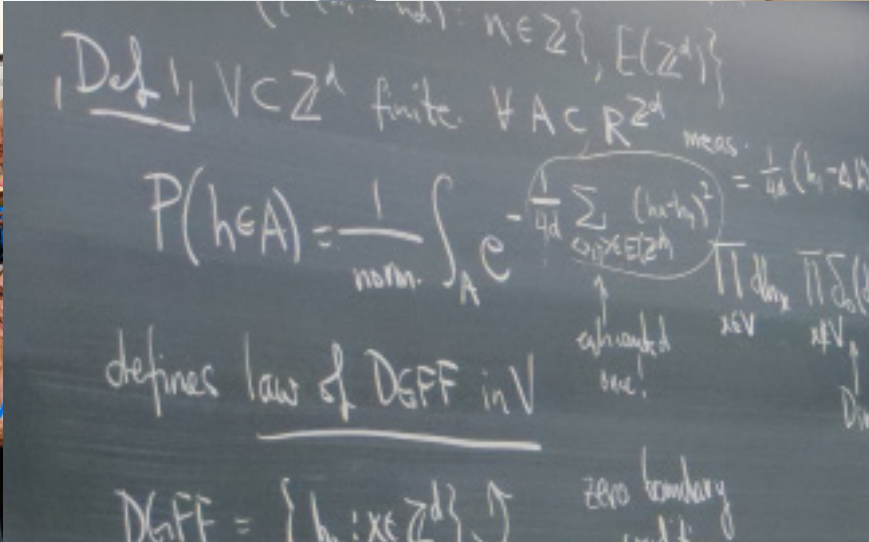
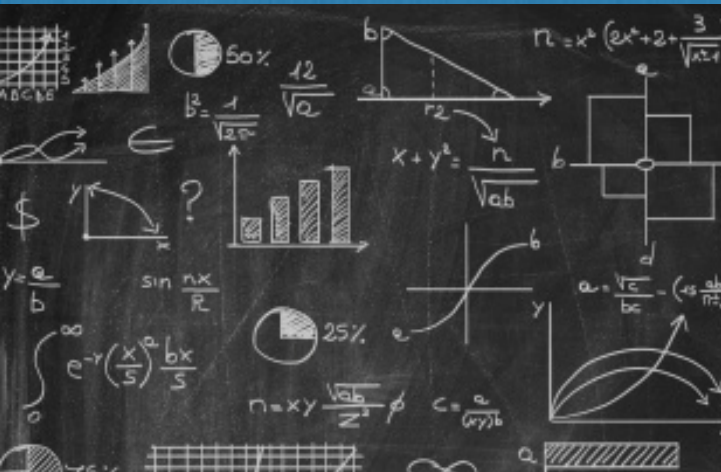


2020 PIMS Diversity In Mathematics: Undergraduate Women's Summer School



Week 2: August 10 - 14, 2020
ONLINE PROGRAM



Photo: Sgt Johanie Maheu, Rideau Hall

© Her Majesty The Queen in Right of Canada represented by the Office of the Secretary to the Governor General (2017) /
© Sa Majesté la Reine du Chef du Canada représentée par le Bureau du secrétaire du gouverneur général (2017)



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 Two:

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

Online, though the zoom links on page 6.

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

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 2 Reading and Preparation Material

Course Instructor: Shonda Dueck, University of Winnipeg

Self-complementary graphs and cyclic hypergraph decompositions

Prerequisites: Discrete Mathematics, Graph Theory, basic Group Theory is an asset (mainly Cyclic Groups).

Course Description: A *hypergraph* consists of a set of points called vertices, and a set of subsets of this vertex set called edges. A simple graph is a hypergraph in which every edge has cardinality 2. Hypergraphs are used to model many types of networks, such as transportation systems, the link structure of websites, and data organization networks. One interesting problem in hypergraph theory is that of decomposing a hypergraph into smaller subhypergraphs which all have the same structure. Such decompositions in which the subhypergraphs have desirable properties, such as high symmetry or regularity, are of special interest since they correspond to key structures in combinatorial design theory that have useful applications in cryptography. We will begin by studying the self-complementary graphs. These are the simple graphs which are isomorphic to their complement, so a self-complementary graph and its complement together decompose the complete graph into two isomorphic subgraphs. We will determine necessary conditions on the order of the self-complementary graphs and look at some nice algebraic techniques for constructing them. The self-complementary graphs are well studied due to their relation to the graph isomorphism problem, which has unknown complexity. Next we will generalize this idea to study the self-complementary hypergraphs, using the same algebraic construction techniques we applied to graphs. We will also construct some self-complementary graphs and hypergraphs which have high symmetry using basic cyclic group theory. Finally, we will study the t -complementary hypergraphs, which are the parts in a cyclic decomposition of the complete hypergraph into t isomorphic hypergraphs. At the heart of this mini course is the study of how permutations of a given finite vertex set V act on the subsets of V , and some basic number theory will come into play.

Tech Requirements: It might be helpful for students to have access to GAP - Groups, Algorithms, Programming - a System for Computational Discrete Algebra. Distributed freely at <https://www.gap-system.org/>

Program Overview: Week 2

Time	MON 10	TUE 11	WED 12	THUR 13	FRI 14
8:30am - 8:50am	Week 2 Check In				
9:00am - 10:00am	Course #2 Lecture Shonda D	Group Breakout Session	Course #2 Lecture	Course #2 Lecture	Group Presentations
10:00am - 10:30am	Break				
10:30am - 12:00pm	Course #2 Lecture Shonda D	High School Math Camps Joint Session with Undergraduate	Group Check-in+ Breakout Session	High School Math Camp: Joint Session with Undergraduates Kseniya Garaschuk	Group Presentations
12:00pm - 2:00pm	Lunch				
2:00pm - 3:00pm	Virtual Hour with Shonda! Group Formation	<u>Advanced Learning and Careers</u> Shane Moor, UBC FOGS Danielle Barkley- UBC Career Services	<u>Faculty Panel</u> Melania Alvarez, PIMS/ UBC Minelle Mahtani, UBC Laleh Behjat, UCalgary Kseniya Garaschuk, UFV	<u>Women in Industry</u> Sampoorna Biswas, CLIR Luz Angelica Mata, MDA Alice Roberts, EA Sports	END

Zoom Links:

- Zoom links have been send to participants of Week 2 only

Undergraduate Participants

1. Samiha Ali, University of Alberta
2. Dora Gurfinkel, University of Texas at Austin
3. Elnaz Hessami Pilehrood, University of Toronto
4. Peizhe Huang, University of Toronto
5. Marie Jerade, University of Ottawa
6. Yamini Kukreja, University of Toronto
7. Lauryn Needham, University of Northern British Columbia
8. Simran Sanghera, University of British Columbia
9. Zerrin Vural, University of Texas at Austin
10. Shu Wang, University of British Columbia
11. Sylvia Zhang, University of British Columbia
12. Yihan Zhu, University of British Columbia

2020 Organizers

1. Pacific Institute for the Mathematical Sciences
2. Malgorzata Dubiel, SFU
3. Veselin Jungic, SFU
4. Malabika Pramanik (Committee Chair), UBC

Guest & Panel Speaker Biographies

Melania Alvarez, PhD, UBC Mathematics/ PIMS Math Education Coordinator

Melania Alvarez de Adem is a Mexican mathematics educator who works as education coordinator and mathematics outreach coordinator at PIMS. She is known for the summer mathematics camps she developed to improve the mathematical education of indigenous secondary-school students. She is a winner of the Adrien Pouliot Award, given by the Canadian Mathematical Society for significant contributions to mathematics education in Canada.

Alvarez grew up in Mexico City, where she completed her undergraduate education at the National Autonomous University of Mexico. She later earned master's degrees in economics from the University of Wisconsin–Madison and in operations research from Stanford University. In 2016 she completed a Ph.D. in mathematics education at Simon Fraser University.

She moved to Vancouver in 2004, and began her mathematics camp program at UBC in 2007. In addition to her work with indigenous people, Alvarez has been active in organizing mathematics competitions, workshops, and fundraising for mathematics education among the general population. During her free time Melania loves doing puzzles and regularly goes on long distance walks. She completed the Shikoku Pilgrimage in Japan in October 2019.

Danielle Barkley, UBC Career Services

Danielle is a Career Educator who works at the Centre for Student Involvement and Careers at the University of British Columbia. The Centre for Student Involvement and Careers offers a variety of services and resources to support UBC students with career development including workshops, employer information sessions, recruitment fairs and advising. Prior to coming to work at UBC in 2017, Danielle worked at McGill University as a career advisor, lecturer, and writing consultant. She received a Bachelors and Masters degree from the University of Toronto, and a PhD from McGill University. Danielle is currently also pursuing coaching training towards accreditation with the International Coaching Federation.

Laleh Behjat, UCalgary

Dr. Laleh Behjat is a professor at the Department of Electrical and Computer Engineering at the University of Calgary, Canada. Her research focuses on developing mathematical techniques and software tools for automating the design of digital integrated circuits. She has won several awards for her work including the 1st place in International Symposium on Physical Design Placement contests, 3rd place in the Design Automation Perspective Challenge in 2015. Dr. Behjat is an Associate Editor of the IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems and Optimization in Engineering from Springer.

Dr. Behjat is passionate about increasing the statues of women in Science, technology, engineering and mathematics (STEM). She acted as an academic advisor for of Google Technical Development Guide and was a member of the Google's Council on Computer Science Education. Dr. Behjat was the recipient of the Association of Professional Engineers and Geoscientists of Alberta (APEGA) Women in Engineering Champion Award, Association of Computing Machinery, Special Interest Group in Design Automation Service Award and Killam Graduate Student Supervision and Mentorship Award. Her team, Schulich Engineering Outreach Team, was also the recipient of the ASTech Leadership Excellence in Science and Technology Public Awareness Award.

Sampoorna Biswas, CLIR Renewables

Sampoorna Biswas is a senior data engineer at Clir Renewables, where she works on the analytical data pipeline for renewable energy data. She holds a Master of Science (Computer Science) degree from UBC and has several years of experience designing machine learning systems as well as designing experiments to test machine learning systems.

Shonda Dueck, University of Winnipeg

Shonda Dueck is an Associate Professor of Mathematics at the University of Winnipeg. She also holds the position of Adjunct Professor in the Faculty of Graduate Studies and Research at the University of Regina. Shonda completed her Ph.D. in Mathematics at the University of Ottawa in the field of algebraic graph theory in 2009, under the supervision of Mateja Sajna. She also completed a Master of Mathematics degree in the Combinatorics and Optimization Department at the University of Waterloo in 2005, under the supervision of Chris Godsil. She completed her Bachelor of Science (Honours) in 2003 at the University of Winnipeg, in her hometown.

Shonda Dueck's research is in the area of algebraic graph and hypergraph theory. She is interested in the action of groups on combinatorial structures. She is particularly interested in cyclic partitions of complete uniform hypergraphs, which are generalizations of the self-complementary graphs. She has also studied the problem of finding the metric and partition dimension of Cayley graphs and hypergraphs. Recently, she has studied the problem of determining the threshold strong dimension of a graph.

Kseniya Garaschuk, University of the Fraser Valley

Kseniya Garaschuk is originally from Belarus. She received her PhD in Combinatorics from the University of Victoria in 2014 and her Master's degree from Simon Fraser University, both in British Columbia, Canada. Kseniya then pursued a Post Doctoral Fellowship with Carl Weiman Science Teaching and Learning Initiative with focus in mathematics education at the University of British Columbia. She is currently an Assistant Professor at the University of the Fraser Valley, Canada. Kseniya is the Editor-in-Chief of *Crux Mathematicorum*, a problem-solving journal published by the Canadian Mathematical Society.

Luz Angélica Caudillo-Mata, Scientist, MDA Corporation

Luz Angélica Caudillo-Mata is a Computational Mathematician. Luz Angélica's professional journey has been shaped by the question: how can one develop and apply mathematics to solve real-world problems? In pursuit of an answer, she gained knowledge in the fields of Mathematics, Computer Science, and Geophysics at the bachelor's, master's, doctoral, and postdoctoral levels. She has also conducted applied multidisciplinary research at top international institutions, such as Lawrence Berkeley and Livermore National Labs in the USA; The University of British Columbia in Canada; the Polytechnique University of Valencia and the Complutense University of Madrid in Spain; and the Mathematics Research Center in Mexico.

Luz Angélica's expertise is in numerical analysis and scientific computing. She specializes in the design and implementation of computational methods and algorithms for partial differential equations (PDE's), PDE-constrained optimization, computational inverse problems, and machine learning. Some of the applications she has worked on are geophysical modeling and prospectivity problems for natural resource (minerals, oil, groundwater) exploration programs, and mechanical structural analysis and optimization for affordable roof construction. As a researcher, Luz Angélica has published her work at top computational mathematics peer-reviewed journals; collaborated in developing mathematical technology and services for industrial applications; presented her research outcomes at numerous high-profile international conferences in computational mathematics, scientific computing, geophysics, and engineering; and co-organized 50+ technical events. She has also co-founded 3 institutional programs to support the diversity of connections among STEM areas, and the mathematical community as a whole.

Currently, Luz Angélica works as an R&D Scientist at MDA Corporation, the Canadian space-tech company behind the iconic Canadarm, where she develops Machine Learning algorithms using satellite imagery and computer vision techniques to develop the next generation of Earth monitoring systems.

Shane Moore, UBC Faculty of Graduate & Postdoctoral Studies

Shane is the Marketing and Recruitment Manager for UBC's Faculty of Graduate and Postdoctoral Studies. He works to promote UBC's more than 300 graduate programs to prospective students around the world. Shane has over 15 years' experience working in the higher education sector for universities in Canada and the UK, in the areas of marketing, student recruitment and career development. In 2010 Shane received an MBA from Liverpool Hope University (UK). Originally from the UK Shane has made Vancouver his home for the last 10 years.

Alice Roberts, EA Sports

Alice Roberts is currently a Security Data Analyst for FIFA at Electronic Arts. She is an alumni of Simon Fraser University where she graduated with a Bachelors of Science in Applied Mathematics & Statistics. She is also the founder and co-organizer of BC's first Undergraduate Mathematics & Statistics Conference. Alice hopes to continue her studies as a Master's student in Statistics in the near future. Her research interests are stochastic processes, in particular rough volatility and data science/machine learning. Her hobbies include: volleyball, dancing, and travelling.