In this second group, there was virtually no difference between the scores of the different racial groups. Apparently, drawing the African Americans' attention to their own demographic information prior to the test led them to do less well.

Concerning math and gender, two groups of students were given a difficult math test. One group was told that it is known that there are no gender differences in performance on the test. The women in this group did significantly better than women in the control group and, interestingly, the men in this group did worse than the men in the control group. In fact, for this group, there was

virtually no difference in average test scores by gender.

It should be noted that stereotype threat can have negative effects on virtually anyone. For example, Aronson described an experiment in which white male students who were particularly strong in mathematics were given a very hard math test. One group was told that the goal of the test was to see why Asians are so good at math. This group scored almost a full standard deviation (.93 SD) below the other group on the test.

Many of these experiments have been carried out "in the field". Most notably, one year the Educational Testing Service altered the procedure for its advanced placement AB Calculus test so that half of the test-takers were asked to identify their genders after taking the test instead of beforehand. The women in this group scored much higher than the women in the control group. In fact, on average, in the group asked to indicate their genders before the test, men scored higher than women, and in the other group, women scored higher than men.

Aronson noted that there are over 350 published replications of these studies. They involve different stereotyped groups and different skills, but the results are all consistent with Aronson's theories.

Additional research has indicated that there are a variety of ways in which this effect can be mitigated. Aronson describes a number of experiments demonstrating the effectiveness of, even briefly, teaching students about stereotype threat in order to diminish its effects. Similarly, informing students that intelligence is malleable and can be improved, that it is not determined at birth, leads to improved test scores for all groups of students, though more so for racial minorities than for whites. He explained how exposure to role models, particularly highly qualified ones, can virtually eliminate the effects of stereotype threat. It also helps to normalize struggle, that is, to let students know that it is normal to have trouble in whatever level of school they are in, and to help them avoid social isolation.

Aronson's presentation generated a lot of excitement at the workshop as participants saw ways they could immediately apply the lessons learned from his work.

## Ongoing Efforts

Some of the most inspiring parts of the workshop were those in which attendees learned about graduate programs that are successful in improving their diversity and their retention rates among women and minorities. Hearing from both faculty and students about their experiences with such graduate programs along with effective summer programs like EDGE and the IAS's Women and Mathematics Program (`http://www.math.ias.edu/wam`) was both encouraging and informative.

The workshop itself was certainly not meant to be the final word on diversity in graduate mathematics. The organizers and MSRI sponsored a list-serve for conference participants which saw a great deal of activity in the following weeks, as information was exchanged and faculty of graduate programs sought to improve their recruitment of women and minority graduate students from the institutions represented at the workshop.

Continuing in the theme of this workshop, three of the participants have organized a workshop at AIM, with the goal of improving recruitment and retention of all mathematics graduate students, with a particular emphasis on women and underrepresented minorities. The AIM workshop, which at the time of this writing is scheduled for August 2009, will build on the 2006 AIM workshop, the 2008 MSRI workshop, and the myriad efforts by groups and individuals in the mathematics community that have resulted in the improvements made thus far.

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[1] Mathematical Sciences Research Institute (MSRI), Promoting Diversity at the Graduate Level in Mathematics: A National Forum, `http://www.msri.org/calendar/workshops/WorkshopInfo/458/show_workshop`.

[2] JOSHUA ARONSON, "Low Numbers: Stereotype Threat and the Performance of Women and Minorities", presentation, Promoting Diversity at the Graduate Level in Mathematics: A National Forum, 2008.

[3] SYLVIA BOZEMAN, "Welcome, Overview, Articulation of Goals", presentation, Promoting Diversity at the Graduate Level in Mathematics: A National Forum, 2008.

[4] ABBE HERZIG, "Supporting Women and People of Color in Graduate Mathematics", presentation, Promoting Diversity at the Graduate Level in Mathematics: A National Forum, 2008.

[5] ELLEN KIRKMAN, "Framing the Issues: What the Data Show, and What We Know about Diversity in the Mathematics Community", presentation, Promoting Diversity at the Graduate Level in Mathematics: A National Forum, 2008.

[6] SHIRLEY MALCOM, "Mathematics Faculty, Mathematics Students: Why Do They Look So Different?", presentation, Promoting Diversity at the Graduate Level in Mathematics: A National Forum, 2008.

[7] KAREN UHLENBECK, "Women and Math Program at the Institute for Advanced Study", presentation, Promoting Diversity at the Graduate Level in Mathematics: A National Forum, 2008.


Note: All videos can be accessed from the URL given in [1].

# Mathematics People

## Bringmann Receives Krupp Prize

KATHRIN BRINGMANN of the University of Minnesota and the University of Cologne has been awarded the Alfried Krupp-Förderpreis for Young Professors. She was honored for her joint work with Ken Ono on Ramanujan's mock theta functions. Following seminal work by the Dutch mathematician Sander Zwegers, Bringmann and Ono have built and applied their theory to many topics in mathematics, including partitions and $q$-series, Moonshine, and elliptic curves. The prize carries a cash award of one million euros (approximately US$1,400,000) for a five-year period and is awarded by the Alfried Krupp von Bohlen und Halbach Foundation. Other mathematicians who have won the prize are Ursula Gather (1987) and Albrecht Böttcher (1992).

*—From a Deutsche Mathematiker-Vereinigung announcement*

## SIAM Prizes Awarded

The Society for Industrial and Applied Mathematics (SIAM) awarded a number of prizes at its annual meeting in July 2009 in Denver, Colorado.

MARY F. WHEELER of the University of Texas at Austin has been awarded the Theodore von Kármán Prize for her seminal research in numerical methods for partial differential equations, her leadership in the field of scientific computation and service to the scientific community, and her pioneering work in the application of computational methods to the engineering sciences, most notably in geosciences. Her work has included developing and applying state-of-the-art algorithms and computational science tools to problems of societal importance in energy and the environment. The prize is awarded every five years for a notable application of mathematics to mechanics and/or the engineering sciences. It carries a cash award of US$1,000.

ANDERS LINDQUIST of the Royal Institute of Technology, Sweden, has been awarded the W. T. and Idalia Reid Prize in Mathematics. He was recognized for his fundamental contributions to the theory of stochastic systems, signals, and control. The prize is given for outstanding work in, or other contributions to, the broadly defined areas of differential equations and control theory. It carries a cash award of US$10,000.

Franco Brezzi of the Institute for Advanced Study (IUSS), Pavia, Italy, was named the John von Neumann Lecturer. He was recognized for his insight, analysis, and exposition, which have had a profound impact on computational science and engineering, particularly his work clarifying the nature of numerical stability and developing tools to devise stable finite element methods. The lectureship is awarded annually for outstanding and distinguished contributions to the field of applied mathematical sciences and for the effective communication of these ideas to the community. It consists of a cash award of US$4,500.

RAFAL GOEBEL of Loyola University, Chicago, was honored with the SIAM Activity Group on Control and Systems Theory (SIAG/CST) Prize for his accomplishments in developing novel and fundamental results for in-depth study of hybrid systems and resolving some long-standing issues in these systems, such as well-posedness of solutions and robustness of asymptotic stability in hybrid control systems. The prize is awarded every two years to a junior researcher for outstanding and significant research contributions to mathematical control or systems theory.

WEINAN E of Princeton University has been awarded the Ralph E. Kleinman Prize for his interdisciplinary contributions and for his exemplary record in mentoring students and postdocs. He has had a profound impact on research in stochastic partial differential equations and turbulence, numerical solutions of multiscale problems, dynamics of interacting dislocations, liquid crystals and polymers, metastability, protein folding, gas dynamics, epitaxial growth, micromagnetics, and superconductivity. The prize is awarded every other year to one individual for outstanding research or other contributions that bridge the gap between mathematics and applications. It carries a cash award of US$5,000.

ASSYR ABDULLE of École Polytechnique Fédérale de Lausanne (EPFL), Switzerland, was honored with the James H. Wilkinson Prize in Numerical Analysis and Scientific Computing. He was recognized for his contributions to a broad range of applied mathematics fields, including stability analysis and mathematical software for stiff initial value problems, efficient solution algorithms for stochastic differential equations, and error analysis of heterogeneous multiscale methods. The prize is awarded every four years for research in, or other contributions to, numerical analysis and scientific computing

during the six years preceding the award. It carries a cash award of US$1,000.

ERIC VANDEN-EIJNDEN of the Courant Institute of Mathematical Sciences, New York University, received the Germund Dahlquist Prize for his work in developing mathematical tools and numerical methods for the analysis of dynamical systems that are both stochastic and multiscale. The prize is awarded to a young scientist (normally under age forty-five) for original contributions to fields associated with Germund Dahlquist, especially the numerical solution of differential equations and numerical methods for scientific computing.

ANDREA BERTOZZI of the University of California, Los Angeles, was selected as the AWM-SIAM Sonia Kovalevsky Lecturer. Her lecture was titled "Swarming by Nature and by Design". The lecture is intended to highlight significant contributions of women to applied or computational mathematics.

ANDREW W. LO of the Massachusetts Institute of Technology was named the I. E. Block Community Lecturer. His lecture was titled "Kill All the Quants?: Models vs. Mania in the Current Financial Crisis". The lectureship is awarded annually and is intended to encourage public appreciation of the excitement and vitality of science.

J. TINSLEY ODEN of the University of Texas at Austin has been awarded the SIAM Prize for Distinguished Service to the Profession. He was the founding director of the Institute for Computational Engineering and Sciences (ICES). The prize is awarded to an applied mathematician who has made distinguished contributions to the furtherance of applied mathematics on the national level.

ARND SCHEEL of the University of Minnesota was honored with the J. D. Crawford Prize of the SIAM Activity Group on Dynamical Systems (SIAG/DS). The prize is awarded to one individual for recent outstanding work on a topic in nonlinear science and carries a US$750 cash award.

MARTIN GOLUBITSKY of The Ohio State University was honored with the 2009 Jürgen Moser Lectureship of the SIAM Dynamical Systems Activity Group. The lectureship is awarded to a person who has made distinguished contributions to nonlinear science. It carries a cash award of US$500.

MARY F. WHEELER of the University of Texas at Austin was awarded the SIAG/Geosciences Career Prize of the SIAM Activity Group on Geosciences. The prize is awarded to an outstanding senior researcher who has made broad and distinguished contributions to the field of geosciences.

JAN M. NORDBOTTEN has been awarded the SIAG/Geosciences Junior Scientist Prize of the SIAM Activity Group on Geosciences. The prize is awarded to an outstanding junior researcher in the field of geosciences for distinguished contributions to the field in the three calendar years prior to the year of the award.

The SIAM Awards in the Mathematical Contest in Modeling were awarded to the following students: For Problem A, The Continuous Problem: Designing a Traffic Circle, the awardees were CHRISTOPHER CHANG, ZHOU FAN, and YI SUN of Harvard University for "A Simulation-Based Assessment of Traffic Circle Control". Their faculty advisor was Clifford H. Taubes. For Problem B, The Discrete Problem: Energy and the Cell Phone, the awardees were STEPHEN FOSTER, BOB POTTER, and TOMMY ROGERS of Southwestern University for "America's New Calling". Their faculty advisor was Richard T. Denman.

The SIAM Student Paper Prizes were awarded to the following students: AWAD H. AL-MOHY of the University of Manchester, United Kingdom, for "A new scaling and squaring algorithm for the matrix exponential", coauthored with Nicholas J. Higham; JIE CHEN of the University of Minnesota for "On the tensor SVD and the optimal low rank orthogonal approximation of tensors", coauthored with Yousef Saad; SHUN ZHANG of Purdue University for "Recovery-based error estimator for interface problems: Conforming linear elements", coauthored with Zhiqiang Cai.

*—From a SIAM announcement*

# Sargsyan Awarded Artin Prize

GRIGOR SARGSYAN of the University of California, Berkeley, has been awarded the 2009 Emil Artin Junior Prize in Mathematics. He was honored for his paper "On the indestructibility aspects of identity crisis", published in the *Archive for Mathematical Logic* **48** (2009), 493–513. The prize was established in 2001 and carries a cash award of US$1,000. It is usually presented every year to an Armenian university student or former student who is under the age of thirty-five for outstanding contributions to algebra, geometry, topology, and number theory—the fields in which Emil Artin made major contributions. The prize committee consisted of A. Basmajian, Y. Movsisyan, and V. Pambuccian.

*—Victor Pambuccian for the Artin Prize Committee*

# Prizes of the London Mathematical Society

The London Mathematical Society (LMS) has awarded several prizes for 2009.

ROGER HEATH-BROWN of the University of Oxford has been awarded the Pólya Prize for his many contributions within analytic number theory and his dynamic application of analytic methods in wide-ranging investigations of problems spanning number theory and arithmetic geometry. VLADIMIR MAZ'YA of the University of Liverpool was awarded the Senior Whitehead Prize in recognition of his contributions to the theory of differential equations. PHILIP MAINI of the University of Oxford has been awarded the Naylor Prize and Lectureship in Applied Mathematics in recognition of his contributions to and influence on the field of mathematical biology. JOSEPH CHUANG of City University London and RADHA KESSAR of the University of Aberdeen have been awarded the Berwick Prize for their joint paper "Symmetric groups, wreath products, Morita

equivalences and Broué's abelian defect conjecture", published in the *Bulletin of the London Mathematical Society*.

Four Whitehead Prizes were awarded. MIHALIS DAFERMOS of the University of Cambridge was honored for his work on the rigorous analysis of hyperbolic partial differential equations in general relativity. CORNELIA DRUTU of the University of Oxford was honored for her work in geometric group theory. ROBERT MARSH of the University of Leeds was selected for his work on representation theory and especially for his research on cluster categories and cluster algebras. MARKUS OWEN of the University of Nottingham was recognized for his contributions to the development of multiscale modeling approaches in systems medicine and biology.

*—From an LMS announcement*

# Prizes of the Canadian Mathematical Society

The Canadian Mathematical Society (CMS) has made several awards for 2009.

MARK BRAVERMAN of the University of Toronto has been named the recipient of the CMS Doctoral Prize for his work on how computability and complexity theory affect our understanding of real-world phenomena. The main part of his thesis contains groundbreaking work on the computability and complexity of Julia sets. His work has covered a wide range of areas of mathematics and computer science, including stochastic processes, algorithms, game theory, machine learning, computer-aided verification, and automated image processing. He has also worked on derandomization, pseudorandomness, and applications of information theory to communication complexity. He was a gold medal winner at the 2000 International Mathematical Olympiad. The prize was inaugurated to recognize outstanding performance by a doctoral student who graduated from a Canadian university during the preceding year (January–December). The prize carries a cash award of C$500 (approximately US$450).

DMITRY JAKOBSON of McGill University, NIKOLAI NADIRASHVILI of CNRS, Marseille, France, and IOSIF POLTEROVICH of the University of Montreal were awarded the G. de B. Robinson Award for their joint paper "Extremal metric for the first eigenvalue on a Klein bottle", published in *Canadian Journal of Mathematics* **58**, no. 2 (2006). The paper is concerned with the study of extremal metrics, considering the problem in the case of the Klein bottle.

DAVID POOLE of Trent University has been awarded the CMS Excellence in Teaching Award, which recognizes sustained and distinguished contributions in teaching at the postsecondary undergraduate level at a Canadian institution.

BILL SANDS of the University of Calgary has been awarded the 2008 Graham Wright Award for Distinguished Service for his work in guiding and nurturing the CMS's International Mathematical Olympiad (IMO) program.

HERMANN BRUNNER of the Memorial University of Newfoundland is the recipient of the 2008 David Borwein Distinguished Career Award for his notable contributions to Canadian mathematics through his research, his teaching, and the breadth of his service to the mathematical community, particularly his work in developing the Atlantic Association for Research in the Mathematical Sciences (AARMS) and, through AARMS, in expanding and enhancing the infrastructure that supports research and graduate training in Atlantic Canada.

*—From a CMS announcement*

# AWM Essay Contest Winners

The Association for Women in Mathematics (AWM) has announced the winners of its 2009 essay contest, "Biographies of Contemporary Women in Mathematics".

The grand prize was awarded to WAI-TING LAM, St. Francis College Ore Creek, Brooklyn, New York, for "The Charm of Topology—Dr. Joan Birman: Mathematics Is Very Beautiful!" This essay won first place in the college category and will be published in the *AWM Newsletter*.

In the grades 9–12 category, first place went to CHRISTINA BAX, National Cathedral School, Bethesda, Maryland, for "Dr. Mahlet Tadesse: A Mathematician's Quest from Ethiopia to the United States". Chosen for honorable mentions were LENA SIZIKOVA, Mission San Jose High School, Fremont, California, for "Music + Math = Linda Kadis" and CARMEN NG, Monte Vista High School, Danville, California, for "Dr. Laura Gunn—Family Misfit".

In the grades 6–8 category, first place was awarded to ANGELA PHAM, Francis of Assisi School, North Tustin, California, for "Maria Droujkova: Beautiful Math Is All About the People". Honorable Mention in the category went to NUR KOSE, Kose Homeschooling, New Castle, Delaware, for "Falls in Love with Math and Science: Biography of Dr. Shaheen Rab".

*—From an AWM announcement*

# SIAM Names 183 Fellows

The Society for Industrial and Applied Mathematics (SIAM) has announced the SIAM Fellows Class of 2009 and the inauguration of the SIAM Fellows Program. Fellowship is an honorific designation conferred on members distinguished for their outstanding contributions to the fields of applied mathematics and computational science. The Fellows were recognized during the 2009 SIAM Annual Meeting in Denver, Colorado. See the SIAM announcement at `http://www.siam.org/prizes/fellows/index.php`.

*—AMS Public Awareness Office*

# Mathematics Opportunities

## NSF Postdoctoral Fellowships

The National Science Foundation (NSF) awards Mathematical Sciences Postdoctoral Research Fellowships (MSPRF) for appropriate research in areas of the mathematical sciences, including applications to other disciplines. A program announcement is available from the website http://www.nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=5301&ods_key=nsf08582. The deadline for proposals is **October 21, 2009**.

*—From an NSF announcement*

## AMS Epsilon Fund

The AMS Epsilon Fund awards grants to summer mathematics programs that support and nurture mathematically talented high school students in the United States. The deadline to apply for funding for summer 2010 programs is **December 15, 2009**. It is anticipated that the application process will be done through a new, online electronic system this year. For more information about the program and updated application information, go to http://www.ams.org/employment/epsilon.html. For more information contact the AMS Membership and Programs Department by email at prof-serv@ams.org or by telephone at 800-321-4267, ext. 4170.

*—From an AMS announcement*

## AMS-AAAS Mass Media Summer Fellowship

The American Association for the Advancement of Science (AAAS) sponsors the Mass Media Science and Engineering Summer Fellows Program, through which graduate students work during the summer in major media outlets. The AMS provides support each year for a graduate student in the mathematical sciences to participate in the program. In past years the AMS-sponsored fellows have held positions at *Scientific American*, *Business Week*, Voice of America, Discovery Channel Online, National Geographic Television, *Popular Science*, *The Chicago Tribune*, and *Time* magazine. Fellows receive a weekly stipend of US$450, plus travel expenses, to work for ten weeks during the summer as reporters, researchers, and production assistants in media organizations. They observe and participate in the process by which events and ideas become news, improve their ability to communicate about complex technical subjects in a manner understandable to the public, and increase their understanding of editorial decision making and of how information is effectively disseminated. Each fellow attends an orientation and evaluation session in Washington, D.C., and begins the internship in mid-June. Fellows submit interim and final reports to AAAS. A wrap-up session is held at the end of the summer.

Mathematical sciences faculty are urged to make their graduate students aware of this program. The deadline to apply for fellowships for the summer of 2010 is **January 15, 2010**. Further information about the fellowship program and application procedures is available online at http://www.aaas.org/programs/education/MassMedia/index.shtml, or applicants may contact Stacey Pasco, Manager, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone 202-326-6441; fax 202-371-9849; email spasco@aaas.org.

Further information is also available at http://www.ams.org/government/massmediaann.html and through the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone 202-588-1100; fax 202-588-1853; email amsdc@ams.org.

*—From the AMS Washington Office*

## Enhancing the Mathematical Sciences Workforce in the Twenty-First Century

The long-range goal of the Enhancing the Mathematical Sciences Workforce in the Twenty-First Century (EMSW21) program of the National Science Foundation (NSF) is to increase the number of well-prepared U.S. citizens, nationals, and permanent residents who pursue careers in the mathematical sciences and in other NSF-supported disciplines. This program builds on the Vertical Integration of Research and Education (VIGRE) program and includes a broadened VIGRE activity, an additional component for Research Training Groups (RTG), and another for Mentoring through Critical Transition Points (MCTP) in the Mathematical Sciences.

The VIGRE program supports projects that involve entire departments in the training process, from the start of the undergraduate career through the completion of a postdoctoral fellowship. The RTG program involves a group of researchers based in a subarea of the mathematical sciences or linked by a multidisciplinary theme and supports training at educational levels from undergraduate to postdoctoral within that focus. The MCTP program supports projects, either departmentally based or conducted by a large group of faculty members, that are aimed at critical transition points in the educational careers of students and junior researchers.

The DMS expects to make between nine and fifteen awards under this program in 2010. The deadline for proposals is **June 1, 2010**. For more information about the program and all of its components, see the website http://www.nsf.gov/pubs/2005/nsf05595/nsf05595.htm.

*—From an NSF announcement*

# Visiting Positions at CIRM

The Centro Internazionale per la Ricerca Matematica (CIRM) announces the creation of four types of visiting positions. Two postdoctoral fellowships will be awarded in 2009–2010. The amount of the fellowship is 23,500 euros (approximately US$33,500) per year. Applicants must have received the Ph.D. degree before November 30, 2009. Preference will be given to applicants whose research programs are connected to the research activity at CIRM and at the Universitá di Trento. The deadline for applications is **September 20, 2009**.

CIRM Visiting Scholars will perform mathematical research in cooperation with scientists and researchers at the University of Trento or, more generally, in the Trento area and will give some research seminars. CIRM Visiting Professors will give short Ph.D. courses, summer courses, or series of seminars. Visits will usually be for between fifteen days and three months. Applications and proposals may be sent at any time.

The Research in Pairs (RIP) Program provides for the presence of two or three partners from universities located in different towns who intend to work on a definite research project and for a well-specified period of time (ranging from one to six weeks). Applicant partners must submit a scientific project in the field of mathematics with a detailed research program. Participants in the RIP Program will also give occasional research seminar talks at the CIRM or at the University of Trento. Applications may be submitted at any time.

For more details about these positions and requirements for submission, see the website `http://science.unitn.it/cirm/PostDocVisitingProfRIP.html`.

*—Augusto Micheletti, CIRM*

# American Institute of Mathematics Call for Proposals

The American Institute of Mathematics (AIM) invites proposals for both its focused workshop and SQuaREs program. AIM workshops are distinguished by their specific mathematical goals. This may involve making progress on a significant unsolved problem or examining the convergence of two distinct areas of mathematics. Workshops are small in size, up to 28 people, to allow for close collaboration among the participants.

SQuaREs, Structured Quartet Research Ensembles, are more long-term in nature. This program brings together groups of four to six researchers for a week of focused work on a specific research problem in consecutive years.

The deadline for proposing a workshop or a SQuaRE is November 1, 2009.

Detailed information about AIM programs, upcoming workshops, and application forms for proposals can be found at `http://www.aimath.org`.

*—Brian Conrey, AIM*



***Worldwide Search for Talent***

City University of Hong Kong aspires to become a leading global university, excelling in research and professional education. The University is committed to nurturing and developing students' talent and creating applicable knowledge in order to support social and economic advancement. Within the next five years, the University will employ another **200 scholars** in various disciplines including **science**, **engineering**, **business**, **social sciences**, **humanities**, **law, creative media, energy**, **environment**, and **biomedical & veterinary sciences**. Its Department of Mathematics has a strong mission to conduct first-class research in applied mathematics and provide high quality education in mathematics.

Applications are invited for:

**Associate Professor/Assistant Professor**
**Department of Mathematics *[Ref. A/584/49]***

**Duties :** Conduct research in areas of Applied Mathematics, teach undergraduate and postgraduate courses, supervise research students, and perform any other duties as assigned.

**Requirements :** A PhD in Mathematics/Applied Mathematics/Statistics with an excellent research record.

**Salary and Conditions of Service**
Remuneration package will be very attractive, driven by market competitiveness and individual performance. Excellent fringe benefits include gratuity, leave, medical and dental schemes, and relocation assistance (where applicable). Initial appointment will be made on a fixed-term contract.

**Information and Application**
Further information on the posts and the University is available at http://www.cityu.edu.hk, or from the Human Resources Office, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong [Fax : (852) 2788 1154 or (852) 3442 0311/email: hrojob@cityu.edu.hk]. Please send the application with a current curriculum vitae to Human Resources Office. **Applications will be considered until positions are filled.** Please quote the reference of the post in the application and on the envelope. The University reserves the right to consider late applications, and not to fill the positions. Personal data provided by applicants will be used for recruitment and other employment-related purposes.

# Reference and Book List

*The **Reference** section of the* Notices *is intended to provide the reader with frequently sought information in an easily accessible manner. New information is printed as it becomes available and is referenced after the first printing. As soon as information is updated or otherwise changed, it will be noted in this section.*

## Contacting the *Notices*

The preferred method for contacting the *Notices* is electronic mail. The editor is the person to whom to send articles and letters for consideration. Articles include feature articles, memorial articles, communications, opinion pieces, and book reviews. The editor is also the person to whom to send news of unusual interest about other people's mathematics research.

The managing editor is the person to whom to send items for "Mathematics People", "Mathematics Opportunities", "For Your Information", "Reference and Book List", and "Mathematics Calendar". Requests for permissions, as well as all other inquiries, go to the managing editor.

The electronic-mail addresses are notices@math.ou.edu in the case of the editor and notices@ams.org in the case of the managing editor. The fax numbers are 405-325-7484 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

## Upcoming Deadlines

**September 1–November 15, 2009:** Applications for travel grants to ICM 2010. See the AMS website, http://www.ams.org/employment/icm2010.html, or contact Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; telephone: 800-321-4267, ext. 4170, or 401-455-4170; email: ICM2010@ams.org.

**September 14, 2009:** Full proposals for NSF Integrative Graduate Education and Research Training (IGERT). See http://www.nsf.gov/pubs/2009/nsf09519/nsf09519.htm.

**September 15, 2009:** Nominations for Alfred P. Sloan Foundation Fellowships. Contact Sloan Research

### Where to Find It

A brief index to information that appears in this and previous issues of the *Notices*.

Fellowships, Alfred P. Sloan Foundation, 630 Fifth Avenue, Suite 2550, New York, New York 10111-0242, or consult the foundation's website: http://www.sloan.org/programs/fellowship_brochure.shtml.

**September 16, 2009:** Nominations for Clay Research Fellowships. See http://www.claymath.org/research_fellows or contact Alagi Patel, telephone: 617-995-2602; email: patel@claymath.org.

**September 18, 2009:** Full proposals for NSF Focused Research Groups (FRG). See http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5671.

**September 20, 2009:** Applications for visiting postdoctoral fellowships at CIRM. See "Mathematics Opportunities" in this issue.

**September 30, 2009:** Applications for spring 2010 semester of Math in Moscow. See http://www.mccme.ru/mathinmoscow or write to: Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax: +7095-291-65-01; email: mim@mccme.ru. For information on AMS scholarships see http://www.ams.org/outreach/mimoscow.html or write to: Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence RI 02904-2294; email: student-serv@ams.org.

**September 30, 2009:** Nominations for 2009 Sacks Prize. See http://www.aslonline.org/Sacks_nominations.html.

**October 1, 2009:** Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@awm-math.org; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

**October 15, 2009:** Proposals for NSA Grants for Research in Mathematics. See http://www.nsa.gov/research/math_research/index.shtml.

**October 15, 2009:** Nominations for Emanuel and Carol Parzen Prize for Statistical Innovation. See http://www.stat.tamu.edu/events/parzenprize/nominations.pdf.

**October 21, 2009:** Proposals for NSF Postdoctoral Research Fellowships. See http://www.nsf.gov/pubs/2008/nsf08582/nsf08582.htm.

**November 1, 2009:** Nominations for Vasil Popov Prize. See http://www.math.sc.edu/~popov/.

**November 1, 2009:** Applications for the January program of the Christine Mirzayan Science and Technology Policy Graduate Fellowship Program of the National Academies. See http://www7.nationalacademies.org/policyfellows; or contact The National Academies Christine Mirzayan Science and Technology Policy Graduate Fellowship Program, 500 Fifth Street, NW, Room 508, Washington, DC 20001; telephone: 202-334-2455; fax: 202-334-1667; email: policyfellows@nas.edu.

**November 2, 2009:** Applications for NRC-Ford Foundation Predoctoral Fellowships. See http://sites.nationalacademies.org/pga/FordFellowships/index.htm; telephone: 202-334-2872; email: infofell@nas.edu; or contact Fellowships Office, Keck 576, National Research Council, 500 Fifth Street, NW, Washington, DC 20001.

**November 9, 2009:** Applications for NRC-Ford Foundation Dissertation and Postdoctoral Fellowships. See http://sites.nationalacademies.org/pga/FordFellowships/index.htm; telephone: 202-334-2872; email: infofell@nas.edu; or contact Fellowships Office, Keck 576, National Research Council, 500 Fifth Street, NW, Washington, DC 20001.

**November 12, 2009:** Full proposals for NSF Project ADVANCE Institutional Transformation (IT) and Institutional Transformation Catalyst (IT-Catalyst) awards. See http://www.nsf.gov/pubs/2009/nsf09504/nsf09504.htm.

**November 15, 2009:** Applications for National Academies Research Associateship Programs. See http://www7.nationalacademies.org/rap/ or contact Research Associateship Programs, National Research Council, Keck 568, 500 Fifth Street, NW, Washington, DC 20001; telephone 202-334-2760; fax 202-334-2759; email: rap@nas.edu.

**December 1, 2009:** Applications for AMS Centennial Fellowships. See http://www.ams.org/employment/centflyer.html; telephone 401-455-4105; email: prof-serv@ams.org; or contact the Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294.

**December 4, 2009:** Entries for 2009 Ferran Sunyer i Balaguer Prize. See http://ffsb.iec.cat.

**December 15, 2009:** Applications for AMS Epsilon Fund grants. See "Mathematics Opportunities" in this issue.

**December 15, 2009:** Nominations for the International Mathematical Union (IMU) Chern Medal Award. See http://www.mathunion.org/fileadmin/IMU/Prizes/Chern/Chern_Medal_Program_Guidelines.pdf.

**January 15, 2010:** Applications for AMS-AAAS Mass Media Summer Fellowships. See "Mathematics Opportunities" in this issue.

**February 1, 2010:** Applications for AWM Travel Grants and Mentoring Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@awm-math.org, or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

**April 15, 2010:** Applications for fall 2010 semester of Math in Moscow. See http://www.mccme.ru/mathinmoscow or write to: Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax: +7095-291-65-01; email: mim@mccme.ru. For information on AMS scholarships see http://www.ams.org/outreach/mimoscow.html or write to: Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence RI 02904-2294; email: student-serv@ams.org.

**May 1, 2010:** Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; or email: awm@awm-math.org. The postal address is: Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

**June 1, 2010:** Applications for NSF's Enhancing the Mathematical

Sciences Workforce in the Twenty-First Century (EMSW21) program. See "Mathematics Opportunities" in this issue.

**October 1, 2010:** Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@awm-math.org; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

## DoD Mathematics Staff

The following agencies of the Department of Defense and the Department of Energy fund research in the mathematical sciences. The names, addresses, and telephone numbers of the pertinent staff members are listed.

**Defense Advanced Research Projects Agency**
Defense Sciences Office
3701 North Fairfax Drive
Arlington, VA 22203-1714
703-526-6630
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*Applied and Computational Mathematics Program*

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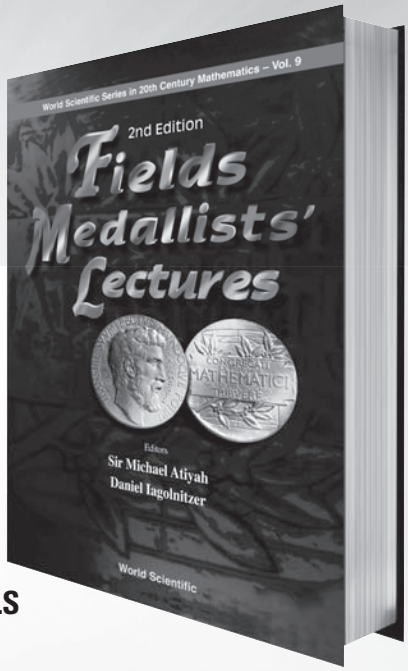


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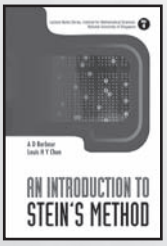


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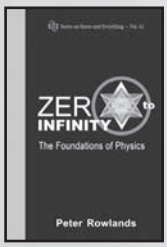


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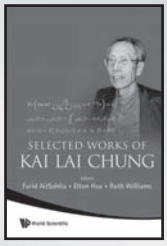


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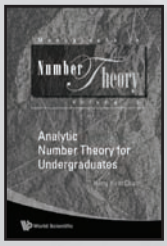


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# From the AMS Secretary

## Report of the Executive Director (2009)

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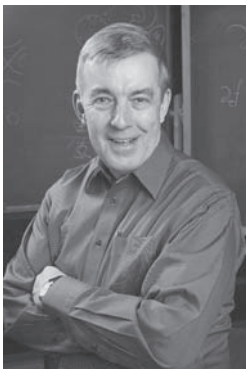

**AMS Executive Director Donald McClure.**

It is traditional for the executive director to report annually on the State of the AMS. In my April report to the Council and May report to the Executive Committee and Board of Trustees, I focused on one topic—the impact on the Society of recent global economic events and the Society's response to the new economic conditions. This report to the broader mathematics community focuses instead on major accomplishments of the AMS in 2008. Of course our response to current economic conditions also warrants some attention.

### Overview

The end of 2008 marked an important turning point for the American Mathematical Society. John Ewing completed thirteen and a half years as executive director. He has been remarkably successful in his executive leadership of the AMS. The two major facets of the AMS, one as a professional membership organization and the other as a scientific publisher, have benefited greatly from his contributions. On behalf of the members, the broader mathematics community, and the volunteer leaders of the Society, I express a profound sentiment of gratitude for John Ewing's work on the Society's behalf.

2008 was a year with a number of notable accomplishments by the AMS in fulfilling its mission to further the interests of mathematics research and scholarship through its publication program, meetings and conferences, advocacy, and professional programs and services.

### Journals

Publishing is central to the achievement of the AMS mission.

In 2006 the Executive Committee and Board of Trustees (ECBT) approved an increase in the number of pages published annually in the Society's four primary journals by twenty percent over a two-year period. This was accomplished without an associated price increase. Total production and distribution costs increased, but in effect, the ECBT approved investing spendable income from long term investments for the improvement of one of the keystones of the Society's mission, its research journals. The change was made only after a considerable amount of discussion about its possible impact on the scholarly quality of the journals and on the editorial functions.

The transition was completed in 2008 and has been a great success. The AMS is delivering twenty percent more research to the community at essentially the same cost to subscribers. Our journals are better and the mathematics community is the primary beneficiary.

| Journal | 2006 | 2007 | 2008 |
|---|---|---|---|
| Journal of the AMS | 29 | 36 | 41 |
| Proceedings | 444 | 477 | 526 |
| Transactions | 242 | 265 | 279 |
| Mathematics of Computation | 114 | 120 | 121 |

*Number of Articles Published*

### Books

The goal of the book program is to be a "publisher of choice" for authors of the best research monographs and advanced mathematics texts. The book program published ninety-nine new books in 2008, including fifty-six monographs and forty-three proceedings. Consistent with its goal, the monographs included a number of notable titles, such as T. Tao's *Structure and Randomness; Markov Chains and Mixing Times* by D. Levin, Yu. Peres, and E. Wilmer; and the first English edition of J. Hadamard's *Lessons in Geometry*.

In October the AMS acquired a series of fifteen advanced mathematics texts, of which ten titles formed the foundation of a new series, *AMS Pure and Applied Undergraduate Texts*. An editorial board headed by Paul Sally

was appointed to guide the growth of the series. This is in keeping with the AMS goal to expand the book publishing program in this new direction.

New international distribution agreements finalized in 2008 are having a positive impact on book sales in Europe and India.

## Mathematical Reviews

*Mathematical Reviews* (MR) and its online version *MathSciNet* are in many ways the most important publications of the AMS, as they provide reviews and bibliographic information about virtually all new mathematics research. Together, they are an indispensable resource to research mathematicians worldwide. In 2008 the MR database and *MathSciNet* continued to expand and the information resources included with *MathSciNet* continued to be enriched.

In 2008 approximately 114,000 items were added to the database, a substantial increase over 2007. Foremost were the 64,000 actual reviews of research publications, bibliographic data for over 21,000 articles from statistics and computer science publications, and over 5,000 items were added from the ever-expanding Digital Mathematics Library (DML). The DML includes retro-digitized mathematics literature, some of which originated before MR was founded in 1940.

2008 also marked a year of transition for *Mathematical Reviews*. Kevin Clancey retired as executive editor in late fall. The Society celebrated his many contributions during his four years at MR, and welcomed Graeme Fairweather as the new executive editor.

## Mathematics Research Communities

In June 2008 the AMS launched a new program of conferences focused on early career research mathematicians: Mathematics Research Communities (MRC). Its principle aim is to foster the formation of networks of mathematical scientists at the beginning of their careers. This goal is a distinguishing feature of MRC. The program is supported by a grant from the National Science Foundation.

Each MRC is organized by senior researchers around a topic of shared interest. One of the 2008 topics, for example, was Computational Algebra and Convexity. Postdocs and advanced graduate students are invited to apply for the program and are selected based on evaluation of their applications by senior organizers.

The main components of the MRC program are a one-week summer conference, a Special Session at the Joint Mathematics Meetings the following January, a mechanism to foster continuing Internet-based communications, and ongoing mentoring from senior colleagues. The initial summer conference is the cornerstone of the program. Within the broad goals of stimulating communication of each participant's interests and forging connections, the format of each summer conference is left up to the organizers.

The inaugural MRC, held at the Snowbird Resort in Utah during the summer of 2008 and reconvened at the 2009 Joint Mathematics Meetings in Washington, was a great success. Both organizers and participants found the experience, including both the summer conference and subsequent Special Session, to be stimulating and fruitful.

## Meetings

The MRC program highlighted above is part of the broad program of meetings and conferences run by the AMS. In 2008 there were eight sectional meetings, the January Joint Mathematics Meetings (JMM), and the December Joint International Meeting with the Shanghai Mathematical Society.

The January 2009 Joint Mathematics Meetings were held in Washington, DC. Over 5,500 individuals participated, a new attendance record. The meeting was very large by other measures as well, such as the number of Special Sessions and the number of speakers (over 2,000).

In 2008 the AMS launched an important new initiative: Travel Grants for Graduate Students to attend JMM. In its first year the program provided support for fifty-nine students to participate in the 2009 Joint Mathematics Meetings. The proposals for support were evaluated by a panel of volunteers. More than 250 proposals were received. The demand was great and the review process was necessarily selective. The reports and testimonials received from the students were extremely enthusiastic.

The travel grant program will be repeated in 2009 for the 2010 Joint Mathematics Meetings in San Francisco. We are working to expand this program to include other meetings and more participants and to try to continue it on an ongoing basis.

## Young Scholars Programs and the Epsilon Fund

In 1999 the AMS established the Epsilon Fund to endow regular funding of independent Young Scholars Programs for mathematically talented high school students. For ten years, the fund has been generously supported by the membership and others in the mathematics community and it has been a development priority for the AMS. The income from the Epsilon Fund supports scholarships for individual students and operating costs of the funded programs.

In 2008 the fund reached an important milestone. Total funding, including funds from AMS unrestricted endowment designated by the Board of Trustees in 1999, reached US$2,000,000, the initial goal set in 1999. At this level the fund can sustain about $100,000 in grants each year. The attainment of the funding goal came sooner than anticipated in 1999, and is due to steady and enthusiastic support by contributors and a very generous contribution in 2008 from an anonymous donor.

The Epsilon Fund represents a program that has a major impact for a modest amount of spendable income. In 2008 ten programs were funded (including multi-year grants) and almost 600 talented students participated in the sponsored programs.

## Advocacy

There are different dimensions to the Society's advocacy efforts. The Washington Office is at the nexus of science-government interactions. It works with other organizations, often in a leadership role, as an advocate for

science and research. The Public Awareness Office is based in Providence and undertakes a broad array of activities aimed at different audiences, e.g., high school students, the media, and the general public, to foster a better understanding of mathematics and its importance.

Examples of activities of the Washington Office in 2008 include testimony before a Senate committee, and organizing events that promote research and advances supported by the National Science Foundation (NSF). Sam Rankin, director of the Washington Office, testified before the Senate Health, Education, Labor and Pensions Committee about the lack of predictable, adequate funding for scientific research. Rankin also chairs the Coalition for National Science Funding (CNSF), an alliance of over 120 organizations united in support of increasing funding of the NSF's research and education programs. In June 2008, as part of CNSF's 14th annual exhibition for policy makers on Capitol Hill, the AMS sponsored an exhibit "Mathematics and Cardiology:? Partners for the Future", presented by Prof. Suncica Canic of the University of Houston. Hers was one of many presentations highlighting research made possible by NSF.

2008 marked the fourth year of support by the AMS for a Congressional Fellow through the program administered by the American Association for the Advancement of Science. In 2007–2008, the AMS sponsored Jeffry Phan, who worked as a legislative assistant in the office of Senator Jeff Bingham (NM), and in 2008–2009, we sponsored James Rath, who worked in the office of Rep. Ruben Hinojosa (TX). AMS support of this program has been highly effective in placing Ph.D. mathematicians in Congressional offices where they can play a valuable public policy role and bring a scientific/mathematical perspective to the formulation of legislation and the decision-making process in Congress: At the end of 2008 there were three Ph.D. mathematicians working in Congress who first went there as Fellows sponsored by the AMS.

## Outreach

The AMS supports and participates in a number of activities that reach beyond the direct concerns of fostering mathematics research and scholarship in North America. We reach out to support mathematicians around the world and to groups beyond the community of research mathematicians. I would like to highlight recent outreach activities of the first type.

For many years the Society has coordinated a book and journal donation program that matches donors of mathematical publications with institutions and libraries in developing countries that need better collections of mathematics literature. The Society itself allocates significant resources to the shipping costs and to the administrative effort of the program. The actual costs have been partially supported by funds from donors, notably the Alan and Katherine Stroock Fund, in addition to AMS operating funds.

In 2008 the AMS started donating funds to the Visiting Lecturer Program of the U.S. National Committee for Mathematics (USNCM). The USNCM program provides productive interaction between mathematicians from the developed world and talented students in the developing world by sending mathematicians to teach intensive advanced undergraduate courses. In particular, AMS sponsored sending mathematicians to Cambodia to teach Real Analysis courses. Following our first sponsorship of the program in 2008, a generous donor underwrote ongoing sponsorship through 2013.

Also in 2008, the AMS started work to assure sponsorship of *MathSciNet* subscriptions for thirty departments in nineteen African countries. The impact of this program is potentially very great and the cost is by comparison very small. Through 2010 the program is funded by a donation to the AMS. The goal is to encourage departments and individuals, principally in the U.S, to sponsor subscriptions.

## AMS Response to Economic Conditions

First the good news: The AMS is very well prepared for the current economic crisis. In response to very difficult economic conditions in the early 1980s, the AMS established and funded an Economic Stabilization Fund (ESF) with a view towards times like the present. The fund was established by the Board of Trustees in May 1980 "to make a funded provision for possible need of cash to finance the operation of some future year in which the Society may find itself short of cash." At that time, the Society faced several years of operating losses through the early 1980s recession.

In later years the Board set a specific level at which the ESF is to be funded. Today it is maintained at the sum of 75% of annual operating expenses plus the current estimate of the obligation of the postretirement health benefit plan. The December 31, 2008, balance of the ESF was $22.9 million. The fully funded ESF is the basis for my claim that the AMS is very well prepared for the current economic crisis. We can draw on this fund if we need to. That contingency needs to be recognized, but it is not looming as an immediate near-term concern.

The Treasurer's Report provides much more information about the impact of equity market losses on the Society's long term investment portfolio.

More broadly, the mathematics community and the academic community as a whole have been severely affected by the precipitous economic decline in late 2008. There are two major effects: (1) state tax revenues have dropped sharply and (2) institutional endowments have suffered major declines because of the decline of equity markets.

The decline in sales tax revenues in the fourth quarter of 2008 was the worst in fifty years.[1] This decline in revenues represented a rapid phase change; state tax revenues in the third quarter of 2008 were actually higher on average than in the corresponding quarter of 2007. The impact of the decline in state revenues immediately affected publicly supported academic institutions.

The losses suffered by institutional endowments have an impact like the one described in the Treasurer's Report for the 30% decline in the Society's long-term investment portfolio in 2008. There is less spendable income, less

[1] *Donald J. Boyd and Lucy Dadayan,* State Revenue Report, *April 2009, The Nelson A. Rockefeller Institute, SUNY Albany.*

## About the Cover

**San Franciso and the Golden Gate**

The cover photograph cover shows San Francisco Bay and the city together with the Golden Gate. It was taken by David Eisenbud in the month of January, from a site very close to the Mathematical Sciences Research Insitute on the hill above Berkeley.

David tells us, "December and January are the months when the air over San Francisco Bay is the clearest (at least if it's not raining!), and the sunsets seem to me the most beautiful. The evening of this photograph was especially clear. In the foreground we see the Lawrence Hall of Science, and below it the University of California and the city of Berkeley, with brightly lit University Avenue stretching from the University down to the Bay. The old ferry pier, at the Berkeley Marina, points to Alcatraz Island, now an interesting tourist destination.

"On the left of the picture is the Bay Bridge, leading from Oakland to San Francisco. The Convention Center (where the Joint Mathematical Meetings will be held in January 2010*) is just behind the buildings on the other side of the Bay Bridge. In the middle of the photo is the well known bridge spanning the Golden Gate, connecting San Francisco on the south with the Marin Headlands on the north. Behind the Golden Gate, we can see the Farallon Islands, clearly visible even though 42 miles away. (Comparing the height of the viewpoint, the height of the bridge towers, and the apparent and actual height of the Farallons, one can compute the diameter of the earth; a puzzle postcard available from MSRI shows a photo making the heights and distances clear, and proposes a formula—see `http://www.msri.org/globalview`.)"

—Bill Casselman, Graphics Editor
(`notices-covers@ams.org`)

*The 2010 Joint Mathematics Meetings will be held January 13–16, in San Francisco, California.

revenue overall, and a need to find ways to close gaps in operating budgets.

The revenue shortfalls have resulted in salary freezes, hiring freezes, budget reductions for libraries, layoffs of limited term contract employees, reductions in operating budgets for departments, and reductions in support for graduate students and postdoctoral associates. All of these actions translate into greater importance of services and support from the AMS.

We are placing a very high priority on being responsive to the changed needs of the community. Our immediate responses include serious commitments to holding down costs of journal subscriptions and dues, attempts to be proactive in addressing the problems of the employment market for young mathematicians, advocacy for support of mathematics from government agencies and providing timely information to academic departments and the mathematics community as a whole.

The impact of the current recession on the academic research community is likely to be prolonged. In the recession of the early 1980s, it took three years for state tax revenues to return to their pre-recession level. In the recession of the early 1990s, it took almost five years for state tax revenues to return to pre-recession levels.[2]

The economic conditions will have a major influence on the focus of our services to the community for several years, but again, the Society is financially prepared to adapt and offer excellent programs for mathematicians.

*—Donald McClure*
*Executive Director*

[2] *Donald J. Boyd,* What will happen to state budgets when the money runs out?*, February 2009, The Nelson A. Rockefeller Institute of Government, SUNY Albany.*

# Officers and Committee Members

Numbers to the left of headings are used as points of reference in an index to AMS committees which follows this listing. Primary and secondary headings are:

1. Officers
   1.1. Liaison Committee
2. Council
   2.1. Executive Committee of the Council
3. Board of Trustees
4. Committees
   4.1. Committees of the Council
   4.2. Editorial Committees
   4.3. Committees of the Board of Trustees
   4.4. Committees of the Executive Committee and Board of Trustees
   4.5. Internal Organization of the AMS
   4.6. Program and Meetings
   4.7. Status of the Profession
   4.8. Prizes and Awards
   4.9. Institutes and Symposia
   4.10. Joint Committees
5. Representatives
6. Index

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| Chair | George E. Andrews |
| | John B. Conway |
| | Robert J. Daverman |
| | John M. Franks |

## 2. Council

#### 2.0.1. Officers of the AMS

| | | |
|---|---|---|
| President | George E. Andrews | 2010 |
| Immediate Past President | | |
| | James G. Glimm | 2009 |
| Vice President | Robert L. Bryant | 2009 |
| | Frank Morgan | 2010 |
| | Bernd Sturmfels | 2010 |
| Secretary | Robert J. Daverman | 2010 |
| Associate Secretaries* | Susan J. Friedlander | 2009 |
| | Michel L. Lapidus | 2009 |
| | Matthew Miller | 2010 |
| | Steven Weintraub | 2010 |
| Treasurer | John M. Franks | 2010 |
| Associate Treasurer | Linda Keen | 2010 |

#### 2.0.2. Representatives of Committees

| | | |
|---|---|---|
| Bulletin | Susan J. Friedlander | 2011 |
| Colloquium | Paul J. Sally, Jr. | 2011 |
| Executive Committee | Sylvain E. Cappell | 2009 |
| Journal of the AMS | Karl Rubin | 2013 |
| Mathematical Reviews | Jonathan I. Hall | 2009 |
| Mathematical Surveys and Monographs | Ralph L. Cohen | 2012 |
| Mathematics of Computation | Chi-Wang Shu | 2011 |
| Proceedings | Ronald Fintushel | 2009 |
| Transactions and Memoirs | Robert Guralnick | 2012 |

*Only one Associate Secretary at a time is a voting member of the Council, namely the cognizant Associate Secretary for the scientific sessions.

#### 2.0.3. Members at Large

| | | | |
|---|---|---|---|
| Aaron Betram | 2011 | Marjorie Senechal | 2009 |
| Robert L. Devaney | 2009 | Joseph H. Silverman | 2010 |
| Rebecca F. Goldin | 2010 | Panagiotis E. Souganidis | |
| Bryna Kra | 2010 | | 2011 |
| William A. Massey | 2011 | Francis Edward Su | 2009 |
| Irena Peeva | 2010 | Michelle L. Wachs | 2011 |
| Frank S. Quinn | 2009 | Sarah J. Witherspoon | 2010 |
| Katherine St. John | 2009 | David Wright | 2011 |

### 2.1. Executive Committee of the Council

| | | |
|---|---|---|
| | George E. Andrews | *ex officio* |
| | Sylvain E. Cappell | 2009 |
| | Ruth M. Charney | 2010 |
| | Robert J. Daverman | *ex officio* |
| | James G. Glimm | *ex officio* |
| | Craig L. Huneke | 2011 |
| | Joseph H. Silverman | 2012 |

# 3. Board of Trustees

| | | |
|---|---|---|
| | George E. Andrews | *ex officio* |
| Chair | John B. Conway | 2010 |
| | John M. Franks | *ex officio* |
| | Eric M. Friedlander | 2009 |
| | Linda Keen | *ex officio* |
| | Ronald J. Stern | 2013 |
| Secretary | Karen Vogtmann | 2012 |
| | Carol S. Wood | 2011 |

# 4. Committees

### 4.1. Committees of the Council

*Standing Committees*

#### 4.1.1. Editorial Boards

| | | |
|---|---|---|
| Chair | Eric Bedford | 2009 |
| | Robert J. Daverman | *ex officio* |
| | Sergei Gelfand | *ex officio* |
| | Michael T. Lacey | 2011 |
| | Alan W. Reid | 2010 |
| | Michael F. Singer | 2011 |
| | Catherine Sulem | 2010 |
| | Irena Swanson | 2009 |

#### 4.1.2. Fellows Program Revision

| | | |
|---|---|---|
| | George E. Andrews | 2010 |
| | James Arthur | 2010 |
| | Susan J. Friedlander | 2010 |
| Chair | James G. Glimm | 2010 |

#### 4.1.3. Nominating Committee

Terms begin on January 1 and expire on December 31 of the year listed.

| | | |
|---|---|---|
| | Percy Deift | 2010 |
| | Irene Fonseca | 2011 |
| | Thomas C. Hales | 2009 |
| | Roger Howe | 2009 |
| | Sheldon H. Katz | 2011 |
| | Ellen E. Kirkman | 2011 |
| | Louise A. Raphael | 2010 |
| | Hema Srinivasan | 2009 |
| Chair | Richard A. Wentworth | 2010 |

*Policy Committees*

#### 4.1.4. Employment Services, Advisory Board on

| | | |
|---|---|---|
| | Laura G. DeMarco | 2011 |
| | Patrick Barry Eberlein | 2012 |
| | Richard M. Hain | 2010 |

#### 4.1.5. Mathematics Research Communities Advisory Board

| | | |
|---|---|---|
| | David Aldous | 2010 |
| | Ruth Chaney | 2009 |
| | Robert J. Daverman | 2009 |
| Chair | David Eisenbud | 2010 |
| | Randall J. LeVeque | 2009 |
| | David C. Manderscheid | 2009 |
| | Hal Schenck | 2010 |
| | Frank Sottile | 2010 |
| | Genevieve Walsh | 2010 |

*Special Committees*

#### 4.1.6. Employment Prospects, Task Force on

Terms expire on May 31 of the year listed.

| | | |
|---|---|---|
| | Douglas L. Costa | 2009 |
| | Annalisa Crannell | 2009 |
| | Eli Donkar | 2009 |
| | Moon Duchin | 2009 |
| | Melvin Hochster | 2009 |
| | Linda Keen | 2009 |
| | Susan R. Loepp | 2009 |
| | James J. Tattersall | 2009 |
| | Carol S. Wood | 2009 |

#### 4.1.7. Search Committee for the Editor of the Notices of the AMS

| | | |
|---|---|---|
| | Robert J. Daverman | 2009 |
| | James Glimm | 2009 |
| | Rebecca Goldin | 2009 |
| | Judy Anita Kennedy | 2009 |
| Chair | Donald E. McClure | 2009 |

### 4.2. Editorial Committees

#### 4.2.1. Abstracts Editorial Committee

All members of this committee serve *ex officio*.

| | |
|---|---|
| Chair | Robert J. Daverman |
| | Susan J. Friedlander |
| | Michel L. Lapidus |
| | Matthew Miller |
| | Steven Weintraub |

### 4.2.2. Bulletin (New Series)

| | | |
|---|---|---|
| Consultant | Gerald L. Alexanderson | 2010 |
| Book Reviews Editor | Robert L. Devaney | 2011 |
| Chief Editor | Susan J. Friedlander | 2011 |
| Consultant | Jane Kister | 2010 |

Associate Editors for Bulletin Articles

| | | | |
|---|---|---|---|
| David J. Benson | 2011 | Gregory Lawler | 2011 |
| Daniel S. Freed | 2011 | Barry Mazur | 2011 |
| Edward Frenkel | 2011 | Paul H. Rabinowitz | 2011 |
| Mark Goresky | 2011 | Panagiotis E. Souganidis | 2010 |
| Andrew J. Granville | 2011 | Yuri Tschinkel | 2011 |
| Bryna R. Kra | 2011 | Michael Wolf | 2011 |

Associate Editors for Book Reviews

| | | | |
|---|---|---|---|
| Jonathan L. Alperin | 2011 | Ken Ono | 2011 |
| Steven G. Krantz | 2011 | Philip E. Protter | 2011 |
| Peter Kuchment | 2011 | Lisa Traynor | 2011 |

### 4.2.3. Collected Works

| | | |
|---|---|---|
| Chair | Dusa McDuff | 2012 |
| | Elias M. Stein | 2012 |
| | William A. Veech | 2011 |

### 4.2.4. Colloquium

| | | |
|---|---|---|
| | Yuri Manin | 2009 |
| Chair | Paul J. Sally, Jr. | 2011 |
| | Peter Sarnak | 2012 |

### 4.2.5. Contemporary Mathematics

| | | |
|---|---|---|
| | George E. Andrews | 2011 |
| Chair | Dennis DeTurck | 2011 |
| | Abel Klein | 2011 |
| | Martin Strauss | 2011 |

### 4.2.6. Graduate Studies in Mathematics

| | | |
|---|---|---|
| Chair | David A. Cox | 2012 |
| | Steven G. Krantz | 2009 |
| | Rafe Mazzeo | 2011 |
| | Martin G. Scharlemann | 2011 |

### 4.2.7. Journal of the AMS

| | | |
|---|---|---|
| | Weinan E | 2009 |
| | Sergey Fomin | 2012 |
| | Gregory Lawler | 2012 |
| | John W. Morgan | 2009 |
| Chair | Karl Rubin | 2011 |
| | Terence Tao | 2011 |

Associate Editors

| | | | |
|---|---|---|---|
| Noga Alon | 2011 | Haynes R. Miller | 2012 |
| Alexei Borodin | 2011 | Assaf Naor | 2011 |
| Robert L. Bryant | 2011 | Andrew M. Odlyzko | 2009 |
| Emanuel Candes | 2011 | Bjorn Poonen | 2009 |
| Pavel I. Etingof | 2011 | Sorin T. Popa | 2011 |
| Mark Goresky | 2011 | Victor S. Reiner | 2009 |
| Christopher Hacon | 2012 | Thomas Scanlon | 2012 |
| Peter Kronheimer | 2012 | Freydoon Shahidi | 2012 |
| Elon Lindenstrauss | 2011 | Avi Wigderson | 2012 |
| Jacob Lurie | 2012 | Lia-Sang Young | 2011 |

### 4.2.8. Mathematical Reviews

AMS staff contact: Graeme Fairweather

| | | |
|---|---|---|
| | Cameron Gordon | 2011 |
| Chair | Jonathan I. Hall | 2009 |
| | Peter Maass | 2012 |
| | Tadao Oda | 2009 |
| | Ronald M. Solomon | 2012 |
| | Trevor D. Wooley | 2012 |

### 4.2.9. Mathematical Surveys and Monographs

| | | |
|---|---|---|
| | Jerry L. Bona | 2009 |
| Chair | Ralph L. Cohen | 2012 |
| | Michael G. Eastwood | 2009 |
| | J. Tobias Stafford | 2009 |
| | Benjamin Sudakov | 2011 |

### 4.2.10. Mathematics of Computation

| | | |
|---|---|---|
| | Susanne C. Brenner | 2012 |
| | Ronald F. Cools | 2011 |
| | Igor Shparlinski | 2011 |
| Chair | Chi-Wang Shu | 2011 |

Associate Editors

| | | | |
|---|---|---|---|
| David W. Boyd | 2009 | Cheryl Praeger | 2012 |
| Daniela Calvetti | 2011 | Renate Scheidler | 2009 |
| Zhiming Chen | 2009 | Christoph Schwab | 2011 |
| Jean-Marc Couveignes | 2011 | Jie Shen | 2011 |
| Ricardo G. Duran | 2009 | Chris J. Smyth | 2009 |
| Ivan P. Gavrilyuk | 2011 | Michael Stillman | 2012 |
| Viviette Girault | 2012 | Daniel B. Szyld | 2009 |
| Ernst Hairer | 2011 | Denis Talay | 2009 |
| Fred J. Hickernell | 2011 | Tao Tang | 2012 |
| Gregor Kemper | 2012 | Paul Tseng | 2012 |
| Francis J. Narcowich | 2011 | Hans W. Volkmer | 2011 |
| Marian Neamtu | 2011 | Jinchao Xu | 2009 |
| Stanley Osher | 2011 | Zhimin Zhang | 2012 |

### 4.2.11. Notices Editorial Board

Terms begin on January 1 and expire on December 31 of the year listed.

| | | |
|---|---|---|
| Editor | Andy R. Magid | 2009 |

Associate Editors

| | | | |
|---|---|---|---|
| Daniel Kalman Biss | 2009 | Robion C. Kirby | 2009 |
| Susanne C. Brenner | 2009 | Steven G. Krantz | 2009 |
| William Casselman | 2009 | Peter C. Sarnak | 2009 |
| Robert J. Daverman | | Mark E. Saul | 2009 |
| | *ex officio* | John R. Swallow | 2009 |
| Lisette de Pillis | 2009 | Lisa M. Traynor | 2009 |
| Susan J. Friedlander | 2009 | | |

### 4.2.12. Proceedings

| | | |
|---|---|---|
| | Mario Bonk | 2011 |
| | Richard Bradley | 2010 |
| | Ted C. Chinburg | 2009 |
| Coordinating | Peter A. Clarkson | 2010 |
| | Walter Craig | 2012 |
| | Alexander N. Dranishnikov | 2011 |
| Chair | Ronald A. Fintushel | 2009 |
| | Franc Forstneric | 2012 |
| | Matthew J. Gursky | 2010 |
| | James Haglund | 2009 |
| | Jonathan I. Hall | 2010 |
| | Birge Huisgen-Zimmerman | 2009 |
| | Marius Junge | 2010 |
| | Nigel Kalton | 2011 |
| | Julia Knight | 2012 |
| | Bryna Kra | 2011 |
| | Michael T. Lacey | 2012 |
| | Gail R. Letzter | 2010 |
| | Wen-Ching Winnie Li | 2009 |
| Coordinating | Martin Lorenz | 2009 |
| | Ken Ono | 2012 |
| | Daniel Ruberman | 2009 |
| Coordinating | Mei-Chi Shaw | 2012 |
| | Brooke E. Shipley | 2012 |
| | Hart F. Smith | 2010 |
| Coordinating | Chuu-Lian Terng | 2009 |

| | | |
|---|---|---|
| | Tatiana Toro | 2010 |
| | Bernd Ulrich | 2009 |
| | Walter Van Assche | 2012 |
| | Mathai Varghese | 2011 |
| | Edward C. Waymire | 2011 |
| | Richard Wentworth | 2009 |
| Coordinating | Jon Wolfson | 2009 |
| | Yingfei Yi | 2012 |

#### 4.2.13. Proceedings of Symposia in Applied Mathematics

| | | |
|---|---|---|
| | Mary C. Pugh | 2009 |
| | Leonid Ryzhik | 2011 |
| Chair | Eitan Tadmor | 2011 |

#### 4.2.14. Transactions and Memoirs

| | | |
|---|---|---|
| | Dan Abramovich | 2010 |
| | Alejandro Adem | 2012 |
| | Luchezar L. Avramov | 2012 |
| | Richard Bass | 2011 |
| | Mark Feighn | 2011 |
| Chair | Robert Guralnick | 2012 |
| | Yunping Jiang | 2011 |
| | Alexander Kleshchev | 2012 |
| | Steffan Lempp | 2011 |
| | William P. Minicozzi II | 2010 |
| | Alexander Nagel | 2010 |
| | Peter Polacik | 2010 |
| | Gustavo Alberto Ponce | 2009 |
| | Jonathan Rogawski | 2011 |
| | Shankar Sen | 2012 |
| | Dimitri Shlyakhtenko | 2010 |
| | Robert J. Stanton | 2009 |
| | John R. Stembridge | 2009 |
| | Daniel I. Tartaru | 2010 |
| | Mina Teicher | 2012 |
| | Christopher Woodward | 2012 |

#### 4.2.15. Translation from Chinese

| | | |
|---|---|---|
| | Sun-Yung Alice Chang | |
| | S.-Y. Cheng | |
| Chair | Tsit-Yuen Lam | |
| | Tai-Ping Liu | |
| | Chung-Chun Yang | |

#### 4.2.16. Translation from Japanese

| | | |
|---|---|---|
| Chair | Shoshichi Kobayashi | 1999 |
| | Masamichi Takesaki | 1999 |

*Standing Committees*

#### 4.2.17. Conformal Geometry and Dynamics

| | | |
|---|---|---|
| | Francois Berteloot | 2011 |
| | Mario Bonk | 2009 |
| | Sun-Yung Alice Chang | 2010 |
| | Pekka Koskela | 2012 |
| Chair | Gaven Martin | 2011 |
| | Susan Mary Rees | 2011 |
| | Caroline Series | 2012 |

#### 4.2.18. History of Mathematics

| | | |
|---|---|---|
| | Joseph W. Dauben | 2011 |
| | Peter L. Duren | 2011 |
| | Robin Hartshorne | 2012 |
| Chair | Karen H. Parshall | 2011 |

#### 4.2.19. Pure and Applied Undergraduate Texts

| | | |
|---|---|---|
| Chair | Paul J. Sally, Jr. | 2012 |
| | Joseph H. Silverman | 2012 |
| | Francis Edward Su | 2012 |
| | Susan Tolman | 2012 |

#### 4.2.20. Representation Theory

| | | |
|---|---|---|
| | Jens Carsten Jantzen | 2012 |
| Chair | Henrik Schlichtkrull | 2012 |
| | Freydoon Shahidi | 2012 |
| | Peter E. Trapa | 2012 |
| | David A. Vogan | 2009 |

#### 4.2.21. Student Mathematics Library

| | | |
|---|---|---|
| | Gerald B. Folland | 2012 |
| | Robin Forman | 2011 |
| Chair | Brad G. Osgood | 2011 |
| | Michael Starbird | 2012 |

#### 4.2.22. University Lecture Series

| | | |
|---|---|---|
| | Jerry L. Bona | 2009 |
| Chair | Eric M. Friedlander | 2010 |
| | Nigel Higson | 2009 |
| | J. Tobias Stafford | 2009 |

## 4.3. Committees of the Board of Trustees

#### 4.3.1. Agenda and Budget

All members of this committee serve *ex officio*.
AMS staff contact: Ellen H. Heiser

| | |
|---|---|
| Chair | George E. Andrews |
| | John B. Conway |
| | Robert J. Daverman |
| | John M. Franks |
| | Linda Keen |

#### 4.3.2. Audit

All members of this committee serve *ex officio*.
AMS staff contact: Connie Pass.

| | |
|---|---|
| | John B. Conway |
| Chair | John M. Franks |
| | Linda Keen |
| | Carol S. Wood |

#### 4.3.3. Investment

AMS staff contact: Connie Pass.

| | | |
|---|---|---|
| Chair | John M. Franks | *ex officio* |
| | Linda Keen | *ex officio* |
| | Henry B. Laufer | 2009 |
| | Ronald J. Stern | *ex officio* |

#### 4.3.4. Salary

All members of this committee serve *ex officio*.
AMS staff contact: Donald E. McClure.

| | |
|---|---|
| | John B. Conway |
| Chair | John M. Franks |
| | Linda Keen |

## 4.4. Committees of the Executive Committee and Board of Trustees

#### 4.4.1. Long Range Planning

All members of this committee serve *ex officio*.
AMS staff contact: Ellen H. Heiser.

| | |
|---|---|
| Chair | George E. Andrews |
| | Ruth M. Charney |
| | John B. Conway |
| | Robert J. Daverman |
| | John M. Franks |
| | Craig L. Huneke |
| | Donald E. McClure |

#### 4.4.2. Nominating

All members of this committee serve *ex officio*.

| | | |
|---|---|---|
| | Ruth M. Charney | |
| | Richard A. Wentworth | |
| Chair | Carol S. Wood | |

#### 4.4.3. Search Committee for the Treasurer

| | | |
|---|---|---|
| | John M. Franks | 2010 |
| | Linda Keen | 2010 |
| | B. A. Taylor | 2010 |
| | Carol S. Wood | 2010 |

## 4.5. Internal Organization of the American Mathematical Society

*Standing Committees*

#### 4.5.1. Archives

| | | |
|---|---|---|
| | Bruce C. Berndt | 2011 |
| | Kenneth R. Meyer | 2010 |
| | Karen H. Parshall | 2009 |

#### 4.5.2. Books and Journal Donations Steering Committee

| | | |
|---|---|---|
| Chair | Augustin Banyaga | 2009 |
| | Huaxin Lin | 2011 |
| | Nageswari Shanmugalingam | 2010 |

#### 4.5.3. Committee on Committees

| | | |
|---|---|---|
| Chair | Krishnaswami Alladi | 2010 |
| | George E. Andrews | *ex officio* |
| | Steven Damelin | 2010 |
| | Robert J. Daverman | *ex officio* |
| | Charles F. Epstein | 2010 |
| | Johnny L. Henderson | 2010 |
| | Chawne M. Kimber | 2010 |
| | Bryna Kra | 2010 |
| | Steven G. Krantz | 2010 |
| | R. James Milgram | 2010 |
| | Ken Ono | 2010 |
| | Kim Ruane | 2010 |
| | Mei-Chi Shaw | 2010 |

#### 4.5.4. Library Committee

| | | |
|---|---|---|
| | Jonathan M. Borwein | 2011 |
| Co-chair | Michael Bowman | 2009 |
| | Roger Chalkley | 2010 |
| | Sherry Chang | 2010 |
| Co-chair | Michael J. Falk | 2009 |
| | Silvio Levy | 2009 |
| | Linda Y. Yamamoto | 2011 |
| | Yunliang Yu | 2010 |

#### 4.5.5. Publications

AMS staff contact: Erin Buck.

| | | |
|---|---|---|
| | George E. Andrews | *ex officio* |
| | Aaron J. Bertram | 2011 |
| | David A. Cox | 2009 |
| | Robert J. Daverman | *ex officio* |
| Chair | Robert L. Devaney | 2009 |
| | Roman J. Dwilewicz | 2010 |
| | Sergei Gelfand | *ex officio* |
| | Mark Goresky | 2011 |
| | Gregory F. Lawler | 2011 |
| | Donald E. McClure | *ex officio* |
| | Andrew M. Odlyzko | 2011 |
| | Joseph H. Silverman | 2010 |
| | Catherine Sulem | 2009 |
| | Carol S. Wood | 2009 |

## 4.6. Program and Meetings

*Standing Committees*

#### 4.6.1. Meetings and Conferences

AMS staff contact: Ellen Maycock

| | | |
|---|---|---|
| | Daljit S. Ahluwalia | 2011 |
| | George E. Andrews | *ex officio* |
| | John B. Conway | 2009 |
| | Robert J. Daverman | *ex officio* |
| | Ryan Garibaldi | 2010 |
| | Aloysius G. Helminck | 2010 |
| | Alex Iosevich | 2011 |
| | William A. Massey | 2011 |
| | Donald E. McClure | *ex officio* |
| | David B. Meredith | 2009 |
| | Irena Peeva | 2010 |
| Chair | Katherine St. John | 2009 |
| | Ann Trenk | 2010 |

#### 4.6.2. Program Committee for National Meetings

| | | |
|---|---|---|
| | Robert Calderbank | 2009 |
| | Suncica Canic | 2011 |
| | Gui-Qiang Chen | 2009 |
| | Robert J. Daverman | *ex officio* |
| | Vaughn F. R. Jones | 2010 |
| Chair | Robion C. Kirby | 2009 |
| | Matthew Miller | *ex officio* |
| | Dana Randall | 2010 |
| | Gigliola Staffilani | 2011 |

#### 4.6.3. Short Course Subcommittee

| | | |
|---|---|---|
| | Yuliy M. Baryshnikov | 2011 |
| | Peter E. Castro | 2009 |
| | Jonathan C. Mattingly | 2011 |
| | Yuval Peres | 2009 |
| Chair | Daniel Rockmore | 2010 |
| | Chi-Wang Shu | 2010 |
| | Lisa G. Townsley | 2009 |

#### 4.6.4. Central Section Program Committee

| | | |
|---|---|---|
| | Joseph G. Conlon | 2010 |
| | Susan J. Friedlander | *ex officio* |
| Chair | Bryna Kra | 2009 |
| | Russell D. Lyons | 2010 |
| | Shmuel A. Weinberger | 2009 |

#### 4.6.5. Eastern Section Program Committee

| | | |
|---|---|---|
| | Bruce A. Kleiner | 2010 |
| | Charles David Levermore | 2009 |
| Chair | John Smillie | 2009 |
| | Michael Vogelius | 2010 |
| | Steven Weintraub | *ex officio* |

#### 4.6.6. Southeastern Section Program Committee

| | | |
|---|---|---|
| | John Etnyre | 2010 |
| | Ian Knowles | 2010 |
| | Matthew Miller | *ex officio* |
| | Stanslav A. Molchanov | 2009 |
| Chair | Victoria Ann Powers | 2009 |

#### 4.6.7. Western Section Program Committee

| | | |
|---|---|---|
| | Thomas Y. Hou | 2010 |
| | Michel L. Lapidus | *ex officio* |
| Chair | Jennifer C. Schultens | 2009 |
| | Rekha Thomas | 2010 |
| | Ravi D. Vakil | 2009 |

#### 4.6.8. Agenda for Business Meetings

| | | |
|---|---|---|
| | Robert J. Daverman | *ex officio* |

#### 4.6.9. Arnold Ross Lecture Series Committee

| | | |
|---|---|---|
| | Thomas C. Hull | 2010 |
| | Frank Morgan | 2009 |
| Chair | Dan Rockmore | 2009 |
| | Daniel B. Shapiro | 2011 |

#### 4.6.10. Colloquium Lecture

| | | |
|---|---|---|
| Chair | Peter Sarnak | 2010 |
| | Gilbert Strang | 2011 |
| | Lai-Sang Young | 2009 |

#### 4.6.11. Gibbs Lecturer for 2009 and 2010, Committee to Select

| | | |
|---|---|---|
| Chair | Weinan E | 2009 |
| | Barry Simon | 2009 |
| | Peter Winkler | 2009 |

## 4.7. Status of the Profession

*Standing Committees*

#### 4.7.1. Academic Freedom, Tenure, and Employment Security

| | | |
|---|---|---|
| | William K. Allard | 2010 |
| | Lisa Carbone | 2011 |
| | Ronald G. Douglas | 2010 |
| | Joseph M. Landsberg | 2011 |
| | Michael K. May | 2010 |
| Chair | Stephen B. Robinson | 2009 |
| | Lorenzo Traldi | 2009 |

#### 4.7.2. Education

AMS staff contact: Samuel M. Rankin III.

| | | |
|---|---|---|
| | George E. Andrews | *ex officio* |
| | Ralph L. Cohen | 2011 |
| | Robert J. Daverman | *ex officio* |
| | Beverly E. J. Diamond | 2011 |
| | Michael E. Gage | 2010 |
| Chair | Lawrence Firman Gray | 2009 |
| | Deborah Hughes Hallett | 2010 |
| | Donald E. McClure | *ex officio* |
| | James E. McClure | 2009 |
| | Harriett S. Pollatsek | 2009 |
| | Frank S. Quinn | 2009 |
| | Ronald J. Stern | 2009 |
| | Sarah J. Witherspoon | 2010 |
| | David Wright | 2011 |

#### 4.7.3. Fan Fund

| | | |
|---|---|---|
| | Weinan E | 2009 |
| Chair | Tsit-Yuen Lam | 2010 |
| | Jinchao Xu | 2011 |

#### 4.7.4. Human Rights of Mathematicians

| | | |
|---|---|---|
| | Margaret Bayer | 2010 |
| | Eduardo Cattani | 2009 |
| | Raul E. Curto | 2011 |
| | Wilfrid Gangbo | 2011 |
| Chair | Joel L. Lebowitz | 2009 |
| | Wen-Ching Winnie Li | 2009 |
| | Parimala Raman | 2010 |
| | Yakov Sinai | 2011 |
| | Joseph C. Watkins | 2010 |

#### 4.7.5. Profession

AMS staff contact: Ellen J. Maycock.

| | | |
|---|---|---|
| Chair | Alejandro Adem | 2009 |
| | George E. Andrews | *ex officio* |
| | Bruce Blackadar | 2010 |
| | Robert J. Daverman | *ex officio* |
| | James A. Donaldson | 2009 |
| | Charles L. Epstein | 2010 |
| | Eric M. Friedlander | 2009 |
| | Bryna Kra | 2010 |
| | Susan Loepp | 2010 |
| | Donald E. McClure | *ex officio* |
| | Christopher K. McCord | 2011 |
| | Rick Miranda | 2011 |
| | Francis Edward Su | 2009 |
| | Michelle Wachs | 2011 |
| | Julius Zelmanowitz | 2011 |

#### 4.7.6. Professional Ethics

| | | |
|---|---|---|
| Chair | Sheldon Axler | 2009 |
| | Michael Beals | 2009 |
| | David B. Leep | 2010 |
| | Lance L. Littlejohn | 2009 |
| | William Trotter | 2010 |
| | Dana P. Williams | 2011 |

#### 4.7.7. Science Policy

AMS staff contact: Samuel M. Rankin III.

| | | |
|---|---|---|
| | George E. Andrews | *ex officio* |
| | Gunnar Carlsson | 2010 |
| | Robert J. Daverman | *ex officio* |
| | James W. Demmel | 2010 |
| | James G. Glimm | *ex officio* |
| | Rebecca F. Goldin | 2010 |
| | Lawrence Firman Gray | 2009 |
| | Donald E. McClure | *ex officio* |
| | Konstantin Mischaikow | 2010 |
| | George C. Papanicolaou | 2011 |
| | Marjorie Senechal | 2009 |
| | Freydoon Shahidi | 2009 |
| | Panagiotis Souganidis | 2011 |
| Chair | Ronald J. Stern | 2009 |
| | Karen Votgman | 2009 |

#### 4.7.8. Young Scholars Awards

Terms expire on June 30.

| | | |
|---|---|---|
| | Irwin Kra | 2011 |
| | Rafe Mazzeo | 2012 |
| Chair | Sergei Tabachnikov | 2010 |
| | Jeremy T. Teitelbaum | 2010 |

## 4.8. Prizes and Awards

*Standing Committees*

#### 4.8.1. AMS Public Policy Award Selection Committee

| | | |
|---|---|---|
| | George E. Andrews | 2011 |
| | James G. Glimm | 2009 |
| | Ronald J. Stern | 2009 |

#### 4.8.2. Award for Distinguished Public Service, Committee to Select the Winner of the

| | | |
|---|---|---|
| | Richard A. Askey | 2013 |
| | C. Herbert Clemens | 2013 |
| | Carolyn R. Mahoney | 2009 |
| Chair | Paul J. Sally, Jr. | 2009 |
| | Richard A. Tapia | 2011 |

#### 4.8.3. The Stefan Bergman Trust Fund

| | | |
|---|---|---|
| | Ronald Coifman | 2009 |
| | Linda Preiss Rothschild | 2011 |
| Chair | Elias M. Stein | 2010 |

#### 4.8.4. Centennial Fellowships

Terms expire on June 30.

| | | |
|---|---|---|
| | Adebisi Agboola | 2010 |
| | Abel Klein | 2011 |
| | Peter B. Kronheimer | 2011 |
| | Loredana Lanzani | 2011 |
| Chair | David R. Larson | 2010 |
| | Judith A. Packer | 2010 |
| | Zinovy Reichstein | 2010 |

#### 4.8.5. Conant Prize, Committee to Select the Winner of the

| | | |
|---|---|---|
| | Georgia Benkart | 2010 |
| Chair | Stephen J. Greenfield | 2009 |
| | Ronald M. Solomon | 2011 |

#### 4.8.6. Joseph L. Doob Prize

| | | |
|---|---|---|
| | Andrew J. Granville | 2012 |
| | Robin C. Hartshorne | 2012 |

#### 4.8.7. Math in Moscow Progam—Travel Support

Terms expire on June 30.

| | | |
|---|---|---|
| Chair | Vladimir V. Chernov | 2010 |
| | Leonid Koralov | 2010 |
| | Alexander Varchenko | 2010 |

#### 4.8.8. Menger Prize, Committee to Select the Winner of the

Terms expire on May 31.

| | | |
|---|---|---|
| Chair | Edward A. Connors | 2010 |
| | Gregory E. Fasshauer | 2011 |
| | Doron Levy | 2010 |

#### 4.8.9. E. H. Moore Research Article Prize, Committee to Select the Winner of the

| | | |
|---|---|---|
| Chair | Carolyn S. Gordon | 2009 |
| | Sergiu Klainerman | 2014 |
| | Kenneth A. Ribet | 2014 |
| | Richard M. Schoen | 2014 |
| | Efim I. Zelmanov | 2009 |

#### 4.8.10. National Awards and Public Representation

| | | |
|---|---|---|
| Chair | George E. Andrews | *ex officio* |
| | Robert J. Daverman | *ex officio* |
| | James G. Glimm | *ex officio* |
| | Arthur M. Jaffe | 2010 |
| | Peter D. Lax | 2009 |

#### 4.8.11. David P. Robbins Prize

| | | |
|---|---|---|
| | Louis J. Billera | 2011 |
| | Carol E. Fan | 2011 |
| | David J. Saltman | 2011 |
| | John R. Stembridge | 2011 |
| Chair | Peter Winkler | 2011 |

#### 4.8.12. Satter Prize, Committee to Select the Winner of the

| | | |
|---|---|---|
| | Benedict H. Gross | 2009 |
| | Jane M. Hawkins | 2011 |
| | Sijue Wu | 2011 |

#### 4.8.13. Steele Prizes

| | | |
|---|---|---|
| | Enrico Bombieri | 2009 |
| Chair | Russell Caflisch | 2009 |
| | Peter S. Constantin | 2011 |
| | Lisa Claire Jeffrey | 2009 |
| | Gregory F. Lawler | 2010 |
| | Richard M. Schoen | 2010 |
| | Joel A. Smoller | 2011 |
| | Richard P. Stanley | 2009 |
| | Terence Chi-Shen Tao | 2011 |

*Special Committees*

#### 4.8.14. Exemplary Program or Achievement by a Mathematics Department, Committee to Select the Winner of the Prize for

| | | |
|---|---|---|
| Chair | Steven A. Bleiler | 2009 |
| | Amy Cohen | 2010 |
| | William Burkley Jacob | 2010 |
| | Michael Moody | 2011 |
| | Roger Wiegand | 2009 |

#### 4.8.15. Prizes, Task Force on

| | | |
|---|---|---|
| | Alejandro Adem | 2010 |
| | Eric Friedlander | 2010 |
| | Robert M. Guralnick | 2010 |
| Chair | William H. Jaco | 2010 |
| | Chawne Kimber | 2010 |
| | Bryna Kra | 2010 |
| | Francis Edward Su | 2010 |

#### 4.8.16. Veblen Prize

| | | |
|---|---|---|
| | Yakov Eliashberg | 2010 |
| Chair | Bruce Kleiner | 2010 |
| | Peter Steven Ozsvath | 2010 |

## 4.9. Institutes and Symposia

*Standing Committees*

#### 4.9.1. Liaison Committee with AAAS

| | | |
|---|---|---|
| | Edward F. Aboufadel | *ex officio* |
| | Jere Confrey | *ex officio* |
| | Keith Devlin | *ex officio* |
| | David Donoho | 2010 |
| | Mark L. Green | 2009 |
| | John Harer | 2009 |
| Chair | William H. Jaco | *ex officio* |
| | Kenneth C. Millett | *ex officio* |
| | Mary Beth Ruskai | 2009 |
| | Donald G. Saari | *ex officio* |

#### 4.9.2. Von Neumann Symposium Selection Committee

| | | |
|---|---|---|
| | Ronald A. DeVore | 2011 |
| | James Sethian | 2011 |

## 4.10. Joint Committees

### 4.10.1. AMS-ASA-AWM-IMS-MAA-NCTM-SIAM Committee on Women in the Mathematical Sciences

| | | |
|---|---|---|
| | Kathryn E. Brenan (SIAM) | 2009 |
| Co-chair | Sandra Clarkson (ASA) | 2010 |
| | Carolyn Connell (MAA) | 2010 |
| | Christine Escher (AMS) | 2009 |
| | Priscilla Greenwood (IMS) | 2009 |
| | Terrell Hodge (AWM) | 2009 |
| | Janine E. Janosky (ASA) | 2009 |
| | Amy Langville (AMS) | 2011 |
| | Nicole Lazar (ASA) | 2011 |
| | Tanya Leise (MAA) | 2011 |
| | Xihong Lin (IMS) | 2010 |
| Co-chair | Maura Mast (AWM) | 2010 |
| | Kathleen M. O'Hara (AMS) | 2010 |
| | Gerald Porter (MAA) | 2011 |
| | Mary Silber (SIAM) | 2011 |
| | Lynda Wiest (NCTM) | 2010 |

### 4.10.2. AMS-ASA-IMS-MAA-SIAM Data Committee

AMS staff contact: James W. Maxwell.

| | | |
|---|---|---|
| | Richard J. Cleary (MAA) | 2011 |
| | Richard M. Dudley (AMS) | 2009 |
| | Susan Geller (MAA) | 2011 |
| | John W. Hagood (AMS) | 2009 |
| | Abbe H. Herzig (AMS) | 2011 |
| | Ellen Kirkman (MAA) | 2010 |
| | James W. Maxwell (AMS) | *ex officio* |
| | Joanna B. Mitro (AMS) | 2010 |
| | Bart S. Ng (SIAM) | 2009 |
| Chair | Polly Phipps (ASA) | 2009 |
| | Douglas C. Ravenel (AMS) | 2010 |
| | Jianguo Sun (IMS) | 2009 |
| | Marie A. Vitulli (AMS) | 2010 |

### 4.10.3. AMS-ASA-MAA-SIAM Joint Policy Board for Mathematics

ASA and SIAM members' terms expire December 31 of the year given.

| | | |
|---|---|---|
| | George E. Andrews (AMS) | 2010 |
| | Douglas Arnold (SIAM) | 2010 |
| | David M. Bressoud (MAA) | 2010 |
| | James Crowley (SIAM) | 2010 |
| | Robert J. Daverman (AMS) | 2010 |
| | Reinhard Laubenbacher (SIAM) | 2010 |
| | Donald E. McClure (AMS) | 2009 |
| | Sally C. Morton (ASA) | 2009 |
| | Steve Pierson (ASA) | 2010 |
| | Tina H. Straley (MAA) | 2010 |
| | Philippe Tondeur (MAA) | 2010 |
| | Ronald Wasserstein (ASA) | 2010 |

### 4.10.4. AMS-ASL-IMS-SIAM Committee on Translations from Russian and Other Slavic Languages

| | |
|---|---|
| Chair | James D. Stasheff (AMS) |

AMS Subcommittee Members

| | |
|---|---|
| Consultant | V. I. Arnol′d |
| | Luchezar Avramov |
| | Igor Dolgachev |
| Consultant | S. G. Gindikin |
| Consultant | Askol′d Georgievič Khovanskiĭ |
| | Robert D. MacPherson |
| | Grigorii A. Margulis |
| Consultant | N. K. Nikol′skiĭ |
| Chair | James D. Stasheff |

ASL Subcommittee Members

| | | |
|---|---|---|
| Chair | Veronica Becher | 2011 |
| | Max Dickmann | 2011 |
| | Andrei Morozov | 2011 |
| | Hiroakira Ono | 2011 |
| | Kai Wehmeier | 2011 |
| | Feng Ye | 2011 |

IMS Subcommittee Members

| | |
|---|---|
| Chair | M. I. Freidlin |
| | B. Pittel |
| | A. Rukhin |
| | W. J. Studden |

### 4.10.5. AMS-MAA Committee on Cooperation

All members of this committee serve *ex officio*.

| |
|---|
| George E. Andrews (AMS) |
| David Bressoud (MAA) |
| Robert J. Daverman (AMS) |
| Joseph A. Gallian (MAA) |
| James G. Glimm (AMS) |
| Donald E. McClure (AMS) |
| Martha J. Siegel (MAA) |
| Tina H. Straley (MAA) |

### 4.10.6. AMS-MAA Committee on Mathematicians with Disabilities

| | | |
|---|---|---|
| | Yousef Alavi (MAA) | 2009 |
| | Lawrence Baggett (AMS) | 2011 |
| | Benson S. Farb (AMS) | 2010 |
| | Theresa C. Michnowicz (MAA) | 2009 |
| | Judith Miller (MAA) | 2011 |
| Chair | Amanda W. Peet (AMS) | 2010 |

### 4.10.7. AMS-MAA Committee on Teaching Assistants and Part-time Instructors (TA/PTI)

| | | |
|---|---|---|
| | David C. Carothers (MAA) | 2009 |
| Chair | John D. Eggers (AMS) | 2009 |
| | Diane L. Herrmann (AMS) | 2009 |
| | Janet McShane (MAA) | 2011 |
| | Calvin C. Moore (AMS) | 2010 |
| | Dennis Pence (MAA) | 2010 |
| | Stephen Robinson (AMS) | 2010 |
| | George T. Yates (MAA) | 2010 |

### 4.10.8. AMS-MAA Joint Archives Committee

| | |
|---|---|
| Bruce C. Berndt (AMS) | 2011 |
| William W. Dunham (MAA) | 2011 |
| Mary W. Gray (MAA) | 2009 |
| Kenneth R. Meyer (AMS) | 2010 |
| Karen H. Parshall (AMS) | 2009 |
| James J. Tattersall (MAA) | 2010 |

#### 4.10.9. AMS-MAA Joint Meetings Committee

All members of this committee serve *ex officio*.

| | | |
|---|---|---|
| | Robert J. Daverman | |
| | Donald E. McClure | |
| Consultant | Penny Pina | |
| | Tina H. Straley | |
| Chair | Gerard Venema | |

#### 4.10.10. AMS-MAA Exhibits Advisory Subcommittee

| | | |
|---|---|---|
| | Robert J. Daverman | |
| | Christine Davis | |
| | Rebecca Elmo | |
| | Norma Flores | |
| | John Grafton | |
| | Elizabeth Huber | |
| Chair | Penny Pina | |
| | Bob Pirtle | |
| | Sandi Lynn Scherer | |
| | Tanja Swijnenberg | |
| | Gerard Venema | |
| | Joan Weiss | |
| | Cheryl Zeigler | |

#### 4.10.11. AMS-MAA Joint Program Committee for the San Francisco, Meeting January 13–16, 2010

| | | |
|---|---|---|
| | Joel Hass (AMS) | |
| | Hugh Montgomery (MAA) | |
| | Dana Randall (AMS) | |
| | Ravi Vakil (MAA) | |

#### 4.10.12. AMS-MAA-SIAM Joint Committee on Employment Opportunities

AMS staff contact: Ellen Maycock.

| | | |
|---|---|---|
| | Edward F. Aboufadel (AMS) | 2009 |
| | Thomas C. Craven (AMS) | 2010 |
| | Sue Geller (MAA) | 2011 |
| Chair | E. McKay Hyde (SIAM) | 2010 |
| | Ellen Maycock (AMS) | *ex officio* |
| | Michael Pearson (MAA) | *ex officio* |
| | Margaret Robinson (MAA) | 2009 |
| | Leon H. Seitelman (SIAM) | 2011 |
| | James Tattersall (MAA) | 2010 |
| | Linda Thiel (SIAM) | *ex officio* |
| | Dana P. Williams (AMS) | 2011 |

#### 4.10.13. AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student

| | | |
|---|---|---|
| | Georgia M. Benkhart (MAA) | 2010 |
| | Anna L. Mazzucato (SIAM) | 2011 |
| | Maeve L. McCarthy (SIAM) | 2010 |
| | Michael E. Orrison, Jr. (AMS) | 2010 |
| Chair | Kannan Soundararajan (AMS) | 2009 |
| | Paul Zorn (MAA) | 2009 |

#### 4.10.14. AMS-SIAM Committee to Select the Winner of the Wiener Prize

| | | |
|---|---|---|
| Chair | James G. Glimm | 2009 |
| | Roland Glowinski | 2009 |
| | Nancy J. Kopell | 2009 |

### *Special Committees*

#### 4.10.15. AMS-Chile Joint Program Committee, December 2010

| | |
|---|---|
| | C. Herbert Clemens |
| | Gustavo Alberto Ponce |
| | Robert S. Rumely |
| | Steven Weintraub |

#### 4.10.16. AMS-Korea Joint Program Committee, December 16–20, 2009

| | |
|---|---|
| | Georgia M. Benkhart |
| | Jeong Han Kim |
| | Hui-Hsiung Kuo |
| | Yong-Geun Oh |

#### 4.10.17. AMS-Sociedad Mexicana Mathematica (SMM) Joint Program Committee, June 2–5, 2010

| | |
|---|---|
| | Ralph L. Cohen |
| | Donald Saari |
| | Gunther Uhlmann |

# 5. Representatives

#### 5.0.1. American Association for the Advancement of Science

Terms expire on February 21.

| | | |
|---|---|---|
| Section A | Donald G. Saari | 2009 |
| Section Q | Jere Confrey | 2009 |

#### 5.0.2. Canadian Mathematical Society

| | | |
|---|---|---|
| | Marjorie Senechal | 2009 |

#### 5.0.3. Conference Board of the Mathematical Sciences

| | | |
|---|---|---|
| | George E. Andrews | 2010 |

#### 5.0.4. Delbert Ray Fulkerson Prize Selection Committee

| | | |
|---|---|---|
| | Daniel J. Kleitman | 2009 |

#### 5.0.5. MAA Committee on the American Mathematics Competition

Term expires on June 30.

| | | |
|---|---|---|
| | Kiran S. Kedlaya | 2009 |

#### 5.0.6. MAA Committee on Undergraduate Program in Mathematics (CUPM)

| | | |
|---|---|---|
| | Randy McCarthy | 2011 |
| | Alan Tucker | 2011 |

#### 5.0.7. Professionals in Science and Technology, Commission on

| | | |
|---|---|---|
| | Polly Phipps | 2009 |

#### 5.0.8. U.S. National Committee on Theoretical and Applied Mechanics

Term expires on October 31.

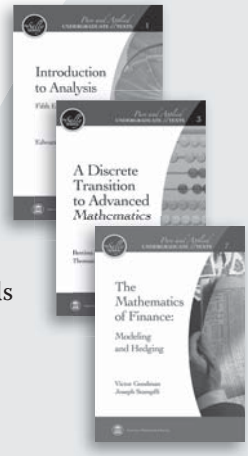
| | | |
|---|---|---|
| | Russel Caflisch | 2012 |

# 6. Index

AMERICAN MATHEMATICAL SOCIETY

*Pure and Applied* Undergraduate Texts Series

TEXTBOOKS FROM THE AMS

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**Introduction to Analysis**
**Fifth Edition**
Edward D. Gaughan
**Volume 1**;1998; 240 pages; Hardcover; ISBN: 978-0-8218-4787-9; List US$62; AMS members US$50; Order code AMSTEXT/1

**Numerical Analysis**
**Mathematics of Scientific Computing, Third Edition**
David Kincaid and Ward Cheney
**Volume 2**; 2002; 788 pages; Hardcover; ISBN: 978-0-8218-4788-6; List US$89; AMS members US$71; Order code AMSTEXT/2

**A Discrete Transition to Advanced Mathematics**
Bettina Richmond and Thomas Richmond
**Volume 3**; 2004; 424 pages; Hardcover; ISBN: 978-0-8218-4789-3; List US$72; AMS members US$58; Order code AMSTEXT/3

**Fourier Analysis and Its Applications**
Gerald B. Folland
**Volume 4**; 1992; 433 pages; Hardcover; ISBN: 978-0-8218-4790-9; List US$72; AMS members US$58; Order code AMSTEXT/4

**Advanced Calculus**
**Second Edition**
Patrick M. Fitzpatrick
**Volume 5**; 2006; 590 pages; Hardcover; ISBN: 978-0-8218-4791-6; List US$82; AMS members US$66; Order code AMSTEXT/5

**Probability: The Science of Uncertainty**
**with Applications to Investments, Insurance, and Engineering**
Michael A. Bean
**Volume 6**; 2001; 448 pages; Hardcover; ISBN: 978-0-8218-4792-3; List US$72; AMS members US$58; Order code AMSTEXT/6

**The Mathematics of Finance**
**Modeling and Hedging**
Victor Goodman and Joseph Stampfli
**Volume 7**; 2001; 250 pages; Hardcover; ISBN: 978-0-8218-4793-0; List US$62; AMS members US$50; Order code AMSTEXT/7

**Geometry for College Students**
I. Martin Isaacs
**Volume 8**; 2001; 222 pages; Hardcover; ISBN: 978-0-8218-4794-7; List US$62; AMS members US$50; Order code AMSTEXT/8

**Abstract Algebra**
Ronald Solomon
**Volume 9**; 2003; 227 pages; Hardcover; ISBN: 978-0-8218-4795-4; List US$62; AMS members US$50; Order code AMSTEXT/9

**Beginning Topology**
Sue E. Goodman
**Volume 10**; 2005; 236 pages; Hardcover; ISBN: 978-0-8218-4796-1; List US$62; AMS members US$50; Order code AMSTEXT/10

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# Statistics on Women Mathematicians Compiled by the AMS

At its August 1985 meeting the Council of the AMS approved a motion to regularly assemble and report in the *Notices* information on the relative numbers of men versus women in at least the following categories: membership in the AMS, invited hour addresses at AMS meetings, speakers at Special Sessions at AMS meetings, percentage of women speakers in AMS Special Sessions by gender of organizers, and members of editorial boards of AMS journals.

It was subsequently decided that this information would be gathered by determining the sex of the individuals in the above categories based on name identification if no other means was available and that additional information on the number of Ph.D.'s granted to women would also be collected using the AMS-ASA-IMS-MAA-SIAM Annual Survey. Since name identification was used, the information for some categories necessitated the use of three classifications:

**Male:** names that were obviously male

**Female:** names that were obviously female

**Unknown:** names that could not be identified as clearly male or female (e.g., only initials given, non-gender-specific names, etc.)

The following is the twenty-third reporting of this information. Updated reports will appear annually in the *Notices*.

**Invited Hour Address Speakers at AMS Meetings (1999–2008)**

| | | |
|---|---|---|
| Male: | 377 | 84% |
| Female: | 74 | 16% |
| Unknown: | 0 | 0% |
| Total: | 451 | |

**Speakers at Special Sessions at AMS Meetings (2004–2008)**

| | | |
|---|---|---|
| Male: | 9,989 | 81% |
| Female: | 2,292 | 18% |
| Unknown: | 205 | 2% |
| Total: | 12,486 | |

**Percentage of Women Speakers in AMS Special Sessions by Gender of Organizers (2008)**

**Special Sessions with at Least One Woman Organizer**

| | | |
|---|---|---|
| Male: | 753 | 73% |
| Female: | 269 | 27% |
| Unknown: | 6 | 1% |
| Total: | 1,028 | |

**Special Sessions with No Women Organizers**

| | | |
|---|---|---|
| Male: | 1,316 | 83% |
| Female: | 238 | 15% |
| Unknown: | 30 | 2% |
| Total: | 1,584 | |

**2008 Members of the AMS Residing in the U.S.**

| | | |
|---|---|---|
| Male: | 14,468 | 67% |
| Female: | 3,739 | 17% |
| Unknown: | 3,567 | 16% |
| Total: | 21,774 | |

**Trustees and Council Members**

| | 2005 | | 2006 | | 2007 | | 2008 | |
|---|---|---|---|---|---|---|---|---|
| Male: | 30 | 71% | 27 | 66% | 27 | 66% | 26 | 63% |
| Female: | 12 | 29% | 14 | 34% | 14 | 34% | 15 | 37% |
| Total: | 42 | | 41 | | 41 | | 41 | |

**Members of AMS Editorial Committees**

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | | 2007 | | 2008 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male: | 198 | 86% | 186 | 85% | 190 | 85% | 195 | 85% | 189 | 84% | 180 | 84% | 184 | 83% | 193 | 84% | 194 | 84% | 168 | 83% |
| Female: | 32 | 14% | 33 | 15% | 34 | 15% | 35 | 15% | 35 | 16% | 34 | 16% | 38 | 17% | 36 | 16% | 36 | 16% | 35 | 17% |
| Total: | 230 | | 219 | | 224 | | 230 | | 224 | | 214 | | 222 | | 229 | | 230 | | 203 | |

**Ph.D.'s Granted to U.S. Citizens**

| | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | | 2007 | | 2008 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male: | 367 | 66% | 379 | 71% | 343 | 69% | 291 | 70% | 341 | 68% | 347 | 68% | 355 | 72% | 399 | 72% | 396 | 69% | 431 | 69% |
| Female: | 187 | 34% | 158 | 29% | 151 | 31% | 127 | 30% | 158 | 32% | 166 | 32% | 141 | 28% | 153 | 28% | 180 | 31% | 191 | 31% |
| Total: | 554 | | 537 | | 494 | | 418 | | 499 | | 513 | | 496 | | 552 | 516 | 576 | 622 | | |

AMERICAN MATHEMATICAL SOCIETY

# Headlines & Deadlines
## *for students*

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Headlines & Deadlines for Students, a service from the AMS Public Awareness Office, provides email notification of mathematics news and of upcoming deadlines. These email notifications are issued about once a month, and when there's special news. Imminent deadlines are included in these emails, which link to a web page that's a centralized source for information relevant to students and faculty advisors, at: **www.ams.org/news-for-students/**

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*Fellowships and Grants*

*New Mathematical Moments*

*Marshall Scholarships*

*Stipends for Study and Travel*

*Trjitzinsky Awards*

*Math in Moscow Semester - Call for Applications*

*AWM Essay Contest*

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*Poster Session Proposals*

*Putnam Exam Results*

*Employment Center Registration*

*Clay Research Fellowships*

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**www.ams.org/news-for-students**

# Mathematics Calendar

**Please submit conference information for the Mathematics Calendar through the Mathematics Calendar submission form at** http://www.ams.org/cgi-bin/mathcal-submit.pl .

The most comprehensive and up-to-date Mathematics Calendar information is available on the AMS website at http://www.ams.org/mathcal/ .

## October 2009

* 5–9 **MBI Current Topic Workshop: Computational Challenges in Integrative Biological Modeling**, Mathematical Biosciences Institute, The Ohio State University, Columbus, OH.
**Description:** Many mathematical models of biological systems have addressed only an isolated aspect of the system—such as its biochemistry or mechanics—and these simplified (yet not simple) models have shed much light on fundamental processes. Recently, biological modeling has now advanced to the point where integrative models that couple multiple processes are often developed. Typically, such models involve different spatial and temporal scales. Examples include models of tumor growth that couple solid mechanics with cell signaling and biochemistry and models of blood flow in the heart that couple solid mechanics, fluid mechanics, and bioelectricity.
**Informationl:** `http://www.mbi.osu.edu/2009/ctwdescription.html`.

* 9–11 **The Second International Conference on Mathematical Modeling and Analysis of Populations in Biological Systems**, University of Huntsville, Huntsville, Alabama.
**Description:** The Second International Conference on Mathematical Modeling and Analysis of Populations in Biological Systems will be held in Huntsville, Alabama, October 9–11, 2009. The general theme of the conference will be on the theory, modeling, and analysis of the temporal dynamics of biological populations. However, an emphasis will be placed on modeling of epidemics. Mathematical models are built on trade-offs between biological accuracy and mathematical tractability. Of particular importance are the effects on a population's dynamics of modeling assumptions concerning spatial or temporal heterogeneities or concerning heterogeneities among the characteristics of individuals within the population and how these characteristics affect the way they interact with their environment. The invited speakers will address a wide variety of theoretical issues, applications (ecological, epidemiological, etc.), and case studies that illustrate the connection of models with data.
**Information:** `http://www.math.uah.edu`.

* 12–17 **International Conference on Stochastic Analysis and Applications**, Hotel Abou Nawas, Hammamet, Tunisia.
**Description:** Stochastic and Infinite Dimensional Analysis; Analysis; Mathematical Finance, Lévy Processes.
**Information:** `http://www.cma.uio.no/conferences/2009/2009_Hammamet.html`.

* 16–18 **New Contexts in Homotopy Theory: A conference in honor of Peter May on the occasion of his 70th birthday**, University of Chicago, Chicago, Illinois
**Organizers:** Maria Basterra (University of New Hampshire), Mark Behrens (MIT), Andrew Blumberg (Stanford University), Jim McClure (Purdue University), Michael Mandell (Indiana University).
**Description:** In conjunction with the Fall 2009 Midwest Topology Seminar, the conference will open Friday afternoon with a colloquium given by Mike Hopkins (Harvard University).

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**This section** contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings and symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete list of meetings of the Society can be found on the last page of each issue.
**An announcement** will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in every third issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.
**In general,** announcements of meetings and conferences carry only the date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. If there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the *Notices* in care of the American Mathematical Society in Providence or electronically to `notices@ams.org` or `mathcal@ams.org`.
**In order** to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence **eight months** prior to the scheduled date of the meeting.
**The complete listing** of the Mathematics Calendar will be published only in the September issue of the *Notices*. The March, June/July, and December issues will include, along with new announcements, references to any previously announced meetings and conferences occurring within the twelve-month period following the month of those issues. New information about meetings and conferences that will occur later than the twelve-month period will be announced once in full and will not be repeated until the date of the conference or meeting falls within the twelve-month period.
**The Mathematics Calendar,** as well as Meetings and Conferences of the AMS, is now available electronically through the AMS website on the World Wide Web. To access the AMS website, use the URL: `http://www.ams.org/`.

**Speakers:** Matt Ando (University of Illinois at Urbana-Champaign), Julia Bergner (University of California at Riverside), Teena Gerhardt (Indiana University, Bloomington), John Greenlees (University of Sheffield, UK), Mike Hill (University of Virginia), Jacob Lurie (Harvard University), Ib Madsen (University of Copenhagen, Denmark), David Nadler (Northwestern University).
**Information:** The conference is supported by an NSF grant and limited travel funding is available for graduate students and postdocs. Please refer inquiries to mcclure@math.purdue.edu; http://math.stanford.edu/~blumberg/mayday.html.

* 19–23 **The Fifteenth International Conference on Difference Equations and Applications**, Estoril, Lisbon, Portugal.
**Description:** The International Conference on Difference Equations and Applications will be held in Estoril, Portugal, October 19-23, 2009. The purpose of the Conference is to bring together both experts and novices in the theory and application of Difference Equations and Discrete Dynamical Systems. The conference is organized by the Center of Mathematical Analysis Geometry and Dynamical Systems of the Technical University of Lisbon. It will be held at the beautiful coast of Estoril under the auspices of the International Society of Difference Equations.
**Information:** http://isdeds.org/icdea2009/.

* 23–24 **Undergraduate Research Conference at the Interface of Biology and Mathematics/UBM, National Institute for Mathematical and Biological Synthesis**, University of Tennessee, Knoxville, Tennessee.
**Description:** This annual conference provides an opportunity for undergraduates to present their work in talks or posters. The conference also includes a panel discussion on career opportunities for students and hosts the NSF UBM PI meeting.
**Speakers:** Dr. Lisa Fauci, Tulane University, and Paul Super, Great Smoky Mountains National Park. Faculty, students, and Tennessee teachers (grades 6–12) are invited to attend.
**Deadline:** The deadline to request financial support is Sept. 9. If no support is needed, the registration deadline is Sept. 29.
**Information:** http://www.nimbios.org/education/UBM/.

## November 2009

* 2–6 **MBI Workshop: Dynamics of Signal Transduction and of Gene-Protein Regulatory Networks**, Mathematical Biosciences Institute, The Ohio State University, Columbus, OH
**Description:** Information about the environment, which organisms collect by membrane receptors, is processed by a complex network of signaling reactions to generate appropriate responses in terms of gene expression, development and differentiation, motility, cell growth and division, and programmed cell death. To survive and exist in harmony with its environment, the cell has to arrive at responses that are robust, specific, and consistent with its role in a cell ensemble. The information processing system is replete with nonlinear interactions, which create bistable switches, signal relaying, adaptation, limit cycle oscillations, and other exotic responses. The purpose of this workshop is to survey recent advances in our understanding of the signal-response characteristics of living cells, and to foster deeper and more fruitful collaborations between theorists and experimentalists.
**Information:** http://www.mbi.osu.edu/2009/ws2description.html.

* 8–10 **MBI Current Topic Workshop: Mathematical Developments Arising from Biology**, Mathematical Biosciences Institute, The Ohio State University, Columbus, OH.
**Description:** This workshop will focus on significant theorems, theories, and algorithms in mathematics that have been or are being inspired by problems in biology. Topics will be chosen from dynamical systems, combinatorics, partial differential equations, probability, statistics, topology, algebraic geometry, and others. The primary goal is to bring new, deep, and interesting mathematical questions to the attention of the entire mathematical sciences community. We plan strong efforts to attract mathematical scientists who have had little previous contact with the biosciences. We believe that through workshops such as this, the MBI can contribute to the enrichment of fundamental research in the mathematical sciences. We plan more extensive MBI programs like this in the future.
**Information:** http://www.mbi.osu.edu/2009/mdbdescription.html.

* 13–15 **The Third Western Conference in Mathematical Finance (WCMF'09)**, Santa Barbara, CA.
**Description:** Annual WCMF meetings promote research in financial mathematics in the Western United States. To receive full consideration for NSF travel support, apply by September 12, 2009. Strong preference will be given to junior researchers and members of underrepresented groups.
**Information:** http://www.pstat.ucsb.edu/WCMF/index.htm.

* 23–27 **School and Workshop "Mathematical Fundations of Quantum Information"**, Universidad de Sevilla, Seville, Spain.
**Description:** Topics concentrate on invariant theory and representation theory in the study of quantum entanglement, and applications to quantum information. The school is aiming for young researchers intending to enter these exciting fields of research. The workshop will consider the same topics with a special emphasis on the Kronecker coefficients of the symmetric group. Lecturers (School): A. Cabello (Sevilla), M. Christandl (LMU-Münich), A. Klyachko (Bilkent), J. G. Luque (Paris-Est-Marne-la-Vallée), J. Y. Thibon (Paris-Est-Marne-la-Vallée).
**Information:** http://www.congreso.us.es/enredo2009.

## January 2010

* 3–10 **Groups, Representations and Number Theory NZIMA/NZMRI Summer Workshop**, Hanmer Springs, New Zealand.
**Description:** The principal speakers and titles for their lecture series are: Martin Bridson, Oxford: TBA; Michel Broue, Universite Paris VII: Local representation theory of finite groups and cyclotomic algebras; Persi Diaconis, Stanford: Probability, Combinatorics and Group Extensions; Roger Howe, Yale: Representations of the general linear group, an algebraic perspective; Gus Lehrer, Sydney: Knot invariants, Hecke algebras and cellular algebras; Marcus du Sautoy, Oxford: Through the looking glass: Groups from a number theoretic perspective. Each speaker will give a short course of lectures aimed at a broad audience. Abstracts for the lecture series are available on the meeting website. You can register to attend the meeting via its webpage until October 30, 2009.
**Information:** http://www.math.auckland.ac.nz/wiki/2010_NZMRI_Summer_Workshop.

* 18–22 **Stochastic Models in Neuroscience**, CIRM, Marseille, France.
**Description:** The aim of the conference is to bring together international experts in mathematical and computational neuroscience with mathematicians working on stochastic processes, ordinary or partial differential equations, and who are interested in applications in neuroscience. It is organized in the framework of the project MANDy (Mathematical Analysis of Neural Dynamics), supported by the French funding agency ANR.

* 25–31 **KAWA—Komplex Analysis Winter School**, Institut Mathematiques de Toulouse, Toulouse, France.
**Description:** The Winter school will consist of four courses: Transfinite diameter and equilibrium measures by S. Boucksom (Paris); Lee-Yang zeros and 2D rational dynamics by M. Lyubich (Stony Brook); Complex methods in symplectic topology, by A. Sukhov (Lille); Bergman kernels in complex geometry, by D. Varolin (Stony Brook). The lectures will start Monday the 25th of January 2010, around 2pm and end on Friday the 29th of January 2010, noon. The workshop will consist of circa 15 talks, starting Friday afternoon and ending Sunday the 31st of January 2010, around 1:00 p.m.

## March 2010

* 8–12 **Workshop on Graphs and Arithmetic**, Centre de recherches mathématiques, Université de Montréal, Montréal, Canada.
**Description:** There is a long history of interaction between number theory and combinatorics. In the past two decades, deep results in automorphic forms and number theory were used to construct (optimal) expanders, which are known to have wide applications in computer science and communication networks. These techniques were generalized to construct higher-dimensional analogues. In the meanwhile, zeta functions for graphs and complexes are better understood. Recent exciting developments in arithmetic combinatorics provide new tools to construct families of good expanders, and these expanders in turn are used to obtain deep number theoretic results. At the same time, the concept of expansion is extended in group theory and computer science to a different context.

* 30–April 1 **Second International Conference on Engineering Systems Management and Its Applications ICESMA2010**, American University of Sharjah, Sharjah, United Arab Emirates.
**Information:** This is the first call for papers. Prospective authors are invited to submit an extended abstract of at most 2 pages to mhariga@aus.edu. C.C. fabdelaziz@aus.edu by October 30, 2009. For further information, please visit the conference website at http://www.aus.edu/conferences/icesma2010.

## June 2010

* 10–12 **Geometric and Probabilistic Aspects of General Relativity**, University of Strasbourg, Strasbourg, France.
**Description:** The focus is on Relativity Theory in Mathematics and in Physics. There will be survey lectures and specialized talks.
**Information:** http://www-irma.u-strasbg.fr/article874.html; email: franchi@math.u-strasbg.fr; email: papadop@math.u-strasbg.fr.

## July 2010

* 5–9 **11-th International Conference on $p$-adic Functional Analysis**, Universite Blaise Pascal, Les Cezeaux, Aubiere, France.
**Description:** The conference follows 10 previous ones held each even years, the last one at Michigan State University (July 2008). It will gather specialists of various domains in $p$-adic analysis: spaces of functions, umbral calculus, Banach and Hilbert spaces, $p$-adic measures, Levi-Civita fields, $p$-adic Weyl algebras, Banach algebras, multiplicative spectrum, differentiable maps and differential manifolds on $p$-adic fields, analytic functions on a complete algebraically closed field, $p$-adic dynamical systems, $p$-adic Nevanlinna theory.
**Information:** email: alain.escassut@math.univ-bpclermont.fr.

## September 2010

* 7–10 **First International Workshop on Differential and Integral Equations with Applications in Biology and Medicine**, Aegean University, Karlovassi, Samos island, Greece.
**Description:** The objective of the DIEBM2010 Workshop is to bring together established scientists and postgraduate students working on aspects of Mathematical Biology, Numerical Analysis and Computing, Biology and Medicine where Differential and Integral equations apply, and to report on current research and future developments. Applications include (but are not limited to): cell population, cell motility and molecular motor models; early childhood diseases models (measles, rubella, etc), diabetes models, cancer, tuberculosis and influenza models, blood production and flow models. Also models associated with functions of various parts of the human body like the heart, kidneys, the pancreas, the eyes, the gastro-intestinal system, to mention a few. A half-day short course on Integral Equations will complement the works of the Workshop.

* 11–17 **NAFSA 9–The 9th International School on Nonlinear Analysis, Function Spaces and Applications**, Trest Castle, Czech Republic.
**Description:** The scientific programme will consist of the following series of invited lectures: Pavel Drabek (Pilsen): Recent results on quasilinear differential equations; Loukas Grafakos (Columbia, MO): Multilinear Harmonic Analysis; Rosario Giuseppe Mingione (Parma): Non-linear aspects of Calderon-Zygmund theory; Jani Onninen (Syracuse, NY): TBA; Winfried Sickel (Jena): Spaces of functions with symmetry constraints; Xavier Tolsa (Barcelona): Calderon-Zygmund theory with non doubling measures. Participants will have the possibility to give short oral contributions.
**Information:** http://www.karlin.mff.cuni.cz/nafsa/2010.

* 20–October 1 **Berlin Mathematical School Summer School 2010 on Discretization in Geometry and Dynamics**, Technische Universität Berlin, Germany.
**Organizers:** Alexander Bobenko and Günter M. Ziegler
**Description:** The aim of this summer school is to give Ph.D. students and post-docs an introduction to the field of Discrete Differential Geometry and explore the latest developments. Topics range from integrable discretizations, polyhedra and tilings to symplectic and variational integrators, discretization artefacts and applications.
**Registration:** On-line registration will be available starting February 2010, until 30 June 2010. http://www.math-berlin.de/summerschool.

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**The following new announcements will not be repeated until the criteria in the next to the last paragraph at the bottom of the first page of this section are met.**

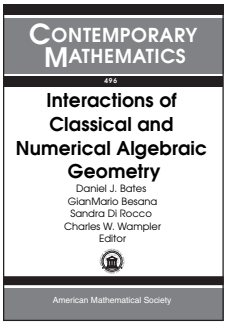
## December 2011

* 16–18 **The International Congress on Science and Technology**, Allahabad, U.P., INDIA
**Description:** The ICST-2011 is organized by the CWS, a non-profit society for the scientists and the technocrats and will take place in Allahabad, U.P., INDIA, from Dec. 16–18, 2011. The conference has the focus on the current trends on frontier topics of the science and technology (Applied Engineering) subjects. The ICST conferences serve as good platforms for our members and the entire science and technological community to meet with each other and to exchange ideas.
**Deadline:** Submission of abstracts with full-length paper to complexgeometry18@yahoo.com Jun 30, 2010. Acknowledgement of accepted papers by email: July 25, 2010.
**Registration:** Sept 15, 2010. All submitted papers will be under peer review and accepted papers will be published in the conference proceeding. Shekhar (N.S.) Int. J. of Sci. and Tech., http://sites.google.com/site/onsciandtech/.
**Contact:** complexgeometry18@yahoo.com. Sushil Shukla (ss123a@rediffmail.com).

# New Publications Offered by the AMS

*To subscribe to email notification of new AMS publications, please go to* http://www.ams.org/bookstore-email.

## Algebra and Algebraic Geometry




### Interactions of Classical and Numerical Algebraic Geometry

**Daniel J. Bates**, *Colorado State University, Fort Collins, CO*, **GianMario Besana**, *DePaul University, Chicago, IL*, **Sandra Di Rocco**, *Kungliga Tekniska Högskolan, Stockholm, Sweden*, and **Charles W. Wampler**, *General Motors Research and Development, Warren, MI*, Editors

This volume contains the proceedings of the conference on Interactions of Classical and Numerical Algebraic Geometry, held May 22–24, 2008, at the University of Notre Dame, in honor of the achievements of Professor Andrew J. Sommese.

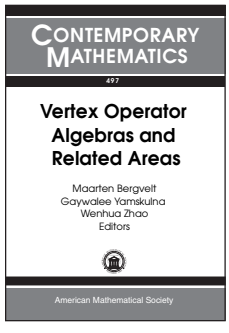
While classical algebraic geometry has been studied for hundreds of years, numerical algebraic geometry has only recently been developed. Due in large part to the work of Andrew Sommese and his collaborators, the intersection of these two fields is now ripe for rapid advancement. The primary goal of both the conference and this volume is to foster the interaction between researchers interested in classical algebraic geometry and those interested in numerical methods.

The topics in this book include (but are not limited to) various new results in complex algebraic geometry, a primer on Seshadri constants, analyses and presentations of existing and novel numerical homotopy methods for solving polynomial systems, a numerical method for computing the dimensions of the cohomology of twists of ideal sheaves, and the application of algebraic methods in kinematics and phylogenetics.

**Contents: E. Allgower**, **S.-G. Cruceanu**, and **S. J. Tavener**, Turning points and bifurcations for homotopies of analytic maps; **L. Bădescu**, On a connectedness theorem of Debarre; **D. J. Bates**, **J. D. Hauenstein**, **A. J. Sommese**, and **C. W. Wampler II**, Stepsize control for path tracking; **T. Bauer**, **S. Di Rocco**, **B. Harbourne**, **M. Kapustka**, **A. Knutsen**, **W. Syzdek**, and **T. Szemberg**, A primer on Seshadri constants; **M. C. Beltrametti** and **P. Ionescu**, A view on extending morphisms from ample divisors; **W. Buczyńska**, **M. Donten**, and **J. A. Wiśniewski**, Isotropic models of evolution with symmetries; **A. Calabri**, **C. Ciliberto**, **F. Flamini**, and **R. Miranda**, Special scrolls whose base curve has general moduli; **F. Catanese**, **M. Franciosi**, and **A. Di Scala**, On varieties whose universal cover is a product of curves (Appendix:Holonomy invariant hypersurfaces); **B. H. Dayton**, Ideals of numeric realizations of configurations of lines; **M. A. De Cataldo**, The standard filtration on cohomology with compact supports with an appendix on the base change map and the Lefschetz hyperplane theorem; **F. Geiß** and **F.-O. Schreyer**, A family of exceptional Stewart-Gough mechanisms of genus 7; **J. D. Hauenstein**, **J. C. Migliore**, **C. Peterson**, and **A. J. Sommese**, Numerical computaion of the dimensions of the cohomology of twists of ideal sheaves; **J. Verschelde**, Polyhedral methods in numerical algebraic geometry; **A. Lanteri** and **H. Maeda**, Double covers of Del Pezzo manifolds and bielliptic curve sections; **T.-Y. Li**, **X. Wang**, and **Y. Zhang**, Total degree vs. mixed volume; **R. Muñoz** and **L. E. S. Conde**, Varieties swept out by grassmannians of lines; **T. Peternell**, Submanifolds with ample normal bundles and a conjecture of Hartshorne; **D. R. Walter**, **M. L. Husty**, and **M. Pfurner**, A complete kinematic analysis of the SNU 3-UPU parrallel robot; **Z. Zeng**, The closedness subspace method for computing the multiplicity structure of a polynomial system.

**Contemporary Mathematics**, Volume 496

October 2009, 362 pages, Softcover, ISBN: 978-0-8218-4746-6, LC 2009011259, 2000 *Mathematics Subject Classification:* 13Pxx, 14C17, 14C20, 14C25, 14D06, 14D20, 14Hxx, 14Jxx, 14Mxx, 14Q15, 65H10, 65H20, **AMS members US$84**, List US$105, Order code CONM/496




### Vertex Operator Algebras and Related Areas

**Maarten Bergvelt**, *University of Illinois at Urbana-Champaign, IL*, and **Gaywalee Yamskulna** and **Wenhua Zhao**, *Illinois State University, Normal, IL*, Editors

Vertex operator algebras were introduced to mathematics in the work of Richard Borcherds, Igor Frenkel, James Lepowsky and Arne Meurman as a mathematically rigorous

formulation of chiral algebras of two-dimensional conformal field theory. The aim was to use vertex operator algebras to explain and prove the remarkable Monstrous Moonshine conjectures in group theory. The theory of vertex operator algebras has now grown into a major research area in mathematics.

These proceedings contain expository lectures and research papers presented during the international conference on Vertex Operator Algebras and Related Areas, held at Illinois State University in Normal, IL, from July 7 to July 11, 2008.

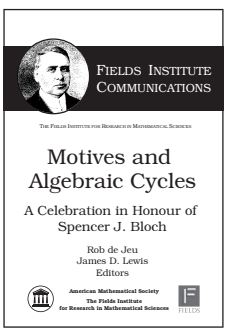
The main aspects of this conference were connections and interactions of vertex operator algebras with the following areas: conformal field theories, quantum field theories, Hopf algebra, infinite dimensional Lie algebras, and modular forms. This book will be useful for researchers as well as for graduate students in mathematics and physics. Its purpose is not only to give an up-to-date overview of the fields covered by the conference but also to stimulate new directions and discoveries by experts in the areas.

*This item will also be of interest to those working in mathematical physics.*

**Contents: D. Adamović** and **A. Milas**, An analogue of modular BPZ-equation in logarithmic (super)conformal field theory; **P. Bantay**, Vector-valued modular forms; **K. Barron**, Alternate notions of N=1 superconformality and deformations of N=1 vertex superalgebras; **A. J. Feingold**, **A. Kleinschmidt**, and **H. Nicolai**, Hyperbolic Weyl groups and the four normed division algebras; **M. R. Gaberdiel** and **T. Gannon**, Zhu's algebra, the $C_2$ algebra, and twisted modules; **C. Goff**, Fusion algebras for vertex operator algebras and finite groups; **M. E. Hoffman**, Rooted trees and symmetric functions: Zhao's homomorphism and the commutative hexagon; **Y.-Z. Huang**, Representations of vertex operator algebras and braided finite tensor categories; **M. Jerković**, Recurrences and characters of Feigin-Stoyanovsky's type subspaces; **C. H. Lam** and **H. Yamauchi**, The FLM conjecture and framed VOA; **H. Li**, On quantum vertex algebras and their modules; **A. R. Linshaw**, Introduction to invariant chiral differential operators; **F. Patras**, Dynkin operators and renormalization group actions in pQFT; **T. J. Robinson**, New perspectives on exponentiated derivations, the formal Taylor theorem, and Faà di Bruno's formula; **G. Trupčević**, Combinatorial bases of Feigin-Stoyanovsky's type subspaces for $\tilde{\mathfrak{sl}}_{\ell+1}(\mathbb{C})$; **M. P. Tuite**, Exceptional vertex operator algebras and the Virasoro algebra.

**Contemporary Mathematics**, Volume 497

October 2009, 227 pages, Softcover, ISBN: 978-0-8218-4840-1, LC 2009018258, 2000 *Mathematics Subject Classification:* 17B67, 17B65, 05E05, 11F11, 17B05, 17B69, 81R10, 81T05, 81T40, 16W30, **AMS members US$63**, List US$79, Order code CONM/497




## Motives and Algebraic Cycles

### A Celebration in Honour of Spencer J. Bloch

**Rob de Jeu**, *Vrije Universiteit, Amsterdam, The Netherlands*, and **James D. Lewis**, *University of Alberta, Edmonton, AB, Canada*, Editors

Spencer J. Bloch has, and continues to have, a profound influence on the subject of Algebraic $K$-Theory, Cycles and Motives. This book, which is comprised of a number of independent research articles written by leading experts in the field, is dedicated in his honour, and gives a snapshot of the current and evolving nature of the subject. Some of the articles are written in an expository style, providing a perspective on the current state of the subject to those wishing to learn more about it. Others are more technical, representing new developments and making them especially interesting to researchers for keeping abreast of recent progress.

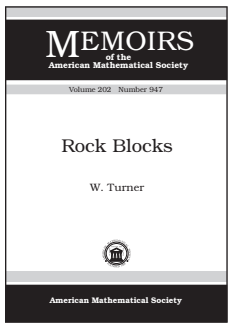
*This item will also be of interest to those working in number theory and geometry and topology.*

Titles in this series are co-published with the Fields Institute for Research in Mathematical Sciences (Toronto, Ontario, Canada).

**Contents: D. Arapura**, Varieties with very little transcendental cohomology; **A. Beilinson**, $\mathcal{L}$-factors for the period determinants of curves; **H. Esnault** and **A. Ogus**, Hodge cohomology of invertible sheaves; **H. Gillet**, Arithmetic intersection theory on Deligne-Mumford stacks; **S. Gorchinskiy**, Notes on the biextension of Chow groups; **B. Kahn**, Démonstration géométrique du théorème de Lang-Néron et formules de Shioda-Tate; **S.-i. Kimura**, Surjectivity of the cycle map for Chow motives; **N. M. Kumar**, **A. P. Rao**, and **G. V. Ravindra**, On codimension two subvarieties in hypersurfaces; **M. Levine**, Smooth motives; **J. D. Lewis**, Cycles on varieties over subfields of $\mathbb{C}$ and cubic equivalence; **S. Lichtenbaum**, Euler characteristics and special values of zeta-functions; **J. Murre** and **D. Ramakrishnan**, Local Galois symbols on $E \times E$; **V. K. Murty**, Semiregularity and Abelian varieties; **N. Naumann**, **M. Spitzweck**, and **P. A. Østvær**, Chern classes, $K$-theory and Landweber exactness over nonregular base schemes; **V. Snaith**, Adams operations and motivic reduced powers; **J. Stienstra**, Chow forms, Chow quotients and quivers with superpotential.

**Fields Institute Communications**, Volume 56

September 2009, 336 pages, Hardcover, ISBN: 978-0-8218-4494-6, LC 2009023440, 2000 *Mathematics Subject Classification:* 11-XX, 14-XX, 16-XX, 19-XX, 55-XX, **AMS members US$91**, List US$114, Order code FIC/56




## Rock Blocks

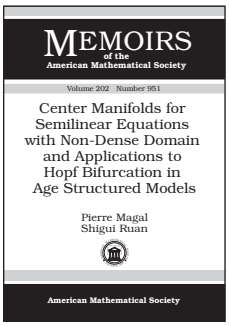
**W. Turner**, *University of Oxford, England*

**Contents:** Introduction; Highest weight categories, $q$-Schur algebras, Hecke algebras, and finite general linear groups; Blocks of $q$-Schur algebras, Hecke algebras, and finite general linear groups; Rock blocks of finite general linear groups and Hecke algebras, when $w < l$; Rock blocks of symmetric groups, and the Brauer morphism; Schur-Weyl duality inside Rock blocks of symmetric groups; Ringel duality inside Rock blocks of symmetric groups; James adjustment algebras for Rock blocks of symmetric groups; Doubles, Schur super-bialgebras, and Rock blocks of Hecke algebras; Power sums; Schiver doubles of type $A_\infty$; Bibliography; Index.

**Memoirs of the American Mathematical Society**, Volume 202, Number 947

November 2009, 102 pages, Softcover, ISBN: 978-0-8218-4462-5, LC 2009029007, 2000 *Mathematics Subject Classification:* 20C30, **Individual member US$40**, List US$66, Institutional member US$53, Order code MEMO/202/947

# Differential Equations



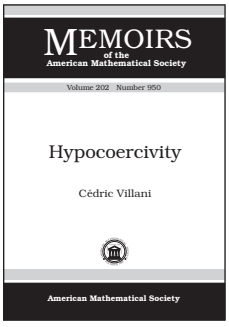

## Center Manifolds for Semilinear Equations with Non-Dense Domain and Applications to Hopf Bifurcation in Age Structured Models

**Pierre Magal**, *Université du Havre, Le Lavre, France*, and **Shigui Ruan**, *University of Miami, Coral Gables, FL*

**Contents:** Introduction; Integrated semigroups; Spectral decomposition of the state space; Center manifold theory; Hopf bifurcation in age structured models; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 202, Number 951

November 2009, 71 pages, Softcover, ISBN: 978-0-8218-4653-7, LC 2009029211, 2000 *Mathematics Subject Classification:* 35K90, 35L10, 92D25, **Individual member US$37**, List US$62, Institutional member US$50, Order code MEMO/202/951




## Hypocoercivity

**Cédric Villani**, *Ecole Normale Supérieure de Lyon, France*

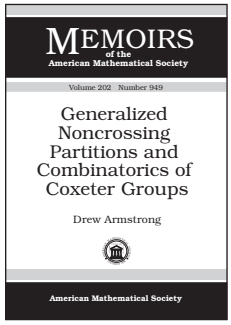
*This item will also be of interest to those working in mathematical physics.*

**Contents:** Introduction; $L = A^*A + B$; The auxiliary operator method; Fully nonlinear equations; Appendices; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 202, Number 950

November 2009, 141 pages, Softcover, ISBN: 978-0-8218-4498-4, 2000 *Mathematics Subject Classification:* 35B40, 35K65, 76P05, **Individual member US$42**, List US$70, Institutional member US$56, Order code MEMO/202/950

# Discrete Mathematics and Combinatorics




## Generalized Noncrossing Partitions and Combinatorics of Coxeter Groups

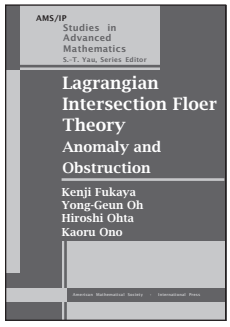
**Drew Armstrong**, *University of Miami, Coral Gables, FL*

**Contents:** Introduction; Coxeter groups and noncrossing partitions; $k$-divisible noncrossing partitions; The classical types; Fuss-Catalan combinatorics; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 202, Number 949

November 2009, 159 pages, Softcover, ISBN: 978-0-8218-4490-8, 2000 *Mathematics Subject Classification:* 05E15, 05E25, 05A18, **Individual member US$43**, List US$72, Institutional member US$58, Order code MEMO/202/949

# Geometry and Topology




## Lagrangian Intersection Floer Theory

### Anomaly and Obstruction

**Kenji Fukaya**, *Kyoto University, Japan*, **Yong-Geun Oh**, *University of Wisconsin, Madison, WI*, **Hiroshi Ohta**, *Nagoya University, Japan*, and **Kaoru Ono**, *Hokkaido University, Sapporo, Japan*

This is a two-volume series research monograph on the general Lagrangian Floer theory and on the accompanying homological algebra of filtered $A_\infty$-algebras. This book provides the most important step towards a rigorous foundation of the Fukaya category in general context. In Volume I, general deformation theory of the Floer cohomology is developed in both algebraic and geometric contexts. An essentially self-contained homotopy theory of filtered $A_\infty$ algebras and $A_\infty$ bimodules and applications of their obstruction-deformation theory to the Lagrangian Floer theory are presented. Volume II contains detailed studies of two of the main points of the foundation of the theory: transversality and orientation. The study of transversality is based on the virtual fundamental chain techniques (the theory of Kuranishi structures and their multisections) and chain level intersection theories. A detailed analysis comparing the orientations of the moduli spaces and their fiber products is carried out. A self-contained account of

the general theory of Kuranishi structures is also included in the appendix of this volume.

Titles in this series are co-published with International Press, Cambridge, MA.

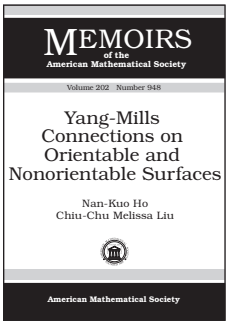
**Contents:** *Part I:* Introduction; Review: Floer cohomology; The $A_\infty$ algebra associated to a Lagrangian submanifold; Homotopy equivalence of $A_\infty$ algebras; Homotopy equivalence of $A_\infty$ bimodules; Spectral sequences; *Part II:* Transversality; Orientation; Appendices; Bibliography; Index.

**AMS/IP Studies in Advanced Mathematics**, Volume 46

***Part 1***: October 2009, 396 pages, Hardcover, ISBN: 978-0-8218-4836-4, LC 2009025925, 2000 *Mathematics Subject Classification:* 53D12, 53D40; 14J32, 81T30, 37J10, 18D50, 55P62, **AMS members US$79**, List US$99, Order code AMSIP/46.1

***Part 2***: October 2009, 805 pages, Hardcover, ISBN: 978-0-8218-4837-1, LC 2009025925, 2000 *Mathematics Subject Classification:* 53D12, 53D40; 14J32, 81T30, 37J10, 18D50, 55P62, **AMS members US$79**, List US$99, Order code AMSIP/46.2

***Set***: October 2009, 1201 pages, Hardcover, ISBN: 978-0-8218-4831-9, LC 2009025925, 2000 *Mathematics Subject Classification:* 53D12, 53D40; 14J32, 81T30, 37J10, 18D50, 55P62, **AMS members US$127**, List US$159, Order code AMSIP/46




## Yang-Mills Connections on Orientable and Nonorientable Surfaces

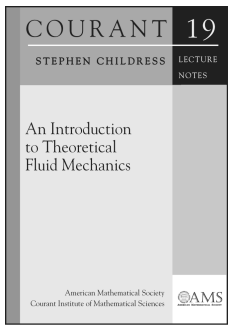
**Nan-Kuo Ho**, *National Cheng-Kung University, Taiwan, ROC*, and **Chiu-Chu Melissa Liu**, *Northwestern University, Evanston, IL, and Columbia University, New York, NY*

**Contents:** Introduction; Topology of Gauge group; Holomorphic principal bundles over Riemann surfaces; Yang-Mills connections and representation varieties; Yang-Mills $SO(2n+1)$-connections; Yang-Mills $SO(2n)$-connections; Yang-Mills $Sp(n)$-connections; Appendix A. Remarks on Laumon-Rapoport formula; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 202, Number 948

November 2009, 98 pages, Softcover, ISBN: 978-0-8218-4491-5, LC 2009029177, 2000 *Mathematics Subject Classification:* 53D20; 58E15, **Individual member US$39**, List US$65, Institutional member US$52, Order code MEMO/202/948

# Mathematical Physics




## An Introduction to Theoretical Fluid Mechanics

**Stephen Childress**, *New York University, Courant Institute of Mathematical Sciences, NY*

This book gives an overview of classical topics in fluid dynamics, focusing on the kinematics and dynamics of incompressible inviscid and Newtonian viscous fluids, but also including some material on compressible flow. The topics are chosen to illustrate the mathematical methods of classical fluid dynamics. The book is intended to prepare the reader for more advanced topics of current research interest.

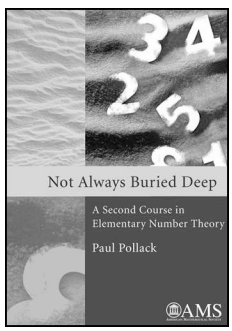
Titles in this series are co-published with the Courant Institute of Mathematical Sciences at New York University.

**Contents:** The fluid continuum; Conservation of mass and momentum; Vorticity; Potential flow; Lift and drag in ideal fluids; Viscosity and the Navier-Stokes equations; Stokes flow; The boundary layer; Energy; Sound; Gas dynamics; Shock waves; Bibliography; Index.

**Courant Lecture Notes**, Volume 19

October 2009, 201 pages, Softcover, ISBN: 978-0-8218-4888-3, 2000 *Mathematics Subject Classification:* 76-01, **AMS members US$25**, List US$31, Order code CLN/19

# Number Theory




## Not Always Buried Deep

### A Second Course in Elementary Number Theory

**Paul Pollack**, *University of Illinois, Urbana-Champaign, IL*

Number theory is one of the few areas of mathematics where problems of substantial interest can be fully described to someone with minimal mathematical background. Solving such problems sometimes requires difficult and deep methods. But this is not a universal phenomenon; many engaging problems can be successfully attacked with little more than one's mathematical bare hands. In this case one says that the problem can be solved in an elementary way. Such elementary methods and the problems to which they apply are the subject of this book.

*Not Always Buried Deep* is designed to be read and enjoyed by those who wish to explore elementary methods in modern number theory. The heart of the book is a thorough introduction to

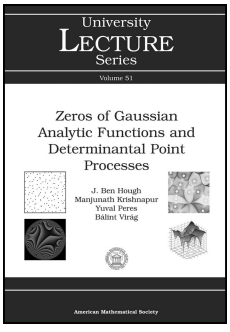
elementary prime number theory, including Dirichlet's theorem on primes in arithmetic progressions, the Brun sieve, and the Erdös–Selberg proof of the prime number theorem. Rather than trying to present a comprehensive treatise, Pollack focuses on topics that are particularly attractive and accessible. Other topics covered include Gauss's theory of cyclotomy and its applications to rational reciprocity laws, Hilbert's solution to Waring's problem, and modern work on perfect numbers.

The nature of the material means that little is required in terms of prerequisites: The reader is expected to have prior familiarity with number theory at the level of an undergraduate course and a first course in modern algebra (covering groups, rings, and fields). The exposition is complemented by over 200 exercises and 400 references.

**Contents:** Elementary prime number theory, I; Cyclotomy; Elementary prime number theory, II; Primes in arithmetic progressions; Interlude: a proof of the Hilbert–Waring theorem; Sieve methods; An elementary proof of the prime number theorem; Perfect numbers and their friends; References; Index.

November 2009, approximately 309 pages, Hardcover, ISBN: 978-0-8218-4880-7, LC 2009023766, 2000 *Mathematics Subject Classification:* 11A15, 11A25, 11A41, 11N05, 11N35, 11N36, 11P05, 11T22, **AMS members US$50**, List US$62, Order code MBK/68

# Probability




## Zeros of Gaussian Analytic Functions and Determinantal Point Processes

**J. Ben Hough**, *HBK Capital Management, New York, NY*, **Manjunath Krishnapur**, *Indian Institute of Science, Bangalore, India*, **Yuval Peres**, *Microsoft Research, Redmond, WA*, and **Bálint Virág**, *University of Toronto, ON, Canada*

The book examines in some depth two important classes of point processes, determinantal processes and "Gaussian zeros", i.e., zeros of random analytic functions with Gaussian coefficients. These processes share a property of "point-repulsion", where distinct points are less likely to fall close to each other than in processes, such as the Poisson process, that arise from independent sampling. Nevertheless, the treatment in the book emphasizes the use of independence: for random power series, the independence of coefficients is key; for determinantal processes, the number of points in a domain is a sum of independent indicators, and this yields a satisfying explanation of the central limit theorem (CLT) for this point count. Another unifying theme of the book is invariance of considered point processes under natural transformation groups.

The book strives for balance between general theory and concrete examples. On the one hand, it presents a primer on modern techniques on the interface of probability and analysis. On the other hand, a wealth of determinantal processes of intrinsic interest are analyzed; these arise from random spanning trees and eigenvalues of random matrices, as well as from special power series with determinantal zeros.

The material in the book formed the basis of a graduate course given at the IAS-Park City Summer School in 2007; the only background knowledge assumed can be acquired in first-year graduate courses in analysis and probability.

*This item will also be of interest to those working in analysis.*

**Contents:** Introduction; Gaussian analytic functions; Joint intensities; Determinantal point processes; The hyperbolic GAF; A determinantal zoo; Large deviations for zeros; Advanced topics: Dynamics and allocation to random zeros; Bibliography.

**University Lecture Series**, Volume 51

October 2009, 151 pages, Softcover, ISBN: 978-0-8218-4373-4, 2000 *Mathematics Subject Classification:* 60G55, 30B20, 30C15, 60G15, 15A52, 60F10, 60D05, 60H25, **AMS members US$31**, List US$39, Order code ULECT/51

# New AMS-Distributed Publications

# Algebra and Algebraic Geometry


## Faisceaux Pervers des Cycles Évanescents des Variétés de Drinfeld et Groupes de Cohomologie du Modèle de Deligne-Carayol

**Pascal Boyer**, *Institut de Mathématiques de Jussieu, Paris, France*

In the first half of the book, the author translates in the geometric situation of Drinfeld varieties, that is, the case of a function field of one variable over a finite field, the principal results of the book of Michael Harris and Richard Taylor, which treats some Shimura varieties over number fields. The author gives in particular the restriction of sheaves to the open strata of vanishing cycles in terms of some local systems, known as Harris-Taylor's local systems, for which he calculates the alternating sum of the cohomology group with compact supports. In the last half of the book, the author describes the monodromy filtration of the perverse sheaf of vanishing cycles and the spectral sequence associated to it. Thanks to the Berkovich–Fargues theorem, the author obtains the description of the local monodromy filtration of the Deligne–Carayol model.

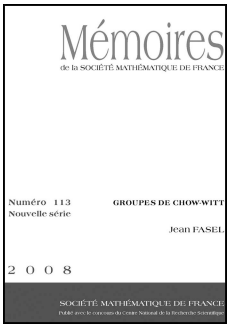
*This item will also be of interest to those working in analysis.*

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

**Contents:** Variétés d'Igusa, systèmes locaux de Harris–Taylor et cycles évanescents des variétés de Drinfeld; Groupes de cohomologie du modèle local: cas Iwahori; Description de la somme alternée des groupes de cohomologie; Filtration de monodromie des cycles évanescents; Compléments sur la cohomologie globale et applications; Figures; Bibliography.

**Mémoires de la Société Mathématique de France**, Number 116

July 2009, 172 pages, Softcover, ISBN: 978-2-85629-272-3, 2000 *Mathematics Subject Classification:* 14G35, 11G09, 11G35, 11R39, 14L05, 11G45, 11Fxx, **Individual member US$50**, List US$55, Order code SMFMEM/116




## Groupes de Chow-Witt

**Jean Fasel**, *ETH Zentrum, Zurich, Switzerland*

In this work the author studies the *Chow-Witt groups*. These groups were defined by J. Barge and F. Morel in order to understand when a projective module $P$ of top rank over a ring $A$ has a free factor of rank one, *i.e.*, is isomorphic to $Q \oplus A$.

First the author shows that these groups satisfy the same functorial propertiels as the classical Chow groups. Then he defines for each locally free $\mathcal{O}_X$-module $E$ of (constant) rank $n$ over a regular scheme $X$ an Euler class $\tilde{c}_n(E)$ that is a refinement of the usual top Chern class $c_n(E)$. The Euler classes also satisfy good functorial properties. In particular, $\tilde{c}_n(P) = 0$ if $P$ is a projective module of rank $n$ over a regular ring $A$ of dimension $n$ such that $P \simeq Q \oplus A$.

Next the author computes the top Chow-Witt group of a regular ring $A$ of dimension 2 and the top Chow-Witt group of a regular $\mathbb{R}$-algebra $A$ of finite dimension. For such $A$, he obtains that if $P$ is a projective module of rank equal to the dimension of the ring then $\tilde{c}_n(P) = 0$ if and only if $P \simeq Q \oplus A$.

Finally, the author examines the links between the Chow-Witt groups and the Euler class groups defined by S. Bhatwadekar and R. Sridharan.

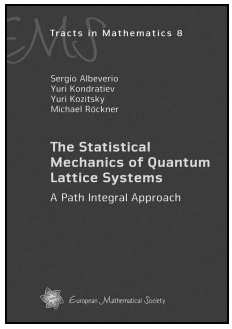
A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

**Contents:** Introduction; Le complexe en $K$-théorie de Milnor; Le complexe de Gersten–Witt d'un schéma régulier; Le complexe de Gersten–Witt d'un schéma de Gorenstein; Le morphisme de transfert; Le calcul du morphisme de transfert; Un autre calcul des différentielles du complexe; Le morphisme de transfert pour les morphismes propres; Complexe de Gersten–Witt et idéaux fondamentaux; Groupes de Chow–Witt d'un schéma; Invariances homotopiques; Produits fibrés et morphismes de complexes; Les classes d'Euler; La classe d'Euler d'un module projectif de rang maximal; La dimension 2; Le groupe de Chow–Witt maximal d'une $\mathbb{R}$-algèbre lisse; Les groupes des classes d'Euler; Théorème d'Eisenbud–Evans et Théorème de Bertini; Catégories triangulées; Le groupe de Witt d'une catégorie exacte; Les groupes de Witt de catégories traingulées; Remarques sur les groupes de Witt d'un corps; Bibliographie.

**Mémoires de la Société Mathématique de France**, Number 113

June 2009, 197 pages, Softcover, ISBN: 978-2-85629-262-4, 2000 *Mathematics Subject Classification:* 13C10, 13D15, 14C15, 14C17, 18F30, **Individual member US$61**, List US$68, Order code SMFMEM/113

# Analysis




## The Statistical Mechanics of Quantum Lattice Systems

### A Path Integral Approach

**Sergio Albeverio**, *University of Bonn, Germany*, **Yuri Kondratiev**, *University of Bielefeld, Germany*, **Yuri Kozitsky**, *Maria Curie-Sklodowska University, Lublin, Poland*, and **Michael Röckner**, *University of Bielefeld, Germany*

Quantum statistical mechanics plays a major role in many fields such as thermodynamics, plasma physics, solid-state physics, and the study of stellar structure. While the theory of quantum harmonic oscillators is relatively simple, the case of anharmonic oscillators, a mathematical model of a localized quantum particle, is more complex and challenging. Moreover, infinite systems of interacting quantum anharmonic oscillators possess interesting ordering properties with respect to quantum stabilization.

This book presents a rigorous approach to the statistical mechanics of such systems, in particular with respect to their actions on a crystal lattice.

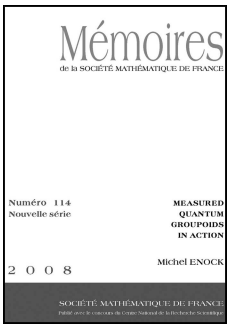
The text is addressed to both mathematicians and physicists, especially those who are concerned with the rigorous mathematical background of their results and the kind of problems that arise in quantum statistical mechanics. The reader will find here a concise collection of facts, concepts, and tools relevant for the application of path integrals and other methods based on measure and integration theory to problems of quantum physics, in particular the latest results in the mathematical theory of quantum anharmonic crystals. The methods developed in the book are also applicable to other problems involving infinitely many variables, for example, in biology and economics.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

**Contents:** Introduction; *Mathematical background:* Quantum mechanics and stochastic analysis; Lattice approximation and applications; Euclidean Gibbs measures; *Physical applications:* Anharmonic crystal as a physical model; Thermodynamic pressure; Phase transitions; Quantum effects; Bibliography; List of symbols; Index.

**EMS Tracts in Mathematics**, Volume 8

July 2009, 392 pages, Hardcover, ISBN: 978-3-03719-070-8, 2000 *Mathematics Subject Classification:* 46-02, 46E35, 42C40, 42B35, 28A80, **AMS members US$62**, List US$78, Order code EMSTM/8




## Measured Quantum Groupoids in Action

**Michael Enock**, *Institut de Mathématiques de Jussieu, Paris, France*

In his thesis Franck Lesieur had introduced a notion of measured quantum groupoid, in the setting of von Neumann algebras, and a simplification of Lesieur's axioms is presented in an appendix of this publication.

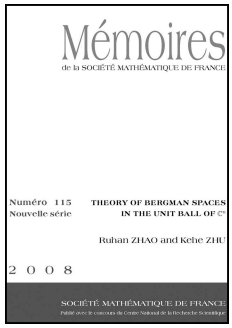
In this book the author develops the notions of actions, crossed-product, and obtains a biduality theorem, following what had been done by Stefaan Vaes for locally compact quantum groups. Moreover, the author proves that the inclusion of the initial algebra into its crossed-product is depth 2, which gives a converse of a result proved by Jean-Michel Vallin and the author. More precisely, to any action of a measured quantum groupoid, the author associates another measured quantum groupoid. In particular, starting from an action of a locally compact quantum group, he obtains a measured quantum groupoid canonically associated to this action; when the action is outer, this measured quantum groupoid is the initial locally compact quantum group.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

**Contents:** Introduction; Preliminaries; Measured quantum groupoids; Left invariance revisited; Corepresentations of measured quantum groupoids; Actions of measured quantum groupoids; Some technical properties of actions; The standard implementation of an action: The case of a $\delta$-invariant; Crossed-product and dual actions; An auxilliary weight on the crossed-product; Biduality; Characterization of crossed-products; Dual weight; bidual weight; depth 2 inclusion associated to an action; The measured quantum groupoid associated to an action; Appendix; Bibliography.

**Mémoires de la Société Mathématique de France**, Number 114

May 2009, 150 pages, Softcover, ISBN: 978-2-85629-265-5, 2000 *Mathematics Subject Classification:* 46L55, 46L89, **Individual member US$50**, List US$55, Order code SMFMEM/114




## Theory of Bergman Spaces in the Unit Ball of $\mathbb{C}^n$

**Ruhan Zhao**, *SUNY, College at Brockport, NY*, and **Kehe Zhu**, *SUNY at Albany, NY*

There has been a great deal of work done in recent years on weighted Bergman spaces $A^p_\alpha$ on the unit ball $\mathbb{B}_n$ of $\mathbb{C}^n$, where $0 < p < \infty$ and $\alpha > -1$. The authors extend this study in a very natural way to the case where $\alpha$ is *any* real number and $0 < p \le \infty$. This unified treatment covers all classical Bergman spaces, Besov spaces, Lipschitz spaces, the Bloch space, the Hardy space $H^2$, and the so-called Arveson space. Some of the results about integral representations, complex interpolation, coefficient multipliers, and Carleson measures are new even for the ordinary (unweighted) Bergman spaces of the unit disk.

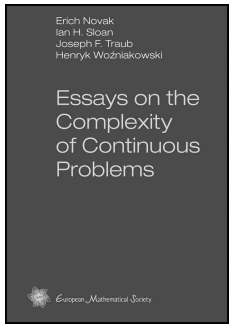
A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

**Contents:** Introduction; Various special cases; Preliminaries; Isomorphism of Bergman spaces; Several characterizations of $A^p_\alpha$; Holomorphic Lipschitz spaces; Pointwise estimates; Duality; Integral representations; Atomic decomposition; Complex interpolation; Reproducing kernels; Carleson type measures; Coefficient multipliers; Lacunary series; Inclusion relations; Further remarks; Bibliography.

**Mémoires de la Société Mathématique de France**, Number 115

July 2009, 103 pages, Softcover, ISBN: 978-2-85629-267-9, 2000 *Mathematics Subject Classification:* 32A36, 32A18, **Individual member US$38**, List US$42, Order code SMFMEM/115

# Applications




## Essays on the Complexity of Continuous Problems

**Erich Novak**, *University of Jena, Germany*, **Ian H. Sloan**, *University of New South Wales, Sydney, Australia*, and **Joseph F. Traub** and **Henryk Woźniakowski**, *Columbia University, New York, NY*

This book contains five essays on the complexity of continuous problems, written for a wider audience.

The first four essays are based on talks presented in 2008 when Henryk Woźniakowski received an honorary doctoral degree from the Friedrich Schiller University of Jena. The focus is on the introduction and history of the complexity of continuous problems, as well as on recent progress concerning the complexity of high-dimensional numerical problems. The last essay provides a

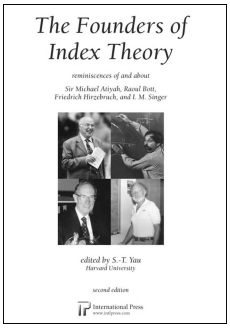
brief and informal introduction to the basic notions and concepts of information-based complexity addressed to a general readership.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

**Contents: E. Novak**, Henryk Woźniakowski and the complexity of continuous problems; **H. Woźniakowski**, Complexity as a new challenge for mathematicians; **J. F. Traub**, A brief history of information-based complexity; **I. H. Sloan**, How high is high-dimensional?; **H. Woźniakowski**, What is information-based complexity?.

June 2009, 105 pages, Hardcover, ISBN: 978-3-03719-069-2, 2000 *Mathematics Subject Classification:* 65-02, 65-03, 00B10, 01A70, **AMS members US$22**, List US$28, Order code EMSCCP

# General and Interdisciplinary




## The Founders of Index Theory

### Reminiscences of and about Atiyah, Bott, Hirzebruch, and Singer, Second Edition

**S.-T. Yau**, *Harvard University, Cambridge, MA*, Editor

Index Theory is one of the most exciting and consequential accomplishments of twentieth-century mathematics. *The Founders of Index Theory* contemplates the four great mathematicians who developed index theory—Sir Michael Atiyah, Raoul Bott, Friedrich Hirzebruch, and I.M. Singer—through the eyes of their students, collaborators and colleagues, their friends and family members, and themselves.

In addition to their own essays and correspondence—of historical importance—this volume presents a variety of material of a decidedly personal as well as compelling mathematical nature, written by some of their most notable students and long-time collaborators, including such leading current figures in mathematics and physics as Simon Donaldson, Edward Witten, and S.T. Yau. In these writings, one perceives the expansive influence of their work across various fields of mathematics and into theoretical physics.

At a time when the long and illustrious careers of Atiyah, Hirzebruch, and Singer are being recognized with birthday celebrations, this second edition of *Founders of Index Theory* remembers the late and much beloved Raoul Bott—in the affectionate words of those three men, as well as family members and long-time friends and colleagues. What emerges is the portrait of a compelling mathematical mind informed by a warm and magnetic personality that was both a joy and inspiration to those who knew him.

This volume includes a generous collection of color and black and white photographs—many rarely seen—of the four principal figures together with their family, friends, and colleagues. These include numerous images of Bott dating from his early childhood to his last years at Harvard University.

*The Founders of Index Theory, Second Edition* is a valuable portrayal of four men who transformed mathematics in a profound manner and who belong to a class of researchers whose interest and influence transcend the conventional boundaries of mathematical fields.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

**Contents:** On Michael Atiyah; On Raoul Bott: In fond remembrance; On Friedrich Hirzebruch; On I.M. Singer; The "Gang of Four" together; Bibliographies.

**International Press**

June 2009, 394 pages, Hardcover, ISBN: 978-1-57146-137-7, 2000 *Mathematics Subject Classification:* 01-XX, **AMS members US$68**, List US$85, Order code INPR/54.R

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### UNIVERSITY OF CALIFORNIA, LOS ANGELES
**Department of Mathematics**
**Faculty Positions Academic Year 2010–2011**

The Department of Mathematics, subject to administrative approval, will consider tenure-track/tenure appointments in a wide range of possible fields with emphasis on applied mathematics. We also plan to make temporary and visiting appointments in the following categories 2–5. Depending on the level, candidates must give evidence of potential or demonstrated distinction in scholarship and teaching.

(1) Tenure-Track/Tenured Faculty Positions. Salary is commensurate with level of experience.

(2) E. R. Hedrick Assistant Professorships. Salary is $61,200 and appointments are for three years. The teaching load is four quarter courses per year.

(3) Computational and Applied Mathematics (CAM) Assistant Professorships. Salary is $61,200, and appointments are for three years. The teaching load is normally reduced to two or three quarter courses per year by research funding as available.

(4) Program in Computing (PIC) Assistant Adjunct Professorships. Salary is $65,500. Applicants for these positions must show very strong promise in teaching and research in an area related to computing. The teaching load is four one-quarter programming courses each year and one seminar every two years. Initial appointments are for one year and possibly longer, up to a maximum service of four years.

(5) Assistant Adjunct Professorships and Research Postdocs. Normally appointments are for one year, with the possibility of renewal. Strong research and teaching background required. The salary range is $53,200–$59,500. The teaching load for adjuncts is six quarter courses per year.

If you wish to be considered for any of these positions you must submit an application and supporting documentation electronically via `http://www.mathjobs.org`.

For fullest consideration, all application materials should be submitted on or before December 9, 2009. Ph.D. is required for all positions.

UCLA and the Department of Mathematics have a strong commitment to the achievement of excellence in teaching and research and diversity among its faculty and staff. The University of California is an Equal Opportunity/Affirmative Action Employer. The University of California asks that applicants complete the Equal Opportunity Employer survey for, Letters and Science, at the following URL:

**Suggested** uses for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

**The 2009 rate is** $110 per inch or fraction thereof on a single column (one-inch minimum), calculated from top of headline. Any fractional text of 1/2 inch or more will be charged at the next inch rate. No discounts for multiple ads or the same ad in consecutive issues. For an additional $10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Headlines will be centered in boldface at no extra charge. Ads will appear in the language in which they are submitted.

There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified ads.

**Upcoming deadlines** for classified advertising are as follows: November 2009 issue–August 28, 2009; December 2009 issue–September 28, 2009; January 2010 issue–October 28, 2009; February 2010 issue–November 25, 2009; March 2010 issue–December 28, 2009; April 2010 issue–January 28, 2010.

**U.S. laws prohibit** discrimination in employment on the basis of color, age, sex, race, religion, or national origin. "Positions Available" advertisements from institutions outside the U.S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U.S. laws. Details and specific wording may be found on page 1373 (vol. 44).

**Situations wanted advertisements** from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada or 401-455-4084 worldwide for further information.

**Submission:** Promotions Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940; or via fax: 401-331-3842; or send email to `classads@ams.org`. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 20904. Advertisers will be billed upon publication.

http://cis.ucla.edu/facultysurvey. Under Federal law, the University of California may employ only individuals who are legally authorized to work in the United States as established by providing documents specified in the Immigration Reform and Control Act of 1986.

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## ILLINOIS

### UNIVERSITY OF CHICAGO
### Department of Mathematics

The University of Chicago Department of Mathematics invites applications for the following positions:

1. L.E. Dickson Instructor: This is open to mathematicians who have recently completed or will soon complete a doctorate in mathematics or a closely related field, and whose work shows remarkable promise in mathematical research and teaching. The appointment typically is for two years, with the possibility of renewal for a third year. The teaching obligation is up to four one-quarter courses per year.

2. Assistant Professor: This is open to mathematicians who are further along in their careers, typically two or three years past the doctorate. These positions are intended for mathematicians whose work has been of outstandingly high caliber. Appointees are expected to have the potential to become leading figures in their fields. The appointment is generally for three years, with a teaching obligation of three one-quarter courses per year.

Applicants will be considered for any of the positions above which seem appropriate. Complete applications consist of (a) a cover letter, (b) a curriculum vitae, (c) three or more letters of reference, at least one of which addresses teaching ability, and (d) a description of previous research and plans for future mathematical research. Applicants are strongly encouraged to include information related to their teaching experience, such as a teaching statement or evaluations from courses previously taught, as well as an AMS cover sheet. If you have applied for an NSF Mathematical Sciences Postdoctoral Fellowship, please include that information in your application, and let us know how you plan to use it if awarded.

Applications must be submitted online through www.mathjobs.org. Questions may be directed to apptsec@math.uchicago.edu. We will begin screening applications on December 1, 2009. Screening will continue until all available positions are filled. The University of Chicago is an Equal Opportunity/Affirmative Action Employer.

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## MASSACHUSETTS

### BOSTON COLLEGE
### Department of Mathematics
### Tenure-Track Positions

The Department of Mathematics at Boston College invites applications for two tenure-track positions at the level of Assistant Professor beginning in September 2010, one in Number Theory or related areas, including Algebraic Geometry and Representation Theory; and the second in either Geometry/Topology or Number Theory or related areas. In exceptional cases, a higher level appointment may be considered. The teaching load for each position is three semester courses per year.

Requirements include a Ph.D. or equivalent in mathematics awarded in 2008 or earlier, a record of strong research combined with outstanding research potential, and demonstrated excellence in teaching mathematics.

A completed application should contain a cover letter, a description of research plans, a statement of teaching philosophy, curriculum vitae, and at least four letters of recommendation. One or more of the letters of recommendation should directly comment on the candidate's teaching credentials.

Applications completed no later than December 1, 2009, will be assured our fullest consideration. Please submit all application materials through http://mathjobs.org.

Boston College will start a Ph.D. program in mathematics beginning fall 2010. Applicants may learn more about the department, its faculty and its programs at http://www.bc.edu/math. Electronic inquiries concerning these positions may be directed to math-search@bc.edu. Boston College is an Affirmative Action/Equal Opportunity Employer. Applications from women, minorities, and individuals with disabilities are encouraged.

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### BOSTON COLLEGE
### Department of Mathematics
### Post-doctoral Position

The Department of Mathematics at Boston College invites applications for a postdoctoral position beginning September 2010. This position is intended for a new or recent Ph.D. with outstanding potential in research and excellent teaching. This is a 3-year Visiting Assistant Professor position, and carries a 2-1 annual teaching load. Research interests should lie within Geometry and Topology or related areas. Candidates should expect to receive their Ph.D. prior to the start of the position and have received the Ph.D. no earlier than Spring 2009.

Applications must include a cover letter, description of research plans, curriculum vitae, and four letters of recommendation, with one addressing the candidate's teaching qualifications. Applications received no later than January 1, 2010, will be assured our fullest consideration. Please submit all application materials through http://mathjobs.org.

Boston College will start a Ph.D. program in mathematics beginning fall 2010. Applicants may learn more about the department, its faculty and its programs at http://www.bc.edu/math. Electronic inquiries concerning this position may be directed to postdoc-search@bc.edu. Boston College is an Affirmative Action/Equal Opportunity Employer. Applications from women, minorities, and individuals with disabilities are encouraged.

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### MASSACHUSETTS INSTITUTE OF TECHNOLOGY
### Department of Mathematics
### Positions for Faculty and Instructors

The Mathematics Department at MIT is seeking to fill positions in Pure and Applied Mathematics and Statistics, at the level of Instructor, Assistant Professor and higher, beginning September 2010. Appointments are based primarily on exceptional research qualifications. Appointees will be expected to fulfill teaching duties and to pursue their own research program. Ph.D. is required by the employment start date.

For more information, and to apply, please visit http://www.mathjobs.org.

To receive full consideration, please submit applications by December 1, 2009. Recommendations should be submitted through mathjobs.org but may also be sent as PDF attachments to hiring@math.mit.edu, or as paper copies mailed to: Mathematics Search Committee, Room 2-345, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307.

Please do not mail or email duplicates of items already submitted via mathjobs.

MIT is an Equal Opportunity, Affirmative Action Employer.

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## NEW JERSEY

### INSTITUTE FOR ADVANCED STUDY, SCHOOL OF MATHEMATICS

The School of Mathematics has a limited number of memberships, some with financial support for research in mathematics and computer science at the institute during the 2010-11 academic year. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree.

During the academic year of 2010-11 Richard Taylor of Harvard University will lead a program on Galois Representations and Automorphic Forms. The program

will embrace all aspects of the conjectural relationship between automorphic forms and Galois representations: functoriality and Langlands' conjectures, analytic approaches (in particular the trace formula) algebraic approaches (those growing out of Wiles's work on Fermat's Last Theorem), p-adic Hodge theory (in particular the so called p-adic Langlands' Program and applications to other problems in number theory. There will be a weekly seminar and a week-long workshop highlighting recent developments connected with the program.

Recently the School established the von Neumann Fellowships, and up to six of these fellowships will be available for the 2010-11 year. To be eligible for a von Neumann Fellowship, applicants should be at least five, but no more than fifteen, years following the receipt of their Ph.D.

The Veblen Research Instructorship is a three-year position which the School of Mathematics and the Department of Mathematics at Princeton University established in 1998. Three-year instructorships will be offered each year to candidates in pure and applied mathematics who have received their Ph.D. within the last three years. The first and third year of the instructorship will be spent at Princeton University and will carry regular teaching responsibilities. The second year will be spent at the Institute and dedicated to independent research of the instructor's choice.

Applications materials may be requested from Applications, School of Mathematics, Institute for Advanced Study, Einstein Drive, Princeton, NJ 08540; email: applications@math.ias.edu. Application forms may be downloaded via a Web connection to: http://www.math.ias.edu.

Application deadline is December 1.

The Institute for Advanced Study is committed to diversity and strongly encourages applications from women and minorities.

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## OHIO

### THE OHIO STATE UNIVERSITY
### College of Mathematical and Physical Sciences
### Department of Mathematics

The Department of Mathematics in the College of Mathematical and Physical Sciences at The Ohio State University anticipates having tenure-track positions available, effective Autumn Quarter 2010. We are interested in all areas of pure and applied math, including financial mathematics. Candidates are expected to have a Ph.D. in mathematics (or related area) and to present evidence of excellence in teaching and research. Further information about the department can be found at http://www.math.ohio-state.edu.

Applications should be submitted online at http://www.mathjobs.org. If you cannot apply online, please contact facultysearch@math.ohio-state.edu or write to: Hiring Committee, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, OH 43210.

Applications will be considered on a continuing basis, but the annual review process begins November 16, 2009.

To build a diverse workforce, Ohio State encourages applications from minorities, veterans, women, and individuals with disabilities. EEO/AA Employer.

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## OREGON

### UNIVERSITY OF OREGON
### Department of Mathematics

The University of Oregon department of mathematics seeks applicants for a full-time tenure-related position in the area of probability at the rank of assistant professor. Minimum qualifications are a Ph.D. in mathematics or closely related field. An outstanding research record, and active participation and excellence in teaching at the undergraduate and graduate levels will be the most important criteria for selection. Please see http://hr.uoregon.edu/jobs/ for a full position announcement. Applicants will please provide a standard AMS cover page, CV, and three letters of recommendation. We strongly prefer applications and letters to be submitted electronically at mathjobs.org. Application materials may also be mailed directly to: Search Committee, Department of Mathematics, 1222 University of Oregon, Eugene, Oregon, 97403-1222. Deadline for applications: December 15, 2009. Candidates should have the ability to work effectively with a diverse community. The University of Oregon is an EO/AA/ADA institution committed to cultural diversity.

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## PENNSYLVANIA

### PENN STATE UNIVERSITY
### Department of Mathematics

Penn State Greater Allegheny invites applications for a tenure-track assistant professor of mathematics position. Teach undergraduate math courses and some computer science course as needed. Assignments may include day, evening, and Saturday classes. Research and service expected. Ph.D. in mathematics with expertise in computer science required. Evidence of potential for excellent teaching, research, and publication in high-quality journals, and professional growth is expected. To learn more about the campus and Penn State, visit http://www.psu.edu/ur/cmpcoll.html. To learn more about the position and how to apply, visit http://www.psu.jobs/Search/Opportunities.html and follow the "Faculty" link. AA/EOE.

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### PENN STATE UNIVERSITY
### Faculty Positions, Department of Mathematics

Subject to availability of funding, the Penn State Mathematics Department will seek to fill openings for S. Chowla Research Assistant Professors and for tenure and tenure-track faculty positions.

S. Chowla Research Assistant Professor. Successful candidates will be new or recent Ph.D.s with exceptional research potential and a commitment to excellence in teaching. These non-tenure-track appointments are for three years. Starting salary is $50,000 for the nine month academic year. The Chowla program is designed to maximize the professional development of its participants and provides a research stipend. The department may in addition make other postdoctoral appointments for two or three year terms. Applicants for the Chowla position will automatically be considered for these positions. Initial offers will be made in January 2010.

Tenure and Tenure-Track Faculty Positions. The department is seeking to fill two or more positions; dependent on the qualifications and experience of the appointee, these may be at the assistant, associate, or full professor level. Areas of emphasis for hiring are Dynamical Systems and its applications; Geometry, including algebraic geometry; Logic and Foundations. However, outstanding candidates from all areas of mathematics will be considered. A Ph.D. degree or its equivalent is required.

Online application via http://www.mathjobs.org is strongly preferred. Review of applications will begin November 23, 2009, and will continue until positions are filled. Required application materials include:

- Online application
- At least three reference letters, one of which should address in detail the candidate's abilities as a teacher
- Curriculum Vitae
- Publication List
- Research Statement
- Teaching Statement

Persons who are unable to apply using the mathjobs.org website or who do not wish to do so may send application materials to:

Search Committee
Department of Mathematics
Penn State University

107 McAllister Building
University Park, PA 16802

Applications from women and members of underrepresented groups are welcomed. Penn State is committed to Affirmative Action, Equal Opportunity, and the diversity of its workforce.

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## TEXAS

### TEXAS A&M UNIVERSITY
### IAMCS-KAUST Postdoctoral Fellowships

The Institute for Applied Mathematics and Computational Science (IAMCS) at Texas A&M University is pleased to invite applications for its IAMCS-KAUST Postdoctoral Fellowships.

IAMCS is an interdisciplinary research institute at Texas A&M University named in 2008 as one of the four inaugural King Abdullah University of Science and Technology (KAUST) Global Research Partner Centers. Its core members number more than thirty faculty from the fields of Mathematics, Statistics, Computer Science, and Engineering.

Fostering collaboration and interdisciplinary research anchored in the mathematical sciences are at the heart of IAMCS's mission. To that end, IAMCS emphasizes among its activities annual research themes. Current and upcoming themes are mathematical and computational challenges in Earth Science, Material Science and Engineering, and the Life Sciences. IAMCS postdoctoral candidates should have demonstrated interest and involvement in interdisciplinary research, and successful candidates will be encouraged to participate in the annual theme activities and to establish research collaborations exploring theme year topics. Moreover, each fellow will be invited to establish collaborations with KAUST faculty, postdocs, and students as well as all of the KAUST Global Research Partner institutions and individual investigators. This offers an unprecedented opportunity for postdoctoral fellows to join a remarkable network of leading research institutions and eminent scholars assembled through the KAUST GRP program.

KAUST is a new graduate research university developed by the Kingdom of Saudi Arabia at a site along the Red Sea a short distance north of Jeddah. Opened in September 2009, it offers world class, state-of-the-art research and instructional facilities supporting its core research and graduate programs in earth sciences, materials science and engineering, biosciences, and applied mathematics and computational science. A key element in KAUST's development as a premier graduate research university is its Global Research Partnership (GRP) program. The GRP consists of its Academic Excellence Alliance Partners, Research Center Partners and Individual Research Scholar Partners.

The IAMCS-KAUST Postdoctoral Fellowships at Texas A&M University are two-year appointments with the possibility of extension to a third year. The fellowship stipend is $53K over 12 months plus fringe benefits. Interested individuals should submit their application materials (CV, research statement, and three letters of recommendation) to the email address KAUST@tamu.edu by 15 December 2009. IAMCS intends to select up to four IAMCS-KAUST Fellows.

Texas A&M University is an Equal Opportunity Employer. The university is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment and strongly encourages applications from women, minorities, and individuals with disabilities.

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### TEXAS A&M UNIVERSITY
### Department of Mathematics

The Department of Mathematics anticipates several openings for tenured, tenure-eligible, and visiting faculty positions beginning fall 2010. The field is open, but we particularly seek applications from individuals whose mathematical interests would augment and build upon existing strengths both within the Mathematics Department as well as other departments in the university. Salary, teaching loads, and start-up funds are competitive. For a tenured position the applicant should have an outstanding research reputation and would be expected to fill a leadership role in the department. An established research program, including success in attracting external funding and supervision of graduate students, and a demonstrated ability and interest in teaching are required. Informal inquiries are welcome. For an Assistant Professorship, we seek strong research potential and evidence of excellence in teaching. Research productivity beyond the doctoral dissertation will normally be expected. We also have several visiting positions available. Our Visiting Assistant Professor positions are three-year appointments and carry a three course per year teaching load. They are intended for those who have recently received their Ph.D. and preference will be given to mathematicians whose research interests are close to those of our regular faculty members. Senior Visiting Positions may be for a semester or one-year period. A complete dossier should be received by December 15, 2009. Early applications are encouraged since the department will start the review process in October 2008.

Applicants should send the completed "AMS Application Cover Sheet", a vita, a summary statement of research and teaching experience, and arrange to have letters of recommendation sent to: Faculty Hiring, Department of Mathematics, Texas A&M University, College Station, Texas 77843-3368. Further information can be obtained from: http://www.math.tamu.edu/hiring.

Texas A&M University is an Equal Opportunity Employer. The university is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment and strongly encourages applications from women, minorities, individuals with disabilities, and veterans. The university is responsive to the needs of dual career couples.

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## UTAH

### UNIVERSITY OF UTAH
### Department of Mathematics
### Hiring 2009–2010

The Department of Mathematics at the University of Utah invites applications for the following positions: Full-time tenure-track or tenured appointments at the level of assistant, associate, or full professor in all areas of mathematics and statistics. Three-year Scott, Wylie, Burgess, and VIGRE Assistant Professorships, depending on funding availability.

Please see our website at http://www.math.utah.edu/positions for information regarding available positions, application requirements and deadlines.

Applications must be completed through the website http://www.mathjobs.org. The University of Utah is an Equal Opportunity, Affirmative Action Employer and encourages applications from women and minorities, and provides reasonable accommodation to the known disabilities of applicants and employees. The University of Utah values candidates who have experience working in settings with students from diverse backgrounds, and possess a strong commitment to improving access to higher education for historically underrepresented students.

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## BRAZIL

### BRAZIL–US
### ADVISOR–MENTOR SOUGHT

**Theorem**. Given a bijection $B(SP, SI)$ from a pre-image set $SP$ onto an image set $SI$, where $SP$ and $SI$ have an element $EC$ in common, then a bijection can be constructed, using only simple bijectivity preserving operations, from $SP - EC$ onto $SI - EC$, i.e., $B^*(SP - \{EC\}, SI - \{EC\})$.

**Proof**. We have only 2 cases for $EC$:

1) If $EC$ is identity subbijected onto itself under $B(SP, SI)$, then we can entirely remove this identity subbijection of $EC$ and what remains will be our bijection $B^*(SP - \{EC\}, SI - \{EC\})$.

NB: bijectivity is trivially preserved by this operation.

2) If $EC$ is not subbijected onto itself under $B(SP, SI)$, then $EC$ in $SP$ is subbijected onto some element $EI$ in $SI$ and some element $EP$ in $SP$ is subbijected onto $EC$ in $SI$. In a simple bijectivity preserving fashion, we can switch ("permute") the pre-image elements $EC$ and $EP$, and we will again have case 1) with $EC$ identity subbijected onto itself, and $EP$ now subbijected onto $EI$, simply but non-trivially constructing a new bijection from $SP$ onto $SI$. Again we have case 1), and the identity subbijection from $EC$ onto itself can again be removed, leaving our needed $B^*(SP - \{EC\}, SI - \{EC\})$.

I need mathematicians (preferably tenured, solid reps) who fully appreciate this theorem and the consequences of its application to bijections onto proper subsets (quasi-definitive of infinity). Though this concept yielded a simple formalization of the paradoxes of infinity then (1800s) known, it was never used to help vet and perhaps resolve these paradoxes, as should have been done before making them an essential part of the foundations of set theory.

Michael Hugh Knowles, Rua Miradouro, 45, Sion, Belo Horizonte, 30310-640, Brazil, mhk@paias.org.

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## INDIA

### INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
### Department of Mathematics

Applications are invited for visiting and permanent faculty positions at all levels. Applicants should have a Ph.D. and an excellent academic record. Outstanding candidates in all areas of mathematical sciences are encouraged to apply. Current departmental interests include Algebra, Algebraic Geometry, Algebraic Topology, Combinatorics, Differential Geometry, Functional Analysis, Harmonic Analysis, Number Theory, Numerical Analysis, Partial Differential Equations, Probability and Statistics. The Department of Mathematics and IIT Bombay offer an environment conducive to research. Teaching duties are about 5 hours a week and consist of at most two courses per semester at the undergraduate (B.Tech.), postgraduate (M.Sc.), or doctoral (Ph.D.) levels. A substantial research grant of Rs. 5,00,000 is available for each new permanent faculty member. In addition, the institute periodically funds participation in international conferences. Faculty enjoy several personal benefits including on-campus housing with free high-speed LAN connection, free or subsidized medical care, and easy access to schools on campus for children. Further information is available at: http://www.math.iitb.ac.in/.

Applications including a curriculum vitae, a list of publications, a statement describing current and planned research, a statement outlining teaching experience, and at least three letters of recommendations should be sent to: Head, Department of Mathematics, IIT Bombay, Powai, Mumbai 400076, India. Applications can also be sent by e-mail to: head.math@iitb.ac.in or by fax to (+91-22) 2572 3480.

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### INDIAN INSTITUTE OF TECHNOLOGY GANDHINAGAR
### Faculty Affairs Unit

IIT Gandhinagar is Looking for Outstanding Mathematics Faculty. IIT Gandhinagar (IITGN) is currently on the lookout for strongly motivated visiting and permanent faculty positions at all levels. Applicants should have a Ph.D. with excellent research credentials. Outstanding candidates in all areas of mathematical sciences are encouraged to apply. IITGN (http://www.iitgn.ac.in) is one of the six new Indian Institutes of Technology that were started by the government of India in 2008. It is currently located at Chandkheda, about 15 minutes drive from both Ahmedabad and Gandhinagar. Ahmedabad is known for its excellent infrastructure with thriving industries, prestigious academic and research institutes, and an ambiance which encourages excellence and entrepreneurship. IITGN provides an excellent ambience conducive to research. Teaching duties average about 5 hours a week. The institute will also provide appropriate seed grants to enable new faculty members to initiate their research immediately upon joining. The institute will also welcome individuals interested in spending a semester or longer as a visiting faculty on sabbatical or otherwise. Indian citizenship is required for permanent faculty but not for the visiting faculty. Interested persons may send their curriculum vitae to:

Faculty Affairs Unit
Directorate Office
Indian institute of Technology Gandhinagar
Vishwakarma Govt Engg College Complex
Chandkheda, Visat-Gandhinagar Highway
Ahmedabad, Gujarat
India - 382424
Phone: +91 - 79 - 2397 2622, 2397 2324
Fax: +91 - 79 - 2397 2622
Email:faculty.recruitment@iitgn.ac.in
Web: http://www.iitgn.ac.in

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## KOREA

### KOREA INSTITUTE FOR ADVANCED STUDY (KIAS)
### School of Mathematics & School of Computational Sciences
### Postdoctoral Research Fellowships

The School of Mathematics and the School of Computational Sciences at the Korea Institute for Advanced Study (KIAS) invites applicants for the positions at the level of postdoctoral research fellows in pure and applied mathematics. KIAS, incepted in 1996, is committed to the excellence of research in basic sciences (mathematics, theoretical physics, and computational sciences) through high-quality research programs and a strong faculty body consisting of distinguished scientists and visiting scholars.

Applicants are expected to have demonstrated exceptional research potential, through the doctoral dissertation and beyond. The annual salary ranges approximately from ¥29,000,000–¥42,000,000 and, in addition, research fund ¥7,000,000–¥10,000,000 is provided each year.

Appointments may start as early as March 2010. The initial appointment will be for two years with a possibility of renewal for two additional years. Those interested are encouraged to contact a faculty member in their research areas. Also, please visit http://www.kias.re.kr/en/notice/job_opportunity.jsp for more information. Applicants should send a cover letter specifying the research area, a CV, a publication list, a summary of research plan, and should arrange for three letters of reference, by December 31, 2009, to be sent to:

School of Mathematics:
Mr. Kwang Won Lee
(kwlee@kias.re.kr)
KIAS 07-43, Cheongnyangni 2-dong
Dongdaemun-gu, Seoul, 130-722, Korea

School of Computational Sciences:
Ms. So Young Kim
(soyoung@kias.re.kr)
KIAS 207-43, Cheongnyangni 2-dong
Dongdaemun-gu, Seoul, 130-722, Korea

Email applications are strongly encouraged.

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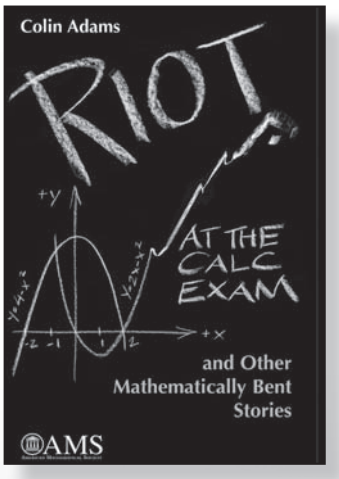
AMERICAN MATHEMATICAL SOCIETY




**Riot at the Calc Exam and Other Mathematically Bent Stories**

**Colin Adams**, *Williams College, Williamstown, MA*

This collection of humorous mathematics stories gives the reader a sense of what it would be like to participate in a mathematical world that is far from dreary. Several of the ideas for the stories were derived from lunchtime discussions at the humorous and friendly mathematics department at Williams College. The stories resonate with both mathematicians and laypeople with an interest in mathematics.

2009; 271 pages; Softcover;
ISBN: 978-0-8218-4817-3;
List US$32; AMS members US$26;
Order code MBK/62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**www.ams.org/bookstore**

AMS
AMERICAN MATHEMATICAL SOCIETY

## PORTUGAL

**CENTER FOR MATHEMATICAL ANALYSIS, GEOMETRY, AND DYNAMICAL SYSTEMS**
**Departamento de Matemática**
**Instituto Superior Técnico**
**Av. Rovisco Pais**
**1049-001 Lisboa, Portugal**
**Postdoctoral Positions**

The Center for Mathematical Analysis, Geometry, and Dynamical Systems of the Department of Mathematics of Instituto Superior Técnico, Lisbon, Portugal, invites applications for postdoctoral positions for research in mathematics, subject to budgetary approval. Positions are for one year, with the possibility of extension for a second year upon mutual agreement. Selected candidates will be able to take up their position between September 1, 2010, and January 1, 2011.

Applicants should have a Ph.D. in mathematics, or in a related area relevant to the scientific interests of the faculty of the center, preferably obtained after December 31, 2007. They must show very strong research promise in one of the areas in which the mathematics faculty of the center is currently active. There are no teaching duties associated with these positions.

Applicants should send a curriculum vitae; reprints, preprints and/or dissertation abstract; description of research project (of no more than 1,000 words); and ask that three letters of reference are sent directly to the director at the above address.

To insure full consideration, complete application packages should be received by December 1, 2009. Additional information about the center and the positions is available at `http://www.math.ist.utl.pt/cam/`.

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## SINGAPORE

**The National University of Singapore (NUS)**
**Department of Mathematics**

The Department of Mathematics at the National University of Singapore (NUS) invites applications for tenured, tenure-track and visiting (including postdoctoral) positions at all levels, beginning in August 2010.

NUS is a research intensive university that provides quality undergraduate and graduate education. The Department of Mathematics, which is one of the largest in the university, has about 70 faculty members and teaching staff whose expertise cover major areas of contemporary mathematical research.

We seek promising scholars and established mathematicians with outstanding track records in any field of pure and applied mathematics. The department offers internationally competitive salaries with start-up grants for research. The teaching load is particularly light for young scholars, in an environment conducive to research with ample opportunities for career development.

The department is particularly interested in, but not restricted to considering, applicants specializing in any of the following areas:

. Analysis and Probability.

. Computational Science, including but not restricted to, Computational Biology, Medical Imaging, Computational Materials Science and Nanoscience.

. Operations Research and Financial Mathematics.

Application materials should be sent to Search Committee via email (as PDF files) to `search@math.nus.edu.sg`.

Please include the following supporting documentation in the application:

· an American Mathematical Society Standard Cover Sheet;

· a detailed CV including publications list;

· a statement (max. of 3 pages) of research accomplishments and plan;

· a statement (max. of 2 pages) of teaching philosophy and methodology. Please attach evaluation on teaching from faculty members or students of your current institution, where applicable;

· at least three letters of recommendation including one which indicates the candidate's effectiveness and commitment in teaching. Please ask your referees to send their letters directly to `search@math.nus.edu.sg`.

Enquires may also be sent to this email address.

Review process will begin on 15 October, and will continue until positions are filled.

For further information about the department, please visit `http://www.math.nus.edu.sg`.

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**References** **(continued from page 1080)**

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*Moscone West Center, San Francisco, CA*
*January 13–16, 2010*

**2010 Employment Center Schedule:**

**November 2, 2009**–Suggested deadline for electronic forms submission to allow for advanced scheduling.

**December 22, 2009**–Advance registration deadline for JMM. Meeting badge will be required for admittance.

After this date, meeting registration fees go up and meeting registration can only happen on site in San Francisco.

**OPEN HOURS:**

**Wednesday, January 13, 2010–8:00 a.m.–7:00 p.m.**
Do not schedule interviews before 9:00 a.m. on this day.

**Thursday, January 14, 2010–8:00 a.m.–7:00 p.m.**

**Friday, January 15, 2010–8:00 a.m.–7:00 p.m.**

**Saturday, January 16, 2010–9:00 a.m.–12:00 noon**

**Note:** Computer scheduling is no longer provided at the Employment Center. When deciding on travel dates, keep in mind that employers may wish to conduct interviews during any of the hours listed above.

The Employment Center offers a convenient, safe, and practical meeting place for employers and applicants attending the Joint Meetings. The focus of the Employment Center is on Ph.D.-level mathematical scientists and those that seek to hire them from academia, business, and government.

## Employment Center Now Fully Electronic

This year all forms will be submitted and accessed electronically on the Web. In addition, registered attendees will be able to utilize a basic scheduling tool in advance on the Web. The website and all information will be available


beginning in September 2009 and will remain accessible through the period of the Employment Center. The same applicant and job information available on the Employment Center/EIMS website during the months preceding the event in San Francisco will be accessible during the JMM on computer terminals available at the Employment Center.

**There will be no printed books or paper forms.** Also, there will be no paper message center since the new electronic system allows for interview arrangements. As of 2009, the on-site computer-scheduling program was discontinued. The new electronic system represents a significant enhancement of the Employment Center.

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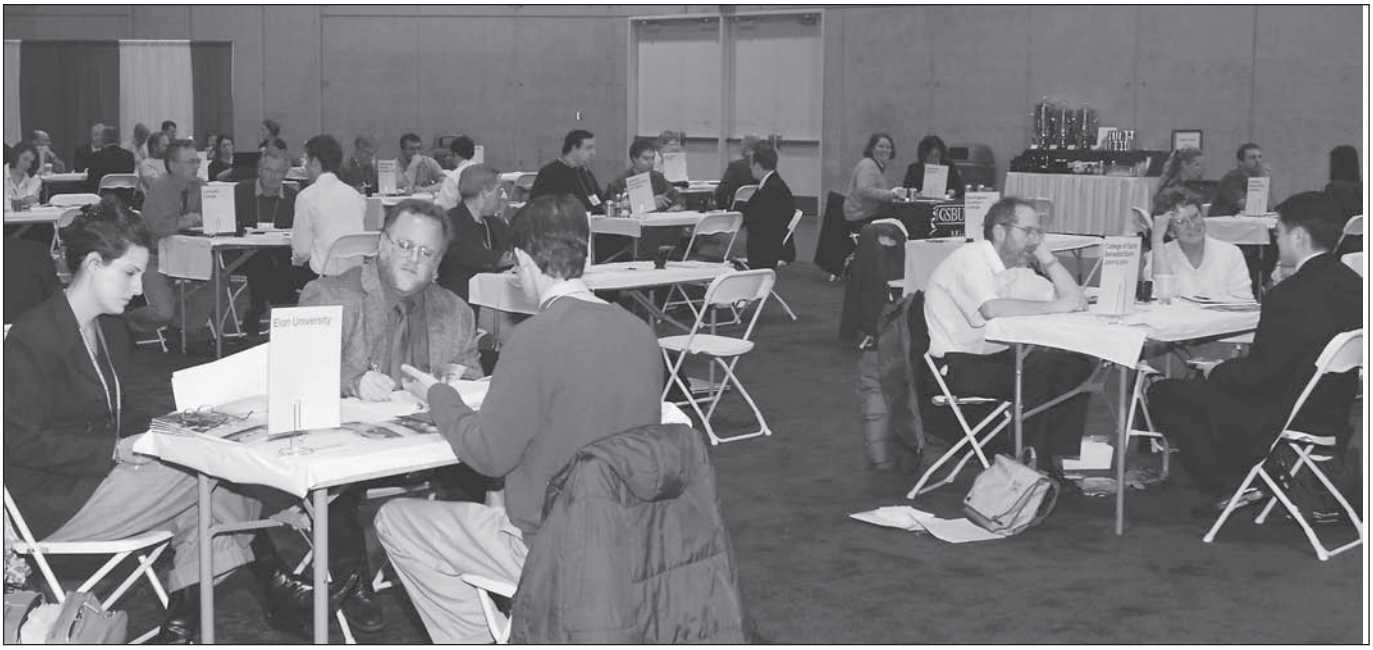
All applicants and employers planning to enter the Employment Center—even just for one interview—must present a 2010 Joint Meeting Registration badge or they will be denied admittance. This is not a new policy, but it will now be strictly enforced. Meeting badges are obtained by registering for the Joint Mathematics Meetings. See the JMM website at: `http://www.ams.org/amsmtgs/2124_intro.html` for registration instructions and rates.




## Employers: Choose a Table

There are two table types available for employers, based on the number of interviewers who will be present at any one time:

• one or two interviewers per table in the "Quiet Area": before 11/2/09 (US$145), after 11/2/09 (US$185), additional table (US$85).

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In addition to the table fees, appropriate ad fees must be paid at the time the ad is submitted. Please note that the traditional advertising site on the AMS website, EIMS, now also serves as the ad placement site for the Employment Center. An existing EIMS ad can be earmarked for Employment Center use, and the table fee will be paid at that time.

All fees are to be paid at the EIMS ad website; fees are no longer paid through the JMM registration form. However, individual registration for the JMM is required for all interviewers and no admittance is possible without a JMM badge.

## Employers: How to Register

Registration begins September 1, 2009, at the following website: `http://eims.ams.org`.

Use of the EIMS website is through password-accessible accounts, one per employer. Please place your ad and select your table type, paying all fees on the website. Whoever places the ad will want to make careful note of the account access password in case faculty or other personnel need to access the resume review and scheduling features in the months leading up to the Employment Center.

Once registered, employers will gain access to applicant data as it is submitted to the site. There will be applicant resumes on the site, but employers will want to notice especially the resumes marked "Employment Center". Also, employers can review and sort the requests for interviews submitted by applicants on the system. To respond to a request, employers will be able to access the applicant's pre-approved schedule and fill in the desired slot or slots. In this way, employers will build their own schedule, which is also viewable after logging in on the system.

To participate in the interviewing program by using a Table Only (not posting an ad or accessing applicant data) purchase a table ON SITE (fee will be US$300) in San Francisco at the JMM registration desk. It is not possible to gain access to applicant data without placing an ad. Also, it is not possible to purchase a Table-Only in advance of the meeting, but availability of tables on site is guaranteed in San Francisco. To display an ad on site, and use no Employment Center services at all, submit your one-page paper ad on site to the Employment Center staff. There is no fee for this service.

For complete information, visit `http://www.ams.org/emp-reg/`.

## Applicants: Making the Decision to Attend

For those who are currently on the job market, the Employment Center is a central meeting place for employers and applicants who are attending the Joint Meetings. After submitting information and a limited number of documents on the Employment Center/EIMS website, applicants will review the jobs ads marked "Employment Center" and, if desirable, mark a box indicating interest. They will also mark hours of availability on their personal schedule screen. Employers may, at any time, respond by filling in an interview slot on the applicant's schedule.

All information is available on the website in advance, and now that this electronic service is in place, there is no other messaging conducted on paper. Computer workstations will be available for brief use on site. The only difference between information available in advance, and what is available on site would be the addition of possible


on-site employer registrations and any last minute scheduling done by employers.

There will ordinarily be no research-oriented postdoctoral positions listed or discussed at the Employment Center. In the current job market, the majority of Employment Center employers are academic departments of mathematical sciences seeking to meet a short list of applicants who applied for their open positions during the fall. Opportunities to meet employers with whom no previous contact was made are becoming quite rare. Each year, a few government or industry employers are present. Often, they are seeking U.S. citizens only due to existing contracts.

If timely registration, following the website instructions, and marking each appropriate employer (thereby seeking interview invitations) does not produce interviews, then there will be little to no opportunity to attract the interest of employers on site. Through the new software the Employment Center intends to become increasingly arranged in advance, predictable, and calm.

Most appointments will go to applicants who applied to jobs during the fall and are now being sought out by the institutions for in-person meetings during the JMM. Applicants should understand that the Employment Center offers no guarantees of interviews or jobs. Hiring decisions are not made during or immediately following such interviews. A good outcome, in the following weeks or months, would be an invitation for a campus visit.

In a recent survey, fifty percent of applicants responding reported being invited for at least one on-campus visit to an employer they had interviewed with at the Employment Center.

### Applicants: How to Register

There are no Employment Center fees for applicants; however, admission to the Employment Center room requires a 2010 JMM badge, obtainable by registering (and paying a fee) for the Joint Mathematics Meetings.

Registration is possible beginning September 1, 2009, at `http://eims.ams.org` and continuing through Day One of the Employment Center in San Francisco. Early registration is vital since most employers will finalize schedules before arriving in San Francisco.

To register for a badge, go to `http://www.ams.org/amsmtgs/2124_intro.html`.

It is possible to attend one or more privately arranged interviews without official Employment Center registration, however, a meeting badge is required to access the interview room.

For complete information, visit `http://www.ams.org/emp-reg/`.

Questions about the Employment Center registration and participation can be directed to Steve Ferrucci, AMS Membership and Programs Department, at 800-321-4267, ext. 4113, or by email to `emp-info@ams.org`.


# AMS Short Course

## *Markov Chains and Mixing Times*

**San Francisco, California, January 11–12, 2010**

**Organized by**
**David Levin, University of Oregon**
**Yuval Peres, University of California, Berkeley, and Microsoft**
**Elizabeth Wilmer, Oberlin college**

In lieu of traditional lecture notes the book entitled *Markov Chains and Mixing Times* coauthored by the organizers will be provided free of charge to the first 80 people who register for this course. A voucher will be provided to all other registrants that will allow them to purchase the book at the deeply discounted price of US$32. All pre-registrants will be notified if they qualified for the book or the voucher. A home mailing address as well as a current email address will be required for those registering for the Short Course in order to receive the book (or voucher) prior to the meeting.

Advance registration fees are: member of the AMS/MAA–US$98; nonmember–US$135; student, unemployed, emeritus–US$46. On-site fees are: member of the AMS/MAA–US$132; nonmember–US$165; student, unemployed, emeritus–US$67. Registration and housing information can be found in this issue of the *Notices*; see the section "Registering in Advance and Hotel Accommodations" in the announcement for the Joint Mathematics Meetings in San Francisco. The registration form is located at the back of this issue.

### General Introduction

Convergence of finite Markov chains to their stationary distributions is an extremely active research area. Many of the arguments are both beautiful and accessible, and the field interacts closely with both theoretical computer science and statistical physics. The main goal of both our book *Markov Chains and Mixing Times* [6] and this Short Course is to encourage wider dissemination of this material to a broad mathematical audience. Much of the material which we will present is related to very recent research in the area, such as [2–5].

Markov chains are a general class of stochastic processes which under mild regularity conditions converge in distribution to a unique stationary probability distribution. Traditionally, undergraduate treatments of Markov chains have focused on analyzing a fixed chain as time goes to infinity. In the past two decades a different asymptotic analysis has emerged. For a Markov chain with a large state space, we care about the finite number of steps needed to get the distribution reasonably close to the limit (stationary) distribution. This number is known as the mixing time of the chain, and there are now many methods for determining its behavior as a function of the geometry and size of the state space.

In 1986 Aldous and Diaconis wrote a wonderful *Monthly* article on mixing times [1]. Since then, the field and its fruitful interactions with computer science and statistical physics have grown tremendously. In the spring of 2005 a research program on Probability, Algorithms, and Statistical Physics was held at the Mathematical Sciences Research Institute in Berkeley, California. This multidisciplinary program united the interests of mathematicians, computer scientists, and physicists in discrete probabilistic models, and one of its major themes was the rigorous study of mixing times for finite Markov chains. Since much of the theory of Markov chain convergence was developed by physicists and computer scientists, the course will allow participants to see how mathematics is enriched by interaction with other disciplines. Several of the models which we will examine in the course will be "particle systems" arising in statistical physics. Interestingly, many of these models exhibit phase transitions: behavior of the model may change abruptly as a parameter describing local interactions passes through a critical value. For our particle systems, the mixing time may vary "fast" (polynomial in the instance size $n$) to "slow" (exponential in $n$) as interaction parameters pass through a critical value.

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The Department of Mathematics invites applications for tenure-track faculty positions at the rank of Assistant Professor in all areas of mathematics, including one position in Risk Management. Other things being equal, preference will be given to areas consistent with the Department's strategic planning.

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Starting rank and salary will depend on qualifications and experience. Fringe benefits include medical/dental benefits and annual leave. Housing will also be provided where applicable. Initial appointment will be on a three-year contract, renewable subject to mutual agreement. A gratuity will be payable upon successful completion of contract.

Applications received on or before 31 December 2009 will be given full consideration for appointment in 2010. Applications received afterwards will be considered subject to availability of positions. Applicants should send a curriculum vitae and at least three research references and one teaching reference to the Human Resources Office, HKUST, Clear Water Bay, Kowloon, Hong Kong, (Fax (852) 2358 0700). Applicants for positions above the Assistant Professor rank should send a curriculum vitae and the names of at least three research referees to the Human Resources Office. More information about the University is available on the University's homepage at http://www.ust.hk.

*(Information provided by applicants will be used for recruitment and other employment related purposes.)*

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Talks will be given by the organizers and also by David Aldous and Alistair Sinclair, University of California, Berkeley.

## References

(Where noted, articles may be retrieved from `http://arxiv.org/`.)

[1] D. ALDOUS and P. DIACONIS, Shuffling cards and stopping times, *Amer. Math. Monthly* **93** (1986), no. 5, 333–348.

[2] P. DIACONIS and L. SALOFF-COSTE, Separation cut-offs for birth and death chains, *Ann. Appl. Probab.* **16** (2006), no. 4, 2098–2122.

[3] J. DING, E. LUBETZKY, and Y. PERES, The mixing time evolution of Glauber dynamics for the mean-field Ising model, *Comm. Math. Physics* (2008), available at `http://arxiv:0806.1906`.

[4] ____ Total-variation cutoff in birth-and-death chains, *Probab. Theory and Rel. Fields* (2008), available at `http://arxiv:0801.2625`.

[5] D. A. LEVIN, M. J. LUCZAK, and Y. PERES, Glauber dynamics for the mean-field Ising model: Cut-off, critical power law, and metastability, *Probab. Theory and Rel. Fields* (2007), available at `http://arxiv:PR/0712.0790`.

[6] D. A. LEVIN, Y. PERES, and E. L. WILMER, *Markov Chains and Mixing Times*, American Mathematical Society, Providence, RI, 2009, with a chapter by James G. Propp and David B. Wilson.

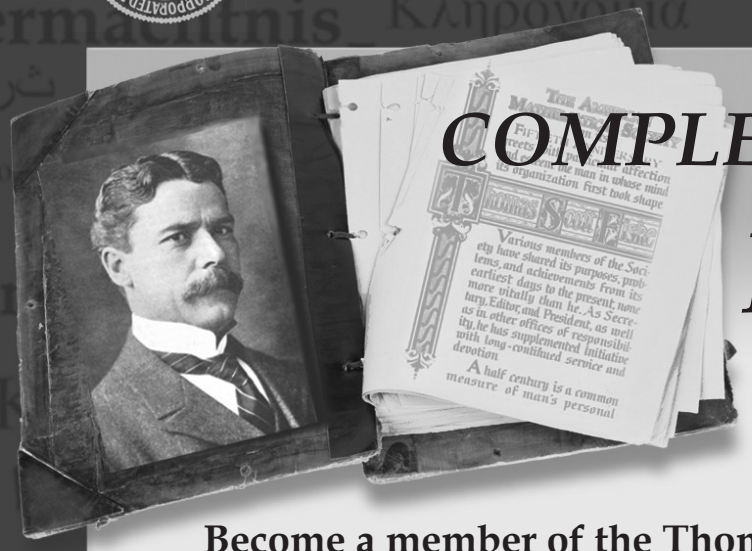
## About the Book

*Markov Chains and Mixing Times* builds on recent interest in chains with large state spaces by examining mixing times and helping to explain how they grow as the size of state spaces increases. The first part of this look at modern methods in the theory of Markov chains offers illustrative examples of techniques. Topics include a discussion of Glauber dynamics and the Metropolis algorithm in the context of "spin systems", and an examination of how under mild conditions Markov chains converge to their stationary distributions. The first part of the book also includes analyses of card shuffling chains. Part II covers more sophisticated techniques, many of which have not previously been presented in textbook form.

Topics include advanced spectral techniques, families of large chains studied in computer science and statistical mechanics, the cutoff phenomenon, and lamplighter chains. The text progresses smoothly from simple to more complicated topics, making it useful for a variety of undergraduate and graduate students and researchers. The text is designed to convey the liveliness of Markov chain convergence, a central part of modern probability theory, to a wide audience.

The organizing speakers will lecture on material directly from the text, and Aldous and Sinclair are leading experts and innovators in the subject matter of the book.

AMERICAN MATHEMATICAL SOCIETY

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# Meetings & Conferences of the AMS

**IMPORTANT INFORMATION REGARDING MEETINGS PROGRAMS:** AMS Sectional Meeting programs do not appear in the print version of the *Notices.* However, comprehensive and continually updated meeting and program information with links to the abstract for each talk can be found on the AMS website. See `http://www.ams.org/meetings/`. Final programs for Sectional Meetings will be archived on the AMS website accessible from the stated URL and in an electronic issue of the *Notices* as noted below for each meeting.

## Waco, Texas

*Baylor University*

### October 16–18, 2009

*Friday – Sunday*

### Meeting #1051

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: August 2009
Program first available on AMS website: September 3, 2009
Program issue of electronic *Notices*: October 2009
Issue of *Abstracts*: Volume 30, Issue 4

### Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**David Ben-Zvi**, University of Texas at Austin, *Title to be announced.*

**Alexander A. Kiselev**, University of Wisconsin, *Title to be announced.*

**Michael C. Reed**, Duke University, *Title to be announced.*

**Igor Rodnianski**, Princeton University, *Title to be announced.*

### Special Sessions

*Applicable Algebraic Geometry*, **Luis David Garcia-Puente**, Sam Houston State University, and **Frank Sotille**, Texas A&M University.

*Commutative Algebra: Module and Ideal Theory*, **Lars W. Christensen**, Texas Tech University, **Louiza Fouli**, University of Texas at Austin, and **David Jorgensen**, University of Texas at Arlington.

*Contemporary Complex and Special Function Theory*, **Roger W. Barnard** and **Kent Pearce**, Texas Tech University, **Kendall Richards**, Southwestern University, and **Alexander Solynin** and **Brock Williams**, Texas Tech University.

*Dynamic Equations on Time Scales: Analysis and Applications*, **John M. Davis**, **Ian A. Gravagne**, and **Robert J. Marks**, Baylor University.

*Formations of Singularities in Geometric Flows*, **Maria-Cristina Caputo**, University of Texas at Austin, and **Natasa Sesum**, Columbia University.

*Fusion Categories and Applications*, **Deepak Naidu** and **Eric Rowell**, Texas A&M University.

*Global Analysis on Homogeneous Spaces*, **Ruth Gornett**, University of Texas at Arlington, and **Ken Richardson**, Texas Christian University.

*Harmonic Analysis and Partial Differential Equations*, **Susan Friedlander**, University of Southern California, **Natasa Pavlovic**, University of Texas at Austin, and **Nikolaos Tzirakis**, University of Illinois at Urbana-Champaign.

*Interdisciplinary Session on Stochastic Partial Differential Equations*, **M. Chekroun**, ENS-Paris and University of

California Los Angeles, and **Shouhong Wang** and **Nathan Glatt-Holtz**, Indiana University.

*Lie Groups, Lie Algebras, and Representations*, **Markus Hunziker**, **Mark Sepanski**, and **Ronald Stanke**, Baylor University.

*Mathematical Aspects of Spectral Problems Related to Physics*, **Klaus Kirsten**, Baylor University, **Gregory Berkolaiko** and **Stephen Fulling**, Texas A&M University, **Jon Harrison**, Baylor University, and **Peter Kuchment**, Texas A&M University.

*Mathematical Models of Neuronal and Metabolic Mechanisms*, **Janet Best**, Ohio State University, and **Michael Reed**, Duke University.

*Numerical Solutions of Singular or Perturbed Partial Differential Equation Problems with Applications*, **Peter Moore**, Southern Methodist University, and **Qin Sheng**, Baylor University.

*Recent Developments on Turbulence*, **Eleftherios Gkioulekas**, University of Texas-Pan American, and **Michael Jolly**, Indiana University.

*The Topology of Continua*, **David Ryden**, Baylor University, **Chris Mouron**, Rhodes College, and **Sergio Macias**, Universidad Nacional Autonoma de Mexico.

*Topological Methods for Boundary Value Problems for Ordinary Differential Equations*, **Richard Avery**, Dakota State University, **Paul W. Eloe**, University of Dayton, and **Johnny Henderson**, Baylor University.

# University Park, Pennsylvania

*Pennsylvania State University*

### October 24–25, 2009

*Saturday – Sunday*

### Meeting #1052

Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: August 2009
Program first available on AMS website: September 10, 2009
Program issue of electronic *Notices*: October 2009
Issue of *Abstracts*: Volume 30, Issue 4

### Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Michael K. H. Kiessling, Rutgers University,** *N-body problems in relativity.*

**Kevin R. Payne, Universita degli di Milano,** *PDE of mixed type: The twin challenges of globalization and diversity.*

**Laurent Saloff-Coste, Cornell University,** *Subelliptic heat kernel measures and holomorphic functions on complex Lie groups.*

**Robert C. Vaughan, Pennsylvania State University,** *Diophantine approximation to curves and surfaces.*

### Special Sessions

*Analytic Number Theory* (Code: SS 16A), **Angel V. Kumchev**, Towson University, **Michael P. Knapp**, Loyola College, and **Robert C. Vaughan**, Pennsylvania State University.

*Arithmetic and Profinite Groups* (Code: SS 19A), **Alireza Salehi-Golsefidy**, Princeton University, **Martin D. Kassabov**, Cornell University, and **Mikhail V. Ershov**, University of Virginia.

*Automorphisms of Riemann Surfaces and Related Topics* (Code: SS 15A), **S. Allen Broughton**, Rose-Hulman Institute of Technology, **Anthony Weaver**, Bronx Community College, the City University of New York, and **Aaron D. Wootton**, University of Portland.

*Combinatorial and Homological Aspects of Commutative Algebra* (Code: SS 3A), **Amanda I. Beecher**, United States Military Academy, and **Alexandre B. Tchernev**, University at Albany.

*Commutative Algebra and Applications to Algebraic Geometry* (Code: SS 11A), **Janet Striuli**, Fairfield University, and **Jooyoun Hong**, Southern Connecticut State University.

*Difference Equations and Applications* (Code: SS 2A), **Michael A. Radin**, Rochester Institute of Technology.

*Function Fields and Their Applications* (Code: SS 20A), **Mihran Papikian** and **Kirsten Eisentrager**, Pennsylvania State University.

*Geometry of Integrable and Non-Integrable Dynamics* (Code: SS 5A), **Boris Khesin**, University of Toronto, and **Mark Levi** and **Sergei Tabachnikov**, Pennsylvania State University.

*Heat Kernel Analysis* (Code: SS 8A), **Maria Gordina**, University of Connecticut, and **Laurent Saloff-Coste**, Cornell University.

*Homotopy Theory* (Code: SS 1A), **James Gillespie** and **Mark W. Johnson**, Pennsylvania State University, Altoona, **Simona Paoli**, University of Haifa, and **Donald Yau**, Ohio State University.

*Integrable Systems and Related Areas* (Code: SS 4A), **Sam Evans** and **Michael Gekhtman**, University of Notre Dame, and **Luen-Chau Li**, Pennsylvania State University.

*Microlocal Analysis and Spectral Theory on Singular Spaces* (Code: SS 14A), **Juan B. Gil** and **Thomas Krainer**, Pennsylvania State University, Altoona.

*New Trends in Triangulated Categories and their Associated Cohomology Theories* (Code: SS 12A), **Sunil Kumar Chebolu**, Illinois State University and **Keir H. Lockridge**, Wake Forest University.

*Nonlinear Waves* (Code: SS 13A), **Bernard Deconinck**, University of Washington, **Diane Henderson**, Pennsylvania State University, **J. Douglas Wright** and **David Ambrose**, Drexel University.

*Partial Differential Equations of Mixed Elliptic-Hyperbolic Type and Applications* (Code: SS 18A), **Barbara Lee Keyfitz**, Ohio State University, and **Kevin Ray Payne**, Universitá di Milano.

*Random Dynamics: Where Probability and Ergodic Theory Meet* (Code: SS 21A), **Manfred Denker**, Pennsylvania State University, and **Wojbor A. Woyczynsk**i, Case Western Reserve University.

*Symplectic, Contact, and Complex Structures on Manifolds* (Code: SS 7A), **Philippe Rukimbira**, **Tedi C. Draghici**, and **Gueo V. Grantcharov**, Florida International University.

*Topics in Mathematical Finance* (Code: SS 10A), **Nick Costanzino**, **Anna L. Mazzucato**, and **Victor Nistor**, Pennsylvania State University.

*n-Body Problems in Relativity* (Code: SS 17A), **Michael K. H. Kiessling**, Rutgers University, **Pavel B. Dubovski**, Stevens Institute of Technology, and **Shadi Tahvildar-Zadeh**, Rutgers University

*q-Series and Related Areas in Enumerative Combinatorics and Number Theory* (Code: SS 9A), **David Little**, **James Sellers**, and **Ae Ja Yee**, Pennsylvania State University

# Boca Raton, Florida

*Florida Atlantic University*

### October 30 – November 1, 2009

*Friday – Sunday*

### Meeting #1053

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: August 2009
Program first available on AMS website: September 17, 2009
Program issue of electronic *Notices*: October 2009
Issue of *Abstracts*: Volume 30, Issue 4

### Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Spyridon Alexakis**, Massachusetts Institute of Technology, *Global conformal invariants: A conjecture of Deser and Schwimmer*.

**Kai-Uwe Bux**, University of Virginia, *Arithmetic groups in positive characteristic*.

**Dino J. Lorenzini**, University of Georgia, *The index of an algebraic variety*.

**Eduardo D. Sontag**, Rutgers University, *Systems biology as a source of interesting problems in mathematics*.

### Special Sessions

*Applied Partial Differential Equations*, **Shar Sajjadi** and **Timothy A. Smith**, Embry Riddle Aeronautical University.

*Arithmetic Geometry*, **Pete L. Clark** and **Dino Lorenzini**, University of Georgia.

*Commutative Ring Theory*, **Alan Loper**, Ohio State University, and **Lee C. Klingler**, Florida Atlantic University.

*Concentration, Functional Inequalities, and Isoperimetry*, **Mario Milman**, Florida Atlantic University, **Christian Houdre**, Georgia Institute of Technology, and **Emanuel Milman**, Institute for Advanced Study.

*Constructive Mathematics*, **Robert Lubarsky**, **Fred Richman**, and **Martin Solomon**, Florida Atlantic University.

*Dynamical Systems*, **William D. Kalies** and **Vincent Naudot**, Florida Atlantic University.

*Enumerative Combinatorics*, **Christian Krattenthaler**, University of Vienna, and **Aaron D. Meyerowitz**, **Heinrich Niederhausen**, and **Wandi Wei**, Florida Atlantic University.

*General Relativity and Related Partial Differential Equations*, **Spyridon Alexakis**, Massachusetts Institute of Technology, and **Gilbert Weinstein**, University of Alabama Birmingham.

*Geometry and Topology*, **Alexander N. Dranishnikov** and **Yuli B. Rudyak**, University of Florida.

*Graded Resolutions*, **Christopher Francisco**, Oklahoma State University, and **Irena Peeva**, Cornell University.

*Graph Theory*, **Zixia Song** and **Yue Zhao**, University of Central Florida.

*Harmonic Analysis*, **Galia D. Dafni**, Concordia University, and **J. Michael Wilson**, University of Vermont, Burlington.

*Homological Aspects of Module Theory*, **Andrew R. Kustin**, University of South Carolina, **Sean M. Sather-Wagstaff**, North Dakota State University, and **Janet Vassilev**, University of New Mexico.

*Hypercomplex Analysis*, **Craig A. Nolder**, Florida State University, and **John Ryan**, University of Arkansas at Fayetteville.

*Invariants of Knots and Links*, **Heather A. Dye**, McKendree University, **Mohamed Elhamdadi**, University of South Florida, and **Louis H. Kauffman**, University of Illinois at Chicago.

*Inverse Problems and Signal Processing*, **M. Zuhair Nashed** and **Qiyu Sun**, University of Central Florida.

*Lattices, Coxeter Groups, and Buildings*, **Kai-Uwe Bux**, University of Virginia, **Jon McCammond**, University of California Santa Barbara, and **Kevin Wortman**, University of Utah.

*Mathematical Models in Biology*, **Patrick de Leenheer**, University of Florida, and **Yuan Wang**, Florida Atlantic University.

*Modular Forms and Automorphic Forms*, **Jonathan P. Hanke**, University of Georgia.

*Partial Differential Equations from Fluid Mechanics*, **Chongsheng Cao**, Florida International University,

**Jiahong Wu**, Oklahoma State University, and **Baoquan Yuan**, Henan Polytechnic University.

*Recent Advances in Probability and Statistics*, **Lianfen Qian** and **Hongwei Long**, Florida Atlantic University.

# Riverside, California

*University of California*

### November 7–8, 2009

*Saturday – Sunday*

### Meeting #1054

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: September 2009
Program first available on AMS website: September 24, 2009
Program issue of electronic *Notices*: November 2009
Issue of *Abstracts*: Volume 30, Issue 4

### Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: September 15, 2009

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Christopher Hacon**, University of Utah, *Classification of algebraic varieties*.

**Birge Huisgen-Zimmerman**, University of California Santa Barbara, *Representations of quivers with relations. Geometric aspects*.

**Jun Li**, Stanford University, *Toward high genus GW-invariants of quintic Calabi-Yau threefolds*.

**Joseph Teran**, University of California Los Angeles, *Title to be announced*.

### Special Sessions

*Algebraic Geometry* (Code: SS 1A), **Christopher Hacon**, University of Utah, and **Ziv Ran**, University of California Riverside.

*Algebraic Structures in Knot Theory* (Code: SS 17A), **Alissa S. Crans**, Loyola Marymount University, and **Sam Nelson**, Claremont McKenna College.

*Arithmetic Combinatorics* (Code: SS 16A), **Mei-Chu Chang**, University of California Riverside, and **Alex Gamburd**, University of California Santa Cruz and Northwestern University.

*Calabi-Yau Manifolds* (Code: SS 15A), **Owen Dearricott**, University of California Riverside, **Jun Li**, Stanford University, and **Bun Wong** and **Yat-Sun Poon**, University of California Riverside.

*Dynamical Systems* (Code: SS 18A), **Nicolai Haydn**, University of Southern California, and **Huyi Hu**, Michigan State University.

*Fluid Mechanics* (Code: SS 5A), **James Kelliher** and **Qi Zhang**, University of California Riverside.

*Fractal Geometry, Dynamical Systems, Number Theory and Analysis on Rough Spaces* (Code: SS 6A), **Michel L. Lapidus**, University of California Riverside, **Hung Lu**, Hawaii Pacific University, and **Erin P. J. Pearse**, University of Iowa.

*Global Riemannian Geometry* (Code: SS 14A), **Fred Wilhelm**, University of California Riverside, and **Peter Petersen**, University of California Los Angeles.

*History and Philosophy of Mathematics* (Code: SS 4A), **Shawnee L. McMurran**, California State University San Bernardino, and **James J. Tattersall**, Providence College.

*Homotopy Theory and Higher Algebraic Structures* (Code: SS 8A), **John Baez** and **Julie Bergner**, University of California Riverside.

*Interactions Between Algebraic Geometry and Noncommutative Algebra* (Code: SS 9A), **Kenneth R. Goodearl**, University of California Santa Barbara, **Daniel S. Rogalski**, University of California San Diego, and **James Zhang**, University of Washington.

*Knotting Around Dimension Three: A Special Session in Memory of Xiao-Song Lin* (Code: SS 11A), **Martin Scharlemann**, University of California Santa Barbara, and **Mohammed Ait Nouh**, University of California Riverside.

*Noncommutative Geometry* (Code: SS 2A), **Vasiliy Dolgushev** and **Wee Liang Gan**, University of California Riverside.

*Operator Algebras* (Code: SS 13A), **Marta Asaeda** and **Aviv Censor**, University of California Riverside, and **Adrian Ioana**, Clay Institute and Caltech.

*Representation Theory* (Code: SS 3A), **Vyjayanthi Chari**, **Wee Liang Gan**, and **Jacob Greenstein**, University of California Riverside.

*Representations of Finite Dimensional Algebras* (Code: SS 7A), **Frauke Bleher**, University of Iowa, **Birge Huisgen-Zimmermann**, University of California at Santa Barbara, and **Markus Schmidmeier**, Florida Atlantic University.

*Research Conducted by Students* (Code: SS 10A), **Robert G. Niemeyer** and **Jack R. Bennett**, University of California Riverside.

*Stochastic Analysis and Applications* (Code: SS 12A), **Michael L. Green**, **Alan C. Krinik**, and **Randall J. Swift**, California State Polytechnic University Pomona.

# Seoul, South Korea

*Ewha Womans University*

### December 16–20, 2009

*Wednesday – Sunday*

### Meeting #1055

*First Joint International Meeting of the AMS and the Korean Mathematical Society.*
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: June 2009
Program first available on AMS website: Not applicable
Program issue of electronic *Notices*: Not applicable
Issue of *Abstracts*: Not applicable

### Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: October 31, 2009

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/internmtgs.html`.

### Invited Addresses

**Young Ju Choi**, Pohang University of Science and Technology, *Title to be announced*.

**Bumsig Kim**, Korea Institute for Advanced Study, *Title to be announced*.

**Minhyong Kim**, University College London, *Title to be announced*.

**Ki-ahm Lee**, Seoul National University, *Title to be announced*.

**James T McKernan**, Massachusetts Institute of Technology, *Title to be announced*.

**Frank Morgan**, Williams College, *Title to be announced*.

**Hee Oh**, Brown University, *Title to be announced*.

**Terence Tao**, University of California Los Angeles, *Title to be announced*.

**Van Vu**, Rutgers University, *Title to be announced*.

### Special Sessions

*Algebraic Combinatorics*, **Dongsu Kim**, Korea Advanced Institute of Science & Technology, **Soojin Cho**, Ajou University, and **Bruce Sagan**, Michigan State University.

*Algebraic Geometry*, **Yongnam Lee**, Sogang University, **Ian Morrison**, Fordham University, and **James McKernan**, Massachusetts Institute of Technology.

*Arithmetic of Quadratic Forms*, **Myung-Hwan Kim**, Seoul National University, and **Wai Kiu Chan**, Wesleyan University.

*Combinatorial Matrix Theory*, **Suk-Geun Hwang**, Kyungpook National University, and **Bryan Shader**, University of Wyoming.

*Computational Science and Engineering*, **Jeehyun Lee**, Yonsei University, and **Max Gunzburger**, Florida State University.

*Creativity, Giftedness, and Talent Development in Mathematics*, **Kyeong-Hwa Lee**, Seoul National University, and **Bharath Sriraman**, University of Montana.

*Cryptography* (Code: SS 22A), **Hyang-Sook Lee**, Ewha Womans University, and **Alice Silverberg**, University of California Irvine.

*Differential and Integral Geometry*, **Young Jin Suh**, Kyungpook National University, **Byung Hak Kim**, Kyung Hee University, **Yongdo Lim**, Kyungpook National University, **Gaoyong Zhang**, Polytechnic University of NYU, and **Jiazu Zhou**, Southwest University.

*Ergodic Theory and Dynamical Systems* **Keonhee Lee**, Chungnam National University, **Jeong-Yup Lee**, Korea Institute for Advanced Study, and **Jane Hawkins**, University of North Carolina.

*Financial Mathematics*, **Hyejin Ku**, York University, **Hyunggeon Koo**, Ajou University, and **Kiseop Lee**, University of Louisville.

*Geometric Structures and Geometric Group Theory*, **In Kang Kim**, Korea Advanced Institute of Science & Technology, and **Seonhee Lim**, Cornell University.

*Geometry of Syzygies and Computations*, **Sijong Kwak**, Korea Advanced Institute of Science & Technology, **Hyungju Park**, Korea Institute for Advanced Study, and **Jerzy Weyman**, Northeastern University.

*Harmonic Analysis and Its Applications*, **Sunggeum Hong**, Chosun University, and **Andreas Seeger**, University of Wisconsin.

*Inverse Problems and Imaging*, **Hyeonbae Kang**, Inha University, and **Gunther Uhlmann**, University of Washington.

*Knot Theory and Related Topics*, **Jae Choon Cha**, Pohang University of Science and Technology, and **Kent Orr**, Inidana University.

*Lie Symmetries and Solitons*, **Woo-Pyo Hong**, Catholic University of Daegu, **Anjan Biswas**, Delaware State University, and **Chaudry M. Khalique**, North-West University.

*Mathematical Analysis in Fluid, Gas Dynamics, and Related Equations*, **Minkyu Kwak**, Chonnam National University, **Hyeong-Ohk Bae**, Ajou University, **Seung-Yeal Ha**, Seoul National University, and **Simon Seok Hwang**, LaGrange College.

*Mathematical Biology*, **Eunok Jung**, Konkuk University, and **Jae-Hun Jung**, SUNY at Buffalo.

*Mathematical Logic and Foundation*, **Byunghan Kim**, Yonsei University, and **Ivo Herzog**, Ohio State University.

*Modular Forms and Related Topics*, **Youn-Seo Choi**, Korea Institute for Advanced Study, **YoungJu Choie**, Pohang University of Science & Technology, and **Wen-ching Winnie Li**, Pennsylvania State University.

*Noncommutative Ring Theory*, **Yang Lee**, Pusan National University, **Nam Kyun Kim**, Hanbat National University, and **Pace P. Nielsen**, Brigham Young University.

*Nonlinear Elliptic Partial Differential Equations*, **Jaeyoung Byeon**, Pohang University of Science & Technology, and **Zhi-Qiang Wang**, Utah State University.

*Nonlinear Partial Differential Equations and Viscosity Solutions*, **Ki-ahm Lee**, Seoul National University, and **Inwon Kim**, University of California Los Angeles.

*Operator Theory and Operator Algebras II*, **Bong Jung**, Kyungpook National University, **Ja A Jeong**, Seoul National University, **George Exner**, Bucknell University, and **Ken Dykema**, Texas A&M University.

*Operator Theory in Analytic Function Spaces*, **Hyung Woon Koo** and **Boo Rim Choe**, Korea University, and **Kehe Zhu**, SUNY at Albany.

*Representation Theory*, **Jae-Hoon Kwon**, University of Seoul, and **Kyu-Hwan Lee**, University of Connecticut.

*Spectral Geometry and Global Analysis*, **Jinsung Park**, Korea Institute for Advanced Study, and **Maxim Braverman**, Northeastern University.

*Symplectic Geometry and Mirror Symmetry*, **Jae-Suk Park**, Yonsei University, **Cheol-Hyun Cho**, Seoul National University, and **Yong-Geun Oh**, University of Wisconsin.

# San Francisco, California

*Moscone Center West and the San Francisco Marriott*

### January 13–16, 2010

*Wednesday – Saturday*

*Joint Mathematics Meetings, including the 116th Annual Meeting of the AMS, 93rd Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society of Industrial and Applied Mathematics (SIAM).*

Associate secretary: Matthew Miller
Announcement issue of *Notices*: October 2009
Program first available on AMS website: November 1, 2009
Program issue of electronic *Notices*: January 2010
Issue of *Abstracts*: Volume 31, Issue 1

### Deadlines

For organizers: April 1, 2009
For consideration of contributed papers in Special Sessions: July 28, 2009
For abstracts: September 22, 2009

### Joint Invited Addresses

**Joseph Harris**, Harvard University, *The interpolation problem*, 11:10 a.m., day to be announced. (AMS-MAA)

**Brian White**, Stanford University, *Title to be announced*, 11:10 a.m., day to be announced. (AMS-MAA)

**AMS Committee on Science Policy-MAA Science Policy Committee Government Speaker**, speaker and title to be announced, 4:20 p.m. on Friday.

**Steven H. Strogatz**, Cornell University, *The calculus of friendship*, 3:00 p.m. on Saturday. (AMS-MAA-SIAM Gerald and Judith Porter Public Lecture).

### Joint Prize Session

**Prize Session and Reception**: In order to showcase the achievements of the recipients of various prizes, the AMS and MAA are cosponsoring this event at 4:25 p.m. on Thursday. A cash bar reception will immediately follow. All participants are invited to attend. The AMS, MAA, and SIAM will award the Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. The AMS will announce the winners of the Distinguished Public Service Award, Levi L. Conant Prize, E. H. Moore Research Article Prize, David P. Robbins Prize, Leroy P. Steele Prizes, Oswald Veblen Prize in Geometry, and the Norbert Wiener Prize in Applied Mathematics. The MAA will award the Chauvenet Prize, Euler Book Prize, Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics, Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics, and Certificates of Meritorious Service. The AWM will present the Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman and the Louise Hay Award for Contributions to Mathematics Education.

This session will also be the venue for the announcement of the Joint Policy Board for Mathematics Communication Award.

## *116th Meeting of the AMS*

### AMS Invited Addresses

**James G. Glimm**, Stony Brook University, *Reflections and perspectives* (AMS Retiring Presidential Address), 3:20 p.m. on Thursday.

**Olga Holtz**, University of California Berkeley, *Zonotopal algebra, analysis, and combinatorics*.

**Richard W. Kenyon**, Brown University, *Laplacians on vector bundles on graphs*.

**Igor Y. Rodnianski**, Princeton University, *Title to be announced*.

**Peter W. Shor**, Massachusetts Institute of Technology, *Quantum channels and their capacities* (AMS Josiah Willard Gibbs Lecture), Wednesday at 8:30 p.m.

**Richard P. Stanley**, MIT, *Permutations: 1) Increasing and decreasing subsequences; 2) Alternating permutations; 3) Reduced decompositions* (AMS Colloquium Lectures), Wednesday–Friday at 1:00 p.m.

**Amie Wilkinson**, Northwestern University, *Chaos and symmetry in partially hyperbolic systems.*

### AMS Special Sessions

**Some sessions are cosponsored with other organizations. These are noted within the parentheses at the end of each listing, where applicable.**

*Algebraic Aspects of Cryptology* (Code: SS 2A), **Jintai Ding**, University of Cincinnati, and **Chris Christensen**, Northern Kentucky.

*Algebraic Methods in Signal Processing* (Code: SS 3A), **Shamgar Gurevich**, University of California Berkeley, **Ronny Hadani**, University of Chicago, **Olga Holtz**, University of California Berkeley and Technical University

Berlin, **Oded Schwartz**, Technical University Berlin, and **Nir Sochen**, Tel Aviv University.

*Analysis and Control Under Uncertainty* (Code: SS 4A), **Xioaming Wang**, Florida State University, **Yanzhao Cao**, Auburn University, and **Catalin Trenchea**, University of Pittsburgh.

*Applications of Algebraic Geometry* (Code: SS 5A), **Frank Sottile**, Texas A&M University, and **Luis Garcia-Puente**, Sam Houston State University.

*Applications of Graph Theory* (Code: SS 6A), **Richard Low**, San Jose State University, and **Ralucca M. Gera**, Naval Postgraduate School.

*Applications of Time Scales to Biology, Economics, and Engineering* (Code: SS 7A), **Martin Bohner**, Missouri University of Science and Technology, **Billur Kaymakcalan**, Southern University-Statesboro, and **Allan Peterson**, University of Nebraska-Lincoln.

*Arithmetic Geometry* (Code: SS 9A), **Bo-Hae Im**, Chung-Ang University, **Jennifer Johnson-Leung**, University of Idaho, and **Jennifer Paulhus**, Kansas State University.

*Arithmetic and Nonarchimedean Dynamics* (Code: SS 8A), **Joseph Silverman**, Brown University, **Michelle Manes**, University of Hawaii, and **Raphael Jones**, College of the Holy Cross.

*Arithmetic of Function Fields* (Code: SS 10A), **Allison Pacelli**, Williams College, and **Michael Rosen**, Brown University.

*Biomathematics: Modeling in Biology, Ecology, and Epidemiology* (Code: SS 12A), **Linda Allen**, Texas Tech University, **Olcay Akman**, Ilinois State University, **Timothy D. Comar**, Benedictine University, and **Sophia Jang** and **Lih-Ing Roeger**, Texas Tech University.

*Categorical and Algebraic Methods in Representation Theory* (Code: SS 13A), **Jon Brundan**, University of Oregon, **Julia Pevtsova**, University of Washington, and **Eric Friedlander**, University of Southern California.

*Commutative Algebra* (Code: SS 15A), **Susan Cooper**, University of Nebraska-Lincoln, and **Graham Leuschke**, Syracuse University.

*Degenerate and Singular Elliptic Partial Differential Equations* (Code: SS 16A), **Marian Bocea** and **Cristina Popovici**, North Dakota State University.

*Difference Equations and Applications* (Code: SS 17A), **Michael Radin**, Rochester Institute of Technology.

*Differential Galois Theory and Group Representations: A Tribute to Andy Magid* (Code: SS 19A), **James Carrell**, University of British Columbia, **Lourdes Juan**, Texas Tech University, **Alex Lubotzky**, Hebrew University, **Brian Parshall**, University of Virginia, and **Marius van der Put**, University of Groningen.

*Enumerative Combinatorics* (Code: SS 18A), **Brian Miceli**, Trinity University, and **Jeff Remmel**, University of California San Diego.

*Geometric Aspects of Link and 3-manifold Invariants* (Code: SS 20A), **Oliver Dasbach**, Louisiana State University, and **Effie Kalfagianni**, Michigan State University.

*Graph Algebras in Analysis and Algebra* (Code: SS 21A), **Gene Abrams**, University of Colorado at Colorado Springs, and **Mark Tomforde**, University of Houston.

*Harmonic Analysis* Code: SS 22A), **Kabe Moen**, Washington University; **Richard Oberlin**, University of California Los Angeles; and **Betsy Stovall**, University of California Los Angeles (a Mathematics Research Communities session).

*Harmonic Analysis and Representations of Reductive p-adic Groups* (Code: SS 23A), **Robert Doran**, Texas Christian University, **Paul Sally**, University of Chicago, and **Loren Spice**, Texas Christian University.

*History of Mathematics* (Code: SS 24A), **Craig Fraser**, University of Toronto, **Deborah Kent**, Hillsdale College, and **Sloan Despeaux**, Western Carolina University (AMS-MAA).

*Integrability of Dynamical Systems and Solitons Equations* (Code: SS 25A), **Zhijun Qiao**, University of Texas-Pan American, **Taixi Xu**, Southern Polytechnic State University, and **Wenxiu Ma**, University of South Florida.

*Interactions of Inverse Problems, Signal Processing and Imaging* (Code: SS 26A), **M. Zuhair Nashed**, University of Central Florida.

*Inverse Problems: Analysis and Computations* (Code: SS 27A), **Gaik Ambartsoumian**, University of Texas at Arlington, **Raluca Felea**, Rochester Institute of Technology, **Hongyu Liu**, University of Washington, **Kui Ren**, University of Texas at Austin, and **Michael VanValkenburgh**, University of California Berkeley (a Mathematics Research Communities session).

*L-Functions and Analytic Number Theory* (Code: SS 28A), **Alina Bucur**, Massachusetts Institute of Technology, **Chantal David**, Concordia University, and **Matilde Lalin**, University of Alberta.

*Markov Chains and Their Statistical Applications* (Code: SS 33A), **James Flegal**, University of California Riverside, **Radu Herbei**, Ohio State University, and **Jessica Zuniga**, Stanford University (a Mathematics Research Communities session).

*Mathematical Challenges of Relativity* (Code: SS 29A), **Paul T. Allen**, Lewis & Clark College, **Michael Eichmair**, M.I.T. and Monash University, **Gustav Holzegel**, Princeton University, **Jared Speck**, University of Cambridge, and **Willie W. Wong**, University of Cambridge (a Mathematics Research Communities session).

*Mathematics and Physical Experiment* (Code: SS 30A), **Roger Thelwell**, **Anthony Tongen**, and **Paul Warne**, James Madison University.

*Mathematics of Computation* (Code: SS 31A), **Susanne Brenner**, Louisiana State University, and **Chi-Wang Shu**, Brown University (AMS-SIAM).

*Nonlinear Hyperbolic Equations and Control Systems in Physics and Engineering* (Code: SS 11A), **Petronela Radu** and **Daniel Toundykov**, University of Nebraska-Lincoln.

*Optimal Frames and Operator Algebras* (Code: SS 35A), **David Larson**, Texas A&M University, **Deguang Han**, University of Central Florida, and **Shidong Li**, San Francisco State University.

*Parabolic Geometries, Integrable Systems, and Twistor Theory* (Code: SS 36A), **Dana Mihai**, Carnegie Mellon University, and **Jonathan Holland** and **George Sparling**, University of Pittsburgh.

*Permutations* (Code: SS 50A), **Richard P. Stanley**, M.I.T., **Ira M. Gessel**, Brandeis University, and **Persi W. Diaconis**, Stanford University.

*Recent Advances in Evolution Equations and Applications* (Code: SS 38A), **Guoping Zhang** and **Gaston N'Guerekata**, Morgan State University, **Yi Li**, University of Iowa, **Wen-Xiu Ma**, University of South Florida, and **Michael Goldberg**, Johns Hopkins University.

*Representation Theory and Nonassociative Algebras* (Code: SS 40A), **Andrew Douglas**, City University of New York.

*Research in Mathematics by Undergraduates* (Code: SS 41A), **Darren Narayan**, Rochester Institute of Technology, **Bernard Brooks**, Rochester Institute of Technology, **Jacqueline Jensen**, Sam Houston State University, **Carl V. Lutzer**, Rochester Institute of Technology, **Vadim Ponomarenko**, San Diego State University, and **Tamas Wiandt**, Rochester Institute of Technology (AMS-MAA-SIAM).

*Spectral Problems on Compact Riemannian Manifolds* (Code: SS 43A), **Carolyn Gordon**, Dartmouth College, **Ruth Gornet**, University of Texas at Arlington, and **Craig Sutton**, Dartmouth College (AMS-AWM).

*Surreal Numbers* (Code: SS 45A), **Lou van den Dries**, University of Illinois, and **Philip Ehrlich**, Ohio University (AMS-ASL).

*The Mathematics of Information and Knowledge* (Code: SS 46A), **Naoki Saito**, University of California Davis, **Ronald R. Coifman**, Yale University, **James G. Glimm**, SUNY at Stony Brook, **Peter W. Jones**, Yale University, **Mauro Maggioni**, Duke University, and **Jared Tanner**, University of Edinburgh.

*Use of Technology in Modern Complex Analysis Research* (Code: SS 47A), **Beth Schaubroeck**, U.S. Air Force Academy, **Michael Dorff**, Brigham Young University, and **James Rolf**, U.S. Air Force Academy.

*Voting Theory* (Code: SS 48A), **Michael Jones**, Mathematical Reviews, **Brian Hopkins**, Saint Peter's College, and **Tommy Ratliff**, Wheaton College.

*Zonotopal Algebra and Its Applications* (Code: SS 49A), **Olga Holtz**, University of California Berkeley and Technical University Berlin, and **Amos Ron**, University of Wisconsin.

## Other AMS Sessions

**Elementary School Teachers as Mathematicians**, Wednesday, 4:30 p.m.–6:00 p.m. This presentation by **Kenneth I. Gross**, University of Vermont, will focus on the critical importance of raising the mathematics knowledge of elementary teachers, the Vermont model for doing so, and the role to be played by college and university mathematics faculty. If we are to raise student achievement at all educational levels and for all students, we must provide elementary teachers with more broad and understanding of mathematics and the capability to translate that knowledge into the elementary school classroom. Sponsored by the AMS and MAA.

**What I Wish I Had Known When Applying for a Job**, Thursday, 2:45 p.m.–4:15 p.m. Sponsored by the Committee on the Profession.

**Who Wants to Be a Mathematician—National Contest**, Thursday, 9:30 a.m.–11:00 a.m., organized by **Michael A. Breen**, AMS, and **William T. Butterworth**, DePaul University. See ten of the nation's best high school students compete for a US$5000 first prize for themselves and US$5000 for their school's math department. Semifinals are at 9:30 a.m. and finals at 10:30 a.m. You are invited to come and take part in this educational and fun presentation.

**Hilbert's Tenth Problem**, Thursday, 10:00 a.m.–noon, organized by **Jeremy Avigad**, Carnegie Mellon University; **Penelope Maddy**, University of California Irvine; and **Charles Steinhorn**, Vassar College. The tenth problem in Hilbert's famous list sought an algorithm that would test a given polynomial equation with integer coefficients in any number of variables to determine whether it had integer solutions. In 1970 Yuri Matiyasevich, building on earlier work over a twenty-year period by Martin Davis, Hilary Putnam, and Julia Robinson, proved that no such algorithms exists. Subsequent efforts seek to determine whether there is such an algorithm for solutions in various rings, especially in the ring of integers of an algebraic number field, and in the rational numbers. The members of the panel, all of whom have contributed either to the solution of Hilbert's original problem or to the later developments, will address various aspects of this endeavor. Cosponsored by the AMS, ASL, and MAA.

**Grad School Fair**, Friday, 8:30 a.m.–10:30 a.m. Here is the opportunity for undergrads to meet representatives from mathematical sciences graduate programs from universities all over the country. January is a great time for juniors to learn more, and college seniors may still be able to refine their search. This is your chance for one-stop shopping in the graduate school market. At last year's meeting about 300 students met with representatives from 45 graduate programs. If your school has a graduate program and you are interested in participating, a table will be provided for your posters and printed materials for US$50 (registration for this event must be made by a person already registered for the JMM), and you are welcome to personally speak to interested students. Complimentary coffee will be served. Cosponsored by the AMS and MAA.

**Current Events Bulletin**, Friday, 1:00 p.m.–5:00 p.m., organized by **David Eisenbud**, University of California Berkeley. Speakers in the session include **Laura G. DeMarco**, University of Illinois at Chicago; **Ben J. Green**, University of Cambridge; **Peter Teichner**, University of California Berkeley; and **David G. Wagner**, University of Waterloo. This session follows the model of the Bourbaki Seminars in that mathematicians with strong expository skills speak on work not their own. Written versions of the talks will be distributed at the meeting and also be available on line at `www.ams.org/ams/current-events-bulletin.html` after the conclusion of the meeting.

**Committee on Science Policy Panel Discussion**, Friday, 2:30 p.m.–4:00 p.m.

**Congressional Fellowship Session**, Friday, 4:30 p.m.–6:30 p.m., organized by **Samuel M. Rankin III**, AMS. This session will describe the AMS Congressional Fellowship, administered by the American Association for the Advancement of Science (AAAS), and the fellowship's unique

public policy learning experience. This fellowship demonstrates the value of science-government interaction by allowing the fellows to bring a technical background and external perspective to the decision-making process in Congress. Previous and current AMS-sponsored Congressional Fellows will give their perspectives on the fellowship to interested meeting participants in an effort to encourage applications for future fellowships.

**Committee on Education Panel Discussion**, Saturday, 8:30 a.m.–10:00 a.m.

## Other AMS Events

**Council**: Tuesday, 1:30 p.m.

**Business Meeting:** Saturday, 11:45 a.m. The secretary notes the following resolution of the Council: Each person who attends a business meeting of the Society shall be willing and able to identify himself as a member of the Society. In further explanation, it is noted that each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society. The Society has a Committee on the Agenda for Business Meetings. The purpose is to make business meetings orderly and effective. The committee does not have legal or administrative power. It is intended that the committee consider what may be called "quasipolitical" motions. The committee has several possible courses of action on a proposed motion, including but not restricted to:

(a) doing nothing,

(b) conferring with supporters and opponents to arrive at a mutually accepted amended version to be circulated in advance of the meeting,

(c) recommending and planning a format for debate to suggest to a business meeting,

(d) recommending referral to a committee, and

(e) recommending debate followed by referral to a committee.

There is no mechanism that requires automatic submission of a motion to the committee. However, if a motion has not been submitted through the committee, it may be thought reasonable by a business meeting to refer it rather than to act on it without benefit of the advice of the committee.

In order that a motion for this business meeting receive the service offered by the committee in the most effective manner, it should be in the hands of the AMS Secretary by December 16, 2009.

## AMS Short Course

This two-day course on *Markov Chains and Mixing Times* is organized by **David Levin**, University of Oregon; **Yuval Peres**, University of California Berkeley and Microsoft; and **Elizabeth Wilmer**, Oberlin College, and takes place on Monday and Tuesday, January 11 and 12. See the complete article beginning on page 1171 of this issue or at `www.ams.org/shcourse-10.html`.

There are separate registration fees to participate.

## AMS Tutorial on Modeling

This tutorial will be an introduction to both numerical and statistical modeling for those who are not currently studying computational science. It is especially designed for individuals who are considering nonacademic employment. The tutorial will be divided into two sessions, each lasting one day. The cost for both sessions is US$25.

**Introduction to Numerical Modeling**, Monday, 9:00 a.m.–noon and 1:30 p.m.–4:30 p.m., presented by **Chi-Wang Shu**, Brown University.

In today's job market, Ph.D. students in mathematics might improve their chances of getting employment if they consider jobs outside the traditional academic job market. Students who have expertise in numerical modeling are marketable to many different types of non-academic employers, including government research labs, research labs of large companies (such as the oil companies), and various computer software companies (such as those who write software for medical science and health industry or for financial markets). Even for students whose major expertise is not in numerical modeling, some knowledge of numerical modeling should enhance the chance to obtain employment from many non-academic employers.

This one-day tutorial is intended for graduate students who are not working in areas related to computational science (numerical analysis, scientific computing, computational engineering, etc.), but would be interested in an introduction to some fundamental ideas for entry level numerical modeling.

The tutorial will start with a general description of numerical modeling, and will explain the difference between a student in a mathematics department majoring in computational science and a student in computer science. While programming (in C or another language) is a necessary skill for any student in numerical modeling, it is the mathematical insight which allows mathematicians to design and improve algorithms that are stable, accurate, and efficient for various applications.

The tutorial will then move to the description of a few selected topics in numerical modeling, including the solutions of large linear systems, the approximations of ordinary differential equations, and finite difference, finite element, and spectral methods for approximating partial differential equations. While it is impossible to give an in-depth coverage of so many topics in one day, we will emphasize the fundamental concepts such as stability, accuracy and efficiency for these algorithms. The tutorial will end with a list of references which will allow interested audience to follow up to gain more in-depth knowledge of the exciting area of numerical modeling.

The lecturer, Professor Chi-Wang Shu, has trained over twenty Ph.D.s at Brown University who are now employed both by academic and by non-academic employers. His research expertise is in scientific computing. In 2007 he was awarded the SIAM/ACM Prize in Computational Science and Engineering jointly by the Society for Industrial and Applied Mathematics, the major society for applied and computational mathematicians, and by the

Association for Computing Machinery, the major association for computer scientists. Professor Shu is Managing Editor of *Mathematics of Computation* and Editor-in-Chief of *Journal of Scientific Computing*.

**Introduction to Statistical Modeling**, Tuesday, 9:00 a.m.–noon and 1:30 p.m.–4:30 p.m., presented by **Wei Zhu**, State University of New York at Stony Brook.

Statistics is a branch of the mathematical sciences that pertains to the collection and analysis of data. The goal of statistical inference is to make a probabilistic statement about the underlying population based on the given sample. A classical statistical model is usually one or a set of stochastic equations (linear or nonlinear) linking the relevant variables observed. For example, one may wish to establish a simple linear regression model predicting the height of a son based on the height of his father. To estimate the regression line, one can simply employ the ordinary least squares (OLS) method developed by Gauss and Legendre. However, when randomness exists in both measurements, the OLS method will no longer be suitable. For instance, in gauging the relationship between the concentrations of organic aerosols and anthropogenic carbon monoxide, we found that both quantities, measured by the mass spectrometer and the UV fluorescence analyzer respectively, contain measurement errors and possibly other volatilities due to air dynamics, and thus the OLS method is obsolete in this situation. What are the alternative modeling methods?

In this one-day workshop intended for those who wish to broaden their horizons (and job market if pertinent) by learning more statistics, we will present a summary of classical as well as modern statistical modeling methods. Beginning with the simple linear regression introduced above, we will move on to the generalized linear models, categorical data analysis, time series models, survival analysis, and structural equation modeling (also called path analysis). We will discuss pertinent job markets and the knowledge/skills necessary for those markets. We will conclude the workshop by introducing the bootstrap resampling method and its role in modern statistical modeling and inference. A list of reference books corresponding to these subjects will be provided for the interested audience.

The lecturer, Professor Wei Zhu, has a B.S. in mathematics and a Ph.D. in Biostatistics. For the past decade, she has applied statistics to a wide spectrum of problems including brain imaging analysis, climate modeling, clinical trials, genetics and proteomics. She is an active educator whose former doctoral students are currently employed in academia, the pharmaceutical, Internet, and financial industries. She is the director of the Data Management and Statistical Analysis Core of the Alzheimer's Disease Research Center at New York University. She is also the director of the Bioinformatics Laboratory at the SBU Center of Excellence in Wireless and Information Technology. She collaborates closely with scientists from the Brookhaven National Laboratory, the Cold Spring Harbor Laboratory, and the National Institutes of Health.

### Department Chairs Workshop

This annual one-day workshop for chairs and leaders of departments of mathematical sciences will be held a day before the start of the Joint Meetings on Tuesday, 8:00 a.m.–6:30 p.m. The workshop format is intended to stimulate discussion among attending chairs and workshop leaders. Sharing ideas and experiences with peers provides a form of department chair therapy, creating an environment that enables attending chairs to address departmental matters from new perspectives.

Past workshop sessions have focused on a range of issues facing departments today, including personnel issues (staff and faculty), long-range planning, hiring, promotion and tenure, budget management, assessments, outreach, stewardship, junior faculty development, communication, and departmental leadership.

There is a separate registration fee to participate. For more information and to register, visit `http://www.ams.org/government/ChairsWorkshop2010.RSVPForm.pdf`. For further information please contact the AMS Washington Office at 202-588-1100 or `amsdc@ams.org`.

## *93rd Meeting of the MAA*

### MAA Invited Addresses

**Manjul Bhargava**, Princeton University, *Title to be announced*, 3:20 p.m. on Wednesday.

**Lenore Blum**, Carnegie Mellon University, *The real computation controversy; Is it real?* 2:15 p.m. on Wednesday.

**Dusa McDuff**, Barnard College, Columbia University, *Symplectic embeddings and continued fractions*, 10:05 a.m. on Saturday.

**Glen van Brummelen**, Quest University, *Reasonable effectiveness: Trigonometry, ancient astronomy, and the birth of applied mathematics*, 9:00 a.m. on Thursday.

**Sue Whitesides**, University of Victoria, *Excursions in geometry and theoretical computer science*, 9:00 a.m. on Friday.

### Presentations by Teaching Award Recipients

Friday, 2:30 p.m.–4:00 p.m., organized by MAA Secretary **Martha J. Siegel**, Towson University, and moderated by MAA President, **David M. Bressoud**, Macalester College. Winners of the Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching will give presentations on the secrets of their success.

### MAA Invited Paper Sessions

**Environmental Modeling**, organized by **Ben Fusaro**, Florida State University, and **Karen Bolinger**, Clarion University; Thursday morning.

**Gems of Number Theory**,organized by **Thomas Koshy**, Framingham University; Thursday morning. This session highlights the beauty and elegance of number theory by focusing on fascinating and sophisticated results, developed over two thousand years through boundless enthusiasm, human ingenuity, and creativity.

**Mathematics and Education Reform**, organized by **William H. Barker**, Bowdoin College; **William G. McCallum**, University of Arizona; and **Bonnie S. Saunders**, University of Illinois at Chicago; Thursday afternoon and Friday morning and afternoon. Cosponsored by the MAA, AMS, and MER.

**Online Delivery of Mathematics**, organized by **Bernd S. W. Schroeder**, Louisiana Tech University; Wednesday afternoon.

**The Scholarship of Teaching and Learning in Mathematics,** organized by **Jacqueline M. Dewar**, Loyola Marymount University; **Thomas F. Banchoff**, Brown University; and **Pam Crawford**, Jacksonville University; Saturday morning. Cosponsored by the MAA and AMS.

**The Mathematics of Origami**, organized by **Tamara Veenstra**, University of Redlands, and **Thomas C. Hull**, Western New England College; Friday morning. Mathematical methods in origami (paper folding) have been receiving increased attention, with applications to protein folding, education, and any number of engineering projects ranging from nanotechnology to heart stents to airbags to solar panel arrays. This session will include general talks on the different aspects of origami mathematics and describe recent advances in the field.

## MAA Minicourses

Minicourses are open only to persons who register for the Joint Meetings and pay the Joint Meetings registration fee in addition to the appropriate minicourse fee. The MAA reserves the right to cancel any minicourse that is undersubscribed. Participants in minicourses #1–#4 are required to bring their own laptop computer equipped with appropriate software. Instructions on how to download any data files needed for those courses will be provided by the organizers. All minicourses will be held in the San Francisco Marriott Hotel. The enrollment in each minicourse is limited to 50; the cost for each minicourse is US$75.

**Minicourse #1**: *Remodeling data analysis*, organized by **Daniel Kaplan** and **Vittorio Addona**, Macalester College. Part 1: Thursday, 10:30 a.m.–12:30 p.m.; Part 2: Saturday, 1:00 p.m.–3:00 p.m. This minicourse presents an approach taken in the first course in statistics and data analysis at Macalester College to bring meaningful mathematics back into data analysis courses by way of statistical modeling. Doing so can dramatically improve the ability of students to analyze data from complex, real-world, multi-variable systems. Modeling provides a strong mathematically unifying framework for statistics and at the same time ties the course more closely to the scientific method and exigencies of realistic, multi-variable data. As a genuine data analysis course that fully implements the GAISE standards, it is required for mathematics majors and other client disciplines like biology and economics. However, it is attractive for liberal arts majors as well. In addition to outlining the statistical modeling approach, the minicourse will provide participants with materials—texts, exercises, in-class activities, software—they can use to adopt the approach at their own institutions.

**Minicourse #2**: *Using GeoGebra to create activities and applets for visualization and exploration*, organized by **Michael K. May**, Saint Louis University. Part 1: Thursday, 1:00 p.m.–3:00 p.m.; Part 2: Saturday, 3:30 p.m.–5:30 p.m. GeoGebra is an easy to use, free, open source, cross platform, program that allows the user to visualize and experiment with both algebraic and geometric representations of mathematical concepts. Constructions can optionally be saved as applets that can be used in any java-enabled browser. Sample applets can be found at `http://www.slu.edu/classes.maymk/GeoGeoGebra/`. The minicourse assumes only novice computer skills and covers an introduction to GeoGebra up through deploying applets in Web pages. We will work through creating several activities to illustrate features of the program and to get participants to create their own activities. Participants are encouraged to load GeoGebra and SeaMonkey onto their computers before the workshop. Installation instructions are available at `http://www.slu.edu/classes/maymk/GeoGebra/InstallationOfSoftware.html`.

**Minicourse #3**: *Educating about the state of the planet and sustainability while enhancing calculus*, organized by **Thomas J. Pfaff**, Ithaca College. Part 1: Thursday, 8:00 a.m.–10:00 a.m.; Part 2: Saturday, 9:00 a.m.–11:00 a.m. Are you concerned about the state of the planet? Do you wish you could help? Over the past five to ten years data has become widely available. Further, society now faces major challenges in climate change and energy security. This minicourse will bring together data, Excel, and sustainability to provide richer context and relevance for calculus. Basically students use Excel to fit curves to real data and then all kinds of fundamentally important questions about sustainability become calculus questions about those curves. Overall the goal is to provide the necessary background information, ideas, and tools to successfully incorporate sustainability themes (or other areas of interest) into a calculus course, without having to change the typical content covered in calculus. Participants will need Excel loaded onto their laptops and are encouraged to bring a calculator.

**Minicourse #4**: *Using video case studies in teaching a proof-based gateway course to the mathematics major*, organized by **James T. Sandefur**, Georgetown University, **Connie M. Campbell**, Millsaps College, and **Kay B. Somers**, Moravian College. Part 1: Wednesday, 9:00 a.m.–11:00 a.m.; Part 2: Friday, 9:00 a.m.–11:00 a.m. Many colleges and universities have a gateway course to help mathematics students make the transition to more theoretical courses, with a goal of helping students learn how to understand and construct proofs. The organizers have been videotaping students writing proofs for problems used in gateway courses, and have been using these videos to expand their understanding of students' difficulties and to learn what support helps the students. They have also been using these videos to help students learn to reflect on their own approaches to writing proofs. In this minicourse, we will discuss strategies implied by the videos, as well as help faculty learn how they might use these videos in their own transition course.

**Minicourse #5**: *Active learning approaches for the foundational mathematics for elementary teachers' courses*, organized by **Laurie J. Burton**, **Cheryl Beaver**, and **Klay**

**T. Kruczek**, Western Oregon University. Part 1: Thursday 10:30 a.m.–12:30 p.m.; Part 2: Saturday, 1:00 p.m.–3:00 p.m. This minicourse is for collegiate mathematics faculty who are new to, or seeking to improve their proficiency in, designing and teaching the K–8 foundational mathematics courses. Minicourse participants will be introduced to the unique challenges of presenting mathematics education content courses to prospective teachers (in contrast to courses directed to other mathematics students) and will be exposed to approaches and resources the workshop leaders have used successfully to meet these challenges. The minicourse will be a hands-on interactive environment showcasing effective pedagogical techniques.

**Minicourse #6**: *Developing departmental self-studies*, organized by **Donna L. Beers**, Simmons College, and **Richard A. Gillman**, Valparaiso University. Part 1: Wednesday, 2:15 p.m.–4:15 p.m.; Part 2: Friday, 2:15 p.m.–4:15 p.m. Self-study is a critical component of departmental program review. It is retrospective, engaging department members and other interested parties (e.g., other departments and the administration) in examining all aspects of departmental programs. It is also forward-looking anticipating new areas for growth and contribution. Self-study entails discussion of issues confronting a department; as such, it is both a process of reflection and a report. This minicourse enables participants to determine how a self-study, which is an administrative mandate, can be a positive opportunity for departmental renewal.

**Minicourse #7**: *Teaching with clickers in the classroom*, organized by **Derek Bruff**, Vanderbilt University, and **Adam Lucas**, Saint Mary's College of California. Part 1: Wednesday, 9:00 a.m.–11:00 a.m.; Part 2: Friday, 9:00 a.m.–11:00 a.m. Classroom response systems ("clickers") are technologies that enable teachers to rapidly collect and analyze student responses to multiple-choice (and sometimes free-response) questions during class. These systems can be used to engage and assess students in any size class on a variety of topics, including precalculus, calculus, differential equations, linear algebra, and statistics. This minicourse explores questions and activities that make the most of these systems, as well as solutions to common challenges involved in teaching with clickers, including writing effective clicker questions, structuring class time using clickers, and responding to results of clicker questions.

**Minicourse #8**: *The Fibonacci and Catalan numbers*, organized by **Ralph Grimaldi**, Rose-Hulman Institute of Technology. Part 1: Thursday, 8:00 a.m.–10:00 a.m.; Part 2: Saturday, 9:00 a.m.–11:00 a.m. In many introductory courses in discrete mathematics or combinatorics, one often encounters the sequences of numbers called the Fibonacci numbers and the Catalan numbers. This minicourse is designed to demonstrate how certain properties of these sequences come about and to examine where ideas related to these sequences arise in applications dealing with geometry, trigonometry, set theory, number theory, tilings, permutations, chemistry, optics, electrostatics, probability, data structures, lattice paths, and graph theory.

**Minicourse #9**: *Getting students involved in undergraduate research*, organized by **Aparna W. Higgins**, University of Dayton, and **Joseph A. Gallian**, University of Minnesota Duluth. Part 1: Thursday, 1:00 p.m.–3:00 p.m. Part 2: Saturday, 3:30 p.m.–5:30 p.m. This course will cover many aspects of facilitating research by undergraduates, such as getting students involved in research, finding appropriate problems, deciding how much help to provide, and presenting and publishing the results. Similarities and differences between research conducted during summer programs and research that can be conducted during the academic year will be discussed. Although the examples used will be primarily in the area of discrete mathematics, the strategies discussed can be applied to any area of mathematics.

**Minicourse #10**: *The hitchhiker's guide to mathematics*, organized by **Dan Kalman**, American University, and **Bruce F. Torrence**, Randolph Macon College. Part 1: Thursday, 9:00 a.m.–11:00 a.m.; Part 2: Saturday, 9:00 a.m.–11:00 a.m. A guided tour of some little known attractions of elementary mathematics, wonders to surprise, delight, and intrigue the mathematical eye. Some may make great enrichment topics for the participants' students, but the course's primary motivations are the edification and enjoyment of the participants themselves. The Hitchhiker's Guide to Mathematics answers questions like these: What does the quadratic formula have to do with the functions max(x,y) and min(x,y)? For which rational x is $\sin^2 x$ rational? What is the point of reversing a polynomial and its derivative, and then dividing one into the other? What are palindromic polynomials, and how can they be solved up to degree 9? Participants are encouraged to bring a calculator.

**Minicourse #11**: *The mathematics of Islam and its use in the teaching of mathematics*, organized by **Victor J. Katz**, University of the District of Columbia. Part 1: Wednesday, 2:15 p.m.–4:15 p.m. Part 2: Friday, 2:15 p.m.–4:15 p.m. In the current world situation, it is critical that American students be exposed to some of the culture of Islam. Thus, this minicourse introduces college teachers to the mathematics of Islam and develops some ideas on using Islamic mathematical ideas in the teaching of mathematics. The course will consider mathematical ideas taken from arithmetic, algebra, geometry, and trigonometry. Participants will read from some of the original sources and discuss the ideas and their implications. In particular, we will consider how some of the examples of Islamic mathematics can be used in modern courses in high school and college.

**Minicourse #12**: *Learning discrete mathematics via historical projects*, organized by **Jerry Lodder**, **Guram Bezhanishvili**, and **David J. Pengelley**, New Mexico State University. Part 1: Wednesday, 2:15 p.m.–4:15 p.m., Part 2: Friday, 2:15 p.m.–4:15 p.m. This minicourse will introduce curricular modules, based entirely on primary historical source material, for courses in discrete mathematics, combinatorics, logic, and computer science. The modules have been authored by an interdisciplinary team of mathematics and computer science faculty at New Mexico State University and Colorado State University at Pueblo.

In the first session we will discuss the pedagogy behind our approach, give a brief outline of the compendium of projects, and provide initial hands-on participant work using four chosen projects. In the second session we will discuss the four projects in detail, lead group discussions, and offer more interactive activities. The projects we have developed so far, as well as our philosophy in teaching with historical sources, can be found on our homepage at http://www.cs.nmsu.edu/historical-projects/.

**Minicourse #13**: T*aking symbols seriously: Teaching form and function in college algebra*, organized by **William G. McCallum**, University of Arizona; **Deborah Hughes Hallett**, University of Arizona and Harvard University; and **Pat Shure**, University of Michigan. Part 1: Wednesday, 9:00 a.m.–11:00 a.m. Part 2: Friday, 9:00 a.m.–11:00 a.m. In this minicourse we will focus on the symbolic aspects of algebra, not the graphical or numerical aspects, giving participants a framework for developing symbolic literacy. We believe procedural fluency requires a foundation of conceptual understanding. We will help participants characterize the kind of understanding we would like to see in our students, and to design courses that promote such understanding. We will give participants the opportunity to construct questions that probe student understanding and to develop examples that demonstrate the importance of college algebra for later coursework in the physical and social sciences.

## MAA Contributed Papers

The MAA Committee on Contributed Paper Sessions solicits contributed papers pertinent to the sessions listed below. Contributed Paper Session organizers generally limit presentations to fifteen minutes. Each session room is equipped with a computer projector, an overhead projector, and a screen. Please note that the dates and times scheduled for these sessions remain tentative. Full descriptions of these sessions may be found at www.maa.org/meetings/jmm.html or see the August issue of the *Notices*, p. 893.

*The Arts and Mathematics*, Saturday afternoon, **Douglas E. Norton**, Villanova University. Sponsored by the Special Interest Group of the MAA on Math and the Arts.

*Developmental Mathematics Education: Helping Under-Prepared Students Transition to College-Level Mathematics*, Thursday afternoon, **Kimberly J. Presser** and **J. Winston Crawley**, Shippensburg University.

*Engaging Students with Classroom Voting*, Thursday morning, **Derek Bruff**, Vanderbilt University, **Kien Lim**, University of Texas at El Paso, and **Kelly Cline**, Carroll College.

*Experiences that Enrich the Education of Mathematics Majors*, Wednesday afternoon, **Suzanne M. Lenhart**, University of Tennessee, **Steven J. Schlicker**, Grand Valley State University, **J. Douglas Faires**, Youngstown State University, and **Michael J. Dorff**, Brigham Young University. Sponsored by the MAA CUPM Subcommittee on Research by Undergraduates.

*How Assessment Results Changed Our Program*, Thursday afternoon, **Dick Jardine**, Keene State College, and **Barbara Edwards**, Oregon State University.

*Improving a Second Course in Statistics*, Wednesday morning, **Nancy J. Boynton**, SUNY Fredonia, **Patricia B. Humphrey**, Georgia Southern University, and **Michael A. Posner**, Villanova University. Sponsored by the SIGMAA on Statistics Education. In order to be considered for this session, applicants should submit a one-page summary of the presentation to Nancy Boynton at nancy.boynton@fredonia.edu along with the abstract to JMM website. Presenters in the session will be considered for the SIGMAA on Statistics Education's Best Contributed Presentation Award.

*Innovative and Effective Ways to Teach Linear Algebra*, Saturday morning, **David M. Strong**, Pepperdine University, **Gilbert Strang**, Massachusetts Institute of Technology, and **David C. Lay**, University of Maryland.

*The MAA SUMMA Program Turns 20—A Retrospective*, Wednesday morning, **William A. Hawkins Jr.**, MAA and the University of the District of Columbia, **Efraim Armendariz**, University of Texas at Austin, **Camille A. McKayle**, University of the Virgin Islands, and **Robert E. Megginson**, University of Michigan, Ann Arbor. Cosponsored by SUMMA and the Committee on Minority Participation in Mathematics.

*Mathematical Texts: Famous, Infamous, and Influential*, Wednesday morning, **Fernando Q. Gouvêa**, Colby College, and **Amy Shell-Gellasch**, Pacific Lutheran University. This session is an extension of the MAA Short Course.

*Mathematics and Sports*, Saturday morning, **Howard L. Penn**, U.S. Naval Academy.

*Mathematics Courses for the Liberal Arts Student*, Friday morning, **Reva Kasman**, Salem State College.

*Mathematics, Equity, Diversity, and Social Justice,* Friday morning, **Patricia Hale**, California State Polytechnic University Pomona, **Shandy Hauk**, University of Northern Colorado, and **Dave Kung**, St. Mary's College, Maryland.

*Mathematics Experiences in Business, Industry and Government*, Thursday morning, **Philip Gustafson**, Mesa State College, and **Michael Monticino**, University of North Texas. Sponsored by the MAA Business, Industry and Government Special Interest Group (BIG SIGMAA).

*Mathlets for Teaching and Learning Mathematics*, Saturday afternoon, **Joe Yanik**, Emporia State University, **Thomas E. Leathrum**, Jacksonville State University, and **David M. Strong**, Pepperdine University. The Mathlets introduced in this session will be available at http://cs.jsu.edu/~leathrum/JMMsession2010.html. Sponsored by the MAA Committee on Technology in Mathematics Education (CTiME).

*My Most Successful Math Club Activity*, Wednesday morning, **Jacqueline A. Jensen**, Sam Houston State University, **Deanna B. Haunsperger**, Carleton College, and **Robert W. Vallin**, Slippery Rock University and the MAA. Sponsored by the MAA Committee on Undergraduate Student Activities and Chapters.

*Online Homework—Innovation and Assessment*, Thursday afternoon, **Michael E. Gage**, **Arnold K. Pizer**, and **Vicki Roth**, University of Rochester.

*Philosophy of Mathematics for Working Mathematicians*, Friday afternoon, **Bonnie Gold**, Monmouth University, and **Carl Behrens**, Alexandria, Virginia. Sponsored by the SIGMAA for the Philosophy of Mathematics.

*Preparing K–12 Teachers to Teach Algebra*, Wednesday afternoon, **Elizabeth Burroughs**, Montana State University, **Angela M. Hodge**, North Dakota State University, and **William G. McCallum**, University of Arizona. Sponsored by the MAA Committee on the Mathematical Education of Teachers (COMET).

*Publishing Mathematics on the Web*, Friday afternoon, **Thomas E. Leathrum**, Jacksonville State University, **William F. Hammond**, The University at Albany, and **Kyle T. Siegrist**, University of Alabama in Huntsville. Sponsored by the MAA Committee on Technology in Mathematics Education (CTiME).

*Quantitative Reasoning and the Environment*, Friday morning, **Maura B. Mast**, University of Massachusetts Boston, **Karen D. Bolinger**, Clarion University, and **Cinnamon Hillyard**, University of Washington Bothell. Jointly sponsored by SIGMAA-EM and SIGMAA-QL.

*Research on the Teaching and Learning of Undergraduate Mathematics*, Friday afternoon, **Keith Weber**, Rutgers University, **Stacy Brown**, Pitzer College, **Natasha A. Speer**, University of Maine, and **Karen A. Marrongelle**, Portland State University. Sponsored by the Special Interest Group of the Mathematical Association of America on Research in Undergraduate Mathematics Education (SIGMAA on RUME)

*The Scholarship of Teaching and Learning in Undergraduate Mathematics*, Wednesday afternoon, **Edwin P. Herman**, and **Nathan M. Wodarz**, University of Wisconsin-Stevens Point.

*Undergraduate Mathematical Biology*, Friday morning, **Timothy D. Comar**, Benedictine University, and **Raina S. Robeva**, Sweet Briar College. Sponsored by the BIO SIGMAA.

*Using Computer Algebra Systems in the Calculus Sequence*, Thursday morning, **William Marion**, Valparaiso University.

*Visualization in Mathematics*, Saturday afternoon, **Sarah J. Greenwald**, Appalachian State University, and **Walter Whiteley**, York University.

*Wavelets in Undergraduate Education*, Thursday afternoon, **Caroline Haddad**, SUNY Geneseo, **Catherine Beneteau**, University of South Florida, **David Ruch**, Metropolitan State College of Denver, **Patrick Van Fleet**, University of St. Thomas.

*General Contributed Paper Sessions*, Wednesday, Thursday, Friday and Saturday morning and afternoons, **Eric S. Marland**, Appalachia State University, and **Daniel J. Curtin**, Northern Kentucky University. Papers may be presented on any mathematical topics. Papers that fit into one of the other sessions should be sent to that session, not to the general session.

## Submission Procedures for MAA Contributed Paper Abstracts

Abstracts must be submitted electronically at `http://www.ams.org/cgi-bin/abstracts/abstract.pl`. Simply select the San Francisco meeting, fill in the number of authors, and then follow the step-by-step instructions. The deadline for abstracts is Tuesday, **September 22, 2009**.

Participants may submit at most two abstracts for MAA contributed paper sessions at any one meeting. If your paper cannot be accommodated in the session in which it is submitted, it will automatically be considered for the general session. Speakers in the general session are limited to one talk.

The organizer(s) of your session will automatically receive a copy of the abstract, so it is not necessary for you to send it directly to the organizer. However, some sessions require separate submissions directly to the organizer, so check for this detail. All accepted abstracts are published in a book that is available to registered participants at the meeting. Questions concerning the submission of abstracts should be addressed to `abs-coord@ams.org`.

## MAA Panels, Posters, and Other Sessions

**Mathematical Collaborations With Other Disciplines: Research Partnerships and Interdisciplinary Programs,** Wednesday, 9:00 a.m.–10:20 a.m., organized by **Joseph Malkevitch**, York College (CUNY). The goal of this panel is to explore how mathematicians and mathematics departments can initiate mutually beneficial research collaborations and interdisciplinary (degree) programs with other disciplines. The panel, including **Steven Brams**, New York University; **Susan L. Ganter**, Clemson University; **James G. Glimm**, SUNY at Stony Brook; and **Suzanne M. Lenhart**, University of Tennessee, will describe successful efforts in starting such collaborations, the difficulties one encounters in such collaborations, and offer advice about starting such collaborations. Sponsored by Mathematics Across the Disciplines Subcommittee of CUPM.

**National Science Foundation Programs Supporting Learning and Teaching in the Mathematical Sciences**, Wednesday, 9:00 a.m.–10:20 a.m., organized by **Henry Warchall**, NSF/DMS; **Karen A. Marrongelle**, NSF/DRL; and **Dennis Davenport**, **Daniel Maki**, and **Lee Zia**, NSF/DUE. A number of NSF divisions offer a variety of grant programs that support innovations in learning and teaching in the mathematical sciences. These programs will be discussed by the organizers/panelists along with examples of successful projects. Anticipated budget highlights and other new initiatives for the next fiscal year will also be presented.

**Cultivating Mathematical Interest and Talent of Precollege Students: Outreach through Summer Math Camps and Academies**, Wednesday, 2:15 p.m.–3:35 p.m., organized by **Michelle L. Ghrist**, U.S. Air Force Academy. This session explores some of the various outreach activities undertaken by faculty members to encourage and cultivate mathematical talent and interest of precollege students at both the middle and high school levels. In particular panelists **David Boliver**, University of Central

Oklahoma; **Peter Kuchment**, Texas A&M University ; **Lisa Rezac**, University of St. Thomas; **Hortensia Soto-Johnson**, University of Northern Colorado; and **Max L. Warshauer**, Texas State University, will focus on summer math camps and academies, especially those that are run primarily as outreach activities rather than as tuition-based. We will discuss motivations, logistics, activities, funding, results, and lessons learned.

**Project NExT/Young Mathematicians' Network Poster Session**, Wednesday, 2:15 p.m.–4:15 p.m., organized by **Kim Roth**, Juniata College, and **Michael C. Axtell**, University of St. Thomas. This poster session is intended to highlight the research activities, both mathematical and pedagogical, of recent or future Ph.D.s in mathematics and related fields. The organizers seek to provide an open venue for people who are near completion, or have finished their graduate studies in the last five years to present their work and make connections with other same-stage professionals, in much the same spirit as the YMN and Project NExT. The posterboard size will be 48" by 36". Posterboards and materials for posting pages on the posters will be provided on site. If you are interested in participating, submit copies of your abstract to maxtell@stthomas.edu and roth@juniata.edu.

**How to Interview for a Job in the Mathematical Sciences**, Wednesday, 3:50 p.m.–5:10 p.m., organized by **David C. Manderscheid**, University of Nebraska-Lincoln. This session is aimed at Ph.D. students and at recent graduates. An overview of the employment process will be given with ample opportunity for participants to ask questions. The emphasis will be on the portion of the employment process from interviewing through accepting an offer. Questions that will be addressed include: How do employers conduct interviews? How can you best prepare for these interviews? How do employers choose to whom they will make offers? How do you negotiate once you have an offer? How do you choose among competing offers? Panelists include **Allen Butler**, Daniel H. Wagner Associates, Inc.; **Sharon Mosgrove**, Concordia University; **James Freeman**, Cornell College; **David C. Manderscheid**; and **Sarah Ann Stewart**, Belmont University. Sponsored by the MAA Committee on Graduate Students and the Young Mathematicians' Network.

**Session for Department Chairs: Assessment of Student Learning Outcomes—Opportunity and Challenge**, Thursday, 9:00 a.m.–10:20 a.m., organized by **Daniel P. Maki**, Indiana University, and **Catherine M. Murphy**, Purdue University Calumet. In the past decade accrediting agencies, both disciplinary and regional, have developed outcomes-based criteria. Responding to the requirement for articulating desired student learning outcomes so they are measurable and choosing measures that are sustainable is a challenge. The process a department goes through to meet the challenge and the insights gained from the collected data provides an opportunity for departments to think deeply about their curriculum and make appropriate changes. Panelists **Jay A. Malmstrom**, Oklahoma City Community College; **Catherine M. Murphy**; and **Nalsey B. Tinberg**, Occidental College, will address three major areas: what do regional accrediting agencies expect; what MAA resources on assessment are available to support mathematical sciences departments; and an example of how even imperfect measures can provide valuable insights both about one's programs and how to improve the measures used. During the question and answer session, department chairs are invited to share their departments' experiences developing and implementing assessment of student learning processes.

**Online Articles From JOMA to Loci**, Thursday, 9:00 a.m.–10:20 a.m., organized by **Thomas E. Leathrum**, Jacksonville State University, and **Lawrence Moore**, Duke University. The MAA and MathDL online journal *Loci* was created in summer of 2008 by merging three earlier online publications of MathDL, the *Journal of OnlineMath and its Applications* (JOMA), Digital Classroom Resources (DCR), and Convergence. This panel will be moderated by the editor of *Loci*, and panelists will include authors representing different areas of *Loci* or its predecessor publications. Panelists are **Nathaniel Miller**, University of Northern Colorado; **Kady Schneiter**, Utah State University; and **Lee Stemkoski**, Adelphi University. This discussion seeks to encourage future authors to publish in *Loci*. Authors will discuss their experiences with publishing in *Loci*, in particular how writing and revising an article is different for an online publication. Sponsored by the MAA Committee on Technology in Mathematics Education (CTiME).

**Mathematical Outreach Programs For Underrepresented Populations**, Thursday, 9:00 a.m.–11:00 a.m., organized by **Elizabeth (Betsy) Yanik**, Emporia State University. This poster session is designed to showcase successful outreach mathematics programs that encourage students from underrepresented populations to continue their study of mathematics. The participants in such programs range in grade level from elementary students to undergraduates. It is expected that posters representing a wide variety of programs will be displayed. Possible programming formats include after-school clubs, special conferences, mentoring programs, and summer camps. Those who are in the process of constructing an outreach program are especially encouraged to attend this session to acquire valuable insights and tips for designing and implementing a mathematics outreach project. We encourage everyone involved with offering outreach activities to consider submitting an abstract to the session organizer, Betsy Yanik, yanikeli@emporia.edu. The deadline for submissions is **December 1, 2009**. Sponsored by the Women and Mathematics Network, a subcommittee of the MAA Committee on the Participation of Women.

**How One Can Become a Referee/Reviewer**, Thursday, 9:30 a.m.–10:50 a.m., organized by **Joseph A. Gallian**, University of Minnesota-Duluth; **Aparna W. Higgins**, University of Dayton; and **T. Christine Stevens**, Saint Louis University. Panelists **Matthias Beck**, San Francisco State University; **Frederick Hoffman**, Florida Atlantic University; **Carl Pomerance**, Dartmouth College; and **Brigitte Servatius**, Worcester Polytechnic Institute, will provide advice about refereeing papers for research and expository journals, writing reviews for *Math Reviews*, and reviewing book manuscripts for publishers. Topics to be addressed include how to write referee's reports and how to write

reviews for *Math Reviews* or book publishers. The panelists will also discuss how much time refereeing and reviewing consume, how refereeing/reviewing "counts" in one's department for promotion and tenure, and how one can become a referee/reviewer. Sponsored by Project NExT.

**Proposal Writing Workshop for Grant Applications to the NSF Division of Undergraduate Education**, Thursday, 10:40 a.m.–noon, organized by **Dennis E. Davenport**, **Daniel P. Maki**, and **Lee L. Zia**, Division of Undergraduate Education, National Science Foundation. Presenters will describe the general NSF grant proposal process and consider particular details relevant to programs in the Division of Undergraduate Education. This interactive session will feature a series of "read/think/share/report" exercises built around a series of short excerpts from sample proposals.

**Statistics ≠ Mathematics: What A First (or Second) Time Teacher of Statistics Should Know**, Thursday, 1:00 p.m.–2:20 p.m., organized by **Michael A. Posner**, Villanova University. Instructors of introductory statistics are sometimes thrown into the classroom without much training on what to expect. One of the first things they learn is that statistics is not simply a field within mathematics. The Guidelines for Assessment and Instruction in Statistics Education (GAISE) report presents what statistically educated citizens should know as well as guidelines for achieving this learning. Many online resources are also available to assist in instruction and assessment in introductory statistics. New and seasoned statistics instructors **Robin Lock**, St. Lawrence University; **Elaine Newman**, Sonoma State University; **Leigh Lunsford**, Longwood University; and **Ken Torre**, Cotati-Rohnert Park Unified School District, will share advice and resources on what a first- (or second-) time teacher of statistics should know. Sponsored by the SIGMAA Stat Ed.

**Poster Session of Projects Supported by the NSF Division of Undergraduate Education**, Thursday, 2:00 p.m.–4:00 p.m., organized by **Jon W. Scott**, Montgomery Community College. This session will feature principal investigators (PIs) presenting progress and outcomes from various NSF-funded projects in the Division of Undergraduate Education. The poster session format will permit ample opportunity for attendees to engage in small group discussions with the PIs and to network with each other. Information about presenters and their projects will appear in the program.

**Excuse Me, Where is the Department of Statistics Education?** Thursday, 2:35 p.m.–3:50 p.m., organized by **Michael A. Posner**, Villanova University. Statisticians and non-statisticians alike are called upon to teach statistics courses to a growing number of college and high school students each year. Very few, however, are trained in interpreting student thinking and understanding and comparing the effectiveness of various pedagogical methods. Even fewer are doing research on how best to teach statistics. The goal of the statistics education field is to promote evidence-based statistics education research to guide the practice of teaching statistics and foster the organizational structures to promote systematic strands of research. A recent report proposes the creation of graduate statistics education programs identifying programmatic structures, discussing faculty support recommendations, and suggesting courses for inclusion in these interdisciplinary programs. This panel brings together those on the cutting edge of statistics education research along with mathematics educators who offer advice on what the statistics education community can learn from the field of mathematics education research. Panelists include **Dennis Pearl**, Ohio State University; **Mike Shaughnessy**, Portland State University; and **Bob delMas** and **Andrew Zieffler**, University of Minnesota. Sponsored by SIGMAA Stat Ed and SIGMAA RUME.

**More Voices from the Partner Disciplines: The Second Round of Curriculum Foundations Workshops**, Thursday, 2:35 p.m.–3:50 p.m., organized by **Sheldon P. Gordon**, Farmingdale State College. CRAFTY, the committee on Curriculum Renewal Across the First Two Years, with the cooperation of the committee on Mathematics Across the Disciplines, is currently organizing a second round of Curriculum Foundations workshops in which leading educators from different fields are brought together to develop recommendations on the current mathematical needs of their students. This round of workshops focuses on disciplines that historically were less math-intensive than the ones represented in the first round. The intent of the project is to promote discussions between mathematics departments and the associated partner disciplines that can lead to mathematics courses and programs that better serve the needs of the students majoring in the other fields. Panelists **Susan L. Ganter**, Clemson University; **Andrew G. Bennett**, Kansas State University; **Sheldon P. Gordon**; **William E. Haver**, Virginia Commonwealth University; and **William Marion**, Valparaiso University, will present some of the more important and perhaps surprising results and recommendations that emerged from the recent workshops in such diverse fields as agriculture, economics, meteorology, and sociology, which are responsible for a surprising number of the students in our courses. Sponsored by MAA CRAFTY.

**Promotion and Tenure: You Know You Want It**, Friday, 9:00 a.m.–10:20 a.m., organized by **Barry A. Balof**, Whitman College, and **Joshua D. Laison**, Willamette College. Is the tenure process in your future? Are you anxious (probably) or unsure (possibly) about what lies ahead? This panel discussion and question/answer session will feature several of your colleagues who have recently been through the process, as well as some colleagues who have been on the other side making the decisions. Panelists include **Jason D. Rosenhouse**, James Madison University; **Francis E. Su**, Harvey Mudd College; **Matthew P. Richey**, St. Olaf College; and **Jacqueline A. Jensen**, Sam Houston State University. Sponsored by the MAA and the Young Mathematicians' Network.

**Becoming a Teacher of College Mathematics: Video Cases for Novice College Mathematics Instructor Professional Development**, Friday, 1:00 p.m.–3:00 p.m., organized by **John D. Eggers**, University of California San Diego; **Shandy Hauk** and **Mark Davis**, University of Northern Colorado; **Eric Hsu**, San Francisco State University; and **Natasha M. Speer**, University of Maine. Discussion,

planning, and action to improve the opportunities for mathematics graduate student teaching assistants (TAs) to learn about teaching is on the rise. In addition to examining the factors that shape TAs' professional lives and their development as teachers of college mathematics, a national collaborative of mathematicians and mathematics education researchers, funded through the U.S. Department of Education FIPSE program have been capturing video of classroom, office hours, and tutoring sessions at colleges and universities around the U.S. This session will include: an introduction to the materials being developed by the College Math Video Cases Project, a screening and discussion of video vignettes, and time for feedback to video case developers. The session will include the chance for attendees to meet and work with those who have published findings in the area of TA preparation. Panelists are **Eric Hsu**; **David E. Meel**, Bowling Green State University; and **Natasha M. Speer**. Sponsored by the AMS-MAA Committee on Teaching Assistants and Part-time Instructors (TA/PTI).

**Current Issues in Actuarial Science Education**, Friday, 5:00 p.m.–7:00 p.m., organized by **Robert E. Buck**, Slippery Rock University; **Bettye Anne Case**, Florida State University; Kevin E. Charlwood, Washburn University; and **Steve Paris**, Florida State University. A diverse group of working actuaries, publishers, and actuarial educators bring new information from professional society committees, specialized publications initiatives, and academic department experience. The pace of change is faster than in most academic areas, and the session helps faculty adjust as quickly as possible not only to educate their students generally, but give the students good professional information and to determine curriculum change that may be necessary. Panelists include **James W. Daniel**, University of Texas-Austin; **Bryan V. Hearsey**, Lebanon Valley College, and representatives from the actuarial societies; the panel will be moderated by **Robert E. Buck**. There will a discussion about organizing an MAA Special Interest Group on Actuarial Education or about reviving the Actuarial Faculty Forum. Sponsored by actuarial educators, Society of Actuaries, Casualty Actuarial Society, and ACTEX Publications.

**Beyond Grading and Tutoring: New Approaches to Students Helping Students**, Saturday, 9:00 a.m.–10:20 a.m., organized by **Daniel E. Flath**, Macalester College; **Lewis D. Ludwig**, Denison University; and **Steven R. Benson**, Lesley University. Many departments use juniors and seniors as graders or tutors, but some programs involve undergraduates helping fellow undergraduates in mathematics in ways beyond these two methods. Panel members **Sonny Painter**, University of Missouri-Kansas City; **Karen Saxe**, Macalester College; and **Catherine A. Beneteau**, University of South Florida, describe successful experiences with three approaches, including training of student assistants and the student perspective. Sponsored by the MAA Committee for the Teaching of Undergraduate Mathematics.

**Technology in Teaching Mathematics: History and Current Practices**, Part 1: Saturday, 1:00 p.m.–3:55 p.m., organized by **Marilyn A. Reba**, Clemson University, and **Lila F. Roberts**, Georgia College & State University. Software trends (Assembly language, FORTRAN, BASIC, Pascal, C, higher level pre-packaged software like spreadsheets, CAS, and geometry software), hardware trends (mainframes, terminals, personal computers, portable computers, calculators, I pods, tablets), and the growth of Internet have revolutionized mathematics teaching. The panel session will focus on how technologies have evolved over the past thirty years to become beneficial tools in the mathematics classroom. In the first part of the session, panelists will discuss how changing technology has altered how we teach calculus, differential equations, linear algebra, statistics, and probability. There will be a break halfway through this session. In the second part, panelists will focus on how the growth of the Internet and Web-based software has changed our teaching materials and how we communicate about mathematic in and out of the classroom. Sponsored by the MAA Committee on Technology in Mathematics Education (CTiME).

## Project NExT Sessions

Project NExT (New Experiences in Teaching) is the MAA's professional development program for new and recent Ph.D.'s in the mathematical sciences. Each year, about seventy new faculty are selected as Project NExT Fellows; application information for 2010–2011 is available at the Project NExT booth in the exhibit area.

The following sessions were organized by the 1994-2005 Project NExT Fellows to address issues of concern to faculty who have four to ten years of teaching experience. All meeting participants are invited to attend.

**Teaching Calculus to Students who Have Had AP Calc: Challenges and Solutions**, Thursday, 8:00 a.m.–9:15 a.m., organized by **Timothy P. Chartier**, Davidson College, and **Stephanie Salomone**, University of Portland. The population of a college calculus class can range from students who have seen calculus through the AP program to students who are seeing the topics for the first time. Some students have seen a subset of the material of the class. Further, students with AP credit can vary widely in the depth of their mathematical training, from familiarity with the mechanics of calculus to an understanding of the theory behind the mechanics. The AP Calculus program can serve as a springboard into college-level mathematical training for strong mathematical students. At the same time, AP training of calculus students can offer a variety of challenges in the calculus classroom. This session will discuss such challenges and innovative ideas and solutions. Panelists include **Michael E. Boardman**, Pacific University; **David M. Bressoud**, Macalester College; **Stephen L. Davis**, Davidson College; **Deborah Hughes-Hallett**, University of Arizona; and **Francis E. Su**, Harvey Mudd College.

**Mathematics and Social Justice**, Thursday, 2:30 p.m.–3:45 p.m., organized by **Lily S. Khadjavi**, Loyola Marymount University, and **David T. Kung**, St. Mary's College of Maryland. Panelists **Shandy Hauk**, University of Northern Colorado; **Eric Hsu**, San Francisco State University; and **Lisa Marano**, West Chester University, will focus on issues at the intersection of mathematics and social justice. In particular, panelists will discuss three ways in which we,

as mathematicians, can address issues of social justice: curricula that focus on social justice issues, programs that focus on social justice within the mathematics world (e.g., Treisman's Emerging Scholars Programs for college students and other efforts to level the playing field within mathematics), and culturally responsive pedagogy and ways to make our classrooms more equitable.

**Organizing and Running an Effective Seminar/Capstone Course for Mathematics Majors**, Saturday, 2:00 p.m.–3:15 p.m., organized by **Karrolyne Fogel**, California Lutheran University, **Russell Goodman**, Central College, and **Thomas Langley**, Rose-Hulman Institute of Technology. Many universities have a capstone/seminar course or experience for their mathematics majors, designed to provide a community of mathematics majors with a meaningful experience beyond textbook mathematics. These experiences vary widely from institution to institution depending on student ability and department culture. Panelists **Mariah Birgen**, Wartburg College; **Lipika Deka**, California State University-Monterey Bay; **Nezam Iraniparast**, Western Kentucky University; and **Brian Miceli**, Trinity University, will describe their departments' courses and support mechanisms, thereby presenting us with a variety of perspectives and ideas on ways to structure a culminating experience.

## Special Interest Groups of the MAA (SIGMAAs)

SIGMAAs will be hosting a number of interesting activities, sessions, and guest lecturers. There are currently nine such focus groups offering members opportunities to interact not only at meetings but throughout the year via newsletters and email-based communications. For more information visit `www.maa.org/SIGMAA/SIGMAA.html`.

**SIGMAA Officers Meeting**, Thursday 10:30 a.m.–noon, chaired by **Amy Shell-Gellasch**, Pacific Lutheran University.

**SIGMAA on Business, Industry, and Government**

*Mathematics Experiences in Business, Industry, and Government*, Thursday morning (see the "MAA Contributed Paper Sessions" section).

**Guest Lecture**, Thursday, 5:45 p.m. by **Barry Cipra**, Northfield, MN, *From Netflix to Gerrymanders: A sample of BIG applications of mathematics*.

See information on a reception on Thursday evening in the "Social Events" section.

**SIGMAA on the History of Mathematics**

*Mathematical Texts: Famous, Infamous, and Influential*, Saturday morning (see the "MAA Contributed Paper Sessions" section).

**Business Meeting and Reception**, Wednesday, 5:30 p.m.–6:30 p.m.

**Guest Lecture**, Wednesday, 6:30 p.m.–7:30 p.m., **Reviel Netz**, Classics Department, Stanford University, *title to be announced*.

**SIGMAA on Statistics Education**

*Improving a Second Course in Statistics*, Wednesday morning (see the "MAA Contributed Paper Sessions" section).

*Statistics ≠ Mathematics: What A First- (or Second-) Time Teacher of Statistics Should Know*, Thursday, 1:00 p.m.–2:20 p.m. (see the "MAA Panels, Posters, and Other Sessions" section).

*Excuse Me, Where Is the Department of Statistics Education?* Thursday, 2:35 p.m.–3:50 p.m. (see the "MAA Panels, Posters, and Other Sessions" section).

**Business Meeting and Reception**, Thursday, 5:45 p.m.–7:15 p.m.

**SIGMAA on Mathematical and Computational Biology**

*Undergraduate Mathematical Biology*, Friday morning (see the "MAA Contributed Paper Sessions" section).

**Business Meeting**, Friday, 6:00 p.m–7:00 p.m.

**Guest Lecture**, Friday, 7:00 p.m.–8:00 p.m., **Alan Hastings**, University of California Davis, *Using mathematical approaches to understand and manage spatially distributed populations: From invasive species to fisheries*.

**SIGMAA on Math Circles**

**Business Meeting**, Wednesday, 5:30 p.m.–6:30 p.m.

*Fostering, Supporting, and Propogating Math Circles*, Thursday, 1:00 p.m.–4:15 p.m., and Saturday, 1:00 p.m.–5:00 p.m., organized by **James S. Tanton**, St. Mark's Institute of Mathematics, and **Tatiana Shubin**, San Jose State University. A math circle is broadly defined as a semiformal, sustained enrichment experience that brings mathematics professionals in direct contact with pre-college students and/or their teachers. They foster passion and excitement for deep mathematics. This session explores issues of conducting, supporting, and propagating math circle activity and welcomes all interested in learning about this work. Along with lectures, displays, and discussions, a demonstration class with local school students will be given during this session.

**SIGMAA on Mathematics Instruction Using the Web**

**Reception and Business Meeting**, Thursday, 5:45 p.m.–6:30 p.m.

*Life after Wolfram Alpha*, Thursday, 6:30 p.m.–7:30 p.m., **Bruce W. Yoshiwara**, Pierce College, will give this presentation and lead a discussion.

**SIGMAA Quantitative Literacy**

*Quantitative Reasoning and the Environment*, Friday morning (see the "MAA Contributed Paper Sessions" section).

**Business Meeting**, Friday, 5:00 p.m.–6:00 p.m.

**SIGMAA on the Philosophy of Mathematics**

*Philosophy of Mathematics for the Working Mathematician*, Friday afternoon (see the "MAA Contributed Paper Sessions" section).

**Business Meeting and Reception**, Friday, 5:00 p.m.–6:00 p.m.

**Guest Lecture**, Friday, 6:00 p.m.–7:00 p.m. **Charles Chihara**, Philosophy Department, University of California Berkeley, *title to be announced*.

**SIGMAA Environmental Mathematics**

*Quantitative Reasoning and the Environment*, Friday morning (see the "MAA Contributed Paper Sessions" section).

*Environmental Mathematics*, Thursday morning (see the "MAA Invited Paper Sessions" section).

**SIGMAA on Math and the Arts**

**Business Meeting**, Friday, 7:00 p.m.–8:00 p.m.

*The Arts and Mathematics*, Saturday afternoon (see the "MAA Contributed Paper Sessions" section).

**SIGMAA on Research and Undergraduate Mathematics Education**

*Excuse Me, Where Is the Department of Statistics Education?* Thursday, 2:35 p.m.–3:50 p.m. (see the "MAA Panels, Posters, and Other Sessions" section).

**Business Meeting**, Thursday, 6:00 p.m.–7:30 p.m.

*Research on the Teaching and Learning of Undergraduate Mathematics*, Friday afternoon (see the "MAA Contributed Paper Sessions" section).

## MAA Sessions for Students

**Grad School Fair**, Friday, 8:30 a.m.–10:30 a.m. Here is the opportunity for undergrads to meet representatives from mathematical sciences graduate programs from universities all over the country. January is a great time for juniors to learn more, and college seniors may still be able to refine their search. This is your chance for one-stop shopping in the graduate school market. At last year's meeting about 300 students met with representatives from 45 graduate programs. If your school has a graduate program and you are interested in participating, a table will be provided for your posters and printed materials for US$50 (registration for this event must be made by a person already registered for the JMM), and you are welcome to personally speak to interested students. Complimentary coffee will be served. Cosponsored by the AMS and MAA.

**Graduate School: Choosing One, Getting In, Staying In**, Thursday, 10:40 a.m.–12:00 noon., organized by **Kristi Meyer**, Wisconsin Lutheran College, and **Aaron Luttman**, Clarkson University. With so many graduate school choices and so much information available online, how do you decide on a list of schools to apply to? How can you strengthen your application so you will be accepted into a program? How do you choose which school to attend? And once you've started a program, how do you successfully navigate grad school and complete your degree? Panelists **Richard McGehee**, University of Minnesota, and **Scott Lambert**, Colby College, will discuss these and other important issues for those students who are considering a graduate degree or thinking about switching graduate programs. Cosponsored by the MAA and the Young Mathematicians' Network.

**Finding a Research Topic and Thesis Advisor**, Thursday, 1:00 p.m.–2:20 p.m., organized by **David C. Manderscheid**, University of Nebraska-Lincoln, and **Aaron Luttman**, Clarkson University. Complex analysis, matroid theory, time scale analysis, or mathematical biology? One of the most important and far-reaching decisions that every graduate student in mathematics must make is what direction of mathematical research to pursue and whom to ask to serve as a thesis advisor. Many students are interested in a variety of areas of mathematics, and choosing a singular area of focus can be difficult. Panelists **Raegan J. Higgins**, Texas Tech University; **Franziska Hinckelmann**, Virginia Polytechnic Institute and State University; **Steven G. Krantz**, Washington University; and **Jennifer McNulty**, University of Montana, four experts in various stages of their mathematical careers, will discuss what factors have influenced their decisions of what research to explore, whom to ask to be their advisor, and whom to take on as graduate students. This panel discussion is aimed at early-career graduate students and undergraduate students who are planning to attend graduate school. Sponsored by the MAA Committee on Graduate Students and the Young Mathematicians' Network.

**Low-Dimensional Topology for Fun and Profit, or How to Extract Money from the R4 Space,** Thursday, 6:00 p.m.–7:00 p.m., presented by **Cliff Stoll**, Acme Klein Bottle Company. For over ten years, Acme Klein Bottle has provided nonorientable manifolds to math folk. Like much of mathematics, it's marginally profitable, but endlessly entertaining. While thousands of computer models of the Klein Bottle populate the Internet, physical models are rarely built. Using Pyrex glass and a torch, we've been able to supply the finite but unbounded demand for one-sided, R3 immersed Klein Bottles. Along the way, we've learned how run a microbusiness within this smallest of niche markets. Our experience may be useful to mathematicians who think about becoming entrepreneurs. So how do you turn your mathematical ideas into a small business? Come to Cliff's talk and find out!

**MAA Lecture for Students**, Friday, 1:00 p.m.–1:50 p.m., will be given by **David T. Kung**, St. Mary's College of Maryland, on *How math made modern music ~~mad~~ irrational.*

**Undergraduate Student Poster Session**, Friday, 4:00 p.m.–5:30 p.m., organized by **Diana M. Thomas**, Montclair State University. The session is reserved to undergraduates and first-year graduate students submitting posters on work done while undergraduates. Abstracts are accepted on a first-come basis. Space is limited and students are encouraged to apply early. Beginning August 1, 2009, students can submit abstracts online at `www.maa.org/students/undergrad/poster09.htm`. Examples of poster topics include a new result, a different proof of a known theorem, an innovative solution of a Putnam problem, a new mathematical model, or method of solution of an applied problem. Purely expository posters cannot be accepted. Prizes will be awarded to the top-rated posters with money provided by the AMS, MAA, AWM, CUR, PME, and by the Moore Foundation. Trifold, self-standing 48" by 36" tabletop posterboards will be provided. Additional material or equipment is the responsibility of the presenters. Questions regarding this session should be directed to Diana Thomas at `thomasdia@mail.montclair.edu`. The

deadline for proposals is **November 7, 2009**. Cosponsored by the MAA-CUPM Subcommittee on Undergraduate Research and the MAA Committee on Undergraduate Student Activities and Chapters (CUSAC).

Some more advanced students might be interested in the session on **How to Interview for a Job in the Mathematical Sciences**, Wednesday at 3:50; see the full description in the "MAA Panels…" section.

Also see the "Social Events" section for the open hours of the **Student Hospitality Center** and the **Reception for Undergraduates**.

## MAA Short Course

This two-day Short Course on *Exploring the Great Books of Mathematics* is organized by **Amy Shell-Gellasch**, Pacific Lutheran University, and **Glen Van Brummelen**, Quest University, and will take place on Monday and Tuesday, January 11 and 12.

Every intellectual endeavor has key moments when some new monumental work shakes its foundations and builds new ones. How these great books affect the future might be clear within months of publication, or may take centuries to develop; in ways we may not even fully recognize, they shape our thoughts. We shall concentrate on only four great books in mathematics, spending half a day on each. We shall delve deeply into the texts, translations, and commentaries, do some reading in each of the original texts, and consider their influences on later generations.

The speakers and their talks:

**Alex Jones**, New York University, *Ptolemy's* Almagest: *Greek mathematics and the heavenly bodies*. Ptolemy wrote his textbook on astronomy, the *Almagest*, in Alexandria around A.D. 150 at the peak of the Roman Empire. In this book he adapted the geometry of the Greeks and the arithmetic of the Babylonians to the problems of finding an accurate, quantitative description of the movements of the Sun, Moon, stars, and planets. We will explore how Ptolemy uses such resources as a place-value notation for precise numerical data, trigonometrical functions, and recursive algorithms to the deduction of how our universe works, resulting in a cosmology that remained the standard one for more than a thousand years.

**George Smith**, Tufts University, *Newton's* Principia. Isaac Newton had developed the calculus to an impressive point by 1671, yet in his *Principia* of 1687 he resorts instead to a form of geometry incorporating limits. That has raised a question about the extent to which his knowledge of the calculus informed the mathematics of the *Principia* —a question that has received such dubious answers as "he did it all first in the calculus and then transformed it into geometry." The diversity of mathematical techniques in the *Principia*, however, makes simple answers to the question impossible. The *Principia* lays out a sustained empirical argument. The diversity of mathematical techniques in it stems from the specific problems for which that argument required mathematical solutions. The course will accordingly first lay out the structure of the argument in the *Principia*, so that attendees can see why each of the proved propositions and lemmas is in the book. It will then examine a selection of propositions central to the argument, each demanding its own distinctive mathematical techniques. The goal will be to put attendees in position to assess for themselves the extent of the influence Newton's mastery of the calculus had on the mathematics at different places in the *Principia*.

**Ivor Grattan-Guinness**, Middlesex University Business School, *Tracking the great writings of mathematics*. In 2005 Elsevier published a book that I edited, *Landmarks in Western Mathematics, 1640–1940*, 1050 pages. In it 77 articles recorded the history of 89 books or papers that substantially influenced the development of mathematics in some way or another over the chosen period. In this lecture I shall review the means by which the writings were chosen, and the various forms of influence that had to be appraised. The difficulties of assessing the impact and influence itself will be emphasized.

**Robert E. Bradley**, Adelphi University, and **Ed Sandifer**, Western Connecticut State College, *Cauchy and the* Cours d'analyse. Cauchy's *Cours d'analyse de l'École royale polytechnique* is often cited as the beginning of modern rigor in mathematics. It is also said that Cauchy wrote the book to improve the teaching of calculus, and that Cauchy was a very unpopular teacher. How rigorous was the *Cours d'analyse*? How different is it from what came before, and from what we use today? Is it a calculus book or an analysis book? Could we (or should we) teach from it today? Why has it never been translated into English? Is it just another "book nobody read"?

**Fernando Q. Gouvêa**, Colby College, *How algebra became modern*. B. L. van der Waerden's *Moderne Algebra* was both an account of and a manifesto for a new approach to algebra. It quickly established the new "abstract" or "structural" approach as the dominant way to understand the subject. It also pretty much created a subject, "modern algebra", that eventually established itself as a standard part of undergraduate mathematics education. We will look at the context and influence of the book, comparing it with other contemporary books and attempting to get a measure of its impact.

There are separate registration fees to participate in this Short Course. See the fee schedule on the registration form at the back of this issue or visit `www.ams.org/amsmtgs/2124_reg.html`.

## Other MAA Events

**Board of Governors**,Tuesday, 9:00 a.m.–5:00 p.m.

**New Committee Chairs Workshop**, Tuesday, 7:00 p.m.–9:00 p.m., organized by **Barbara J. Faires**, MAA Secretary-Elect, and **Martha J. Siegel**, MAA Secretary. Are you an incoming chair of an MAA committee or a new editor of one of the MAA publications? This workshop will feature an orientation to MAA policies and procedures, as well as active participation in discussion of challenging situations that have occurred (and probably will occur) as committee chairs and editors go about the work of the association.

**Section Officers**, Wednesday, 2:30 p.m.–5:00 p.m.

**Business Meeting**, Saturday, 11:10 a.m.–11:40 a.m., organized by MAA Secretary, **Martha J. Siegel**, Towson University, and moderated by MAA President **David M. Bressoud**, Macalester College.

**Department Liaisons Meeting**, day and time to be determined.

**Joint PME and MAA Student Chapter Advisors' Meeting**, day and time to be determined.

**Minority Chairs Meeting**, day and time to be determined.

See the listings for various receptions in the "Social Events" section.

### MAA Ancillary Workshops

Two workshops have been organized for presentation on Tuesday, January 12, before the Joint Mathematics Meetings actually begin. They will be held in the San Francisco Marriot Hotel. There is no cost to participate. To apply see www.causeweb.org/workshop.

**Teaching Introductory Statistics**, Tuesday, 8:30 a.m.–5:00 p.m., presented by **Carolyn K. Cuff**, Westminster College, and **Michael A. Posner**, Villanova University. In May, 2005, the American Statistical Association endorsed the Guidelines for Assessment and Instruction in Statistics Education (GAISE). The guidelines were created to give sufficient structure to instructors and yet allow sufficient generality to include good practices in the many flavors of the first statistics course. The recommendations include: 1. Emphasize statistical literacy and develop statistical thinking; 2. Use real data; 3. Stress conceptual understanding rather than mere knowledge of procedures; 4. Foster active learning in the classroom; 5. Use technology for developing conceptual understanding and analyzing data; and 6. Use assessments to improve and evaluate student learning.

This workshop will consider the implementation of those guidelines in a first-level statistics course. What are the big ideas of statistics? How can those big ideas be communicated to students? What are effective evaluation and assessment tools? We will begin to answer those questions through considering ways to engage students in statistical literacy and thinking. The contrast between conceptual and procedural understanding will be explained using examples.

The workshop is meant for instructors new to teaching introductory statistics.

For most of the workshop, participants will engage in many of the classic activities that all statistics instructors should know. Different types of available technology will be demonstrated; different types of texts will be explored. Internet sources of real data, activities, and best practices articles will be examined. Participants will find out how they can continue to answer the three questions by becoming involved in statistics education related conferences, newsletters, and groups.

**Become a Catalyst for Change in Statistics Education**, Tuesday, 9:00 a.m.–5:00 p.m., presented by **Joan Garfield**, **Bob delMas**, and **Andy Zieffler**, University of Minnesota, and **Allan Rossman** and **Beth Chance**, California Polytechnic Institute. This one-day workshop will feature materials developed by the NSF-funded CATALST project (Change Agents for Teaching and Learning Statistics). The changes we are working towards are in both content and pedagogy of the introductory, non-calculus based statistics course. The materials to be shared are designed to help students achieve the learning goals listed in the ASA-endorsed GAISE Report (see amstat.org). We have developed sets of hands-on activities that form units based around a particular real world problem (e.g., how to develop a SPAM filter for email) and the related statistical ideas that emerge from this type of problem. The problems, called "Model Eliciting Activities", are rich and complex open-ended problems that stimulate statistical thinking, engage students in creating developing and testing unique models to solve the problem, and prepare them to learn the statistical content that follows in the unit. The CATALST materials focus on important ideas of statistical inference and the use of simulation throughout the course.

## *Activities of Other Organizations*

This section includes scientific sessions. Several organizations or special groups are having receptions or other social events. Please see the "Social Events" section of this announcement for details.

### Association for Symbolic Logic (ASL)

This two-day program on Friday and Saturday will include sessions of contributed papers as well as Invited Addresses by **François Loeser**, Ecole Normale Superieure CNRS; **Fernando Ferreira**, Universidade de Lisboa; **John Harrison**, Intel Corporation; **Christopher Miller**, Ohio State University; **Joseph Miller**; University of Wisconsin, Madison; **Stevo Todorcevic**, Université Denis Diderot, Paris VII, and University of Toronto; and **Slawomir Solecki**, University of Illinois at Urbana-Champaign.

See also these cosponsored events by the ASL: *Surreal Numbers* on Wednesday in the "AMS Special Sessions" listings, and the panel discussion on *Hilbert's Tenth Problem* on Thursday at 10:00 a.m. in the "AMS Other Sessions" section.

### Association for Women in Mathematics (AWM)

**Thirty-first Annual Emmy Noether Lecture,** Thursday, 10:05 a.m., will be given by **Carolyn S. Gordon**, Dartmouth College, on *You can't hear the shape of a manifold.* This lecture series is supported by the U.S. Department of Energy.

Also see the Special Session on *Spectral Problems on Compact Riemannian Manifolds* jointly sponsored by the AWM in the "AMS Special Session" listings.

A luncheon will be given in honor of the lecturer on Thursday; see the "Social Events" section for details.

**Dual Careers or Dueling Careers? Jobs and the Two-Body Problem**, Wednesday, 2:15 p.m.–3:40 p.m. This panel discussion moderated by **Georgia Benkart**, University of Wisconsin–Madison, includes panelists **Christine Min**

**Wotipka**, Stanford University; **Ellen Spertus**, Mills College and Google, **David C. Manderscheid**, University of Nebraska –Lincoln; and **Maia Averett**, Mills College. Just before the panel discussion, AWM will recognize the honorees for the Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman and the Louise Hay Award for Contributions to Mathematics Education. Note that formal prizewinner announcements are made at the Joint Prize Session on Thursday afternoon.

**Business Meeting**, Wednesday, 3:45 p.m.–4:15 p.m.

**Workshop**, Saturday, 8:20 a.m.–4:20 p.m. With funding from the Office of Naval Research and the National Security, AWM will conduct its workshop for women graduate students and women who have received the Ph.D. within the last five years. Twenty women mathematicians are selected in advance of this workshop to present their research; graduate students will present posters, and recent Ph.D.s will give 20-minute talks. At 1:00 p.m. there is a panel discussion on *Career opportunities: The early years*, moderated by **Rachelle C. DeCoste**, Wheaton College, with panelists **Ann Almgren**, Lawrence Berkeley National Lab, **Maura B. Mast**, University of Massachusetts–Boston, **Sharon M. Frechette**, College of the Holy Cross, and **Ulrica Y. Wilson**, Morehouse College. All mathematicians (female and male) are invited to attend the entire program. Departments are encouraged to help graduate students and recent Ph.D.s who do not receive funding to obtain some institutional support to attend the workshop and other meeting sessions. Updated information about the workshop is available at `www.awm-math.org/workshops.html`. AWM seeks volunteers to lead discussion groups and act as mentors for workshop participants. If you are interested, please contact the AWM office; inquiries regarding future workshops may be made to the office at `awm@awm-math.edu`.

**Reception**, Wednesday, 9:30 p.m.–11:00 p.m. See the listing in the "Social Events" section of this announcement.

### National Association of Mathematicians (NAM)

**Granville-Brown-Haynes Session of Presentations by Recent Doctoral Recipients in the Mathematical Sciences**, Friday, 1:00 p.m.–4:00 p.m.

**Cox-Talbot Address**, to be given Friday after the banquet; speaker and title to be announced.

**Panel Discussion**, Saturday, 9:00 a.m.–9:50 a.m.

**Business Meeting**, Saturday, 10:00 a.m.–10:50 a.m.

**Claytor-Woodard Lecture**: Saturday, 1:00 p.m., speaker and title to be announced.

See details about the banquet on Friday in the "Social Events" section.

### National Science Foundation (NSF)

The NSF will be represented at a booth in the exhibit area. NSF staff members will be available to provide counsel and information on NSF programs of interest to mathematicians. The booth is open the same days and hours as the exhibits. Times that staff will be available will be posted at the booth.

### Pi Mu Epsilon (PME)

**Council Meeting**, Friday, 8:00 a.m.–11:00 a.m.

### Rocky Mountain Mathematics Consortium (RMMC)

**Board of Directors Meeting**, Friday, 2:15 p.m.–4:10 p.m.

### Society for Industrial and Applied Mathematics (SIAM)

This program consists of an Invited Address at 11:10 a.m. on Thursday by **Brenda Dietrich**, IBM, *title to be announced*, and a series of Minisymposia scheduled Wednesday through Saturday.

### Young Mathematicians Network (YMN)

**Open Forum**, Thursday, 7:30 p.m.–8:30 p.m., organized by **Sarah Ann Stewart**, Belmont University, and **Joshua D. Laison**, Willamette University. All meeting attendees, including undergraduates and graduate students, are invited to discuss topics and issues affecting young mathematicians.

Also see details about other sessions cosponsored by the YMN under these headings: *MAA Panels, Posters, and Other Sessions* **Promotion and Tenure**… Friday at 9:00 a.m.; **Project NExT-YMN Poster Session**, Wednesday at 2:15 p.m.; **How to Interview**…, Wednesday at 3:50 p.m.; and *MAA Sessions for Students* **Graduate School: Choosing One**… Monday at 2:15 p.m.; **Finding a Research Topic**…, Thursday at 1:00 p.m.).

### Others

**Mathematical Art Exhibition**, organized by **Robert Fathauer**, Tessellations Company, **Nathaniel A. Friedman**, ISAMA and SUNY Albany, and **Anne Burns**, Long Island University, C. W. Post University. A popular feature at the last Joint Mathematics Meetings, this exhibition provides a break in your day. On display are works in various media by artists who are inspired by mathematics and by mathematicians who use visual art to express their findings. Fractals, symmetry, and tiling are some of the ideas at play here. Don't miss this unique opportunity for a different perspective on mathematics. The exhibition will be open during the regular exhibit hours.

**Summer Program for Women in Mathematics (SPWM) Reunion**, Thursday 1:00 p.m.–4:00 p.m., organized by **Murli M. Gupta**, George Washington University. SPWM participants will describe their experiences from past programs.

## *Social Events*

All events listed are open to all registered participants. It is strongly recommended that for any event requiring a ticket, tickets should be purchased through advance registration. Only a very limited number of tickets, if any, will be available for sale on site. If you must cancel your participation in a ticketed event, you may request a 50% refund by returning your ticket(s) to the Mathematics Meetings Service Bureau (MMSB) **by January 4**. After that date no refunds can be made. Special meals are available at banquets upon advance request, but this must be indi-

cated on the Advance Registration/Housing Form. Special meals may be subject to additional fees.

**AMS Banquet**: As a fitting culmination to the meetings, the AMS banquet provides an excellent opportunity to socialize with fellow participants in a relaxed atmosphere. The participant who has been a member of the Society for the greatest number of years will be recognized and will receive a special award. The banquet will be held on Saturday, with dinner served at 7:30 p.m. Tickets are US$53 including tax and gratuity. The banquet will be preceded by a reception at 6:30 p.m.

**Association of Christians in the Mathematical Sciences (ACMS) Reception and Banquet**, Friday, 6:00 p.m.–8:30 p.m. This annual dinner at 6:30 p.m. is preceded by a reception at 6:00 p.m. and will be followed by an after-dinner talk by Glen Van Brummelen. Tickets must be ordered by **November 30**; see www.acmsonline.org for details and cost.

**Association of Lesbian, Gay, Bisexual, and Transgendered Mathematicians Reception**, Thursday, 6:00 p.m.–7:30 p.m. This reception is open to all in the GLBT mathematical community as well as partners, friends, and supporters. We have had excellent turnouts, so come and see old friends and make new ones!

**AWM Reception**: There is an open reception on Wednesday at 9:30 p.m. after the AMS Gibbs Lecture. This has been a popular, well-attended event in the past.

**AWM Luncheon to honor Noether Lecturer, Carolyn S. Gordon,** Thursday. Those interested may email awm@awm-math.org; a sign-up sheet for those interested will also be located at the AWM table in the exhibit area and also at the AWM panel discussion and Business Meeting on Wednesday afternoon.

**Brigham Young University Reception**, Friday, 6:00 p.m. –7:30 p.m. all friends and alumni, and participants in BYU programs (e.g., CURM, REU, Summer Math Institute) are invited to attend. Please contact Michael Dorff, mdorff@math.byu.edu, for more information.

**Budapest Semesters in Mathematics Annual Alumni Reunion**, Friday, 6:00 p.m.–8:00 p.m. All alumni, family, and spouses are invited.

**University of Chicago Mathematics Alumni Reception**, Thursday, 6:00 p.m.–7:00 p.m.

**Claremont Colleges Alumni Reception**, Thursday, 6:00 p.m.–8:00 p.m. Please join your fellow Claremont College math faculty, alumni, students, and special guests. H'ors d'oeuvres and drinks will be provided. Please send your RSVP to alumni@hmc.edu.

**Reception for Graduate Students and First-Time Participants**, Wednesday, 5:30 p.m.–6:30 p.m. The AMS and the MAA cosponsor this social hour. Graduate students and first-timers are especially encouraged to come and meet some old-timers to pick up a few tips on how to survive the environment of a large meeting. Refreshments will be served.

**University of Illinois at Urbana-Champaign Department of Mathematics Alumni Reception**, Friday, 5:30 p.m.–7:30 p.m. Everyone ever connected with the department is encouraged to get together for conversation and to hear about mathematics at the University of Illinois. Please see www.math.uiuc.edu/jmm-reception.html.

**Knitting Circle**, Thursday, 8:15 p.m.–9:45 p.m. Bring a project (knitting/crochet/tatting/beading/etc.) and chat with other mathematical crafters!

**MAA–Project NExT Reception**, Friday, 8:30 p.m.–10:30 p.m., organized by **T. Christine Stevens**, St. Louis University, **Joseph A. Gallian**, University of Minnesota-Duluth, and **Aparna W. Higgins**, University of Dayton. All Project NExT Fellows, consultants, and other friends of Project NExT are invited.

**MAA Two-Year College Reception**, Thursday, 5:45 p.m.–7:00 p.m., is open to all meeting participants, particularly two-year faculty members. This is a great opportunity to meet old friends and make some new ones. There will be hot and cold refreshments and a cash bar. Sponsored by Pearson Education.

***Mathematical Reviews* Reception**, Friday, 6:00 p.m.–7:00 p.m. All friends of *Mathematical Reviews* (*MR*) are invited to join reviewers and *MR* editors and staff (past and present) for a reception in honor of all the efforts that go into the creation and publication of the *Mathematical Reviews* database. Refreshments will be served.

**Mathematical Institutes Open House**, Wednesday, 5:30 p.m.–8:00 p.m. Participants are warmly invited to attend this open house cosponsored by several North American mathematical institutes. Come find out about the latest activities and programs at each of the institutes that may be suited to your own research interests.

**MER Banquet:** The Mathematicians and Education Reform (MER) Forum welcomes all mathematicians who are interested in precollege, undergraduate, and/or graduate educational reform to attend the MER banquet on Thursday evening. This is an opportunity to make or renew contacts with other mathematicians who are involved in education projects and to engage in lively conversation about educational issues. The after-dinner discussion is an open forum for participants to voice their impressions, observations, and analyses of the current education scene. There will be a cash bar beginning at 6:30 p.m. Dinner will be served at 7:30 p.m. Tickets are US$53 each, including tax and gratuity.

**University of Michigan Alumni and Friends Reception**, Friday, 5:30 p.m.–7:00 p.m.

**NAM Banquet**, Friday, 6:00 p.m.–8:40 p.m. The National Association of Mathematicians will host a banquet on Friday evening. A cash bar reception will be held at 6:00 p.m., and dinner will be served at 6:30 p.m. Tickets are US$53 each, including tax and gratuity.

**NSA Women in Mathematics Society Networking Session**, Thursday, 6:00 p.m.–8:00 p.m. All participants are welcome to this annual event. Please stop by the NSA booth in the exhibit hall for the exact location.

**New Mexico State University Mathematics Association Reception**, Thursday, 6:00 p.m.–7:30 p.m. Current and former students and faculty as well as other friends of the New Mexico State University Department of Mathematical Sciences are cordially invited to this reception.

**University of Oregon Mathematics Department Reception**, Thursday, 6:30 p.m.–7:30 p.m. All alumni and friends are welcome.

**Student Hospitality Center**, Wednesday–Friday, 9:00 a.m.–5:00 p.m., and Saturday, 9:00 a.m.–3:00 p.m., organized by **Richard** and **Araceli Neal**, American Society for the Communication of Mathematics.

**Reception for Undergraduates,** Wednesday, 4:00 p.m.–5:00 p.m.

## *Other Events of Interest*

**AMS Information Booth**: All meetings participants are invited to visit the AMS Information Booth during the meetings. A special gift will be available for participants, compliments of the AMS. AMS staff will be at the booth to answer questions about AMS programs and membership.

**Book Sales and Exhibits**: All participants are encouraged to visit the book, education media, and software exhibits from 12:15 p.m.–5:30 p.m. on Wednesday, 9:30 a.m.–5:30 p.m. on Thursday and Friday, and 9:00 a.m.–noon on Saturday. Books published by the AMS and MAA will be sold at discounted prices somewhat below the cost for the same books purchased by mail. These discounts will be available only to registered participants wearing the official meetings badge. Participants visiting the exhibits are required to display their meetings badge in order to enter the exhibit area.

The AMS and the MAA cordially invite all registered participants to enjoy complimentary tea and coffee while perusing the associations' booths.

**Mathematical Sciences Employment Center**: Those wishing to participate in the Mathematical Sciences Employment Center should read carefully the important article about the center beginning on page 1168 in this issue of *Notices* or at `www.eims.ams.org.` Employers should pay the appropriate fees; there are no fees for applicants to participate, except that all Employment Center participants must also register for the Joint Mathematics Meetings (JMM). Official meeting badges are required to enter the Employment Center.

**Networking Opportunities**: There are many opportunities to meet new friends and greet old acquaintances in addition to the vast array of scientific sessions offered at these meetings. These opportunities are listed on the newcomers page at `www.ams.org/amsmtgs/2124_newcomers.html`. Newcomers may want to investigate the many receptions listed in the "Social Events" section, the Student Hospitality Center, and the Employment Center. Onsite, a Networking Center featuring casual seating and lists of registered participants sorted by school and math subject classification will be available for your perusal. This is a great place to relax between sessions and forge new friendships.

## *Registering in Advance and Obtaining Hotel Accommodations*

The AMS and MAA make every effort to keep participant expenses at meetings and registration fees for meetings as low as possible. We work hard to negotiate the best hotel rates and to make the best use of your registration dollars to keep the meetings affordable for you. The AMS and the MAA encourage all participants to register for the meeting. When you pay the registration fee, you are helping to support a wide range of activities associated with planning, organizing, and running a major meeting of this size.

**How to Register in Advance**: The importance of advance registration cannot be overemphasized. Advance registration fees are considerably lower than the fees that will be charged for registration at the meetings. Participants registering by **November 18** may receive their badges, programs, and tickets (where applicable) in advance by mail approximately three weeks before the meetings. Those who do not want their materials mailed should check the box on the form. Because of delays that occur in U.S. mail to Canada, advance registrants from Canada must pick up their materials at the meetings. Because of delays that occur in U.S. mail to overseas, materials are never mailed overseas. There will be a special Registration Assistance Desk at the Joint Meetings to assist individuals who either did not receive this mailing or who have a problem with their registration. Please note that a US$5 replacement fee will be charged for programs and badges that are mailed but not taken to San Francisco. Acknowledgments of registrations will be sent by email to the email addresses given on the Advance Registration/Housing Form. If you do not wish your registration acknowledged by email, please mark the appropriate box on the form.

**Internet Advance Registration**: This service is available for advance registration and hotel reservations at `www.ams.org/amsmtgs/2124_reg.html.` VISA, MasterCard, Discover, and American Express are the only methods of payment which are accepted for Internet advance registration, and charges to credit cards will be made in U.S. funds. All Internet advance registrants will receive acknowledgment of payment upon submission of this form.

**Cancellation Policy**: Those who cancel their advance registration for the meetings, MAA Minicourses, or Short Courses by **January 8** (the deadline for refunds for banquet tickets is January 4) will receive a 50% refund of fees paid. No refunds will be issued after this date.

**Joint Mathematics Meetings Registration Fees**

| | by Dec. 22 | at meeting |
|---|---|---|
| Member of AMS, ASL, Canadian Mathematical Society, MAA, SIAM | US$220 | US$288 |
| Emeritus Member of AMS, MAA; Unemployed; Graduate Student; High School Teacher; Librarian; Developing Countries Special Rate | 45 | 55 |
| Undergraduate Student | 35 | 45 |
| Temporarily Employed | 177 | 206 |
| Nonmember | 342 | 444 |
| High School Student | 5 | 10 |
| One-Day Member of AMS, ASL, CMS, MAA, SIAM | N/A | 157 |
| One-Day Nonmember | N/A | 245 |
| Nonmathematician Guest | 15 | 15 |

| | | |
|---|---|---|
| **MAA Minicourses** *if space is available | 75 | 75* |
| **Grad Student Fair** (table/posterboard/electricity) | US$50 | N/A |
| **AMS Short Course** | | |
| Member of AMS or MAA | US$98 | US$132 |
| Nonmember | 135 | 165 |
| Student/Unemployed/Emeritus | 46 | 67 |
| **MAA Short Course** | | |
| MAA or AMS Member | US$150 | US$160 |
| Nonmember | 200 | 210 |
| Student/Unemployed/Emeritus | 75 | 85 |

**Full-Time Students:** Those currently working toward a degree or diploma. Students are asked to determine whether their status can be described as graduate (working toward a degree beyond the bachelor's), undergraduate (working toward a bachelor's degree), or high school (working toward a high school diploma) and to mark the Advance Registration/Housing Form accordingly.

**Emeritus:** Any person who has been a member of the AMS or MAA for twenty years or more and who retired because of age or long-term disability from his or her latest position.

**Librarian:** Any librarian who is not a professional mathematician.

**Unemployed:** Any person currently unemployed, actively seeking employment, and not a student. It is not intended to include any person who has voluntarily resigned or retired from his or her latest position.

**Developing Country Participant**: Any person employed in developing countries where salary levels are radically noncommensurate with those in the U.S.

**Temporarily Employed**: Any person currently employed but who will become unemployed by June 1, 2010, and who is actively seeking employment.

**Nonmathematician Guest**: Any family member or friend who is not a mathematician and who is accompanied by a participant in the meetings. These official guests will receive a badge and may attend all sessions and the exhibits.

**Participants Who Are Not Members of the AMS** and register for the meetings as a nonmember will receive mailings after the meetings are over with a special membership offer.

Advance registration and on-site registration fees only partially cover the expenses of holding meetings. All mathematicians who wish to attend sessions are expected to register and should be prepared to show their badges if so requested. Badges are required to enter the exhibit area, to obtain discounts at the AMS and MAA Book Sales, and to cash a check with the Joint Meetings cashier.

Advance registration forms accompanied by insufficient payment will be returned, thereby delaying the processing of any housing request, or a US$5 charge will be assessed if an invoice must be prepared to collect the delinquent amount. Overpayments of less than US$5 will not be refunded.

For each invalid check or credit card transaction that results in an insufficient payment for registration or housing, a US$5 charge will be assessed. Participants should check with their tax preparers for applicable deductions for education expenses as they pertain to these meetings.

If you wish to be included in a **list of individuals sorted by mathematical interest**, please provide the one mathematics subject classification number of your major area of interest on the Advance Registration/Housing Form. (A list of these numbers is available by sending an empty email message to `abs-submit@ams.org`; include the number 1035 as the subject of the message.) Copies of this list will be available for your perusal in the Networking Center.

If you do not wish to be included in any mailing list used for promotional purposes, please indicate this in the appropriate box on the Advance Registration/Housing Form.

**Advance Registration Deadlines**

There are four separate advance registration deadlines, each with its own advantages and benefits.

| | |
|---|---|
| **EARLY** meetings advance registration (room drawing) | **November 4** |
| **ORDINARY** meetings advance registration (hotel reservations, materials mailed) | **November 18** |
| **FINAL** meetings advance registration (advance registration, Short Courses, Employment Center, MAA Minicourses, banquets) | **December 22** |

**Early Advance Registration**: Those who register by the **early** deadline of **November 4** will be included in a random drawing to select winners of complimentary hotel rooms in San Francisco,. Multiple occupancy is permissible. The location of rooms to be used in this drawing will be based on the number of complimentary rooms available in the various hotels. Therefore, the free room may not necessarily be in the winner's first-choice hotel. The winners will be notified by mail prior to **December 24**. So register early!

**Ordinary Advance Registration**: Those who register **after November 4** and by the **ordinary** deadline of **November 18** may use the housing services offered by the MMSB but are not eligible for the room drawing. You may also elect to receive your badge and program by mail in advance of the meetings.

**Final Advance Registration**: Those who register after **November 18** and by the **final** deadline of **December 22** must pick up their badges, programs, and any tickets for social events at the meetings. Unfortunately, it is sometimes not possible to provide **final** advance registrants with housing, so registrants are strongly urged to make their hotel reservations by **November 18**. Please note that the **December 22 deadline is firm**; any forms received after that date will be returned and full refunds issued. To pick up your materials, please come

to the Meetings Registration Desk in the first-floor lobby of the Moscone West Convention Center.

### Hotel Reservations

Participants should be aware that the AMS and MAA contract only with facilities who are working toward being in compliance with the public accommodations requirements of the ADA.

Participants requiring hotel reservations should read the instructions on the preceding hotel pages. Participants who did not reserve a room during advance registration and would like to obtain a room at one of the hotels listed on the preceding pages should call the hotels directly after **December 22**. However, after that date the MMSB can no longer guarantee availability of rooms or special convention rates. Participants should be aware that most hotels are starting to charge a penalty fee to guests for departure changes made before or after guests have checked into their rooms. These hotels are indicated on the hotel page at `www.ams.org/amsmtgs/2124_hotelpage.html`. Participants should also inquire about this at check-in and make their final plans accordingly.

Participants should also be aware that it is general hotel practice in most cities to hold a nonguaranteed reservation until 6:00 p.m. only. When one guarantees a reservation by paying a deposit or submitting a credit card number as a guarantee in advance, however, the hotel usually will honor this reservation up until checkout time the following day. If the individual holding the reservation has not checked in by that time, the room is then released for sale, and the hotel retains the deposit or applies one night's room charge to the credit card number submitted.

If you hold a guaranteed reservation at a hotel but are informed upon arrival that there is no room for you, there are certain things you can request the hotel do. First, they should provide for a room at another hotel in town for that evening at no charge. (You already paid for the first night when you made your deposit.) They should pay for taxi fares to the other hotel that evening and back to the meetings the following morning. They should also pay for one telephone toll call so that you can let people know you are not at the hotel you expected. They should make every effort to find a room for you in their hotel the following day and, if successful, pay your taxi fares to and from the second hotel so that you can pick up your baggage and bring it to the first hotel. Not all hotels in all cities follow this practice, so your request for these services may bring mixed results or none at all.

**Importance of Staying in the Official Meetings Hotels**: Your patronage of the official Meetings hotels enables the JMM to secure the meeting space at a greatly reduced cost which helps to keep the cost of the meeting and your registration fees down.

**Room Drawing**: Win FREE room nights at our official hotels as listed on the hotel pages. Multiple winners! Participants who register and reserve a room at any of the listed meetings hotels by November 4, 2009, will automatically be included in a random drawing to select a winner of free room nights in that hotel. The number of drawings to be made will be based on the number of complimentary room nights available in the various hotels. Multiple occupancy is permissible. The winners will be drawn at random from the hotel reservation lists and notified by email or phone prior to December 24, 2009.

## *Miscellaneous Information*

**Audio-Visual Equipment**: Standard equipment in all session rooms is one overhead projector and screen. Invited 50-minute speakers are automatically provided with two overhead projectors and a laptop projector; AMS Special Sessions and Contributed Papers, and MAA Invited and Contributed Paper Sessions, are provided with the standard equipment and a laptop projector. Blackboards are not available, nor are Internet hookups in session rooms. Any request for additional equipment should be sent to `wsd@ams.org` and received by November 1.

Equipment requests made at the meetings most likely will not be granted because of budgetary restrictions. Unfortunately no audio-visual equipment can be provided for committee meetings or other meetings or gatherings not on the scientific program.

**Childcare**: The American Mathematical Society and the Mathematical Association of America will again offer childcare services for the Joint Mathematics Meetings to registered participants.

The childcare will be offered through KiddieCorp Children's Program. KiddieCorp is an organization that has been providing high quality programs for children of all ages at meetings throughout the United States and Canada since 1986. Read all about them at `www.kiddiecorp.com/`.

The childcare services provided at the JMM are for children ages 6 months through 12 years old. Space per day will be limited and is on a space available basis. The dates and times for the program are January 13–16, 2010, 8:00 a.m.–5:00 p.m. each day. It will be located at the San Francisco Marriott Hotel. Parents are encouraged to bring snacks and beverages for their children but items such as juice boxes, Cheerios, and crackers will be provided. KiddieCorp can arrange meals for children at cost plus 15% or parents can be responsible for meals for their children.

Registration starts on September 1. The registration fee is US$30 per family (nonrefundable). Additional cost will be US$10 per hour per child or US$8 per hour per child for graduate students. These reduced child care rates are made possible to the meetings participant by the American Mathematical Society and the Mathematical Association of America, who heavily subsidize the cost of this service, thus keeping this program affordable for families. Parents must be registered for the JMM to participate. Full payment is due at the time of registration with KiddieCorp. Deadline for registering is **December 16, 2009**.

If parents do not pick up their children at the time scheduled or by the end of the day (no later than 5:00 p.m.), they will be charged a late fee of US$5 per child for every 15 minutes thereafter.

Cancellations must be made to KiddieCorp prior to December 16, 2009, for a full refund. Cancellations made after

that date will be subject to a 50% cancellation fee. Once the program has begun, no refunds will be issued.

To register, go to https://www.kiddiecorp.com/jmmkids.htm or call KiddieCorp at (858) 455-1718 to request a form.

**Email Services**: Limited email access for all Joint Meetings participants will be available in an email center located near the JMM Registration Desk. The hours of operation will be published in the program. Participants should be aware that **complimentary Internet access** will be available in the public areas of the San Francisco Marriott Hotel. A list of nearby restaurants/cafes that offer free wireless access will be published in the program.

**Information Distribution**: Tables are set up in the exhibit area for dissemination of general information of possible interest to the members and for the dissemination of information of a mathematical nature not promoting a product or program for sale. Information must be approved by the director of meetings prior to being placed on these tables.

If a person or group wishes to display information of a mathematical nature promoting a product or program for sale, they may do so in the exhibit area at the Joint Books, Journals, and Promotional Materials exhibit for a fee of US$50 (posters are slightly higher) per item. Please contact the exhibits manager, MMSB, P.O. Box 6887, Providence, RI 02940, or by email at cpd@ams.org for further details.

The administration of these tables is in the hands of the AMS-MAA Joint Meetings Committee, as are all arrangements for Joint Mathematics Meetings.

**Local Information**: For information about the city see www.onlyinsanfrancisco.com/groups/jmm.asp.

**Petition Table:** At the request of the AMS Committee on Human Rights of Mathematicians, a table will be made available in the exhibit area at which petitions on behalf of named individual mathematicians suffering from human rights violations may be displayed and signed by meetings participants acting in their individual capacities. For details contact the director of meetings in the Providence office at 401-455-4145 or by email at pop@ams.org.

Signs of moderate size may be displayed at the table but must not represent that the case of the individual in question is backed by the Committee on Human Rights unless it has, in fact, so voted. Volunteers may be present at the table to provide information on individual cases, but notice must be sent at least seven days in advance of the meetings to the director of meetings in the Providence office. Since space is limited, it may also be necessary to limit the number of volunteers present at the table at any one time. The Committee on Human Rights may delegate a person to be present at the table at any or all times, taking precedence over other volunteers.

Any material that is not a petition (e.g., advertisements, résumés) will be removed by the staff. At the end of the exhibits on Saturday, any material on the table will be discarded, so individuals placing petitions on the table should be sure to remove them prior to the close of exhibits.

**Telephone Messages**: The most convenient method for leaving a message is to do so with the participant's hotel. Another method would be to leave a message at the meetings registration desk from January 13 through 16 during the hours that the desk is open. These messages will be posted on the Mathematics Meetings Message Board; however, staff at the desk will try to locate a participant in the event of a bona fide emergency. The telephone number will be published in the program and daily newsletter.

## Travel/Transportation

**Travel to Moscone Convention Center**: Moscone West, part of the Moscone Convention Center (www.moscone.com) is located at Fourth and Howard Streets. The main address of Moscone Center is 747 Howard Street, San Francisco. General driving directions to Moscone Center are listed at www.moscone.com/directions/driving.shtml. Consult your preferred Internet mapping site for more specific directions. The parking map located at www.moscone.com/pdf/MosconeParkingMap.pdf is helpful for reference for the immediate area.

Moscone West is very accessible via San Francisco's public transit systems, BART (Bay Area Rapid Transit, www.bart.gov, see system map at http://bart.gov/stations/index.aspx, and MUNI, www.sfmta.com, see map at http://transit.511.org/static/providers/maps/SF_712200722226.pdf. The BART/MUNI station for Moscone West is Powell Street. If you are traveling within California in an area serviced by Caltrain, www.caltrain.com, see the map at http://www.caltrain.com/caltrain_map.html. The San Francisco station at Fourth and Townsend is approximately three-quarters of a mile from the Moscone Center.

**Traveling from the airports**: San Francisco is on Pacific Standard Time, and is conveniently served by two local airports: San Francisco International Airport (SFO), which is thirteen miles southeast of Moscone Center; and Oakland (OAK), which is nineteen miles slightly southeast.

Terminal maps of each airport can be found online: San Francisco International Airport at www.flysfo.com/web/page/as_airportmaps.htm and Oakland International Airport (OAK) Terminal 1 Map at www.flyoakland.com/terminal_1_map.html and Terminal 2 map at www.flyoakland.com/terminal_2_map.html.

**Driving from the airports to Moscone Center**

**From SFO**: Take the free AirTrain blue line to get to the rental car center. The address of the airport is 1 McDonnell Rd., San Francisco, CA 94128 (for www.mapquest.com) or S. McDonnell Rd. & S. Link Rd, San Francisco, CA 94128 (for maps.yahoo.com) or go to www.visitingdc.com/maps/san-francisco-airport-directions.asp and insert your desired destination address. Take Route 101 North, then I-80 East. Exit at Fourth Street. Take a left on Bryant, a left on Third, and a left at Howard Street. Moscone West is at Fourth and Howard. To drive to your hotel, see the hotel page at 1202 for its specific address.

**From OAK**: In Oakland, there is a rental car shuttle that operates every ten minutes; however, it operates on demand between 1:30 a.m. and 4:30 a.m. The address of the airport is 1 Airport Dr., Oakland, CA 94621. Head southeast on Airport Drive and stay to the right. Take I-880 North toward Oakland. Merge onto I-80 West to San

# How to Obtain Hotel Accommodations – 2010 JMM

## General Instructions

Participants must register in advance in order to obtain hotel accommodations through the Mathematics Meetings Service Bureau (MMSB). Special rates have been negotiated exclusively for this meeting at the following hotels: the San Francisco Marriott, the Intercontinental San Francisco, the W Hotel San Francisco, the Serrano Hotel, the Parc 55 Hotel San Francisco, the Handlery Union Square, the Holiday Inn Civic Center, the Powell Hotel, the Hotel Mark Twain, and the Hotel Whitcomb. Reservations must be made through the MMSB to receive these rates. These hotels can ONLY start accepting reservations directly after **December 22**, at which time rooms and rates will be based on availability; higher rates will be applied to any rooms reserved directly with these hotels at the JMM rates before **December 22.**

**To make a reservation**, please submit a completed housing section of the Advance Registration/Housing (ARH) Form (via paper or the web) by **November 18**. If you use the web, you will be required to supply a credit card to reserve your room. If you submit a paper form, you will need either a credit card number or a check deposit for one night's stay. **Sorry, reservations cannot be taken by phone.** The web form can be found at **www.ams.org/meetreg?meetnum=2124.** The paper form can be found at the back of this announcement. Participants interested in suites should contact the MMSB directly at mmsb@ams.org or 1-800-321-4267 ext. 4137 or 4144 for further information.

## Confirmations

The Marriott, the Intercontinental, the Holiday Inn Civic Center, and the Hotel Whitcomb will be sending email confirmations. The other hotels will not send separate hotel confirmations. You may contact the MMSB after December 21 if you would like to receive your confirmation number.

## ADA Accessibility

All hotels are in compliance with ADA, and most have auxiliary aids and services available on request and TTY/TDD phones. The Mark Twain does not have TTY/TDD phones. TTY/TDD phones must be requested in advance at the Holiday Inn.

### Deadlines

| | |
|---|---|
| • Complimentary Room Drawing: | **Nov. 4** |
| • Reservations through MMSB: | **Nov. 18** |
| • Changes/Cancellations through MMSB: | **Dec. 14** |

### Complimentary Room Drawing

Anyone who reserves a room through the MMSB by **November 4** is eligible for a drawing to receive complimentary room nights during the meeting. See *How to Register in Advance* for details.

## Environmental Policies

The majority of the hotels have successful "green" programs in place. Since 2004 Marriott has been awarded more ENERGY STAR labels than any other hotel company. In addition, the Parc 55 has received an ENERGY STAR label, the Intercontinental is LEED green-certified, the Hotel Whitcomb is considered a "green" hotel, and the Serrano's Kimpton EarthCare program is nationally recognized.

## Rates

- Subject to a 15.5% state tax/TID tax.
- Only certified students or unemployed mathematicians qualify for student rates.
- See the Advanced Registration/Housing (ARH) Form for a detailed breakdown of rates for each hotel.

## Guarantee Requirements

- One night deposit by check, or
- Credit cards: Visa, MC, AMEX, Diners, and Discover.

## Cancellation Policies (cancellation without penalty)

- Marriott, W Hotel, Serrano, Parc 55, Handlery, Powell, Holiday Inn: 72 hours before arrival
- Mark Twain: 48 hours before arrival
- Intercontinental and Whitcomb: 24 hours before arrival

## Check-in/Check-out

Check-in at Marriott is 4:00 p.m.; check-in at the Powell is 2:00 p.m. Check-in at all other hotels is 3:00 p.m. Check-out at all hotels is 12:00 p.m.

## Internet Access/Wireless

- **Marriott:** Complimentary wireless internet on the first floor, by Starbucks, the bar and around the corner in the secluded seating area, as well as upstairs in the restaurant; wired/wireless in guest rooms for a daily rate of US $12.95
- **Parc 55:** Wireless internet in lobby and public areas for a daily rate of US $12.95, and wired/wireless in guest rooms for a daily rate of US $12.95 (same fee covers both areas)
- **W Hotel and Intercontinental:** Complimentary wireless internet in lobby; wired/wireless in guest rooms for a daily rate of US $14.95
- **Handlery:** Wireless internet access in lobby and public spaces for a daily rate of US $9.95, and in guest rooms for a daily rate of US $9.95 (same fee covers both areas).
- **Mark Twain:** Wireless/wired internet available in guest rooms for a daily rate of US $9.95. Internet available in lobby kiosk for US $3.00 for 15 minutes; US $6.00 for 45 minutes
- **Serrano Hotel:** Complimentary wireless internet access in public spaces; complimentary wireless internet in guest rooms with Kimpton In-Touch sign up at www.kimptonhotels.com/intouch/KIT_overview.aspx
- **Holiday Inn, Powell Hotel, Hotel Whitcomb:** Complimentary wireless internet available in all guest rooms, lobby and public areas

| **Marriott San Francisco**<br>**(hdqtrs, ~1.5 blocks from Moscone West)** | **Intercontinental San Francisco**<br>**(~1.5 blocks from Moscone West)** | **W Hotel San Francisco**<br>**(~1.5 blocks from Moscone West)** | **Serrano Hotel**<br>**(~5 blocks from Moscone West)** |
|---|---|---|---|
| 55 Fourth Street<br>San Francisco, CA 94103<br>415-896-1600<br>Single/Double: US $175<br>Student Single/Double: US $140<br><br>Smoke-free hotel. Restaurants: Bin 55, Fourth St. Bar & Deli, Mission Steak House, The View (bar), and Starbucks. Fitness center; Indoor pool; Spa services available; Business center; Full amenities in guest rooms; In-room safe; Windows open slightly in suites, but not in regular sleeping rooms; Children under 18 free in room with an adult; Cribs available upon request at no charge. No pets allowed except service animals. Valet parking for US $55.86 per day; Self parking US $13 hourly, $55.86 daily. **Confirmations sent by email only.** | 888 Howard Street<br>San Francisco, CA 94103-3011<br>415-616-6500<br>Single/Double: US $175<br>Student Single/Double US $140<br><br>Smoke-free hotel. Restaurant: Luce. Fitness center (24 hrs); Indoor pool; Spa services available; Business center; Full amenities in guest rooms; In-room safe; Children under 18 free in room with an adult; Cribs available upon request at no charge. Pets allowed with US $50 non-refundable fee (pets cannot be left unattended in guest room). Valet parking only for US $55.86 per day. **Confirmations sent by email only.** | 181 Third Street<br>San Francisco, CA 94103<br>415-777-5300<br>Single/Double: US $169<br>Student Single/Double: US $140<br><br>Non-smoking hotel. Restaurants: W Café, XYZ, XYZ Bar. Fitness center; Heated indoor pool; Spa services available; Business center; Full amenities in guest rooms including CD/DVD player; In-room safe; Children under 18 free in room with an adult; Cribs available upon request at no charge. Pets allowed (dogs and cats), contact directly for additional information and fees. Valet parking only for registered guests for US $45 per day plus tax. Hybrids US $22.50 per day plus tax. **No separate hotel confirmations will be sent.** | 405 Taylor Street<br>San Francisco, CA 94102<br>415-885-2500<br>Single/Double: US $160<br><br>Smoke-free hotel. Restaurant: Ponzu (next to Serrano Hotel). Fitness center; Spa services available; Business center (24 hrs); Full amenities in guest rooms; In-room safe; Children under 18 free in room with an adult; Cribs available upon request at no charge. Pet-friendly hotel. Valet parking with unlimited in-and-out privileges is US $39.95 plus tax per day (oversized vehicles $49.95). Hybrids 25% off overnight parking. **No separate hotel confirmations will be sent.** |
| **Parc 55 Hotel San Francisco**<br>**(~2.5 blocks from Moscone West)** | **Handlery Union Square Hotel**<br>**(~5 blocks from Moscone West)** | **Holiday Inn Civic Center**<br>**(~5 blocks from Moscone West)** | **The Powell Hotel**<br>**(~2.5 blocks from Moscone West)** |
| 55 Cyril Magnin Street<br>San Francisco, CA 94102<br>415-392-8000<br>Single/Double: US $152<br>Student Single/Double: US $135<br><br>Restaurants: Cityhouse Steakhouse, Cityhouse Bar, Barbary Coast, Siam Thai. Fitness center (24 hrs); Business center; Full amenities in guest rooms; In-room safe; Windows open in rooms; Children under 13 free in room with an adult; Cribs available for a US $20 one-time charge. Pet-friendly rooms available (additional cost). Valet parking only for US $44.00 per day plus tax. **No separate hotel confirmations will be sent.** | 351 Geary Street<br>San Francisco, CA 94102<br>415-781-7800<br>Single/Double: US $146<br>Student Single/Double US $136<br><br>Smoke-free hotel. Restaurant: "The Daily Grill." Outdoor heated pool; Business center; Full amenities in guest rooms; In-room safe; Children under 14 free in room with an adult; Cribs available upon request at no charge. Pets allowed starting July 2009. On-site, covered valet parking with unlimited in-and-out privileges for US $38 per day plus tax (oversized vehicles US $47). **No separate hotel confirmations will be sent.** | 50 Eighth Street<br>San Francisco, CA 94103<br>415-626-6103<br>Single/Double: US $120<br>Student Single/Double: US $110<br><br>Restaurants: 50$^{on}$Eight Bar and Lounge. Fitness center; Outdoor heated pool; Business Center (24 hrs); Full amenities in guest rooms; In-room safe; Windows open in all rooms with balconies; Children under 18 free in room with an adult; Cribs available upon request at no charge. Pets under 20 lbs allowed with a daily fee of US $75 plus tax. Self-parking in indoor 24-hour garage for $29 per day plus tax. **Confirmations sent by email only.** | 28 Cyril Magnin Street<br>San Francisco, CA 94102<br>415-398-3200<br>Single/Double: US $110<br>Student Single/Double: US $99<br><br>Smoke-free hotel. Restaurant: Jazz Bistro. No room service. No business center, but there is a computer kiosk in the lobby with a printer available free of charge. ClubOne health clubs day pass/discount available for guests. Full amenities in guest rooms; Safety deposit boxes behind front desk; Windows open in rooms; Children under 12 free in room with an adult; Playpens (not cribs) available. Pets allowed with a deposit against damages and a liability waiver. Valet parking only for US $35.34 per day with in-and-out privileges. **No separate hotel confirmations will be sent.** |

| Hotel Mark Twain<br>(7 blocks from Moscone West) | Hotel Whitcomb<br>(~5 blocks from Moscone West) |
|---|---|
| 345 Taylor Street<br>San Francisco, CA 94102<br>415-673-2332<br>Single/Double: US $99 | 1231 Market Street<br>San Francisco, CA 94103<br>415-626-8000<br>Single/Double: US $99 |
| No smoking hotel. Restaurants: Fish and Farm, Taylor Street Coffee Shop. Small fitness center (24 hrs); Small basic business center; Full amenities in guest rooms include refrigerators and ceiling fans; In-room safes; Safety deposit boxes available at the front desk; Children under 13 free in room with an adult. Valet parking only with unlimited in-and-out privileges for US $25 plus tax for a standard-sized vehicle. **No separate hotel confirmations will be sent.** | No smoking hotel. Restaurants: Market Street Grill, The Tavern Piano Bar, and Starbucks. Small fitness center (24 hrs); Business center; Full amenities in guest rooms; In-room safe; Children under 17 free in room with an adult; Cribs available upon request at no charge. Valet parking only, with unlimited access, is available for US $28 plus tax. **Confirmations sent by email only.** |


## Hostels

As an alternative housing choice, there are several hostels within a reasonable distance from the Moscone West (approximate distance listed). Please go online or call directly for further information and reservations.

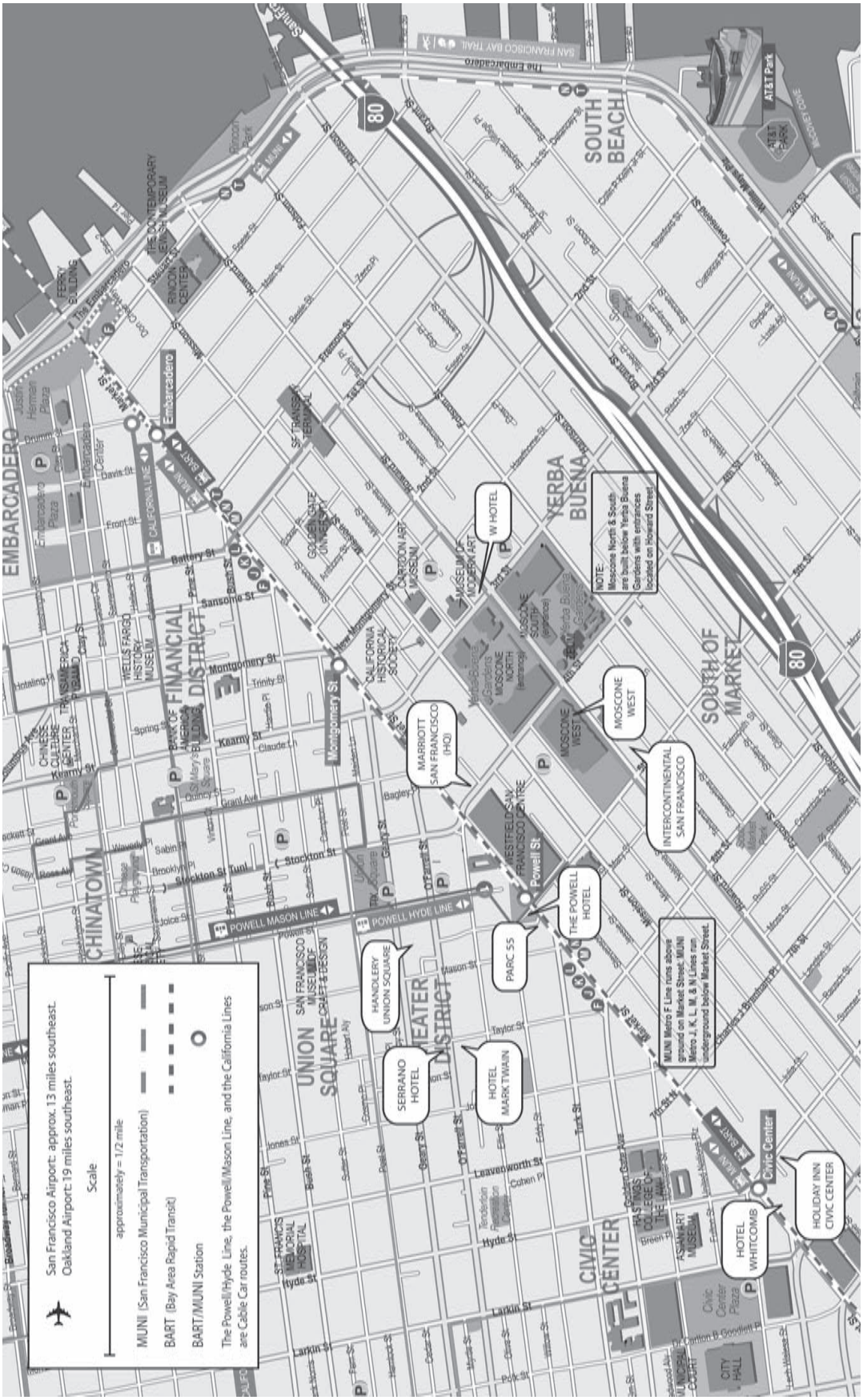
**The Adelaide**
(.8 mile from Moscone West)
5 Isadora Duncan Street
San Francisco, CA 94102
415-359-1915
Email: info@adelaidehostel.com
Website: www.adelaidehostel.com
Range: US $17-70

**Hostelling International**
**San Francisco City Center**
(.8 mile from Moscone West)
685 Ellis Street
San Francisco, CA 94109
415-474-5721
Email: sfcitycenter@norcalhostels.org
Website: www.sfhostels.com
Range: US $23-100 (Complimentary wireless)

**Hostelling International**
**San Francisco Downtown**
(.6 mile from Moscone West)
312 Mason Street
San Francisco, CA 94102
415-788-5604
Email: dtinfo@sfhostels.com
Website: www.sfhostels.com
Range: US $25-69 (Complimentary wireless)

**Hostelling International**
**Fisherman's Wharf**
(2.7 miles from Moscone West)
240 Fort Mason
San Francisco, CA 94123
415-771-7277
Email: jeannec@norcalhostels.org
Website: www.sfhostels.com
Range: US $26-125 (Complimentary wireless)

**USA Hostels San Francisco**
(~1 mile from Moscone West)
711 Post Street
San Francisco, CA 94109
877-483-2950
Email: marketing@usahostels.com
Website: www.usahostels.com
Range: US $29-90




**Joint Mathematics Meetings, San Francisco, California**
**Hotel Map**

Map courtesy of the San Francisco Convention and Visitors Bureau and the Map Network.

Francisco. Exit onto Fremont Street and turn left at Howard Street. Moscone West is at Fourth and Howard.

**Public Transportation from the Airports**

SFO: The San Francisco Airport BART Station is located on the Departures/Ticketing Level of the International Terminal (Boarding Area G side). The station is easily reached by taking the free AirTrain to the Garage G/BART Station stop. The BART fare from SFO to the Powell Street station is approximately US$8.

OAK: The nearest BART station is Coliseum/Oakland Airport Station. AirBart operates between the Coliseum/Oakland Airport station and Oakland Airport every 10 minutes daily. Service on weekdays and Saturdays is 5:00 a.m. to midnight; 8:00 a.m. to midnight on Sundays and holidays. The shuttle stop for AirBart is located between Terminal 1 & 2 at Oakland Airport's third curbside. The fare for AirBart is US$3; Seniors, children (under 12), and the disabled are US$1. The fare on BART from Coliseum/Oakland Airport to Powell Street is US$3.80. The public bus system, AC Transit (www.actransit.com) also provides transportation from the airport to the Coliseum/Oakland Airport BART station via the 50 and 805 lines. The 805 is a late night service, running hourly starting at 1:25 a.m.

**Taxis and Shuttles**

Taxi: One-way taxi fare to the San Francisco Marriott Hotel is approximately US$40 from SFO and US$51 from OAK.

SuperShuttle: www.supershuttle.com. The fare to the San Francisco Marriott Hotel in a nine-passenger shared van is US$17 each person from SFO and US$27 (for the first passenger; additional passengers are US$15 in shared van) from OAK.

**Discounted Car Rental**

**Avis Rent A Car** is the official car rental company for the meetings. Depending on variables such as location, length of rental, and size of vehicle, Avis will offer participants the best available rate which can range from 5%–25% discount off regular rates. Participants must use the assigned Meeting Avis Discount Number (J098887) and meet Avis rate requirements to receive the discount. (Rate discounts are available at all corporate and participating licensee locations.) Reservations can be made by calling 1-800-331-1600 or online at www.avis.com.

All car rentals include unlimited free mileage and are available to renters 25 years and older. Renters must also meet Avis's driver and credit requirements. Return to the same rental location or additional surcharges may apply. Rates do not include any state or local surcharges, tax, optional coverages, or gas refueling charges.

### Travel Information for International Participants

International participants should view the important information about traveling to the United States at www7.nationalacademies.org/visas/Traveling_to_US.html.

Because of increased scrutiny of visa applicants, many potential attendees of scientific meetings in the United States have experienced unusual delays in obtaining travel visas. If you need a letter of invitation from the AMS and have not yet requested it, please send email to meet@ams.org and an invitation will be forwarded as soon as possible. In order to compose and send your letter, we will need your document number, email address, and your complete mailing address. Also see this very informative document from the U.S. Department of State which lists answers to frequently asked questions about the processing of visas (www.ams.org/amsmtgs/FAQ-Bus-1-Visa.pdf). You should also be aware that this meeting has been registered with the U.S. Department of State.

**Machine Readable Passports Required by June 26, 2005**: The Department of Homeland Security reminds travelers from the 27 Visa Waiver Program (VWP) countries (see the website cited above for a list) that as of June 26, 2005, they must have a machine-readable passport to enter the United States without a visa. Beginning June 26, 2005, transportation carriers will be fined US$3,300, per violation, for transporting any VWP traveler to the United States without a machine-readable passport. Similarly, VWP travelers arriving in the United States on that date without a machine-readable passport should not anticipate being granted one-time entry into the country. As an alternative for persons with immediate travel plans who are unable to obtain a machine-readable passport in time, the individual may apply for a U.S. visa at a U.S. Consulate or Embassy abroad.

### Weather

In January in San Francisco you will find average daily high and low temperatures between 58°F and 46°F. January also sees more rain than any other month of the year. Please plan accordingly. Visit your favorite weather site for up-to-the-minute forecasts, or see www.usatoday.com/weather/default.htm.

# Lexington, Kentucky

*University of Kentucky*

### March 27–28, 2010

*Saturday – Sunday*

### Meeting #1057

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: January 2010
Program first available on AMS website: February 11, 2010
Program issue of electronic *Notices*: March 2010
Issue of *Abstracts*: Volume 31, Issue 2

### Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 8, 2009
For abstracts: February 2, 2010

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

### Invited Addresses

**Percy A. Deift**, Courant Institute- New York University, *Title to be announced*.

**Irina Mitrea**, Worcester Polytechnic Institute, *Title to be announced*.

**Bruce Reznick**, University of Illinois at Urbana Champaign, *Title to be announced*.

**Bernd Ulrich**, Purdue University, *Title to be announced*.

**Doron Zeilberger**, Rutgers University, *3x+1* (Erdős Memorial Lecture).

### Special Sessions

*Advances in Algebraic Coding Theory* (Code: SS 6A), **Heide Gluesing-Luerssen**, University of Kentucky, and **Jon-Lark Kim**, University of Louisville.

*Advances in Algebraic Statistics* (Code: SS 2A), **Sonja Petrović** University of Illinois, Chicago, and **Ruriko Yoshida**, University of Kentucky.

*Combinatorial Algebra* (Code: SS 7A), **Juan C. Migliore**, University of Notre Dame, and **Uwe Nagel**, University of Kentucky.

*Commutative Algebra* (Code: SS 1A), **Alberto Corso**, University of Kentucky, **Claudia Polini**, University of Notre Dame, and **Bernd Ulrich**, Purdue University.

*Complex Analysis and Potential Theory* (Code: SS 4A), **James E. Brennan** and **Vladimir Eiderman**, University of Kentucky.

*Function Theory, Harmonic Analysis, and Partial Differential Equations* (Code: SS 5A), **Joel Kilty**, Centre College, **Irina Mitrea**, Worcester Polytechnic Institute, and **Katharine Ott**, University of Kentucky.

*Geometric Function Theory and Analysis on Metric Spaces* (Code: SS 3A), **John L. Lewis**, University of Kentucky, and **Nageswari Shanmugalingam**, University of Cincinnati.

*Inverse Problems, Riemann-Hilbert Problems, and Nonlinear Dispersive Equations* (Code: SS 10A), **Peter A. Perry**, University of Kentucky, and **Peter Topalov**, Northeastern University.

*Matroid Theory* (Code: SS 9A), **Jakayla Robbins**, University of Kentucky, and **Xiangqian Zhou**, Wright State University.

*Partial Differential Equations in Geometry and Variational Problems* (Code: SS 8A), **Luca Capogna**, University of Arkansas, and **Changyou Wang**, University of Kentucky.

*Recent Progress in Numerical Methods for Partial Differential Equations* (Code: SS 12A), **Alan Demlow**, University of Kentucky, and **Xiaobing H. Feng**, University of Tennessee at Knoxville.

*Relative Homological Algebra* (Code: SS 11A), **Edgar E. Enochs**, University of Kentucky, and **Alina C. Iacob**, Georgia Southern University.

# St. Paul, Minnesota

*Macalester College*

### April 10–11, 2010

*Saturday – Sunday*

### Meeting #1058

Central Section
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: February 2010
Program first available on AMS website: February 25, 2010
Program issue of electronic *Notices*: April 2010
Issue of *Abstracts*: Volume 31, Issue 2

### Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 22, 2009
For abstracts: February 16, 2010

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Charles Doering**, University of Michigan, *Title to be announced*.

**Matthew James Emerton**, Northwestern University, *Title to be announced*.

**Vladimir Touraev**, University of Indiana, *Title to be announced*.

**Peter Webb**, University of Minnesota, *Title to be announced*.

### Special Sessions

*Combinatorial Representation Theory* (Code: SS 3A), **Tom Halverson**, Macalester College, and **Victor Reiner**, University of Minnesota.

*Probabilistic and Extremal Combinatorics* (Code: SS 2A), **Ryan Martin** and **Maria Axenovich**, Iowa State University.

*Quantum Invariants of 3-manifolds and Modular Categories* (Code: SS 1A), **Thang Le**, Georgia Institute of Technology, **Eric Rowell**, Texas A&M University, and **Vladimir Touraev**, Indiana University.

*Universal Algebra and Order* (Code: SS 4A), **Jeffrey Olson**, Norwich University, **Jeremy Alm**, Illinois College, **Kristi Meyer**, Wisconsin Lutheran College, and **Japheth Wood**, Bard College.

# Albuquerque, New Mexico

*University of New Mexico*

### April 17–18, 2010
*Saturday – Sunday*

### Meeting #1059
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: February 2010
Program first available on AMS website: March 4, 2010
Program issue of electronic *Notices*: April 2010
Issue of *Abstracts*: Volume 31, Issue 3

### Deadlines
For organizers: September 17, 2009
For consideration of contributed papers in Special Sessions: December 29, 2009
For abstracts: February 23, 2010

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses
**Kenneth Bromberg**, University of Utah, *Title to be announced.*

**Danny Calegari**, California Institute of Technology, *Title to be announced.*

**Ioana Dumitriu**, University of Washington, *Title to be announced.*

**Steffen Rhode**, University of Washington, *Title to be announced.*

### Special Sessions
*Dyadic and Non-Dyadic Harmonic Analysis* (Code: SS 2A), **M. Cristina Pereyra**, University of New Mexico, and **Stephanie A. Salomone**, University of Portland.

*Topics in Geometric Group Theory* (Code: SS 1A), **Matthew Day**, California Institute of Technology, **Daniel Peter Groves**, University of Illinois at Chicago, **Jason Manning**, SUNY at Buffalo, and **Henry Wilton**, University of Texas.

*Trends in Commutative Algebra* (Code: SS 3A), **Louiza Fouli**, New Mexico State University, and **Janet Vassilev**, University New Mexico.

# Newark, New Jersey

*New Jersey Institute of Technology*

### May 22–23, 2010
*Saturday – Sunday*

### Meeting #1060
Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: March 2020
Program first available on AMS website: April 8, 2010
Program issue of electronic *Notices*: May 2020
Issue of *Abstracts*: Volume 31, Issue 3

### Deadlines
For organizers: November 23, 2009
For consideration of contributed papers in Special Sessions: February 2, 2010
For abstracts: March 30, 2010

# Berkeley, California

*University of California Berkeley*

### June 2–5, 2010
*Wednesday – Saturday*

### Meeting #1061
*Eighth Joint International Meeting of the AMS and the Sociedad Matemática Mexicana.*
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: February 2010
Program first available on AMS website: April 22, 2010
Program issue of electronic *Notices*: June 2010
Issue of *Abstracts*: Volume 31, Issue 3

### Deadlines
For organizers: November 3, 2009
For consideration of contributed papers in Special Sessions: February 16, 2010
For abstracts: April 13, 2010

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/internmtgs.html`.

### Invited Addresses
**Alejandro Adem**, University of British Columbia and PIMS, *Title to be announced.*

**Peter W-K Li**, University of California Irvine, *Title to be announced.*

**Ernesto Lupercio**, CINVESTAV, *Title to be announced.*

**Victor Perez Abreu**, CIMAT, *Title to be announced.*

**Alberto Verjovsky**, IM-UNAM, *Title to be announced.*

**Maciej Zworski**, University of California Berkeley, *Title to be announced.*

### Special Sessions

*Analytic Aspects of Differential Geometry* (Code: SS 2A), **Lizhen Ji**, University of Michigan, and **Jiaping Wang**, University of Minnesota.

*Harmonic Analysis, Microlocal Analysis, and Partial Differential Equations* (Code: SS 1A), **Gunther Uhlmann**, University of Washington, and **Salvador Perez Esteva**, UNAM.

# Syracuse, New York

*Syracuse University*

### October 2–3, 2010

*Saturday – Sunday*

### Meeting #1062

Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: To be announced
Program first available on AMS website: August 19, 2010
Program issue of electronic *Notices*: October
Issue of *Abstracts*: Volume 31, Issue 4

### Deadlines

For organizers: March 2, 2010
For consideration of contributed papers in Special Sessions: June 15, 2010
For abstracts: August 10, 2010

# Los Angeles, California

*University of California Los Angeles*

### October 9–10, 2010

*Saturday – Sunday*

### Meeting #1063

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2010
Program first available on AMS website: August 26, 2010
Program issue of electronic *Notices*: October 2010
Issue of *Abstracts*: Volume 31, Issue 4

### Deadlines

For organizers: March 10, 2010
For consideration of contributed papers in Special Sessions: June 22, 2010
For abstracts: August 17, 2010

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Greg Kuperberg**, University of California Davis, *Title to be announced*.

**Cris Moore**, University of New Mexico, *Title to be announced*.

**Stanley Osher**, University of California Los Angeles, *Title to be announced*.

**Terence Tao**, University of California Los Angeles, *Title to be announced* (Einstein Public Lecture in Mathematics).

**Melanie Wood**, Princeton University, *Title to be announced*.

### Special Sessions

*Large Cardinals and the Continuum* (Code: SS 2A), **Matthew Foreman**, University of California Irvine, **Alekos Kechris**, California Institute for Technology, **Itay Neeman**, University of California Los Angeles, and **Martin Zeman**, University of California Irvine.

*Topology and Symplectic Geometry* (Code: SS 1A), **Robert Brown** and **Ciprian Manolescu**, University of California Los Angeles, and **Stefano Vidussi**, University of California Riverside.

# Notre Dame, Indiana

*Notre Dame University*

### October 29–31, 2010

*Friday – Sunday*

### Meeting #1064

Central Section
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: August 2010
Program first available on AMS website: September 16, 2010
Program issue of electronic *Notices*: October 2010
Issue of *Abstracts*: Volume 31, Issue 4

### Deadlines

For organizers: February 19, 2010
For consideration of contributed papers in Special Sessions: July 20, 2010
For abstracts: September 7, 2010

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Laura DeMarco**, University of Illinois at Chicago, *Title to be announced*.

**Jordan Ellenberg**, University of Wisconsin, *Title to be announced*.

**David Fisher**, Indiana University, *Title to be announced*.

**Jared Wunsch**, Northwestern University, *Title to be announced*.

### Special Sessions

*Commutative Algebra and Its Interactions with Algebraic Geometry* (Code: SS 2A), **Claudia Polini**, University of Notre Dame, **Alberto Corso**, University of Kentucky, and **Bernd Ulrich**, Purdue University.

*Hilbert Functions in Commutative Algebra and Algebraic Combinatorics* (Code: SS 3A), **Fabrizio Zanello**, Michigan Technological University, **Juan Migliore**, University of Notre Dame, and **Uwe Nagel**, University of Kentucky.

*Singularities in Algebraic Geometry* (Code: SS 1A), **Nero Budur**, University of Notre Dame, and **Lawrence Ein**, University of Illinois at Chicago.

# Richmond, Virginia

*University of Richmond*

### November 6–7, 2010

*Saturday – Sunday*

### Meeting #1065

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: September
Program first available on AMS website: September 23, 2010
Program issue of electronic *Notices*: November
Issue of *Abstracts*: Volume 31, Issue 4

### Deadlines

For organizers: March 8, 2010
For consideration of contributed papers in Special Sessions: July 27, 2010
For abstracts: September 14, 2010

# Pucon, Chile

### December 15–18, 2010

*Thursday – Sunday*
*First Joint International Meeting between the AMS and the Sociedad de Matematica de Chile.*
Associate secretary: Robert J. Daverman
Announcement issue of *Notices*: June 2010
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

### Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# New Orleans, Louisiana

*New Orleans Marriott and Sheraton New Orleans Hotel*

### January 5–8, 2011

*Wednesday – Saturday*
*Joint Mathematics Meetings, including the 117th Annual Meeting of the AMS, 94th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).*
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: October 2010
Program first available on AMS website: November 1, 2010
Program issue of electronic *Notices*: January 2011
Issue of *Abstracts*: Volume 32, Issue 1

### Deadlines

For organizers: April 1, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# Statesboro, Georgia

*Georgia Southern University*

### March 12–13, 2011

*Saturday – Sunday*
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

### Deadlines

For organizers: August 12, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# Iowa City, Iowa

*University of Iowa*

### March 18–20, 2011

*Friday – Sunday*
Central Section
Associate secretary: Georgia Benkart

Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

### Deadlines

For organizers: July 16, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# Worcester, Massachusetts

*College of the Holy Cross*

### April 9–10, 2011

*Saturday – Sunday*
Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

### Deadlines

For organizers: September 9, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# Las Vegas, Nevada

*University of Nevada*

### April 30 – May 1, 2011

*Saturday – Sunday*
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

### Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Special Sessions

*Geometric PDEs* (Code: SS 1A), **Matthew Gursky**, Notre Dame University, and **Emmanuel Hebey**, Universite de Cergy-Pontoise.

# Boston, Massachusetts

*John B. Hynes Veterans Memorial Convention Center, Boston Marriott Hotel, and Boston Sheraton Hotel*

### January 4–7, 2012

*Wednesday – Saturday*
*Joint Mathematics Meetings, including the 118th Annual Meeting of the AMS, 95th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).*
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2011
Program first available on AMS website: November 1, 2011
Program issue of electronic *Notices*: January 2012
Issue of *Abstracts*: Volume 33, Issue 1

### Deadlines

For organizers: April 1, 2011
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# San Diego, California

*San Diego Convention Center and San Diego Marriott Hotel and Marina*

### January 9–12, 2013

*Wednesday – Saturday*
*Joint Mathematics Meetings, including the 119th Annual Meeting of the AMS, 96th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).*
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: October 2012
Program first available on AMS website: November 1, 2012
Program issue of electronic *Notices*: January 2012
Issue of *Abstracts*: Volume 34, Issue 1

**Deadlines**
For organizers: April 1, 2012
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# Baltimore, Maryland

*Baltimore Convention Center, Baltimore Hilton, and Marriott Inner Harbor*

**January 15–18, 2014**
*Wednesday – Saturday*
*Joint Mathematics Meetings, including the 120th Annual Meeting of the AMS, 97th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).*
Associate secretary: Matthew Miller
Announcement issue of *Notices*: October 2013
Program first available on AMS website: November 1, 2013
Program issue of electronic *Notices*: January 2013
Issue of *Abstracts*: Volume 35, Issue 1

**Deadlines**
For organizers: April 1, 2013
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# San Antonio, Texas

*Henry B. Gonzalez Convention Center and Grand Hyatt San Antonio*

**January 10–13, 2015**
*Saturday – Tuesday*
*Joint Mathematics Meetings, including the 121st Annual Meeting of the AMS, 98th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association of Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).*
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: October 2014
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2015
Issue of *Abstracts*: Volume 36, Issue 1

**Deadlines**
For organizers: April 1, 2014
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# Seattle, Washington

*Washington State Convention & Trade Center and the Sheraton Seattle Hotel*

**January 6–9, 2016**
*Wednesday – Saturday*
*Joint Mathematics Meetings, including the 122nd Annual Meeting of the AMS, 99th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association of Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).*
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2015
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2016
Issue of *Abstracts*: Volume 37, Issue 1

**Deadlines**
For organizers: April 1, 2015
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# Atlanta, Georgia

*Hyatt Regency Atlanta and Marriott Atlanta Marquis*

**January 4–7, 2017**
*Wednesday – Saturday*
*Joint Mathematics Meetings, including the 123rd Annual Meeting of the AMS, 100th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association of Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).*
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: October 2016
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2017
Issue of *Abstracts*: Volume 38, Issue 1

**Deadlines**
For organizers: April 1, 2016
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

# Program at a Glance

This document provides a thumbnail sketch of all scientific and social events so you can easily see which events may overlap and better plan your time.


**Joint Mathematics Meetings**
San Francisco, CA
January 13–16, 2010

## Monday, January 11

| | |
|---|---|
| 8:00 a.m.–noon | **REGISTRATION FOR SHORT COURSES AND AMS TUTORIAL** |
| 9:00 a.m.–4:30 p.m. | **MAA SHORT COURSE ON EXPLORING THE GREAT BOOKS OF MATHEMATICS, PART I** |
| 9:00 a.m.–4:30 p.m. | **AMS TUTORIAL ON MODELING, PART I** *Introduction to numerical modeling.* |
| 9:30 a.m.–5:00 p.m. | **AMS SHORT COURSE ON MARKOV CHAINS AND MIXING TIMES, PART 1** |

## Tuesday, January 12

| | |
|---|---|
| 8:00 a.m.–6:00 p.m. | **AMS DEPARTMENT CHAIRS WORKSHOP** |
| 8:30 a.m.–5:00 p.m. | **MAA ANCILLARY WORKSHOP ON STATISTICS** *Teaching introductory statistics.* |
| 8:30 a.m.–5:00 p.m. | **MAA ANCILLARY WORKSHOP ON STATISTICS** *Become a catalyst for change in statistics education.* |
| 9:00 a.m.–4:30 p.m. | **AMS SHORT COURSE ON MARKOV CHAINS AND MIXING TIMES, PART II** |
| 9:00 a.m.–4:30 p.m. | **MAA SHORT COURSE ON EXPLORING THE GREAT BOOKS OF MATHEMATICS, PART II** |
| 9:00 a.m.–4:30 p.m. | **AMS TUTORIAL ON MODELING, PART II** *Introduction to statistical modeling.* |
| 9:00 a.m.–5:00 p.m. | **MAA BOARD OF GOVERNORS** |
| 1:30 p.m.–10:00 p.m. | **AMS COUNCIL** |
| 3:00 p.m.–7:00 p.m. | **JOINT MEETINGS REGISTRATION**, First Floor Lobby, Moscone Center West |
| 7:00 p.m.–9:00 p.m. | **MAA NEW COMMITTEE CHAIRS WORKSHOP** |

## Wednesday, January 13

| | |
|---|---|
| 7:30 a.m.–4:00 p.m. | **JOINT MEETINGS REGISTRATION**, First Floor Lobby, Moscone Center West |
| | **AMS SPECIAL SESSIONS** |
| 8:00 a.m.–11:00 a.m. | *Mathematics of Computation, I (AMS-SIAM)* |
| 8:00 a.m.–11:00 a.m. | *Surreal Numbers, I (AMS-ASL)* |
| 8:00 a.m.–11:00 a.m. | *Degenerate and Singular Elliptic Partial Differential Equations, I* |
| 8:00 a.m.–11:00 a.m. | *Difference Equations and Applications, I* |
| 8:00 a.m.–11:00 a.m. | *Harmonic Analysis (Mathematics Research Communities session), I* |
| 8:00 a.m.–11:00 a.m. | *Inverse Problems: Analysis and Computations (Mathematics Research Communities session), I* |
| 8:00 a.m.–11:00 a.m. | *Mathematical Challenges of Relativity (Mathematics Research Communities session), I* |
| 8:00 a.m.–11:00 a.m. | *Algebraic Aspects of Cryptology, I* |
| 8:00 a.m.–11:00 a.m. | *Markov Chains and Their Statistical Applications (Mathematics Research Communities session), I* |
| 8:00 a.m.–11:00 a.m. | *Zonotopal Algebra and Its Applications, I* |
| 8:00 a.m.–11:00 a.m. | *Applications of Graph Theory, I* |

8:00 a.m.–11:00 a.m. *Arithmetic and Nonarchimedean Dynamics, I*

**MAA CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–11:00 a.m. *Mathematical Texts: Famous, Infamous, and Influential*
8:00 a.m.–11:00 a.m. *My Most Successful Math Club Activity*
8:00 a.m.–11:00 a.m. *Improving a Second Course in Statistics*
8:00 a.m.–11:00 a.m. *The MAA SUMMA Program Turns 20—A Retrospective*
8:00 a.m.–11:00 a.m. *Gemeral Contributed Paper Session, I*

8:00 a.m.–6:00 p.m. **AMS CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–6:00 p.m. **SIAM MINISYMPOSIA**

8:00 a.m.–7:00 p.m. **EMPLOYMENT CENTER**

9:00 a.m.–11:00 a.m. **MAA MINICOURSE #13: PART A** *Taking symbols seriously: Teaching form and function in College Algebra.*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE #4: PART A** *Using video-case studies in teaching a proof-based gateway course to the mathematics major.*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE #7: PART A** *Teaching with clickers in the classroom.*

9:00 a.m.–5:00 p.m. **STUDENT HOSPITALITY CENTER**

9:00 a.m.–10:20 a.m. **MAA CUPM SUBCOMMITTEE ON MATHEMATICS ACROSS THE DISCIPLINES PANEL DISCUSSION** *Mathematical collaborations with other disciplines: Research partnerships and interdisciplinary programs.*

9:00 a.m.–10:20 a.m. **MAA PANEL DISCUSSION** *National Science Foundations programs supporting learning and teaching in the mathematical sciences.*

10:05 a.m.–10:55 a.m. **AMS INVITED ADDRESS** *Title and speaker to be announced.*

12:15 p.m.–5:30 p.m. **EXHIBITS AND BOOK SALES** *Come to the Grand Opening at 12:15!*

1:00 p.m.–2:00 p.m. **AMS COLLOQUIUM LECTURES: LECTURE I** *Permutations: Increasing and decreasing subsequences.* **Richard P. Stanley**

2:15 p.m.–3:05 p.m. **MAA INVITED ADDRESS** *The real computation controversy: Is it real?* **Lenore Blum**

**AMS SPECIAL SESSIONS**

2:15 p.m.–6:15 p.m. *Mathematics of Computation, II (AMS-SIAM)*
2:15 p.m.–6:15 p.m. *Surreal Numbers, II (AMS-ASL)*
2:15 p.m.–6:15 p.m. *Difference Equations and Applications, II*
2:15 p.m.–6:15 p.m. *Geometric Aspects of Link and 3-manifold Invariants, I*
2:15 p.m.–5:15 p.m. *Harmonic Analysis (Mathematics Research Communities session), II*
2:15 p.m.–5:15 p.m. *Inverse Problems: Analysis and Computations (Mathematics Research Communities session), II*
2:15 p.m.–5:15 p.m. *Mathematical Challenges of Relativity (Mathematics Research Communities session), II*
2:15 p.m.–6:15 p.m. *Algebraic Aspects of Cryptology, II*
2:15 p.m.–5:15 p.m. *Markov Chains and Their Statistical Applications (Mathematics Research Communities session), II*
2:15 p.m.–6:15 p.m. *Zonotopal Algebra and Its Applications, II*
2:15 p.m.–6:15 p.m. *Applications of Graph Theory, II*
2:15 p.m.–6:15 p.m. *Arithmetic and Nonarchimedean Dynamics, II*

2:15 p.m.–6:00 p.m. **MAA INVITED PAPER SESSION ON ONLINE DELIVERY OF MATHEMATICS**

2:15 p.m.–4:15 p.m. **MAA MINICOURSE #11: PART A** *The mathematics of Islam and its use in the teaching of mathematics.*

2:15 p.m.–4:15 p.m. **MAA MINICOURSE #12: PART A** *Learning discrete mathematics via historical projects.*

2:15 p.m.–4:15 p.m. **MAA MINICOURSE #6: PART A** *Developing departmental self-studies.*

**MAA CONTRIBUTED PAPER SESSIONS**

2:15 p.m.–6:00 p.m. *Experiences that Enrich the Education of Mathematics Majors*
2:15 p.m.–6:00 p.m. *Preparing K–12 Teachers to Teach Algebra*
2:15 p.m.–6:00 p.m. *Scholarship of Teaching and Learning in Undergraduate Mathematics*

2:15 p.m.–6:00 p.m. *General Contributed Paper Session, II*

2:15 p.m.–4:15 p.m. **MAA-YOUNG MATHEMATICIANS' NETWORK POSTER SESSION**

2:15 p.m.–3:25 p.m. **MAA PANEL DISCUSSION** *Cultivating mathematical interest and talent of precollege students: Outreach through summer math camps and academies.*

2:15 p.m.–3:40 p.m. **AWM PANEL DISCUSSION** *Dual careers or dueling careers? Jobs and the two-body problem.*

2:30 p.m.–5:00 p.m. **MAA SECTION OFFICERS**

3:20 p.m.–4:10 p.m. **MAA INVITED ADDRESS** *Title to be announced.* **Manjul Bhargava**

3:45 p.m.–4:15 p.m. **AWM BUSINESS MEETING**

3:50 p.m.–5:10 p.m. **MAA COMMITTEE ON GRADUATE STUDENTS-YOUNG MATHEMATICIANS' NETWORK PANEL DISCUSSION** *How to interview for a job in the mathematical sciences.*

4:00 p.m.–5:00 p.m. **RECEPTION FOR UNDERGRADUATE STUDENTS**

4:00 p.m.–5:00 p.m. **AMS-MAA SPECIAL PRESENTATION** *Elementary school teachers as mathematicians.*

5:30 p.m.–7:30 p.m. **SIGMAA ON THE HISTORY OF MATHEMATICS BUSINESS MEETING, RECEPTION, AND GUEST LECTURE**

5:30 p.m.–6:30 p.m. **SIGMAA ON MATH CIRCLES FOR STUDENTS AND TEACHERS BUSINESS MEETING**

8:30 p.m.–9:30 p.m. **AMS JOSIAH WILLARD GIBBS LECTURE** *Title to be announced.* **Peter W. Shor**

9:30 p.m.–11:00 p.m. **AWM RECEPTION**

# Thursday, January 14

7:30 a.m.–4:00 p.m. **JOINT MEETINGS REGISTRATION**, First Floor Lobby, Moscone Center West

8:00 a.m.–7:00 p.m. **EMPLOYMENT CENTER**

**AMS SPECIAL SESSIONS**

8:00 a.m.–12:00 p.m. *Arithmetic of Function Fields, I*

8:00 a.m.–12:00 p.m. *Commutative Algebra, I*

8:00 a.m.–12:00 p.m. *Geometric Aspects of Link and 3-manifold Invariants, II*

8:00 a.m.–12:00 p.m. *Graph Algebras in Analysis and Algebra, I*

8:00 a.m.–12:00 p.m. *Interactions of Inverse Problems, Signal Processing and Imaging, I*

8:00 a.m.–12:00 p.m. *Algebraic Methods in Signal Processing, I*

8:00 a.m.–12:00 p.m. *Mathematics of Information and Knowledge, I*

8:00 a.m.–12:00 p.m. *Voting Theory, I*

8:00 a.m.–12:00 p.m. *Analysis and Control Under Uncertainty, I*

8:00 a.m.–12:00 p.m. *Applications of Time Scales to Biology, Economics, and Engineering, I*

8:00 a.m.–12:00 p.m. *Arithmetic Geometry, I*

8:00 a.m.–10:00 a.m. **MAA INVITED PAPER SESSION ON ENVIRONMENTAL MODELING**

8:00 a.m.–10:00 a.m. **MAA MINICOURSE #3: PART A** *Educating about the state of the planet and sustainability while enhancing calculus.*

8:00 a.m.–10:00 a.m. **MAA MINICOURSE #8: PART A** *The Fibonacci and Catalan numbers.*

**MAA CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–12:00 p.m. *General Contributed Paper Session, III*

8:00 a.m.–12:00 p.m. *Mathematics Experiences in Business, Industry and Government*

8:00 a.m.–12:00 p.m. *Using Computer Algebra Systems in the Calculus Sequence*

8:00 a.m.–12:00 p.m. *Engaging Students with Classroom Voting*

8:00 a.m.–4:15 p.m. **AMS CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–9:15 a.m. **MAA-PROJECT NEXT PANEL DISCUSSION** *Teaching calculus to students who have had AP calc: Challenges and solutions.*

8:00 a.m.–4:15 p.m. **SIAM MINISYMPOSIA**

| | |
|---|---|
| 9:00 a.m.–9:50 a.m. | **MAA INVITED ADDRESS** *Reasonable effectiveness: Trigonometry, ancient astronomy, and the birth of applied mathematics.* **Glen Van Brummelen** |
| 9:00 a.m.–11:00 a.m. | **MAA MINICOURSE #10: PART A** *The hitchhiker's guide to mathematics.* |
| 9:00 a.m.–11:00 a.m. | **MAA COMMITTEE ON THE PARTICIPATION OF WOMEN/WOMEN IN MATHEMATICS NETWORK POSTER SESSION** *Mathematical outreach programs for underrepresented populations.* |
| 9:00 a.m.–5:00 p.m. | **STUDENT HOSPITALITY CENTER** |
| 9:00 a.m.–10:20 a.m. | **MAA COMMITTEE ON TECHNOLOGY IN MATHEMATICS EDUCATION PANEL DISCUSSION** *Online articles from JOMA to Loci.* |
| 9:00 a.m.–10:20 a.m. | **MAA SESSION FOR DEPARTMENT CHAIRS** *Assessment of student learning outcomes: Opportunity and challenge.* |
| 9:30 a.m.–11:00 a.m. | **AMS SPECIAL PRESENTATION** *Who wants to be a mathematician—national contest.* |
| 9:30 a.m.–10:50 a.m. | **MAA-PROJECT NEXT PANEL DISCUSSION** *How one can become a referee/reviewer.* |
| 9:30 a.m.–5:30 p.m. | **EXHIBITS AND BOOK SALES** |
| 10:00 a.m.–12:00 p.m. | **MAA INVITED PAPER SESSION ON GEMS OF NUMBER THEORY** |
| 10:00 a.m.–12:00 p.m. | **AMS-ASL-MAA PANEL DISCUSSION** *Hilbert's Tenth Problem.* |
| 10:05 a.m.–10:55 a.m. | **AWM EMMY NOETHER LECTURE** *You can't hear the shape of a manifold.* **Carolyn S. Gordon** |
| 10:30 a.m.–12:30 p.m. | **MAA MINICOURSE #1: PART A** *Remodeling data analysis.* |
| 10:30 a.m.–12:30 p.m. | **MAA MINICOURSE #5: PART A** *Active learning approaches for the foundational mathematics for elementary teachers courses.* |
| 10:30 a.m.–12:00 p.m. | **SIGMAA OFFICERS MEETING** |
| 10:40 a.m.–12:00 p.m. | **MAA-YMN PANEL DISCUSSION** *Graduate school: Choosing one, getting in, staying in.* |
| 10:40 a.m.–12:00 p.m. | **MAA WORKSHOP** *Proposal writing workshop for grant applications to the NSF Division of Undergraduate Education.* |
| 11:10 a.m.–12:00 p.m. | **SIAM INVITED ADDRESS** *Title to be announced.* **Brenda Dietrich** |
| 1:00 p.m.–2:00 p.m. | **AMS COLLOQUIUM LECTURES: LECTURE II** *Permutations: Alternating permutations.* **Richard P. Stanley** |
| | **AMS SPECIAL SESSIONS** |
| 1:00 p.m.–4:00 p.m. | *Arithmetic of Function Fields, II* |
| 1:00 p.m.–4:00 p.m. | *Nonlinear Hyperbolic Equations and Control Systems in Physics and Engineering, I* |
| 1:00 p.m.–4:00 p.m. | *Degenerate and Singular Elliptic Partial Differential Equations, II* |
| 1:00 p.m.–4:00 p.m. | *Graph Algebras in Analysis and Algebra, II* |
| 1:00 p.m.–4:00 p.m. | *Algebraic Methods in Signal Processing, II* |
| 1:00 p.m.–4:20 p.m. | *Representation Theory and Nonassociative Algebras, I* |
| 1:00 p.m.–4:00 p.m. | *Use of Technology in Modern Complex Analysis Research, I* |
| 1:00 p.m.–4:00 p.m. | *Voting Theory, II* |
| 1:00 p.m.–4:00 p.m. | *Analysis and Control Under Uncertainty, II* |
| 1:00 p.m.–4:00 p.m. | *Applications of Time Scales to Biology, Economics, and Engineering, II* |
| 1:00 p.m.–4:00 p.m. | *Arithmetic Geometry, II* |
| 1:00 p.m.–4:10 p.m. | **MAA-AMS-MER INVITED PAPER SESSION ON MATHEMATICS AND EDUCATION REFORM, I** |
| 1:00 p.m.–3:00 p.m. | **MAA MINICOURSE #2: PART A** *Using GeoGebra to create activities and applets for visualization and exploration.* |
| 1:00 p.m.–3:00 p.m. | **MAA MINICOURSE #9: PART A** *Getting students involved in undergraduate research.* |
| | **MAA CONTRIBUTED PAPER SESSIONS** |
| 1:00 p.m.–4:10 p.m. | *General Contributed Paper Session, IV* |
| 1:00 p.m.–4:15 p.m. | *Developmental Mathematics Education: Helping Under-Prepared Students Transition to College-Level Mathematics* |
| 1:00 p.m.–4:10 p.m. | *Online Homework—Innovation and Assessment* |
| 1:00 p.m.–4:10 p.m. | *How Assessment Results Changed Our Program* |

1:00 p.m.–4:15 p.m. *Wavelets in Undergraduate Education*

1:00 p.m.–2:20 p.m. **MAA COMMITTEE ON GRADUATE STUDENTS-YMN PANEL DISCUSSION** *Finding a research topic and thesis advisor.*

1:00 p.m.–2:20 p.m. **SIGMAA ON STATISTICS EDUCATION PANEL DISCUSSION** *Statistics ≠ mathematics: What a first- (or second-) time teacher of statistics should know.*

1:00 p.m.–4:15 p.m. **SIGMAA ON MATH CIRCLES FOR STUDENTS AND TEACHERS, PART I** *Fostering, supporting, and propogating Math Circles (Part II is Saturday at 1:00 p.m.).*

1:00 p.m.–4:00 p.m. **SUMMER PROGRAM FOR WOMEN IN MATHEMATICS (SPWM) REUNION**

2:00 p.m.–4:00 p.m. **MAA POSTER SESSION ON PROJECTS SUPPORTED BY THE NSF DIVISION OF UNDERGRADUATE EDUCATION**

2:15 p.m.–3:05 p.m. **AMS INVITED ADDRESS** *Speaker and title to be announced.*

2:30 p.m.–3:45 p.m. **MAA-PROJECT NEXT PANEL DISCUSSION** *Mathematics and social justice.*

2:35 p.m.–3:50 p.m. **MAA CRAFTY PANEL DISCUSSION** *More voices from the partner disciplines: The second round of curriculum foundations workshops.*

2:35 p.m.–3:50 p.m. **SIGMAA ON STATISTICS EDUCATION AND SIGMAA ON RESEARCH IN UNDERGRADUATE MATHEMATICS EDUCATION PANEL DISCUSSION** *Excuse me; where is the department of statistics education?*

2:45 p.m.–4:15 p.m. **AMS COMMITTEE ON THE PROFESSION PANEL DISCUSSION** *What I wish I had known when applying for a job.*

3:20 p.m.–4:10 p.m. **AMS RETIRING PRESIDENTIAL ADDRESS** *Reflections and perspectives.* **James G. Glimm**

4:25 p.m.–5:25 p.m. **JOINT PRIZE SESSION**

5:30 p.m.–6:30 p.m. **JOINT PRIZE SESSION RECEPTION**

5:45 p.m.–6:45 p.m. **SIGMAA ON BUSINESS, INDUSTRY, AND GOVERNMENT GUEST LECTURE**

5:45 p.m.–6:30 p.m. **SIGMAA ON MATHEMATICS INSTRUCTION USING THE WEB RECEPTION AND BUSINESS MEETING**

5:45 p.m.–7:15 p.m. **SIGMAA ON STATISTICS EDUCATION BUSINESS MEETING AND RECEPTION**

6:00 p.m.–7:00 p.m. **MAA SPECIAL LECTURE FOR STUDENTS**

6:00 p.m.–7:30 p.m. **SIGMAA ON RESEARCH IN UNDERGRADUATE MATHEMATICS EDUCATION BUSINESS MEETING**

6:00 p.m.–7:00 p.m. **UNIVERSITY OF CHICAGO MATHEMATICS ALUMNI RECEPTION**

6:00 p.m.–8:00 p.m. **CLAREMONT COLLEGES ALUMNI RECEPTION**

6:00 p.m.–7:30 p.m. **ASSOCIATION OF LESBIAN, GAY, BISEXUAL AND TRANSGENDERED MATHEMATICIANS RECEPTION**

6:00 p.m.–7:30 p.m. **NEW MEXICO STATE UNIVERSITY RECEPTION**

6:30 p.m.–7:30 p.m. **SIGMAA ON MATHEMATICS INSTRUCTION USING THE WEB PRESENTATION AND DISCUSSION**

6:30 p.m.–9:00 p.m. **MER BANQUET**

6:30 p.m.–7:30 p.m. **UNIVERSITY OF OREGON MATHEMATICS DEPARTMENT RECEPTION FOR ALUMNI AND FRIENDS**

7:15 p.m.–8:00 p.m. **SIGMAA ON BUSINESS, INDUSTRY, AND GOVERNMENT RECEPTION**

7:30 p.m.–8:30 p.m. **YOUNG MATHEMATICIANS' NETWORK OPEN FORUM**

8:15 p.m.–9:45 p.m. **KNITTING CIRCLE**

# Friday, January 15

7:30 a.m.–4:00 p.m. **JOINT MEETINGS REGISTRATION**, First Floor Lobby, Moscone Center West

8:00 a.m.–7:00 p.m. **EMPLOYMENT CENTER**

**AMS SPECIAL SESSIONS**

8:00 a.m.–11:00 a.m. *Spectral Problems on Compact Riemannian Manifolds, I (AMS-AWM)*
8:00 a.m.–11:00 a.m. *Nonlinear Hyperbolic Equations and Control Systems in Physics and Engineering, II*
8:00 a.m.–11:00 a.m. *Biomathematics: Modeling in Biology, Ecology, and Epidemiology, I*
8:00 a.m.–11:00 a.m. *Enumerative Combinatorics, I*
8:00 a.m.–11:00 a.m. *Interactions of Inverse Problems, Signal Processing and Imaging, II*
8:00 a.m.–11:00 a.m. *L-Functions and Analytic Number Theory, I*
8:00 a.m.–11:00 a.m. *Mathematics and Physical Experiment, I*
8:00 a.m.–11:00 a.m. *Representation Theory and Nonassociative Algebras, II*
8:00 a.m.–11:00 a.m. *Use of Technology in Modern Complex Analysis Research, II*
8:00 a.m.–10:55 a.m. **MAA INVITED PAPER SESSION ON THE MATHEMATICS OF ORIGAMI**
8:00 a.m.–10:55 a.m. **MAA-AMS-MER INVITED PAPER SESSION ON MATHEMATICS AND EDUCATION REFORM, II**

**MAA CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–11:00 a.m. *General Contributed Paper Session, V*
8:00 a.m.–11:00 a.m. *Undergraduate Mathematical Biology*
8:00 a.m.–10:55 a.m. *Mathematics, Equity, Diversity, and Social Justice*
8:00 a.m.–11:00 a.m. *Mathematics Courses for the Liberal Arts Students*
8:00 a.m.–11:00 a.m. *Quantitative Reasoning and the Environment*
8:00 a.m.–6:00 p.m. **AMS CONTRIBUTED PAPER SESSIONS**
8:00 a.m.–5:30 p.m. **ASL INVITED ADDRESSES AND CONTRIBUTED PAPERS**
8:00 a.m.–6:00 p.m. **SIAM MINISYMPOSIA**
8:00 a.m.–11:00 a.m. **PME COUNCIL MEETING**
8:30 a.m.–10:30 a.m. **AMS-MAA GRADUATE STUDENT FAIR** *Undergrads! Take this opportunity to meet representatives from mathematical sciences graduate programs.*
9:00 a.m.–9:50 a.m. **MAA INVITED ADDRESS** *Excursions in geometry and theoretical computer science.* **Sue Whitesides**
9:00 a.m.–11:00 a.m. **MAA MINICOURSE #13: PART B** *Taking symbols seriously: Teaching form and function in college algebra.*
9:00 a.m.–11:00 a.m. **MAA MINICOURSE #4: PART B** *Using video-case studies in teaching a proof-based gateway course to the mathematics major.*
9:00 a.m.–11:00 a.m. **MAA MINICOURSE #7: PART B** *Teaching with clickers in the classroom.*
9:00 a.m.–5:00 p.m. **STUDENT HOSPITALITY CENTER**
9:00 a.m.–10:20 a.m. **MAA-YOUNG MATHEMATICIANS' NETWORK PANEL DISCUSSION** *Promotion and tenure: You know you want it.*
9:30 a.m.–5:00 p.m. **EXHIBITS AND BOOK SALES**
10:05 a.m.–10:55 a.m. **AMS INVITED ADDRESS** *Speaker and title to be announced.*
1:00 p.m.–2:00 p.m. **AMS COLLOQUIUM LECTURES: LECTURE III** *Permutations: Reduced compositions.* **Richard P. Stanley**
1:00 p.m.–1:50 p.m. **MAA LECTURE FOR STUDENTS** *How math made modern music ~~mad~~ irrational!* **David T. Kung**
1:00 p.m.–5:00 p.m. **AMS CURRENT EVENTS BULLETIN**

**AMS SPECIAL SESSIONS**

1:00 p.m.–6:00 p.m. *Research in Mathematics by Undergraduates, I (AMS-MAA-SIAM)*
1:00 p.m.–6:00 p.m. *History of Mathematics, I (AMS-MAA)*
1:00 p.m.–6:00 p.m. *Spectral Problems on Compact Riemannian Manifolds, II (AMS-AWM)*
1:00 p.m.–6:00 p.m. *Commutative Algebra, II*
1:00 p.m.–6:00 p.m. *Enumerative Combinatorics, II*
1:00 p.m.–6:00 p.m. *Differential Galois Theory and Group Representations: A Tribute to Andy Magid, I*
1:00 p.m.–6:00 p.m. *L-Functions and Analytic Number Theory, II*

1:00 p.m.–6:00 p.m. *Recent Advances in Evolution Equations and Applications*
1:00 p.m.–6:00 p.m. *The Mathematics of Information and Knowledge, II*
1:00 p.m.–6:00 p.m. **MAA-AMS-MER INVITED PAPER SESSION ON MATHEMATICS AND EDUCATION REFORM, III**

**MAA CONTRIBUTED PAPER SESSIONS**
1:00 p.m.–6:00 p.m. *General Contributed Paper Session, VI*
1:00 p.m.–5:00 p.m. *Philosophy of Mathematics for Working Mathematicians*
1:00 p.m.–6:00 p.m. *Publishing Mathematics on the Web*
1:00 p.m.–6:00 p.m. *Research on the Teaching and Learning of Undergraduate Mathematics*
1:00 p.m.–4:00 p.m. **NAM GRANVILLE-BROWN-HAYES SESSION OF PRESENTATIONS BY RECENT DOCTORAL RECIPIENTS IN THE MATHEMATICAL SCIENCES**
1:00 p.m.–3:00 p.m. **AMS-MAA COMMITTEE ON TEACHING ASSISTANTS AND PART-TIME INSTRUCTIONS PANEL DISCUSSION** *Becoming a teacher of college mathematics: Video cases for novice college mathematics instructor professional development.*
2:15 p.m.–4:15 p.m. **MAA MINICOURSE #11: PART B** *The mathematics of Islam and its use in the teaching of mathematics.*
2:15 p.m.–4:15 p.m. **MAA MINICOURSE #12: PART B** *Learning discrete mathematics via historical projects.*
2:15 p.m.–4:15 p.m. **MAA MINICOURSE #6: PART B** *Developing departmental self-studies.*
2:15 p.m.–4:10 p.m. **ROCKY MOUNTAIN MATHEMATICS CONSORTIUM BOARD OF DIRECTORS MEETING**
2:30 p.m.–4:00 p.m. **MAA PRESENTATIONS BY TEACHING AWARD RECIPIENTS**
2:30 p.m.–4:00 p.m. **AMS COMMITTEE ON SCIENCE POLICY PANEL DISCUSSION**
4:00 p.m.–5:30 p.m. **MAA POSTER SESSION ON RESEARCH BY UNDERGRADUATE STUDENTS**
4:20 p.m.–5:10 p.m. **AMS COMMITTEE ON SCIENCE POLICY-MAA SCIENCE POLICY COMMITTEE GOVERNMENT SPEAKER** *Speaker and title to be announced.*
4:30 p.m.–6:30 p.m. **AMS CONGRESSIONAL FELLOWSHIP SESSION**
5:00 p.m.–7:00 p.m. **MAA PANEL DISCUSSION** *Current issues in actuarial science education.*
5:00 p.m.–6:00 p.m. **SIGMAA ON QUANTITATIVE LITERACY BUSINESS MEETING**
5:15 p.m.–7:00 p.m. **SIGMAA ON THE PHILSOPHY OF MATHEMATICS BUSINESS MEETING, RECEPTION, AND GUEST LECTURE**
5:30 p.m.–7:30 p.m. **UNIVERSITY OF ILLINOIS,URBANA-CHAMPAIGN DEPARTMENT OF MATHEMATICS ALUMNI RECEPTION**
5:30 p.m.–7:00 p.m. **UNIVERSITY OF MICHIGAN ALUMNI AND FRIENDS RECEPTION**
6:00 p.m.–8:00 p.m. **SIGMAA ON MATHEMATICAL AND COMPUTATIONAL BIOLOGY BUSINESS MEETING AND GUEST LECTURE**
6:00 p.m.–8:00 p.m. **BUDAPEST SEMESTERS IN MATHEMATICS REUNION**
6:00 p.m.–7:30 p.m. **BRIGHAM YOUNG UNIVERSITY MATHEMATICS ALUMNI AND FRIENDS RECEPTION**
6:00 p.m.–7:00 p.m. **AMS *MATHEMATICAL REVIEWS* RECEPTION**
6:00 p.m.–9:30 p.m. **NAM BANQUET**
7:00 p.m.–8:00 p.m. **SIGMAA ON MATHEMATICS AND THE ARTS BUSINESS MEETING**
7:30 p.m.–8:15 p.m. **NAM COX-TALBOT ADDRESS** *Speaker and title to be announced*
8:30 p.m.–10:30 p.m. **MAA-PROJECT NEXT RECEPTION** *All Project NExT Fellows, consultants, and other friends of Project NExT are invited.*

# Saturday, January 16

7:30 a.m.–2:00 p.m. **JOINT MEETINGS REGISTRATION**, First Floor Lobby, Moscone Center West

**AMS SPECIAL SESSIONS**
8:00 a.m.–11:00 a.m. *Research in Mathematics by Undergraduates, II (AMS-MAA-SIAM)*

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|---|---|
| 8:00 a.m.–11:00 a.m. | *History of Mathematics, II (AMS-MAA)* |
| 8:00 a.m.–11:00 a.m. | *Biomathematics: Modeling in Biology, Ecology, and Epidemiology, II* |
| 8:00 a.m.–11:00 a.m. | *Categorical and Algebraic Methods in Representation Theory, I* |
| 8:00 a.m.–11:00 a.m. | *Harmonic Analysis and Representations of Reductive p-adic Groups, I* |
| 8:00 a.m.–11:00 a.m. | *Integrability of Dynamical Systems and Solitons Equations, I* |
| 8:00 a.m.–11:00 a.m. | *Mathematics and Physical Experiment, II* |
| 8:00 a.m.–11:00 a.m. | *Optimal Frames and Operator Algebras, I* |
| 8:00 a.m.–11:00 a.m. | *Parabolic Geometries, Integrable Systems, and Twistor Theory, I* |
| 8:00 a.m.–11:00 a.m. | *Applications of Algebraic Geometry, I* |
| 8:00 a.m.–11:00 a.m. | *Permutations, I* |
| 8:00 a.m.–10:55 a.m. | **MAA-AMS INVITED PAPER SESSION ON THE SCHOLARSHIP OF TEACHING AND LEARNING IN MATHEMATICS** |
| 8:00 a.m.–6:00 p.m. | **AMS CONTRIBUTED PAPER SESSIONS** |
| | **MAA CONTRIBUTED PAPER SESSIONS** |
| 8:00 a.m.–11:00 a.m. | *General Contributed Paper Session, VII* |
| 8:00 a.m.–11:00 a.m. | *Innovative and Effective Ways to Teach Linear Algebra* |
| 8:00 a.m.–11:00 a.m. | *Mathematics and Sports* |
| 8:00 a.m.–5:30 p.m. | **ASL INVITED ADDRESSES AND CONTRIBUTED PAPERS** |
| 8:00 a.m.–6:00 p.m. | **SIAM MINISYMPOSIA** |
| 8:20 a.m.–4:30 p.m. | **AWM WORKSHOP** *This session has several parts that will be listed separately by time in this program. All presentations are open to all JMM participants.* |
| 8:30 a.m.–10:30 a.m. | **AWM WORKSHOP: RESEARCH PRESENTATIONS BY RECENT PH.D.'S, I** |
| 8:30 a.m.–10:00 a.m. | **AMS COMMITTEE ON EDUCATION PANEL DISCUSSION** *Title to be announced.* |
| 9:00 a.m.–9:50 a.m. | **AMS INVITED ADDRESS** *Speaker and title to be announced.* |
| 9:00 a.m.–11:00 a.m. | **MAA MINICOURSE #10: PART B** *The hitchhiker's guide to mathematics.* |
| 9:00 a.m.–11:00 a.m. | **MAA MINICOURSE #3: PART B** *Educating about the state of the planet and sustainability while enhancing calculus.* |
| 9:00 a.m.–11:00 a.m. | **MAA MINICOURSE #8: PART B** *The Fibonacci and Catalan numbers.* |
| 9:00 a.m.–2:00 p.m. | **STUDENT HOSPITALITY CENTER** |
| 9:00 a.m.–10:20 a.m. | **MAA COMMITTEE FOR THE TEACHING OF UNDERGRADUATE MATHEMATICS PANEL DISCUSSION** *Beyond grading and tutoring: New approaches to students helping students.* |
| 9:00 a.m.–9:50 a.m. | **NAM PANEL DISCUSSION** |
| 9:00 a.m.–12:00 p.m. | **EXHIBITS AND BOOK SALES** |
| 9:00 a.m.–12:00 p.m. | **EMPLOYMENT CENTER** |
| 10:00 a.m.–10:50 a.m. | **NAM BUSINESS MEETING** |
| 10:05 a.m.–10:55 a.m. | **MAA INVITED ADDRESS** *Symplectic embeddings and continued fractions.* **Dusa McDuff** |
| 10:30 a.m.–11:00 a.m. | **AWM WORKSHOP: POSTER SESSION WITH PRESENTATIONS FROM WOMEN GRADUATE STUDENTS** |
| 11:10 a.m.–11:40 a.m. | **MAA BUSINESS MEETING** |
| 11:45 a.m.–12:15 p.m. | **AMS BUSINESS MEETING** |
| 1:00 p.m.–2:00 p.m. | **NAM CLAYTOR-WOODARD LECTURE** *Speaker and title to be announced.* |
| | **AMS SPECIAL SESSIONS** |
| 1:00 p.m.–6:00 p.m. | *Research in Mathematics by Undergraduates, III (AMS-MAA-SIAM)* |
| 1:00 p.m.–6:00 p.m. | *History of Mathematics, III (AMS-MAA)* |
| 1:00 p.m.–6:00 p.m. | *Biomathematics: Modeling in Biology, Ecology, and Epidemiology, III* |
| 1:00 p.m.–6:00 p.m. | *Categorical and Algebraic Methods in Representation Theory, II* |
| 1:00 p.m.–6:00 p.m. | *Differential Galois Theory and Group Representations: A Tribute to Andy Magid, II* |

1:00 p.m.–6:00 p.m. *Harmonic Analysis and Representations of Reductive p-adic Groups, II*
1:00 p.m.–6:00 p.m. *Integrability of Dynamical Systems and Solitons Equations, II*
1:00 p.m.–6:00 p.m. *Optimal Frames and Operator Algebras, II*
1:00 p.m.–6:00 p.m. *Parabolic Geometries, Integrable Systems, and Twistor Theory, II*
1:00 p.m.–6:00 p.m. *Applications of Algebraic Geometry, II*
1:00 p.m.–6:00 p.m. *Permutations, II*

1:00 p.m.–3:00 p.m. **MAA MINICOURSE #1: PART B** *Remodeling data analysis.*

1:00 p.m.–3:00 p.m. **MAA MINICOURSE #5: PART B** *Active learning approaches for the foundational mathematics for elementary teachers courses.*

**MAA CONTRIBUTED PAPER SESSIONS**
1:00 p.m.–5:30 p.m. *General Contributed Paper Session, VIII*
1:00 p.m.–6:00 p.m. *Arts and Mathematics*
1:00 p.m.–5:30 p.m. *Mathlets for Teaching and Learning Mathematics*
1:00 p.m.–5:30 p.m. *Visualization in Mathematics*

1:00 p.m.–3:55 p.m. **MAA COMMITTEE ON TECHNOLOGY IN MATHEMATICS EDUCATION PANEL DISCUSSION** *Technology in teaching mathematics: History and current practices.*

1:00 p.m.–5:00 p.m. **SIGMAA ON MATH CIRCLES FOR STUDENTS AND TEACHERS, PART II** *Fostering, supporting, and propogating Math Circles.*

1:00 p.m.–2:00 p.m. **AWM WORKSHOP PANEL DISCUSSION** *Career opportunities: The early years.*

2:00 p.m.–3:15 p.m. **MAA-PROJECT NEXT PANEL DISCUSSION** *Organizing and running an effective seminar/ capstone course for mathematics majors.*

2:30 p.m.–4:30 p.m. **AWM WORKSHOP: RESEARCH PRESENTATIONS BY RECENT PH.D.'S, II**

3:00 p.m.–4:00 p.m. **AMS-MAA-SIAM GERALD AND JUDITH PORTER PUBLIC LECTURE** *The calculus of friendship.* **Steven Strogatz**

3:30 p.m.–5:30 p.m. **MAA MINICOURSE #2: PART B** *Using GeoGebra to create activities and applets for visualization and exploration.*

3:30 p.m.–5:30 p.m. **MAA MINICOURSE #9: PART B** *Getting students involved in undergraduate research.*

6:30 p.m.–7:30 p.m. **AMS BANQUET RECEPTION**

7:30 p.m.–10:00 p.m. **AMS BANQUET**

# 2010 Joint Mathematics Meetings Advance Registration/Housing Form

Name _____
(please write name as you would like it to appear on your badge)

Mailing Address _____

_____

Telephone _____ Fax: _____

In case of emergency (for you) at the meeting, call: Day # _____ Evening #: _____

Email Address _____
Acknowledgment of this registration and any hotel reservations will be sent to the email address given here, unless you check this box: *Send by U.S. Mail* ☐

Affiliation for badge _____ Nonmathematician guest badge name: _____
(company/university) (accompanying registered mathematician; please note charge below)

☐ **I DO NOT want my program and badge to be mailed to me on 12/11/09. (Materials will be mailed to the address listed above unless you check this box.)**

## Registration Fees

**Membership** ✓ all that apply. First row is eligible for JMM member registration fee.
❑ AMS ❑ MAA ❑ ASL ❑ CMS ❑ SIAM
❑ ASA ❑ AWM ❑ NAM ❑ YMN

| **Joint Meetings** | **by Dec 22** | **at mtg** | **Subtotal** |
|---|---|---|---|
| ❑ Member AMS, MAA, ASL, CMS, SIAM | US $220 | US $288 | |
| ❑ Nonmember | US $342 | US $444 | |
| ❑ Graduate Student | US $ 45 | US $ 55 | |
| ❑ Undergraduate Student | US $ 35 | US $ 45 | |
| ❑ High School Student | US $ 5 | US $ 10 | |
| ❑ Unemployed | US $ 45 | US $ 55 | |
| ❑ Temporarily Employed | US $177 | US $206 | |
| ❑ Developing Countries Special Rate | US $ 45 | US $ 55 | |
| ❑ Emeritus Member of AMS or MAA | US $ 45 | US $ 55 | |
| ❑ High School Teacher | US $ 45 | US $ 55 | |
| ❑ Librarian | US $ 45 | US $ 55 | |
| ❑ Press | US $ 0 | US $ 0 | |
| ❑ Nonmathematician Guest | US $ 15 | US $ 15 | |
| | | | $ _____ |

**AMS Short Course:** *Markov Chains and Mixing Times (1/11–1/12)*

| | | | |
|---|---|---|---|
| ❑ Member of AMS or MAA | US $ 98 | US $135 | |
| ❑ Nonmember | US $132 | US $165 | |
| ❑ Student, Unemployed, Emeritus | US $ 46 | US $ 67 | |

The first 80 people who sign up for this course will receive a book (shipped by mid-late December). See details in announcement.
**To ensure its receipt please list your home address above**. $ _____

**MAA Short Course:** *Exploring the Great Books of Mathematics. (1/11–1/12)*

| | | | |
|---|---|---|---|
| ❑ Member of MAA or AMS | US $150 | US $160 | |
| ❑ Nonmember | US $200 | US $210 | |
| ❑ Student, Unemployed, Emeritus | US $ 75 | US $ 85 | |
| | | | $ _____ |

**AMS Tutorial on Modeling:** *An Introduction to Numerical and Statistical Modeling (1/11)* US $ 25 US $ 25
$ _____

**MAA Minicourses (see listing in text)**
I would like to attend: ❑ One Minicourse ❑ Two Minicourses
Please enroll me in MAA Minicourse(s) #_____ and/or #_____
In order of preference, my alternatives are: #_____ and/or #_____
Price: US $75 for each minicourse.
(For more than 2 minicourses call or email the MMSB.) $ _____

**Employment Center** *Please go to http://eims.ams.org to register. For further information contact Steven Ferrucci at emp-info@ams.org.*

**Graduate Program Fair**
❑ Graduate Program Table US $ 50 N/A
$ _____

**Events with Tickets**
MER Banquet (1/14) US $53.00 #____Regular #____Veg #____Kosher
NAM Banquet (1/15) US $53.00 #____Regular #____Veg #____Kosher
AMS Banquet (1/16) US $53.00 #____Regular #____Veg #____Kosher
$ _____

**Other Events**
❑ Graduate Student/First Time Attendee Reception (1/14) (no charge)

**Total for Registrations and Events** $ _____

## Payment

Registration & Event Total (total from column on left) $ _____
Hotel Deposit (only if paying by check) $ _____

**Total Amount To Be Paid** **$** _____
(Note: A US $5 processing fee will be charged for each returned check or invalid credit card. Debit cards are not accepted.)

**Method of Payment**
❑ Check. Make checks payable to the AMS. Checks drawn on foreign banks must be in equivalent foreign currency at current exchange rates.
❑ Credit Card. VISA, MasterCard, AMEX, Discover (no others accepted)
Card number: _____
Exp. date: _____ Zipcode of credit card billing address: _____
Signature: _____
Name on card: _____
❑ Purchase order # _____ (please enclose copy)

## Other Information

*Mathematical Reviews* field of interest # _____
How did you hear about this meeting? Check one: ❑ Colleague(s) ❑ *Notices* ❑ *Focus* ❑ Internet
❑ This is my first Joint Mathematics Meetings.
❑ I am a mathematics department chair.
❑ For planning purposes for the MAA Two-year College Reception, please check if you are a faculty member at a two-year college.
❑ I would like to receive promotions for future JMM meetings.
❑ **Please do not include my name on any promotional mailing list.**
❑ Please ✓ this box if you have a disability requiring special services.

## Mail to:

**Mathematics Meetings Service Bureau (MMSB)**
**P. O. Box 6887**
**Providence, RI 02940-6887** Fax: 401-455-4004
Questions/changes call: 401-455-4143 or 1-800-321-4267 x4143; mmsb@ams.org

## Deadlines *Please register by the following dates for:*

| | |
|---|---|
| To be eligible for the complimentary room drawing: | **Nov. 4, 2009** |
| For housing reservations, badges/programs mailed: | **Nov. 18, 2009** |
| For housing changes/cancellations through MMSB: | **Dec. 14, 2009** |
| For advance registration for the Joint Meetings, Short Courses, MAA Minicourses, Tutorial & Tickets: | **Dec. 22, 2009** |
| For 50% refund on banquets, cancel by: | **Jan. 4, 2010*** |
| For 50% refund on advance registration, Minicourses & Short Courses, cancel by: | **Jan. 8, 2010*** |

***no refunds after this date**

*Registration for the Joint Meetings is not required for the Short Courses or the Tutorial, but it is required for the Minicourses & Employment Center.*

# San Francisco Joint Mathematics Meetings Hotel Reservations

Please see the hotel page in the announcement or web for detailed information on each hotel. To ensure accurate assignments, please rank hotels in order of preference by writing 1, 2, 3, etc., in the column on the left and by circling the requested room type and rate. If the rate or the hotel requested is no longer available, you will be assigned a room at a ranked or unranked hotel at a comparable rate. Please call the MMSB for details on suite configurations, sizes, availability, etc. Suite reservations can only be made through the MMSB to receive the convention rate. Reservations at the following hotels must be made through the MMSB to receive the convention rates listed. Reservations made directly with the hotels at the JMM rate will be changed to a higher rate. All rates are subject to a 15.5% sales tax. **Guarantee requirements: First night deposit by check (add to payment on reverse of form) or a credit card guarantee.**

❑ Deposit enclosed (see front of form) ❑ Hold with my credit card Card Number _____ Exp. Date _____ Signature _____

**Date and Time of Arrival** _____ **Date and Time of Departure** _____

**Name of Other Room Occupant** _____ **Arrival Date** _____ **Departure Date** _____ **Child (give age(s)** ____

| Order of choice | Hotel | Single | Double 1 bed | Double 2 beds | Triple 2 beds | Triple 2 beds w/cot | Triple - king or queen w/cot | Quad 2 beds | Quad 2 beds w/cot | Suites Starting rates |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Marriott San Francisco (Hdqtrs)** | US $175 | US $175 | US $175 | US $195 | N/A | US $195 | US $215 | N/A | US $349 |
| | **Marriott Student Rate** | US $140 | US $140 | US $140 | US $160 | N/A | US $160 | US $180 | N/A | N/A |
| | **Intercontinental San Francisco** | US $175 | US $175 | US $175 | US $195 | N/A | US $215 | US $215 | N/A | US $269 |
| | **Intercontinental Student Rate** | US $140 | US $140 | US $140 | US $160 | N/A | US $180 | US $180 | N/A | N/A |
| | **W Hotel San Francisco** | US $169 | US $169 | US $169 | US $209 | N/A | US $239 | US $249 | N/A | US $1000 |
| | **W Hotel Student Rate** | US $140 | US $140 | US $140 | US $180 | N/A | US $210 | US $220 | N/A | N/A |
| | **Serrano Hotel** | US $160 | US $160 | US $160 | US $180 | N/A | N/A | US $200 | N/A | US $259 |
| | **Parc 55 Hotel San Francisco** | US $152 | US $152 | US $152 | US $172 | N/A | US $192 | US $192 | N/A | US $625 |
| | **Parc 55 Student Rate** | US $135 | US $135 | US $135 | US $155 | N/A | US $175 | US $175 | N/A | N/A |
| | **Handlery Union Square Hotel** | US $146 | US $146 | US $146 | US $156 | N/A | N/A | US $166 | N/A | US $300 |
| | **Handlery Student Rate** | US $136 | US $136 | US $136 | US $146 | N/A | N/A | US $156 | N/A | N/A |
| | **Holiday Inn Civic Center** | US $120 | US $120 | US $120 | US $145 | US $165 | US $165 | US $170 | US $190 | US $299 |
| | **Holiday Inn Student Rate** | US $110 | US $110 | US $110 | US $135 | US $155 | US $155 | US $160 | US $180 | N/A |
| | **The Powell Hotel** | US $110 | US $110 | US $110 | US $125 | N/A | N/A | US $140 | N/A | US $250 |
| | **Powell Hotel Student Rate** | US $99 | US $99 | US $99 | US $114 | N/A | N/A | US $129 | N/A | N/A |
| | **Hotel Mark Twain** | US $99 | US $99 | US $99 | US $109 | N/A | N/A | US $119 | N/A | US $209 |
| | **Hotel Whitcomb** | US $99 | US $99 | US $99 | US $109 | US $129 | US $129 | US $119 | US $139 | US $295 |

**Special Housing Requests:**.

❑ I have disabilities as defined by the ADA that require a sleeping room that is accessible to the physically challenged. My needs are: _____

❑ Other requests: _____

❑ I am a member of a hotel frequent-travel club and would like to receive appropriate credit.

The hotel chain and card number are: _____

**Email confirmations** (no paper) will be sent by the Marriott, the Intercontinental, the Holiday Inn Civic Center, and the Hotel Whicomb. The other hotels will not be sending confirmations.

**If you are not making a reservation, please check off one of the following:**

❑ I plan to make a reservation at a later date.

❑ I will be making my own reservations at a hotel not listed. Name of hotel: _____

❑ I live in the area or will be staying privately with family or friends.

❑ I plan to share a room with _____, who is making the reservations.

# Meetings and Conferences of the AMS


### Associate Secretaries of the AMS

**Western Section: Michel L. Lapidus,** Department of Mathematics, University of California, Surge Bldg., Riverside, CA 92521-0135; e-mail: lapidus@math.ucr.edu; telephone: 951-827-5910.

**Central Section**: **Susan J. Friedlander**, Department of Mathematics, University of Illinois at Chicago, 851 S. Morgan (M/C 249), Chicago, IL 60607-7045; e-mail: susan@math.nwu.edu; telephone: 312-996-3041. **Georgia Benkart** (after January 31, 2010), University of Wisconsin-Madison, Department of Mathematics, 480 Lincoln Drive, Madison, WI 53706-1388; e-mail: benkart@math.wisc.edu; telephone: 608-263-4283.

**Eastern Section**: **Steven H. Weintraub**, Department of Mathematics, Lehigh University, Bethlehem, PA 18105-3174; e-mail: steve.weintraub@lehigh.edu; telephone: 610-758-3717.

**Southeastern Section**: **Matthew Miller,** Department of Mathematics, University of South Carolina, Columbia, SC 29208-0001, e-mail: miller@math.sc.edu; telephone: 803-777-3690.

**2009 Seoul, Korea Meeting:** Georgia Benkart, University of Wisconsin-Madison, Department of Mathematics, 480 Lincoln Drive, Madison, WI 53706-1388; e-mail: benkart@math.wisc.edu; telephone: 608-263-4283.


The Meetings and Conferences section of the *Notices* gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. **Information in this issue may be dated. Up-to-date meeting and conference information can be found at** www.ams.org/meetings/.

## Meetings:



### Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 89 in the January 2009 issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

### Abstracts

Speakers should submit abstracts on the easy-to-use interactive Web form. No knowledge of LaTeX is necessary to submit an electronic form, although those who use LaTeX may submit abstracts with such coding, and all math displays and similarly coded material (such as accent marks in text) must be typeset in LaTeX. Visit http://www.ams.org/cgi-bin/abstracts/abstract.pl. Questions about abstracts may be sent to abs-info@ams.org. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

**Conferences:** (see http://www.ams.org/meetings/ for the most up-to-date information on these conferences.)

Co-sponsored conferences:

March 18-21, 2010: First International Conference on Mathematics and Statistics, AUS-ICMS '10, American University of Sharjah, Sharjah, United Arab Emirates (please see http://www.aus.edu/conferences/icms10/ for more information).

June 17-19, 2010: Coimbra Meeting on 0-1 Matrix Theory and Related Topics, University of Coimbra, Portugal (for more information please see http://www.mat.uc.pt/~cmf/01MatrixTheory).

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*–Bulletin of the AMS*

*Cambridge Studies in Advanced Mathematics*

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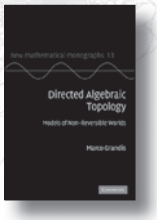


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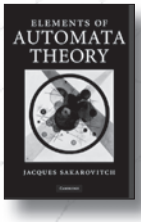


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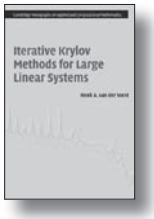


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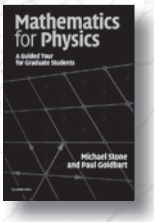


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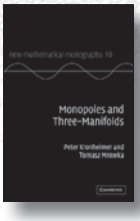


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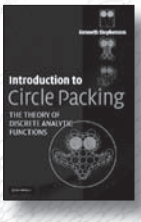


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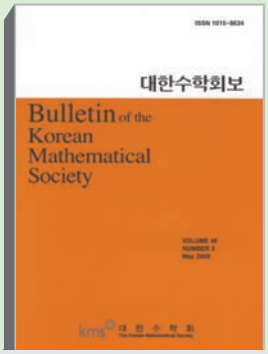
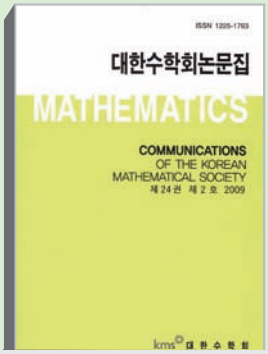
# The Korean Mathematical Society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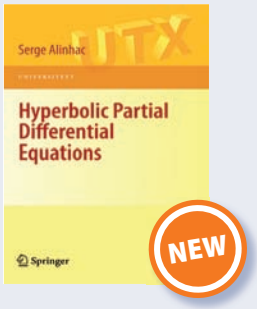


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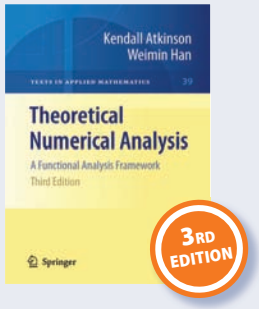


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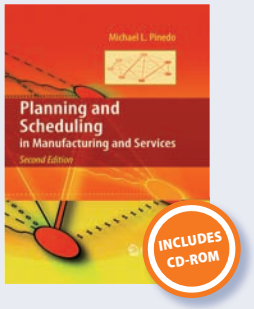


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