Diversity in Math Festival: Speaker Abstracts

Morning Session: Academic (NS2 3201)

[9:00-9:30] Mathematics of Color

Natalia Komarova *UC Irvine*
ABSTRACT: Color perception, and color categorization in humans is a fascinating topic. Different languages have different numbers of color terms (ranging from two basic color terms to 12 basic color terms), and then split the color space differently. We study the problem of color categorization from a mathematical and evolutionary prospective. What is an optimal partitioning of a color space into color categories? How do people manage to arrive at a shared color categorization system that allows successful communication? What are symmetry properties of this problem, and what is the role of population heterogeneity? These are other questions will be discussed in this talk.

[9:30-10:15] (PLENARY TALK) Mathematics of Crime

Andrea Bertozzi *UC Los Angeles*
ABSTRACT: In this lecture Andrea Bertozzi will tell the story of the UCLA team that developed a 'predictive policing' computer program that zeros-in on areas that have the highest probability of crime. She will also discuss how mathematics play an increasing role in studying crime, especially crimes of opportunity and gang crime.

[10:30-10:45] Analysis of An Age Dependent Elastic Malaria Model

Giovanny Marquez *CSU Northridge*
ABSTRACT: Malaria is caused by a parasite that is transferred from an infectious female mosquito (a vector) to a susceptible human or from an infectious human to a susceptible vector when it takes a blood meal. The deadliest and most prevalent parasite in Kenya is P. faciparum species which we consider. According to the WHO 2015 data 70% of all deaths due to malaria were in children under five. Hence, in order to develop a mathematical model for malaria, one should consider age of humans. We consider a community at the very beginning of a potential malaria epidemic in the highlands of Kenya. Since the disease has not proliferated, the general population are not using any protective measures against vectors (e.g., Insecticide Treated Nets (ITNs) and Long Lasting Treated Nets (LLNs)). We further assume that surveillance by government agencies detects the proliferation of the disease, which initiates a promotional and educational campaign by government agencies for the distribution and use of ITNs and LLNs by the general public. Studies have shown that if educational campaigns or a change of behavior due to the fear of becoming infected can result in a measurable proportion of the population using ITNs and LLNs, then the severity of an epidemic may significantly diminish.

[10:45-11:00] The Two-Page Local Crossing Number of the Complete Graph

Leah Schulman & Julian Corpeño *CSU Northridge*
ABSTRACT: The complete graph on n vertices, K_n, is the graph whose set of vertices has n elements and whose set of edges consists of all pairs of vertices. A drawing of a graph is a specific representation of it where vertices are represented by points and edges by curves connecting these points. In this talk, we consider *two-page* book drawings of the complete graph. That is, drawings where the vertices are placed on a line (the spine of the book) and edges are drawn on two half-planes (the pages) attached to this line. The local crossing number of a drawing D of the complete graph K_n is the largest number of crossings on any single edge of D. The local crossing number of the complete graph K_n is the minimum local crossing number of D over all drawings D of K_n. The purpose of our research is to find or estimate the local crossing number of K_n drawn as a *two-page* graph, denoted as $lcr_2(n)$. We present upper

and lower bounds for $lcr_2(n)$ and determine its order of magnitude.

[11:00-11:15] Differences of Harmonic Numbers and the abc-conjecture

Natalia da Silva & Hector Salgado *CSU Dominguez Hills*
ABSTRACT: We investigated which numbers can or cannot be written as a difference of harmonic numbers and looked at their connection to the abc-conjecture. We found that there are only eleven numbers less than 100 that cannot be written as a difference of harmonic numbers (we call these ndh-numbers). The smallest ndh-number is 41, which is also Euler's largest lucky number and is a very interesting number. We then showed there are infinitely many ndh-numbers, some of which are the primes congruent to 41 modulo 48. For each Fermat or Mersenne prime we either proved that it is an ndh-number or found all ways it can be written as a difference of harmonic numbers. Finally, as suggested by Lenstra in his talk, we interpreted Gersonides' theorem as "The abc-conjecture is true on the set of harmonic numbers" and we expanded the set on which the abc-conjecture is true by adding (one at a time) the following sets:

- a finite set of ndh-numbers,
- the infinite set of primes of the form $48k + 41$,
- the set of Fermat primes, and
- the set of Mersenne primes.

[11:45-12:00] An invitation to algebraic geometry

Jose Gonzalez *UC Merced*
ABSTRACT: I will introduce the field of mathematics called algebraic geometry and I will overview some of the problems that have motivated my work as a researcher in this area.

[12:00-12:15] Obstruction - Flat Spaces

Christopher Lopez *UC Irvine*
ABSTRACT: Given a space in which we can locally measure angles, we are interested in determining when it is possible to to extend our original space to a larger space such that our original space is the boundary of the larger space and the larger space has certain desirable properties. One motivation for investigating this problem is given in physics, the holographic principle describes the idea that, under certain conditions, we can determine the behavior of particles in a space by understanding the behavior of particles on the boundary of the space. A necessary condition for the extension to be possible is that a conformally invariant geometric quantity called the ambient obstruction tensor vanish on the boundary space. This tensor may be viewed as a high order Laplacian of the Ricci tensor appearing in the Einstein equations in general relativity. In this talk, we will describe how we can use a partial differential equation that generalizes the heat equation to help determine when we can modify a given space so that the ambient obstruction tensor vanishes on that space.

[12:15-12:30] Looking for tumors without a scalpel

Laure Giovangigli *UC Irvine*
ABSTRACT: I will present a model of spectroscopic imaging of cell suspensions that I developed during my PhD. We first apply a sinusoidal current at the boundary of a medium in which lies a single cell. We then consider a periodic medium and derive the effective properties of the medium. We show that these properties carry information on the microscopic structure of the medium and can thus be used to determine if a tissue is sick or healthy.

Morning Session: Career (NS2 3201)

[9:00-9:30] When Opportunity Calls, Jump: Non-Traditional Career Routes with Degrees in Mathematics

Rachel Winston *Brandman University*

ABSTRACT: Euclid once said, "There is no royal road to geometry." Similarly, there is no royal road to career success. You must make choices along the way. Some may have succeeded by doing "x" and you can follow. However, there are other very successful "y" and "z" pathways too. Then, there is always the ubiquitous upsilon pathway, , which ironically starts with a "u" for "your way" with its apparent visual fork in the road leading you to new choices. Thus, the goal is to envision the life you want and both passionately and persistently work to achieve your evolving goals, jumping at opportunities along the way.

Mathematical thinking, problem solving, critical reasoning, logic, spatial orientation, and computation are transferrable skills needed in today's workforce. Opportunities exist outside the traditional route for those with a strong work ethic and persistence. Alternative career pathways for those adept in mathematics are not necessarily obvious. Yet, if you are willing to learn, reach beyond limitations, expand your tool chest, and strive for excellence, the possibilities are only limited by your creativity and imagination.

Increasing levels of responsibility require the commitment to develop latent skills in communication, writing, politics, law, and salesmanship. Seek the best in every aspect of your being to become the best in your field, or at least the swatch of career cloth you have chosen to weave.

Standards, conformity, and rules limit choices. However, life's boundaries are removed when your mind is free. This presentation will expand your perspective and free you to think beyond limitation.

[9:30-9:45] Sweat, Luck and Bravery: My Journey through Academia

Stacy Musgrave *Cal Poly Pomona*

ABSTRACT: I will share my winding journey through academia ? from an undergraduate history major (briefly) to a PhD in pure mathematics to a postdoctoral position in math education, landing me as a tenure-track math education professor in a math department in charge of organizing a seminar for women in the RUME (Research in Undergraduate Math Education) community. This journey has taken me across the country and back, involved a lot of hard work, a bit of luck, and a lot of "putting on a brave face."

As I reflect on this journey, I'll share insights from my own experiences and observations of others as the road to tenure-track becomes increasingly narrow and full of roadblocks. What helped me succeed? What could I have done differently? And how is it playing out now?

[9:45-10:15] The Magic of Math: How I Built a Career

Neil Sahota *IBM*

ABSTRACT: New food recipes... sports training... making movies... writing music... what do these things have in common? Math! Learn how math can be used beyond traditional science careers to develop new products and services for the whole world. Understand how you can build a successful and exciting career as a mathematician.

[10:30-11:15] (PLENARY TALK) How you can find a BIG Job: Mathematical Scientists in Business Industry and Government

Rachel Levy *Harvey Mudd College*

ABSTRACT: The US is producing more PhDs in the mathematical sciences (pure/applied mathematics, operations research, statistics) than tenure track positions. Companies need people who can employ mathematical tools to find insights, develop solutions and recommend sound decisions. The availability and quantity of data has increased awareness of mathematical sciences in the workplace, but since many PhD programs were developed to produce

more professors, departments are reconsidering how to prepare students for this job landscape. The BIG Math Network was launched in January 2017 at bigmathnetwork.wordpress.com. The BIG Math Network brings together mathematical scientists (societies, institutes, employers) to facilitate pathways into BIG jobs. In this workshop, we?ll address three important questions: 1. What skills/qualities do people trained in the mathematical sciences bring to the workforce? 2. What assumptions/biases about mathematical scientists might a job candidate need to address? 3. What can you do to better position yourself for a BIG job?

[11:45-12:00] T.B.A.

Cynthia Northrup *McGraw-Hill Education*
ABSTRACT:

[12:00-12:15] T.B.A.

Daniel J. Vera *Surlamer LLC*
ABSTRACT:

[12:15-12:30] A Career with the U.S. Navy and A Scholarship For Education

Sara Melvin *Naval Sea Systems Command/UC Los Angeles*
ABSTRACT: The U.S. Navy provides great opportunities for applying mathematical knowledge and to fund higher educational pursuits. Throughout my career path, I jumped from one applied mathematics problem to the other in search for my true career passion. During this period of time, I was introduced to Machine Learning and the world of Data Science which combined math, statistics, and computer science in the most beautiful way. To succeed in this field, I returned to school as a SMART scholar for a Computer Science Master's at the University of California Los Angeles (UCLA).

In exchange for the funding, I am placed to work for the U.S. Navy at NAVSEA Port Hueneme after graduation. During my various breaks in school, I applied the theory of gamification in the construction of a customizable video game for the training of both sailors and civilians.

However, while attending graduate school, I was given the opportunity to apply my mathematical background to my research in data science. I collaborate with the University of California Institute of Predictive Technology and Intel Basis on modeling students' level of tiredness from wearable activity trackers wristbands. This information leads to wristband suggestions on how to change your daily activities to maintain a healthier level of restfulness.

In conclusion, the U.S. Navy is a great place for Mathematicians to apply their knowledge to various application and is a great source of funding for higher educational opportunities. I highly suggest you take a look at their internship programs such as the Naval Research Enterprise Internship Program (NREIP) to gain a better perspective.

Morning session: Diversity (NS2 1201)

[9:00-9:30] Democratizing access to authentic math experiences

Alessandra Pantano *UC Irvine*
ABSTRACT: Typically developed in an out-of-school setting, Math Circles are a pedagogical ecosystem where K-12 students or teachers engage in deep mathematical investigations with math professionals (university faculty or graduate students). By focusing on problem solving and mathematical discovery rather than procedures, math circles can be very effective in increasing students' proficiency and appreciation for mathematics. Unfortunately, de facto or by design, most math circle programs around the county are exclusively targeting highly talented students who are already extremely passionate about mathematics, and mathematically very advanced. Most groups who are traditionally underrepresented in mathematics-related studies and careers have been left out by math circles as well.

In this talk we describe a UC Irvine initiative aimed at providing equitable, ambitious and caring math instruction for underserved youth in the Santa Ana community.

[9:45-10:00] An Unexpected Journey Through the World of Numbers

Roberto Soto *CSU Fullerton*
ABSTRACT: How do you know if you are "called" to become a mathematician? What are the "signs" that steer you towards this decision? What roadblocks can cause you to take an unexpected detour? In this talk I would like to share the journey that led to my PhD in math at the age of 40 and why I decided to pursue such a path.

[10:00-10:15] Socio-Psychological Interventions: Can They Improve STEM Persistence and Beliefs?

Di Xu *UC Irvine*
ABSTRACT: The disproportionate number of college students leaving the sciences before attaining their intended STEM degrees has been a persistent issue for decades. More troubling is that this lack of persistence has been especially prevalent among first-generation (FG) college students and underrepresented minority (URM) students. The present study explores the potential benefits of both a belongingness and a growth mindset intervention upon first-year Biology students. The study measures outcomes including beliefs, performance, and ultimately, persistence as a Biology major. Preliminary results indicate that although there was no effect of the interventions on same-term academic performance, there was an association between the interventions and motivation variables. Policy implication will be briefly discussed during the presentation.

[10:30-10:45] Why so few women of color and URM in STEM? The lessons from the research on under-represented youth's authoring of future self in science

Hosun Kang *UC Irvine*
ABSTRACT: Despite decreasing achievement gaps, under-representations of females and African Americans, Latino/a and Native Americans in physical sciences, engineering, and computer science persist. Educational researchers from different research traditions offer different insights into the reasons why the under-representation of female and minorities in STEM fields persist. Aligning myself with critical equity scholars and grounded in social practice theory and feminists? writing of intersectionality, I argue that this on-going under-representation might be better framed as an identity gap. In this talk, I present the findings from two studies that explore the ways youth?s participation in science-related activities informs how they see possible future self(s) in STEM careers. The findings point out three potential leverage points for increasing middle school girls? identification with STEM careers, in particular girls from ethnic minority backgrounds. I argue that the girls from non-dominant backgrounds can see possible future selves in STEM careers if they are provided with expanded opportunities to participate in science-related activities beyond school science that lead to positive perceptions of self(s) in science.

[10:45-11:00] Inquiry: One Piece of the Equity Puzzle

Gail Tang *University of La Verne*
ABSTRACT: Although many policy documents include equity as part of mathematics education standards and principles, researchers continue to explore means by which equity might be supported. Teaching practices that include active learning have been proposed to address this issue (e.g., CBMS, 2016; NCTM, 2014). In this paper, we theoretically explore the ways in which active learning teaching practices that focus on teaching for inquiry (e.g., Inquiry-Based Learning (IBL) or Inquiry-Oriented Instruction (IOI)) support equity in the classroom. Specifically, we claim that some characteristics of inquiry (Student Ownership, Knowledge Building, Peer-Involvement, Doing Mathematics, Student-Instructor Relationship, and Student Success) put forth by Cook, Murphy, and Fukawa-Connelly (2016) may align with the Four Dimensions of Equity (Access, Achievement, Identity, and Power) proposed by Gutirrez (2009). Therefore, inquiry teaching may be a first step for a focus on equity without compromising the excellence (Gutirrez,

2002) or material that is often prescribed in undergraduate mathematics courses.

[11:00-11:15] T.B.A.

Amanda Ruiz *UC San Diego*
ABSTRACT:

[11:00-12:30] (PLENARY TALK) How we get students PUMPed into PhDs

M. Helena Noronha *CSU Northridge*

ABSTRACT: Underrepresented minority (URM) and first-generation college math majors, as well those with financial constraints abound in several parts of the country and in particular in Southern California. Some of these students are unaware of the many opportunities available to them, how a PhD degree can boost their careers or, even worse, lack confidence that they can succeed in graduate school. In this talk I will describe how my collaborators and I have been mentoring these math majors at local campuses of California State University system. Our work is changing the culture in our departments; that is, through our mentoring, students are inspired, build self-confidence, and raise their aspirations. This is the project named PUMP: Preparing Undergraduates through Mentoring towards PhDs. I will also talk about lessons that we have learned, challenges to be faced, and how we are extending this work to local Community Colleges.

Afternoon Session: Academic (PCB 1100)

[2:20-3:05] (PLENARY TALK) Using mathematics to fight cancer

Ami Radunskaya *Pomona College*
ABSTRACT: What can mathematics tell us about the treatment of cancer? In this talk I will present some of work that I have done in the modeling of tumor growth and treatment over the last ten years. Cancer is a myriad of individual diseases, with the common feature that an individual's own cells have become malignant. Thus, the treatment of cancer poses great challenges, since an attack must be mounted against cells that are nearly identical to normal cells. Mathematical models that describe tumor growth in tissue, the immune response, and the administration of different therapies can suggest treatment strategies that optimize treatment efficacy and minimize negative side-effects. However, the inherent complexity of the immune system and the spatial heterogeneity of human tissue gives rise to mathematical models that pose unique challenges for the mathematician. In this talk I will give a few examples of how doctors, immunologists, and mathematicians can work together to understand the development of the disease and to design effective treatments.

This talk is intended for a general audience: no knowledge of biology or advanced mathematics will be assumed.
