LSA MATHEMATICS
UNIVERSITY OF MICHIGAN

Weekly Seminar & Events Bulletin

January 25th, 2015 - January 31st, 2015

Monday, January 26, 2015	
12:00pm-1:00pm	**Mathematical Biology** -- Mark Reimers (Michigan State University, Neuroscience Program) *Two vignettes in computational Neuroscience: from data to models* -- 335 West Hall
3:00pm-4:00pm	**Group, Lie and Number Theory** -- Andrei Jorza (University of Notre Dame) *Automorphic cycles and p-adic L-functions on families of Hilbert modular forms* -- 4096 East Hall
3:00pm-4:00pm	**SPECIAL EVENT** -- Anush Tserunyan (Univ. of Illinois at Urbana) *Finite generating partitions for continuous actions of countable groups* -- 3096 East Hall
3:10pm-4:00pm	**Student AIM Seminar** -- Bobbie Wu (UM) *The Barycentric Formula for Interpolation and Integration* -- 1866 East Hall
4:00pm-5:00pm	**Complex Analysis, Dynamics and Geometry** -- Jeff Diller (University of Notre Dame) *Dynamics on P^2: an example* -- 3096 East Hall
4:00pm-5:00pm	**Student Combinatorics Seminar** -- Visu Makam (UM) *Universal Enveloping Algebras* -- 3866 East Hall
5:00pm-6:00pm	**Baby Algebraic Geometry** -- Rachel Karpman (UM) *Meet the Flag Varieties* -- 4096 East Hall
5:15pm-6:30pm	**Teaching Mathematics** -- Daniel Visscher (Univ Michigan Mathematics) *Comparing oral and traditional assessment in a content course for pre-service elementary school teachers* -- 3096 East Hall

Tuesday, January 27, 2015	
3:00pm-4:00pm	**Student Commutative Algebra** -- Robert Walker (UM) *Uniform Bounds in Affine Toric Rings* -- 1866 East Hall
5:00pm-6:00pm	**Student Analysis** -- Matt Jacobs (UM) *Riemann Hilbert Problems and Orthogonal polynomials* -- 2866 East Hall

Wednesday, January 28, 2015	
2:00pm-3:00pm	**Student Arithmetic** -- Corey Everlove (UM) *Large gaps between primes* -- 2866 East Hall
4:00pm-6:00pm	**Algebraic Geometry** -- Ian Shipman (University of Michigan) *Ulrich bundles and arithmetically Cohen-Macaulay varieties* -- 4096 East Hall

Thursday, January 29, 2015	
3:00pm-4:00pm	**Commutative Algebra** -- Mel Hochster (University of Michigan) *Lim Cohen-Macaulay sequences give closure operations and big Cohen-Macaulay modules* -- 3096 East Hall
3:10pm-5:00pm	**Analysis/Probability Learning Seminar** -- Roman Vershynin (UM) *Mathematics of networks. 3. Concentration and regularization of the Laplacian* -- 4448 EH (Psychology wing)
4:00pm-5:00pm	**Differential Equations** -- Manuel Gnann (Univ. of Michigan) *Regularity for the Navier-slip thin-film equation in the perfect wetting regime* -- 4088 East Hall
4:00pm-5:00pm	**Student Algebraic Geometry** -- Robert Walker (University of Michigan) *Uniform Bounds in Affine Toric Rings* -- 4096 East Hall

Friday, January 30, 2015	
2:00pm-3:00pm	**SPECIAL EVENT** -- Uriya First (UBC) *Rational Isomorphism of Quadratic Forms and Related Objects* -- 1866 East Hall
3:00pm-4:00pm	**Applied Interdisciplinary Mathematics** -- Todd Kapitula (Calvin College) *Reformulating spectral problems with the Krein matrix* -- 1084 East Hall
3:00pm-4:30pm	**Arithmetic Geometry Learning Seminar** -- Andrew Snowden (UM) *Basic properties of higher K-theory* -- 1866 EH

4:10pm-5:00pm **Combinatorics** -- Pablo Soberon (U. Michigan) *Fixed directions in mass partitions problems* -- 3866 East Hall

Abstracts for the week of January 25th, 2015 - January 31st, 2015

Mathematical Biology
Monday, January 26, 2015, 12:00pm-1:00pm
335 West Hall
Mark Reimers (Michigan State University, Neuroscience Program)
Two vignettes in computational Neuroscience: from data to models

This talk will describe two models for brain dynamics and their relation to data

The first is a model for slow (delta-band) activity over the surface of mouse cortex. We develop a linear model for both intrinsic regional dynamics and communication between cortical regions, and use this model to estimate some of the effective connectivity between different cortical regions. Our estimates from dynamical data correspond well to known anatomical connections. Short-term predictions from this model are correlated 65% with observed data. The model is being extended to non-linear dynamics.

The second model reproduces the gamma rhythm found in active regions of cortex. There have been several models that generate plausible rhythms in the gamma range (30-50 Hz); but the parameters of these models are not realistic. Furthermore recent genomic data from healthy human subjects indicates very high variability in key parameters of these models, and current models are not robust to this variability. We propose a more realistic model drawing on data; the distinctive feature is high diversity among connection strengths. This model gives much more realistic gamma rhythms, on all measures, and is also more robust to inter-individual variation.

Group, Lie and Number Theory
Monday, January 26, 2015, 3:00pm-4:00pm
4096 East Hall
Andrei Jorza (University of Notre Dame)
Automorphic cycles and p-adic L-functions on families of Hilbert modular forms

In certain cases p-adic L-functions, which interpolate p-adically special values of L-functions, vanish even if the L-function doesn't vanish. In such cases the Mazur-Tate-Teitelbaum conjecture and its generalizations compute the derivative of the p-adic L-function in terms of an arithmetically defined quantity called the p-adic L-invariant. A crucial component for the study of these conjectures is the availability of so-called two variable p-adic L-functions in families of automorphic forms. In joint work with D. Barrera and M. Dimitrov we construct such two variable p-adic L-functions for finite slope Hilbert modular forms using integration against certain automorphic cycles and we prove a Mazur-Tate-Teitelbaum conjecture when the Hilbert modular form is special at p.

SPECIAL EVENT
Monday, January 26, 2015, 3:00pm-4:00pm
3096 East Hall
Anush Tserunyan (Univ. of Illinois at Urbana)
Finite generating partitions for continuous actions of countable groups

Let a countable group G act continuously on a Polish space X. A countable Borel partition P of X is called a generator if the set of its translates {gA : g in G, A in P} generates the Borel sigma-algebra of X. For G=Z, the Kolmogorov-Sinai theorem gives a measure-theoretic obstruction to the existence of finite generators: they don't exist in the presence of an invariant probability measure with infinite entropy. It was asked by B. Weiss in the late 80s whether the nonexistence of any invariant probability measure guarantees the existence of a finite generator. We show that the answer is positive for an arbitrary countable group G and sigma-compact X (in particular, for locally compact X). We also show that finite generators always exist for aperiodic actions in the context of Baire category (i.e. allowing ourselves to disregard a meager set), thus answering a question of A. Kechris from the mid-90s.

Student AIM Seminar
Monday, January 26, 2015, 3:10pm-4:00pm
1866 East Hall
Bobbie Wu (UM)
The Barycentric Formula for Interpolation and Integration

We will introduce the barycentric formula for polynomial interpolation, which leads to an excellent interpolation algorithm that is fast and stable. Similar formula can be derived for the Cauchy integral formula to provide an algorithm that solves the boundary value problem of Laplace equation. Such algorithm proves to be spectrally accurate everywhere in the domain including points that are almost touching the boundary.

Complex Analysis, Dynamics and Geometry
Monday, January 26, 2015, 4:00pm-5:00pm
3096 East Hall
Jeff Diller (University of Notre Dame)
Dynamics on P^2: an example

I have recently been interested in dynamics of rational surface maps that preserve a meromorphic two form. In this talk I will focus on one particular example, recently studied by my student Han Liu. Pictures indicate clearly that the dynamics of this map, though complicated, are tractable and mostly concentrated in R^2. It turns out that one can arrive at a complete pointwise description of the dynamics by using the linear action of the map on the Picard group to identify some key distinguishing geometric features. Well-chosen perturbations of this example lead to maps with equal first and second dynamical degrees whose dynamics can still, to some extent, be understood.

Student Combinatorics Seminar
Monday, January 26, 2015, 4:00pm-5:00pm
3866 East Hall
Visu Makam (UM)
Universal Enveloping Algebras

For any lie algebra, one can construct its universal enveloping algebra. This construction passes from the non-associative structure to a more familiar setting of a unital associative algebra, which captures the important properties of the lie algebra. In understanding representations, it plays a similar role to that of the group algebra.

Baby Algebraic Geometry
Monday, January 26, 2015, 5:00pm-6:00pm
4096 East Hall
Rachel Karpman (UM)
Meet the Flag Varieties

The flag variety FL(n) parametrizes maximal nested sequences of subspaces of an n-dimensional vector space. We show how to embed FL(n) in a projective variety, and define an atlas of coordinate charts on FL(n). We then introduce the Schubert decomposition of FL(n), which has a rich combinatorial structure. Finally, we relate the Schubert decomposition of FL(n) to the Schubert decomposition of the Grassmannian. This talk will feature lots of examples, and should be accessible to students currently taking Math 631.

Teaching Mathematics
Monday, January 26, 2015, 5:15pm-6:30pm
3096 East Hall
Daniel Visscher (Univ Michigan Mathematics)
Comparing oral and traditional assessment in a content course for pre-service elementary school teachers

A recent study on oral assessments summarizes several advantages to giving oral assessments, including that they: (1) develop communication skills, (2) are a more authentic assessment, (3) are more inclusive of different learning style and needs, and (4) are better at gauging understanding (Huxham, Campbell, Westwood, 2012). We anticipate an additional potential advantage: (5) they provide instant and interactive feedback, thereby providing opportunities to learn.

During the fall semester of 2014, Daniel used oral assessments in conjunction with traditional written assessments across both sections (N=42) of a "Number and Operations" course (Math 385) for future elementary teachers. In this seminar, we will describe how the oral assessments were used, our research questions, research design, and preliminary results. Then we will turn our focus to one of our research questions in particular (related to point (5) above):

To what extent do students learn during the process of taking an oral exam and how does that compare to traditional written assessments?

We hope to discuss, with the help of the audience, how powerful our video data is (or is not) in beginning to answer this question. This is relevant to this year's seminar goal of understanding what we mean by "evidence" in math education research.

Student Commutative Algebra
Tuesday, January 27, 2015, 3:00pm-4:00pm
1866 East Hall
Robert Walker (UM)
Uniform Bounds in Affine Toric Rings

By starting from a 2-dimensional SC-R cone (strongly convex, rational polyhedral) in R^2, we can obtain a 2-dimensional affine toric ring R over a field K. Similar to the setting of equicharacteristic regular rings, we want a uniform bound theorem for select prime ideals in R, and I have a conjectural formulation in view. By now, I can verify the conjecture if R is a Veronese ring or a "d-th power binomial ring" (operative term), and we'll start the talk from these examples.

But recently, Karen Smith and I figured out a linear algebra/elementary number theory framework that allows us to reduce the general version of the conjecture to one for SC-R cones that are friendlier to think about geometrically. The goal of the talk will be to explain this framework and, hopefully, how I am using it to gradually extend the range of cases where the conjecture is known to hold.

Student Analysis
Tuesday, January 27, 2015, 5:00pm-6:00pm
2866 East Hall
Matt Jacobs (UM)
Riemann Hilbert Problems and Orthogonal polynomials

I will explain the connection between orthogonal polynomials on the real and the circle and their connection to Riemann Hilbert Problems. Then I will show how the Riemann Hilbert problem can be used to obtain asymptotic expansions of the polynomials as the degree approaches infinity

Student Arithmetic
Wednesday, January 28, 2015, 2:00pm-3:00pm
2866 East Hall
Corey Everlove (UM)
Large gaps between primes

While the results of Zhang, Maynard, and others on small gaps between primes in the last two years has attracted a great deal of attention, there have also been some new results about large gaps between primes. In this talk, I will start by reviewing some facts about the distribution of primes then sketch proofs of some classical results about large gaps due to Westzynthius and Rankin. I will also give a survey of the more recent results.

Algebraic Geometry
Wednesday, January 28, 2015, 4:00pm-6:00pm
4096 East Hall
Ian Shipman (University of Michigan)
Ulrich bundles and arithmetically Cohen-Macaulay varieties

Consider a smooth variety X embedded in projective space. Unless X is a projective space embedded linearly, the graded section ring for the embedding will have an isolated singularity. One approach to studying these singularities, and thus the geometry of X, is to consider maximal Cohen-Macaulay modules over the section ring. This leads to the notion of arithmetically Cohen-Macaulay (aCM) varieties and aCM bundles. I will overview some of the trends in the study of aCM bundles with a special emphasis on certain class of aCM bundles called Ulrich bundles. In particular, I will explain some of the remarkable consequences of the mere existence of Ulrich bundles.

Commutative Algebra
Thursday, January 29, 2015, 3:00pm-4:00pm
3096 East Hall
Mel Hochster (University of Michigan)
Lim Cohen-Macaulay sequences give closure operations and big Cohen-Macaulay modules

The talk will describe joint work of Bhargav Bhatt, Linquan Ma, and the speaker. A sequence of nonzero R-modules is lim Cohen-Macaulay if for some (equivalently, every) system of parameters x of R, the length of the higher Koszul homology of M_n with respect to x is $o(\nu(M_n))$, where $\nu(M_n)$ is the least number of generators of M_n. We show that each such sequence yields a closure operation on submodules of finitely generated R-modules. This in turn implies that R has a big Cohen-Macaulay module. Characteristic p tight closure is a special case. If R is a complete local domain, integrally closed ideals are closed, and one obtains strong forms of colon-capturing, including Dietz's form.

Analysis/Probability Learning Seminar
Thursday, January 29, 2015, 3:10pm-5:00pm
4448 EH (Psychology wing)
Roman Vershynin (UM)
Mathematics of networks. 3. Concentration and regularization of the Laplacian

This is the last of three lectures on mathematical understanding of complex networks. It is based on Grothendieck's factorization, which itself can be deduced from two Grothendieck's results (one of them from the first lecture). Combining it with paving arguments, we show that the Laplacian concentrates even for totally sparse random graphs, modulo a simple regularization. We deduce that spectral clustering (of the first lecture) works for totally sparse networks after a simple regularization. This results validates the simplest of the (very few) proposed plausible approaches to totally sparse networks, and it confirms some earlier empirical predictions. This is a joint work with E. Levina and Can Le, both at UM Statistics (paper to be available soon).

Differential Equations
Thursday, January 29, 2015, 4:00pm-5:00pm
4088 East Hall
Manuel Gnann (Univ. of Michigan)
Regularity for the Navier-slip thin-film equation in the perfect wetting regime

We investigate perturbations of traveling wave solutions to a thin-film equation with quadratic mobility and a zero contact angle condition at the triple junction between the three phases liquid, gas, and solid. This equation can be derived from the Navier-Stokes system of a liquid droplet with a Navier-slip condition at the liquid-solid interface. Existence and uniqueness have been established by the author joint with Giacomelli, KnÃ¼pfer, and Otto in previous work. As solutions are generically non-smooth, the approach relied on suitably subtracting the leading-order singular expansion at the free boundary. In this talk, we substantially improve this result by showing the regularizing effect of the degenerate-parabolic equation to arbitrary orders of the singular expansion. This result turns out to be natural in view of the properties of the source-type self-similar profile.

Student Algebraic Geometry
Thursday, January 29, 2015, 4:00pm-5:00pm
4096 East Hall
Robert Walker (University of Michigan)
Uniform Bounds in Affine Toric Rings

In 2001-2002, the collaborations Ein-Lazarsfeld-Smith and Hochster-Huneke obtained a result that, among other things, compares symbolic and ordinary powers of any ideal in any Noetherian regular ring containing a field; in practice, I call this the Uniform Bound Theorem for Equicharacteristic Regular Rings. A similar result holds for smooth rings over a field, saying that the symbolic and ordinary powers of any prime ideal coincide.

In structure, affine toric rings (i.e., the coordinate rings of affine toric normal varieties) are "mused to be" the nicest class after regular rings on the one hand, and smooth rings on the other (since their singularities are rational), and I am currently investigating whether there is a result for this class that is analogous to the above facts in the regular and smooth settings, respectively. The goal of this talk will be to motivate a conjecture I have in view, and hopefully to outline current progress on verifying it. (For a more explicit spiel, see the Student Commutative Algebra abstract for this week.)

This will be a practice run for a talk I am volunteering in the Commutative Algebra Seminar the following Thursday, and I invite audience feedback for improvement.

SPECIAL EVENT
Friday, January 30, 2015, 2:00pm-3:00pm
1866 East Hall
Uriya First (UBC)
Rational Isomorphism of Quadratic Forms and Related Objects

Let R be a discrete valuation ring with fraction field F. Two algebraic objects (say, quadratic forms) defined over R are said to be rationally isomorphic if they become isomorphic after extending scalars to F. In the case of unimodular quadratic forms, it is a classical result that rational isomorphism is equivalent to isomorphism. This has been recently extended to "almost umimodular" forms by Auel, Parimala and Suresh. I will present further generalizations to related objects: hermitian forms over involutary R-algebras, quadratic spaces equipped with a group action ("G-forms"), and systems of quadratic forms. The results can be regarded as versions of the Grothendieck-Serre conjecture for certain non-reductive groups.
(Joint work with Eva Bayer-Fluckiger.)

Applied Interdisciplinary Mathematics
Friday, January 30, 2015, 3:00pm-4:00pm
1084 East Hall
Todd Kapitula (Calvin College)
Reformulating spectral problems with the Krein matrix

Successful resolution of spectral problems in Hamiltonian systems requires not only that we locate the eigenvalues, but also that we determine the Krein signatures of those which are purely imaginary. The well-known Evans function determines the location and multiplicity of the eigenvalues, but in its classical form it does not allow a determination of the signatures. On the other hand, the Krein matrix, and the accompanying Krein eigenvalues, allow us to not only find the eigenvalues, but the graphs can be used to determine the signatures. We will briefly consider the construction of the matrix, and discuss its role in applications.

Arithmetic Geometry Learning Seminar
Friday, January 30, 2015, 3:00pm-4:30pm
1866 EH
Andrew Snowden (UM)
Basic properties of higher K-theory

TBA

Combinatorics
Friday, January 30, 2015, 4:10pm-5:00pm
3866 East Hall
Pablo Soberon (U. Michigan)
Fixed directions in mass partitions problems

During this talk we explore what measure partition results can be obtained in euclidean spaces if we impose additional geometric restrictions on the partition, in the form of fixing directions of subdividing hyperplanes. This leads to generalizations of Alon's classic necklace-splitting theorem as well as a positive answer to a conjecture by Mikio Kano regarding partitions of R^2 with paths using only vertical and horizontal segments.