Program for 2019 NYC Regional Math Alliance Conference
Saturday September 21

All events take place in the North Academic Center (NAC) building.

9:15-9:45	(outside 1/203)	Greetings and Registration
9:45-10:00	(1/203)	Opening remarks
10:00-10:45	(1/203)	Prof. Gideon Zamba (Univ. of Iowa) *Bring Math Back to the World and the World Back to Math*
10:45-11:15		Coffee break
11:15-12:25	(5/108 and 5/109)	Short talks in Parallel Sessions
12:30-1:25	(outside 1/203)	Lunch
1:30-2:20	(1/203)	Panel discussion on Graduate programs in the NYC area. Panelists: • Melody Goodman, Professor of Biostatistics, NYU College of Global Public Health • Zheng-chao Han, Professor of Mathematics at Rutgers University • Patrick Hooper, co-Graduate Advisor for CCNY Master's Program in Mathematics • Ilya Kofman, Deputy Executive Director of Mathematics PhD Program of the CUNY Graduate Center • Aihua Li, Professor of Mathematical Sciences at Montclair State University • Thaddeus Tarpey, PhD Program Director, NYU School of Medicine, Division of Biostatistics, Department of Population Health
2:30-3:00	(1/203)	Prof. Bill Barker (Bowdoin) and Prof. David Goldberg (Purdue) *Creating Opportunities for Community College Students at Four Year Colleges – A Pilot Project*
3:00-3:30	(outside 1/203)	Coffee break
3:30-4:40	(5/108 and 5/109)	Short talks in Parallel Sessions
4:45-5:30	(Room tba)	Poster presentations and networking

Parallel sessions 11:15-12:25

Time	In NAC 5/108	In NAC 5/109
11:15-11:35	Smocked Metric Spaces and their Tangent Cones	Parabolic iteration
	V. Antonetti, M. Farahzad and J. Mujo	H. Hu
11:40-12:00	Rhombitrihexagonal tiling billiards	Bayesian Phylogenetic Inference of a Stochastic Block Model
	N. Escorcia, A. Maiga and S. Wynter	Y. Guo
12:05-12:25	Local Subgroup Structures of Abstract Commensurators	General Electric Aviation Material Wear Data Analysis
	S. Young	V. Filardi

Parallel sessions 3:30-4:40

Time	In NAC 5/108	In NAC 5/109
3:30-3:50	Introduction to Residual Finiteness growth functions	The Interlace Polynomial of Shell Graphs
	A. Timashova	C. Petzold
3:55-4:15	Improved bound on residual finiteness growth of lamplighter groups	Big Data Information Reconstruction for the Multi-State Hard Core Model
	J. Chen	Z. Lin
4:20-4:40	A low memory MPC algorithm for the minimum cut	Line graphs and edge-centrality measures
	M. Echevarria	R. Khan

Poster session 4:45-5:30, room TBD

Poster presenters and topics:

- Osanna Bandeli (Montclair State University), *The Number of Solutions for Three Cubes to Sum up to 0 Module a Prime Number*: This research focuses on counting the number of solutions for three nonzero cubes to sum to 0 modulo a prime number p which is congruent to 1 modulo 3. We first used the Cayley table to examine the situation for small primes and we develop a python code to find solutions. The types of solutions are further studied. We give an explicit formula for the number of solutions of Type I. For the number of solutions of Type II, we provide a lower bound. Properties of the total number of solutions are provided. We show that every solution is derived from a 3-part partition of 0 using nonzero cubes modulo p. The behavior and the number of such partitions are discussed.
- Junjie Chen and Anastasiia Timashova (CCNY), *Residual finiteness growths of Lamplighter groups*
- Marino Echevarria (CCNY), *A low memory MPC algorithm for the minimum cut*: We present an $O(log^4(n))$ round approximation algorithm for the min- imum cut problem in the Massively Parallel Computation (MPC) model of distributed computing with strictly sublinear memory per machine. MPC is a theoretical abstraction of the popular MapReduce framework and associated implementations used for distributed computing. Here we present a solution to a well studied problem in graph theory, the minimum cut problem usually shortened to the mincut problem. The mincut of a graph is the minimum number of edges that must be removed in a graph before the graph becomes disconnected. It can be used as a measure of fault tolerance in objects that can be modeled as networks such as road, sewer, and computer networking systems. In MPC it is usually easier to solve problems when given larger memory per machine. In fact, there exist mincut algorithms that run in constant rounds when near linear and super linear memory per machine are allowed, but to our knowledge, this is the first algorithm for the mincut in low memory MPC. With $log^2(n)$ extra memory the algorithm terminates $O(log^2(n))$ rounds.
- Vincent Filardi (CCNY), *General Electric Aviation Material Wear Data Analysis*: Our project with General Electric Aviation focused on extracting the features of materials data that were most critical to the overall wear of the materials. We wished to predict specific properties of materials based on existing data. We employed predictive analysis to find trends among the deepest and average block and shoe wear. The features focused on in the analysis were the base alloy families, ambient target temperature, contact stress target, initial sliding friction coefficient, stroke, initial driver load, and total cycles. After much collaboration and analysis, we constructed models to predict the most effective and efficient material combinations and provided more insight on future experimental procedures.
- Seychelle Khan (St. John's University), *Image-Guided Radiation Therapy*: Image-Guided Radiation Therapy uses CT scans and cone-beam images to locate tumors in cancer patients. This is done by digitally placing the cone-beam image over the CT scan and ensuring that the position of the tumor overlaps in both images. This project aimed to create a metric to determine whether the position of the tumor was correctly established in prostate images. The method that was chosen relied on the physics on which Image-Guided Radiation Therapy is based (Beer's Law). Matlab was used to determine and implement an optimization function which would correct the images to allow for easier identification of the tumor.
- Nancy R McKeon (Rutgers), *Analyzing the Effectiveness of New and Old Antipsychotics*:The objective of this study was to evaluate the effectiveness of antipsychotic drugs in typical settings within the population of schizophrenia patients using data from the Clinical Antipsychotic Trials of Intervention and Effectiveness. Our main outcome was final Positive and Negative Syndrome Scale (PANSS) scores.

Abstracts for talks

- Victoria Antonetti (Princeton), Maziar Farahzad (Stony Brook), and Julinda Mujo (Lehman College), *Smocked Metric Spaces and their tangent spaces*: We introduce the notion of a smocked metric spaces and explore the balls and geodesics in a collection of different smocked spaces. We find their rescaled Gromov-Hausdorff limits and prove these tangent cones at infinity exist, are unique, and are normed spaces.
- Bill Barker (Bowdoin) and David Goldberg (Purdue), *Creating Opportunities for Community College Students at Four Year Colleges — A Pilot Project*: This session will discuss the development and implementation of a new program that would select incoming freshmen at NYC community colleges with strong math skills and provide a structured experience that would enable them to make the transition to Bowdoin College and then to thrive there. Most of these students will be interested in pursuing a doctoral degree in a mathematical science upon graduation from Bowdoin but it is also expected that some students will use this opportunity to explore other options. Our hope is to demonstrate the viability of this model and then to invite other institutions to become involved. We also hope that the success of this project will lead to its adoption nationally.
- Junjie Chen (CCNY), *Residual finiteness growths of Lamplighter groups*: We will give a couple of equivalent definitions of the Lamplighter group. We will then improve on the best known bounds for its residual finiteness growth. In particular, any lamplighter group has super-linear residual finiteness growth.
- Marino Echavarria (CCNY), *A low memory MPC algorithm for the minimum cut*: We present an $O(log^4(n))$ round approximation algorithm for the min- imum cut problem in the Massively Parallel Computation (MPC) model of distributed computing with strictly sublinear memory per machine. MPC is a theoretical abstraction of the popular MapReduce framework and associated implementations used for distributed computing. Here we present a solution to a well studied problem in graph theory, the minimum cut problem usually shortened to the mincut problem. The mincut of a graph is the minimum number of edges that must be removed in a graph before the graph becomes disconnected. It can be used as a measure of fault tolerance in objects that can be modeled as networks such as road, sewer, and computer networking systems. In MPC it is usually easier to solve problems when given larger memory per machine. In fact, there exist mincut algorithms that run in constant rounds when near linear and super linear memory per machine are allowed, but to our knowledge, this is the first algorithm for the mincut in low memory MPC. With $log^2(n)$ extra memory the algorithm terminates $O(log^2(n))$ rounds.
- Natalia Escoria (St. John's University), Abdoulaye Maiga (CCNY) and Simon Wynter (Cornell), *Tiling billiards on the rhombitrihexagonal tiling*: We will talk about the rhombitrihexagonal tiling billiards which is one of the many tiling in dynamical systems which have not yet been studied by anyone. We will first define the tiling billiards and explain important concepts to know about tiling billiards in general and emphasized the particularities of our tiling. Then we will end the talk by mentioning and explaining an important property (i.e folding property) of the rhombitrihexagonal tiling which isn't necessary true for every tiling. We will also mention the further results we are trying to show about the rhombitrihexagonal tiling. We have been mentored by Professor Hooper.
- Vincet Filardi (CCNY), *General Electric Avation Material Wear Data Analysis*: Our project with General Electric Aviation focused on extracting the features of materials data that were most critical to the overall wear of the materials. We wished to predict specific properties of materials based on existing data. We employed predictive analysis to find trends among the deepest and average block and shoe wear. The features focused on in the analysis were the base alloy families, ambient target temperature, contact stress target, initial sliding friction coefficient, stroke, initial driver load, and total cycles. After much collaboration and analysis, we constructed models to predict the most effective and efficient material combinations and provided more insight on future experimental procedures.
- Yanqiu Guo (Queensborough Community College), *Bayesian Phylogenetic Inference of Stochastic Block Model with Different In-block and Out-block Mutations on Random Graphs*: In this project, we will analyze a classification problem on a deep network, by considering a broadcasting process on an infinite communication tree, where information is transmitted from the root of the tree to all the vertices with certain probability of error. The tree reconstruction problem is to determine whether symbols at the n-th level of the tree contain non-vanishing information about the root, as n goes to infinity. Its connection to the clustering problem in the setting of the stochastic block model, which has wide applications in machine learning and data mining, has been well established. For the stochastic block model (SBM), an "information-theoretically-solvable-but-computationally-hard" region, or say "hybrid-hard phase", appears whenever the reconstruction bound is not tight of the corresponding reconstruction on the tree problem.
- Hongzhong Hu (Laguardia Community College), *Parabolic iteration*

- Ziyan Lin (Queensborough Community College), *Big Data Information Reconstruction for the Multi-State Hard Core Model*: Ramanan et al. proposed a generalization of the hard core model as an idealized model of multicasting in communication networks. In this generalization, the multi-state hard core model, the capacity C is allowed to be a positive integer, and a configuration in the model is an assignment of states from $\{0, ..., C\}$ subject to the constraint that the states of adjacent nodes may not sum to more than C. This project will focus on the reconstruction threshold of the multi-state hard core model on regular d-ary trees. This problem has a wide range of applications in various fields such as biology, information theory and statistical physics, and its close connections to cluster learning, data mining and deep learning have been well established in recent years.
- Cheyenne Petzold (Montclair State University), *The Interlace Polynomial of Shell Graphs*: Interlace polynomials were originally based on a problem relating to DNA sequencing by hybridization. The original problem was to find the number of 2-in, 2-out digraphs for a given number of Euler circuits. Arratia, Bollóbas, and Sorkin introduced the interlace polynomial of a graph, a polynomial which is generated from performing a toggling process on the graph. The interlace polynomial of a graph is well related to the structural properties of the graph and it has been shown that the toggling process can be used on any simple graph. Our project focuses on a certain type of simple graph. The graph of our interest is build by adding cords to cycles. We develop the recursive formulas and explicit sub formulas for our graph.
- Anastasiia Timashova (CCNY) *Introduction to Residual Finiteness Growth Functions*: The residual finiteness growth function gives an invariant that indicates how well-approximated a finitely generated group is by its finite quotients. We will give an introduction to residual finiteness and its growth function.
- Samuel Young (CCNY), *Local Subgroup Structures of Abstract Commensurators*: The abstract commensurator of a group, $Comm(G)$, generalizes the notion of the automorphism group $Aut(G)$. We study a new variation of $Comm(F_2)$, which embeds in $Comm(F_2)$, which we show is not locally residually finite.
- Gideon Zamba (Iowa), *Bring Math Back to the World and the World Back to Math*: Applied mathematics is a field of constant adaptability to the world's contingencies. Such adaptability requires a solid training and understanding of theoretical and pure mathematical thinking—as the activity of applied thinking is vitally connected with research in pure mathematics. One such applied mathematical field of data-driven inference is the field of statistics. As the world continues to rely more on data for decision making, statistics and associated data-driven fields have gained an increased recognition as they attempt to answer questions associated with information gained from data. The purpose of this talk is to educate the audience about the fields of statistics and biostatistics, about statistical involvements, and further provide examples of settings where statistical theory finds an application and where real-world applications call for new statistical developments. The presentation further elaborates on the broadening of the mathematical field; and further provides some general advice about mathematical and computational skills needed for a successful graduate degree in data-driven fields. The presentation is not technical.