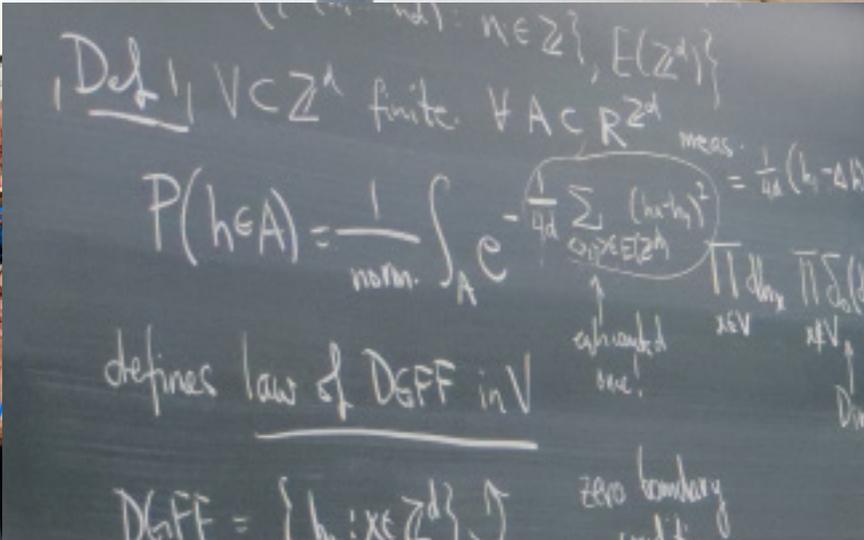
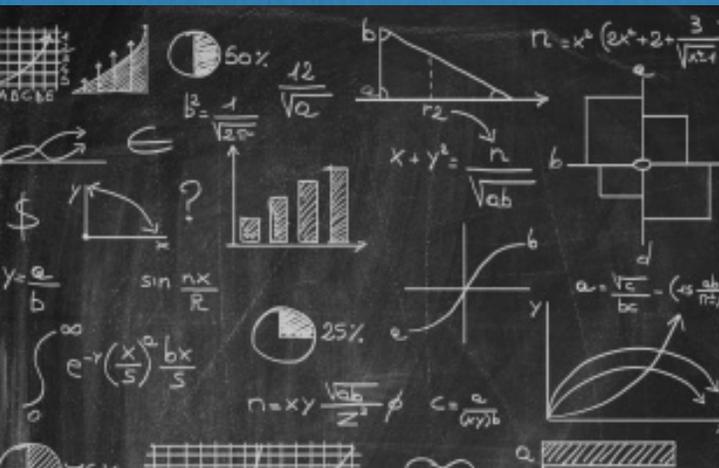


# 2020 PIMS Diversity In Mathematics: Undergraduate Women's Summer School



Week 1: August 4 - 8, 2020  
ONLINE PROGRAM



Photo: Sgt Johanie Maheu, Rideau Hall

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THE GOVERNOR GENERAL • LA GOUVERNEURE GÉNÉRALE

**Message from the Governor General on the occasion of the third edition of the Diversity in Mathematics program**

Math is the language of science, technology and engineering. And in math, there is a place for everyone—all genders, races, identities and orientations. *Every voice*. After all, inclusivity in math, and in all STEM fields, brings diversity in knowledge—differing points of view that shape the direction and velocity of innovation.

Whether you are in high school or university, you all share an interest in math and a curiosity to see where it can take you. The possibilities are endless and the sky is not the limit. The Diversity in Mathematics program is a chance to discover the types of careers you could have and find like-minded people who can inspire you to pursue your dreams.

And when the program is over, remember that each of you has something to bring to this unique world we share. Your wit, your passion and your contributions are needed in every field.

Thank you to the University of British Columbia, Simon Fraser University and the Pacific Institute for the Mathematical Sciences for offering such a challenging opportunity to young, inquisitive minds!

I wish all of you a productive and informative program.

$$e^{i\pi} + 1 = 0$$



THE GOVERNOR GENERAL · LA GOUVERNEURE GÉNÉRALE

### **Message de la gouverneure générale à l'occasion de la troisième édition du programme Diversité en mathématiques**

Les mathématiques sont la langue des sciences, de la technologie et de l'ingénierie. Et en mathématiques, chaque personne fait partie de l'équation : peu importe son genre, sa race, son identité et son orientation. *Chaque perspective compte!* Après tout, l'inclusion dans les mathématiques, et dans tous les domaines des STIM, favorise la diversité des connaissances et des points de vue et permet d'influencer l'orientation et la vitesse de l'innovation.

Que vous soyez au secondaire ou à l'université, vous avez tous un intérêt pour les mathématiques et une envie de découvrir où elles peuvent vous mener. Sachez que les possibilités sont infinies, qu'il n'y a aucune limite. Le programme Diversité en mathématiques vous permettra de découvrir les différentes carrières qui s'offrent à vous et de côtoyer des personnes aux vues similaires qui pourraient vous inspirer à poursuivre vos rêves.

Et une fois le programme terminé, n'oubliez pas que vous avez une contribution à apporter à ce monde unique qui est le nôtre. Votre vivacité d'esprit, votre passion et vos compétences seront les variables d'une formule gagnante dans tous les domaines.

Merci à l'Université de la Colombie-Britannique, à l'Université Simon Fraser et au Pacific Institute for the Mathematical Sciences de proposer une expérience aussi stimulante aux jeunes esprits avides de connaissances!

Je vous souhaite un programme formateur et enrichissant.



$e^{i\pi} + 1 = 0$

# Week One:

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**Q: Where do I check in on the first day?**

Online, though the zoom link on page 3.

**Q: Will the program change?**

Program changes and updates will be announced at each session.

**Q: Should my video always be off?**

No, please have your video on so that your colleagues and the instructors can see you. If you need to step away for a few minutes, you can turn it off, but let your colleagues know through the chat.

**Q: Where can I go for help during the sessions?**

If you need assistance or have a question during the summer school, please connect with the PIMS Program Manager: [ruths@pims.math.ca](mailto:ruths@pims.math.ca)

**Q: What is the joint High School Session about?**

In these sessions, undergraduates are paired up with students from the DIM High School Summer camp, and will work on various STEM issues together.

## Course #1: Reading and Preparation Material

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**Course Instructor:** Tracey Balehowsky, University of Helsinki

### Inverse problems and images

**Prerequisites:** Multivariable calculus, second year linear algebra (in particular comfortability with SVD, bases, eigenvalues and eigenspaces).

**Course Description:** Many problems which we would like to solve in the sciences can be abstractly described as follows: given our observations (measurements) of the system we seek to understand, determine the properties of the system which gave rise to the observations. Mathematically, we call this situation an inverse problem, since we know something about solutions (observations) to our model of the system, but we want to determine the coefficients of our model (which encode information about the system's properties). In this course we will introduce inverse problems arising in imaging, such as computed tomography (CT scan) and magnetic resonance imaging (MRI). We will explore some mathematical techniques used for image construction, denoising, and sampling.

**Tech Requirements:** Access to computers with Matlab. I plan to have the student fill in some prewritten code to run.

# Program Overview: Week one

Time	MON 3 (BC STAT)	TUE 4	WED 5	THUR 6	FRI 7	SAT 8
8:30am - 8:50am		Registration, & Welcome from PIMS Deputy Director: Prof. Marni Mishna Intro of Instructors: Shonda, Tracey + Laura				
9:00am - 10:00am		Course #1 Lecture Tracey B	Course #1 Lecture	Course #1 Lecture	Course #1 Lecture	Course #1 Lecture
10:00am - 10:30am		Break				
10:30am - 12:00PM		Info hour with Tracey	Group Set Up+ Lab work	Group Set Up+ Lab work	High School Math Camp: Joint Session 2 with Shawn Desaulniers	Group Set Up+ Problem Session
12:00pm - 2:00pm		Lunch				
Afternoon Events		1:30- 3:00pm High School Math Campus Joint Session 1 Callysto With Laura G Funderburk	2:00-3:00pm <u>Faculty Presentation</u> Alia Hamieh-UNBC	3:00- 4:15pm <u>Public Lecture</u> John Mighton	2:00pm- 3:15pm <u>Academic Journeys</u> Priyanka Mishra, PDF, SFU Alejandra Herera Phd UBC Emily Korfanty, MSC, UVic	Free

## Zoom Links:

- Zoom links to this event are not posted online.

# Week 1: Undergraduate Participants

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1. Samiha Ali, University of Alberta
2. Adan Amer, McMaster University
3. Gisele Arevalo, University of Alberta
4. Meiyong Ding, University of British Columbia
5. Claire Gao, University of Washington
6. Effie Gao, Simon Fraser University
7. Dora Gurfinkel, University of Texas at Austin
8. Elnaz Hessami Pilehrood, University of Toronto
9. Peizhe Huang, University of Toronto
10. Marie Jerade, University of Ottawa
11. Yamini Kukreja, University of Toronto
12. Alexandria Lee-Robinson, BinghamtonU. New York
13. Kira Li, University of British Columbia
14. Annika MacKenzie, University of British Columbia
15. Aishwarya More, University of British Columbia
16. Simran Sanghera, University of British Columbia
17. Samuelle Simard-Provençal, Vancouver Island University
18. Lan Tang, McMaster University
19. Siena Thalassinis, Queen's University
20. Ashley Van Spankeren, University of Victoria
21. Zerrin Vural, University of Texas at Austin
22. Haoya Wang, University of Alberta
23. Diana Wong, SFU
24. Yvonne Wong, University of British Columbia
25. Yihan Zhu, University of British Columbia

## Speaker Biographies:

### PIMS Public Lecture: John Mighton, Jump Math

#### **All Things Being Equal: Why Math is the Key to a Better World.**

Math provides us with mental tools of incredible power. When we learn math we learn to see patterns, to think logically and systematically, to draw analogies, to perceive risk, to understand cause and effect--among many other critical skills. Yet we tolerate and in fact expect a vast performance gap in math among students and live in a world where many adults aren't equipped with these crucial tools. This learning gap is unnecessary, dangerous and tragic, and it has led us to a problem of intellectual poverty which is apparent everywhere--in fake news, political turmoil, floundering economies, even in erroneous medical diagnoses. The study of math is an ideal starting point to break down social inequality and empower individuals to build a smarter, kinder, more equitable world. In this talk Mighton will share his vision for a numerate society for all, not just a chosen few.

### **Speaker Biography:**

Dr. John Mighton is a playwright turned mathematician and author who founded JUMP Math as a charity in 2001. His work in fostering numeracy and in building children's self-confidence through success in math has been widely recognized. He has been named a Schwab Foundation Social Entrepreneur of the Year, an Ernst & Young Social Entrepreneur of the Year for Canada, an Ashoka Fellow, an Officer of the Order of Canada, and has received five honorary doctorates. John is also the recipient of the 10th Annual Egerton Ryerson Award for Dedication to Public Education.

John developed JUMP Math to address both the tragedy of low expectations for students and that of math anxiety in teachers. John began tutoring children in math as a financially-struggling playwright, and his success in helping students achieve levels of success that teachers and parents had thought impossible fueled his belief that everyone has great untapped potential.

The experience of repeatedly witnessing the heart-breaking paradox of high potential and low achievement led him to conclude that the widely-held assumption that mathematical talent is a rare genetic gift has created a self-fulfilling prophecy of low achievement. A generally high level of math anxiety among many elementary school teachers, itself an outcome of that belief system, creates an additional challenge. John had to overcome his own "massive math anxiety" before making the decision to earn a Ph.D. in Mathematics at the University of Toronto. He was later awarded an NSERC Fellowship for postdoctoral research in knot and graph theory. He is currently a Fellow of the Fields Institute for Research in Mathematical Sciences and has taught mathematics at the University of Toronto. He has also lectured in philosophy at McMaster University, where he received a master's degree in philosophy. His plays have been performed around the world and he is the recipient of several national awards for theatre, including two Governor General's Awards. He played the role of Tom in the film Good Will Hunting.

## **Faculty and Panel Speaker Biographies**

### **Tracey Balehowsky, University of Helsinki**

Tracey Balehowsky is a Postdoctoral Researcher in the Inverse Problems group at the University of Helsinki. She concurrently held a Postdoctoral Fellowship at the Mathematical Sciences Research Institute and a Visiting Scholarship at the University of California at Berkeley in the fall of 2019. She is a member of both the Finnish Inverse Problems Society and the Women in Analysis Research Network. Tracey received her PhD in Mathematics in 2017 from the University of Toronto.

Tracey works on geometric inverse problems which have applications to particle kinematics, electromagnetic cloaking, quantum gravity theories (AdS/CFT), and imaging. Broadly, she studies the recovery of (pseudo-) Riemannian metrics from boundary or mapping data. She has also studied Ricci flow on asymptotically hyperbolic geometries. Her mathematical work incorporates concepts and structures from minimal surface theory, differential geometry, and the analysis of partial differential equations, amongst others.

Website: <https://blogs.helsinki.fi/balehows/>

### **Shawn Desaulniers- Instructor UAlberta**

Shawn Desaulniers is a Metis Canadian who grew up in Thunder Bay, Ontario. He received his Honours Bachelor of Science degree from Lakehead University in mathematics. After earning a doctorate degree in theoretical mathematics from the University of Alberta in 2008 he worked at Okanagan College and the University of British Columbia. In 2017 he returned to the University of Alberta where he primarily works with teaching candidates and on Indigenous student initiatives. In the past, he has helped to organize several conferences and workshops relating to mathematics and mathematical education, as well as problem-solving events and puzzle exhibits in BC and Alberta.

**Laura Gutierrez-Funderburk, Callysto**

Laura Gutierrez-Funderburk is a data scientist for the [Callysto](#) project, a federally-funded initiative in Canada helping students and teachers learn data science skills (coding, data analysis, and data visualization). Laura has developed numerous data science teaching resources for students and teachers alike. She is experienced in research, conference organization, and facilitating data science learning experiences which celebrate diversity and are tailored to a variety of skill levels. Laura holds a Bachelor of Mathematics from Simon Fraser University (SFU). Her alma mater recognized her work in creating enriching learning experiences by awarding her the Terry Fox Gold medal. Laura enjoys sharing her enthusiasm for coding and problem solving, and hopes this will inspire students to explore mathematics and data science.

**Alia Hamieh, University of Northern British Columbia**

Dr. Hamieh received her PhD in Mathematics from the University of British Columbia in May 2013. She obtained her MSc and BSc in Mathematics from the American University of Beirut. Before joining the Mathematics and Statistics Department at UNBC as an Assistant Professor, Dr. Hamieh was a PIMS Post-doctoral Fellow at the University of Lethbridge (2015-2017) and a Coleman Post-doctoral Fellow at Queen's University (2013-2015). Her research interests are in number theory motivated by questions regarding modular forms and special values of L-functions in the number field setting. In particular, her research is primarily focused on questions regarding the non-vanishing, the size and the distribution of such values.

**Alejandra D. Herrera Reyes, Post doctorate Fellow, University of Nottingham**

Alejandra completed her PhD in 2019 in the math biology group, at UBC, under the supervision of Professor Daniel Coombs. Her research was a collage of different mathematics and different biological systems, but all connected by the use of fluorescence microscopy. She analyzed cell adhesions and immunologic systems with differential equations, stochastic processes, numerical simulations, and statistics. Alejandra is from a small city in Mexico, Aguascalientes, where she was lucky enough to learn about math Olympiads through her high-school math teacher. The Olympiads allowed her to discover that the subject both challenged and entertained her, ultimately reaching to national level and winning a bronze medal. This gave her the opportunity to interview for an undergraduate degree in mathematics, at the Universidad de Guanajuato where she started her real journey in Mathematics in 2004. She first fell in love with probability, but was curious about biology, and so decided to focus on Applied Mathematics. In 2010, she began her master's degree at UBC and continued on for a PhD, which she successfully completed. She is now a post doctorate fellow at the University of Nottingham. Alejandra likes to color, read, write, embroider, listen to music and podcasts, and dance. She enjoys the company of her friends and family, and loves to travel whenever time permits.

**Emily Rose Korfanty, MSC, University of Victoria**

Emily is currently preparing to defend her Master's thesis in December. Her research is in an area of pure mathematics; specifically, operator algebras and dynamical systems. In particular, she is looking at groupoid  $C^*$ -algebras for iterated function systems. She started her undergraduate degree at Trent University in Peterborough Ontario in physics, then switched to a joint major with physics and mathematics in her second year. She spent a full summer trying to decide between the two for graduate school, and attending the PIMS Summer School for Women in Math (2016) definitely helped her to make that decision. Eventually she decided to go to Victoria to work with one of the few researchers in Canada with expertise in tiling dynamical systems. She went into the program knowing almost nothing about operator algebras, but was careful to pick a kind and supportive supervisor; he has been so helpful to her, breaking into a field like this. Her supervisor has also supported her in joining the co-op program, which has helped her get a better perspective on her career options. She is currently considering proceeding to a PhD, but is looking into other jobs too.

**Priyanka Mishra, UTexas**

Dr. Priyanka Mishra is an early career scientist in the neuroscience department at the University of Texas at San Antonio. She is researching to understand the genetic mechanism of brain hyperactivity disorders at the level of single-cell biology. Before moving to Texas in 2020, she worked as a Postdoc Researcher in Molecular Biology and Biochemistry Department of Simon Fraser University at Burnaby, British Columbia. Priyanka obtained her Ph.D. in Biological Sciences in 2018 from India, studying drug biology of sennosides compound. She holds a Master's (2008) and Bachelors's (2006) degree both in Biology from India.

In her journey of delivering science beginning 2012 to as of 2020, Priyanka has addressed at 14 conferences fording Canada, Spain, USA, and India; authored more than 18 articles in highly cited journals and serves on the editorial and referee board with many publishers. She is a profoundly enthusiastic outreach doer in STEM. Stealing time away from her professional involvements, Priyanka enjoys networking, exploring, reading, sports, and binge-watching tv shows. Obsessed with her inherited forte in cuisine, she takes her cooking seriously and is fabulous at it!

**Lili Yan, UC, Irvine**

Lili is currently a PhD student at University of California, Irvine under the supervision of Professor Katya Krupchyk. She is interested in inverse problems for elliptic PDE, especially inverse problem for polyharmonic operators. Roughly speaking, this inverse problem can be stated as follows: given the knowledge of the set of the Cauchy data for a first order perturbation of the polyharmonic operator on the boundary of a compact Riemannian manifold, determine the first order perturbation inside the manifold uniquely. Lili comes from a small city in China, and went to Beijing for her undergraduate study. After four years she was fortunate to receive an offer from UCI, where she met one of the most important persons in her life, Katya Krupchyk. Katya is a great advisor, who is always very patient and enthusiastic. Lili is learning a lot from Katya, and enjoys her time under Katya's mentorship.