DEPARTMENT OF MATHEMATICS AND STATISTICS
FACULTY OF SCIENCE, YORK UNIVERSITY

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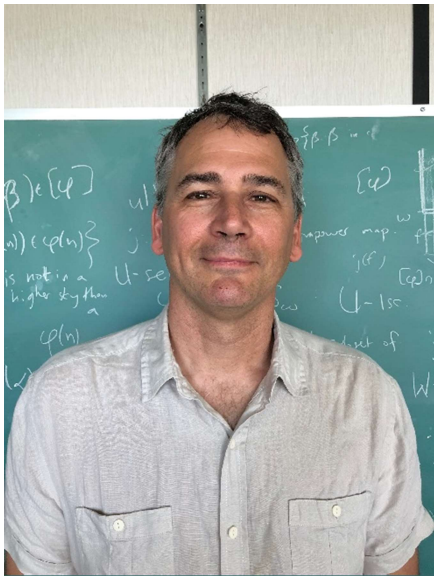
The Chair's Perspective

As I look back on the past year's events in our department I am struck by the great diversity of accomplishments and the new and ongoing activities by our faculty, students and alumni. The arrival of new colleagues (welcome Iain Moyles and Andrew Skelton!), exciting developments in research, establishment of our new teaching and research lab, and our growing outreach activities fill me with pride at all that has been done and optimism for what the future holds for our department. I am particularly proud of the energy and initiatives of our graduate students in the past few years. In between the stress and hard work of establishing a program of research in mathematics or statistics, and working as teaching assistants to fund their studies, our students have established an energetic weekly graduate student research seminar and founded the first student chapter of the Association of Women in Mathematics hosting, this past year, a workshop at the Fields (more details in the newsletter). I am excited to see the mark these students will make in their careers, be it in research, teaching or to whatever they turn their talents and expertise.



Departmentpedia

PassingsGeorge L. O'Brien, professor emeritus passed away on August 4, 2018. (See next page.)
Recognitions

Patrick Ingram was awarded the G. de B. Robinson Award by the CMS this year.

Tom Salisbury became a CMS Fellow as of December 2018.

The announcement for the York Research Chairs was made in April 2018 and **Huaiping Zhu** was one of the Tier 2 recipients. Congratulations Huaiping!

Tatiana Kachira graduated with an Honours BSc in pure mathematics in 2005. She won academic awards already starting in first year, and was on our Putnam team three times. Since early summer of this year she has been a First Officer for Porter Airlines. She has flown to at least 17 of their 23 destinations.

New Members

Iain Moyles obtained his BSc in Physics from Ontario Tech University in 2009 as well as an MSc and PhD in Applied Mathematics from the University of British Columbia in 2011 and 2015 respectively. He spent three and a half years as a researcher in Ireland before joining the department of Mathematics and Statistics at York in January 2019. He is an applied and industrial mathematician with expertise in mathematical modelling, analysis, and scientific computing. His research interests are in a variety of fields including nutrient transport, groundwater contamination, pattern formation, geosciences, and electrochemical systems. He is happy to join an excellent department and welcomes chats in his office S519.

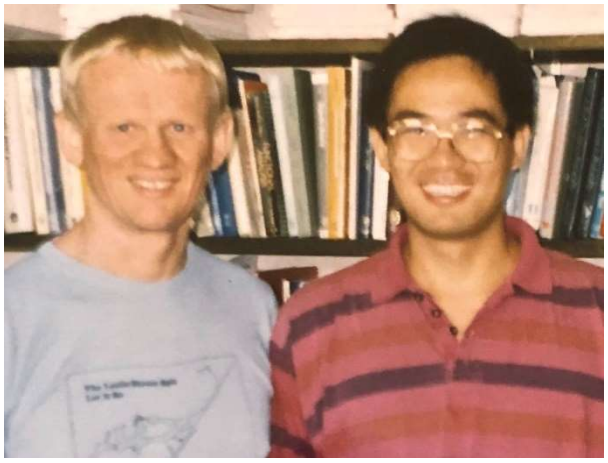
Andrew Skelton completed his BSc at McMaster University and BEd at the University of Ottawa. After working as a high school teacher, he completed his MSc at Brock University and PhD at the University of Guelph. He taught at both Brock and Guelph for five years before his arrival at York. He is interested in student engagement, supporting the transition to first-year university and student involvement in learning outcomes. His office is a boundary point of the department so he welcomes visitors from afar, especially if they are bearing edible and/or potable gifts.

Future Members

Tom Salisbury's granddaughter, Charlotte Salisbury, was born September 6, 2018. Congratulations to all!

Patrick Ingram's second child, Emil, was born on September 8. Congratulations to Patrick and family!

George L. O'Brien, 1944-2018



George O'Brien and former PhD student Jason Sun

George L. O'Brien, Professor Emeritus in York University's Department of Mathematics and Statistics, passed away on August 4, 2018. His death followed a long and courageous battle with early-onset Alzheimer's, the illness that led him to retire early from York in 2008.

Born September 19, 1944 in Northern Ireland, George was the son of a military doctor, so moved frequently as a child. From Queen's University he earned a B.Sc. in 1966 and an M.Sc. in 1968. From Dartmouth College he earned an A.M. in 1969 and a Ph.D. in 1971, under the supervision of John Lamperti. Following this he moved to York, becoming Full Professor in 1982.

George's research spanned a broad range of topics from Probability Theory, but with special attention paid to stochastic inequalities, and to stationary or self-similar stochastic processes. In the 1990's his attention turned to an approach to the theory of large deviations based on capacities and sup-measures, about which he wrote multiple papers, many co-authored with Wim Vervaat.

George served York University in multiple roles. Notable among these were terms as Departmental Graduate Program director, Department Chair, and Associate Dean of the Faculty of Arts. Outside York, he served on the NSERC grant selection committee for Statistics, on the Boards of Directors of both the Canadian Mathematical Society and the Fields Institute, and as Associate Editor for the Canadian Journal of Statistics. He organized two major international meetings at York – the 4th and 21st Conference on Stochastic Processes and their Applications, held in 1974 and 1992 respectively. He was recognized by appointment as both a Fields Institute Fellow and a Fellow of the Institute of Mathematical Statistics

George was a generous friend, a colleague of great integrity, and a valued mentor to his younger colleagues in probability. He was an avid runner, meeting regularly with friends to run in the ravines near York. But most of all, he enjoyed spending time with friends and family, especially at the family cottage on the Muskoka river. He is survived by his wife Beth, his children Liam (Nina) and Katie, his sister Deirdre, and his brother Brian (Barbara). His daughter Meg and his sister Ruth predecease him.

Our annual **Undergraduate Student Award Ceremony** was held on Wednesday, November 28, 2018 in the Senate Chamber. Opening remarks were delivered by Professor Paul Szeptycki and Associate Dean Alex Mills, Faculty of Science. The awardees were:

NSERC Summer Research Award

Raman Abbaspour : Hongmei Zhu (Supervisor)
Wesley Eardley-Somes : Ed Furman (Supervisor)
Nicholas Chrobok : Jane Heffernan (Supervisor)
Jordan Teitlebaum : Ada Chan (Supervisor)

Mathematical Contest in Modelling

Team 1 :
Xiang Li
Dan Li
Puyuan Zhao

Team 2 :
Stephen De Cristoforo
Jenny Kazazi
Samuel Wilson

Putnam Competition Participants

Sina Adineh
Gian Alix
Jordan Teitlebaum

Dean's Undergraduate Research Award

Daniel Park : Tom Salisbury (Supervisor)
Jiyu Wang : Walter Tholen (Supervisor)

Ray and Joe Abramson Award

Maria Mehmood

George & Frances Denzel Award

Kevin Joseph

Abe Karrass / Donald Solitar Mathematics Award

Taran Singh Nijjar

Irvine R. Pounder Award

Jiayi Li : 1st year
Xiang Li : 4th year
Jiyu Wang : 3rd year

Alice Turner Award

Andi Qian

George R. & Mary L. Wallace Award

Divya Chaturvedi : Actuarial Science
Jiyu Wang : Applied Mathematics

Moshe Shimrat Prize

Jordan Teitlebaum

Emerson Vincent Sauder Memorial Scholarship

Ziqing Wang

Congratulations to all of our successful participants!

AWM Women in Math Workshop at Fields

This November 9th was a cold and dreary morning in Toronto. The executive committee of the student chapter of the Association for Women in Mathematics (AWM), which is comprised of Yohana Solomon, Allysa Lumley and Snezhana Kirusheva, along with the help of Marco Tosato had gathered at the Fields Institute to celebrate the achievements of female mathematicians. The day started with an hour-long coffee and breakfast. Mathematicians from around the world, at every stage of their careers, gathered to share experiences and swap stories. At 10am Dr Megumi Harada, this year's winner of the Krieger Nielson Prize, delivered the keynote address. She regaled us with tales of how to make connections between equivariant symplectic geometry and other areas of mathematics. Contributed speakers followed this talk. First, an undergraduate from Princeton University named Jenny Kauffman, who discussed some very interesting properties about graphs, followed by a graduate student, Kuan Liu from Sick Kids here in Toronto, who discussed using statistics to discuss treatment plans.

After a delicious lunch break, we resumed our talks. The next speaker was a graduate student, Anila Yadavalli from North Carolina State University, who discussed Darboux transformations and their uses for solving systems of differential equations with infinitely many equations. Following this we heard from a Postdoc, Stephanie Sadownik, who had done some research in Math Education. This talk focused on the use of Google Classroom to teach mathematics to grade school students. This inspired a very robust discussion asking multiple questions about the pros and cons of using technology in pedagogy. The final contributed talk was presented by a faculty member, Amanda Montejano, from National Autonomous University of Mexico, who discussed Ramsey theory and the unfortunately named anti-Ramsey theory.

After come coffee (obviously) and some sighs about the gloomy weather, there was a discussion group led by three professionals, Sue Ann Campbell (Waterloo), Ada Chan (York U) and Elissa Ross (Mesh Consultants) and was moderated by Lillian Beltaos (President of the Nikola Tesla Historical Society of Alberta). The group discussed certain problems which arise in mathematics related to the lack of representation of women and other minorities in the field. There were a number of ideas exchanged regarding the issues that exist and in some cases some solutions were posed. It was resolved at the end that we should have another instalment of the workshop in a warmer place which would better reflect the mood of the participants — which for the most part was exuberant and excited to work more.

The day ended with some exciting poster presentations, which varied in topic from hysteresis (a phenomena commonly noticed in engineering) to number theory game called "p-ordering". Participants as well as members of the community came to admire the posters and engage the presenters in conversation about their work. Some conversations drifted back to the discussion panel topics.

Overall, the workshop was a rousing success.

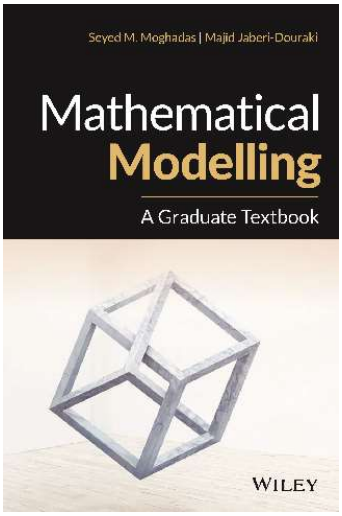
(See photo on next page.)

Pan-InfORM Workshop

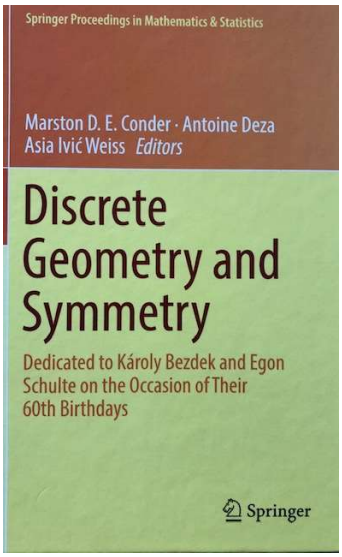
Seyed Moghadas organized the 6th biannual meeting of Pan-InfORM (Pandemic Influenza Outbreak Research Modelling) on October 1-2, 2018, at York University. On the 10th anniversary of Pan-InfORM, this workshop brought together interdisciplinary and complementary expertise to engender discussions on the development of strategic collaborations and multi-stakeholder partnerships to improve knowledge translation activities with a greater uptake and understanding of disease modelling outcomes in heath policy decision-making. The workshop was funded by the Canadian Institutes of Health Research and in partnership with the National Collaborating Centre for Infectious Diseases.

Stay connected with the happenings of the department through our facebook page (facebook.com/MathStatYorkU), twitter page (twitter.com/YorkUMathStats) and LinkedIn group (linkedin.com/groups/6805022/)!

Readings

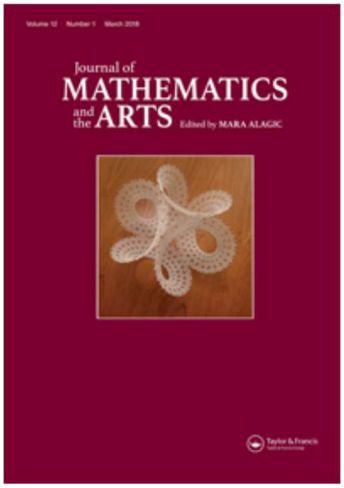


Seyed Moghadas and his former postdoctoral fellow, **Majid Jaberi-Douraki**, published a textbook for Mathematical Modelling. The book offers a comprehensive guide to both analytical and computational aspects of mathematical modelling that encompasses a wide range of subjects. It provides an overview of the basic concepts of mathematical modelling and reviews the relevant topics from differential equations and linear algebra. The book also explores the various types of mathematical models, and includes various examples that describe a variety of techniques from dynamical systems theory. The analytical techniques in this book examine compartmental modelling, stability, bifurcation, discretization, and fixed-point theories. The theoretical analyses involve systems of ordinary differentia equations for deterministic models. The book also contains a review of probability and random variables as the requirements of stochastic processes. In addition, it describes algorithms for computer simulation of both deterministic and stochastic models, and outlines a number of well-known models that illustrate their application in different fields of study.

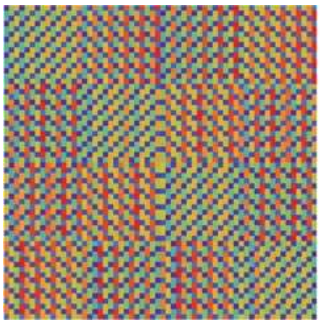
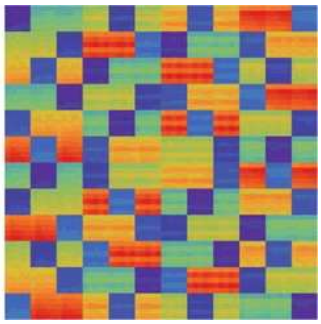


Asia Ivic Weiss: The subject of the book is the interplay between different approaches to discrete geometry. The book contains papers on convex and abstract polytopes and their recent generalizations, tiling and packing, zonotopes, isoperimetric inequalities, and on geometric and combinatorial aspects of linear optimization.

PhD student receives Outstanding Paper Award from Journal
(http://science.yorku.ca/research_news/phd-student-math-receives-outstanding-paper-award-journal/)



Congratulations to PhD student John Maxwell Campbell for receiving the "Outstanding Paper Award" from the *Journal of Mathematics and the Arts*. His paper is titled "Visualizing large-order groups with computer-generated Cayley tables. Campbell is a PhD student and Carswell Scholar in the Department of Mathematics and Statistics. His research interests are in algebraic combinatorics, particularly within the theory of combinatorial Hopf algebras. Under the supervision of Professors Michael Zabrocki and Ada Chan, Campbell's doctoral research is focused on introducing new Hopf algebra structures and revealing new combinatorial properties concerning known Hopf algrebras. He is also interested in computer science and is developing symbolic computation functions within the Mathematica computer algebra system.

J.M. Campbell
Visualizing large-order groups with computer-generated Cayley tables
Volume 11, Issue 2, Pages 67–99
(https://doi.org/10.1080/17513472.2018.1433741)

Groups are some of the most fundamental objects in algebra, and arise in every branch of mathematics. This article explores the visualization of a group's multiplication table (its *Cayley Table*) as a colourful image, and discusses the relationships between the group and its visualizations. As one jury member observed, 'Campbell's paper provides a very strong example of how visualization can provide a significant boost to clarity and understanding, while at the same time being beautiful enough to serve as art'.

The award is given out every two years to 'the author(s) of an outstanding article illuminating connections between mathematics and the arts'. The Associate Editors considered all research articles published in Volumes 10 and 11 of the journal, and voted on a short list of four articles. The short list was then given to a four-person jury, who read the articles and selected the final winner. The jury members for this award were Ingrid Daubechies, Lynn Gamwell, Douglas Norton, and Laura Taalman.

Many thanks to the Associate Editors for building the short list, to the jury members for selecting the award recipient, and to all *JMA* authors for making it difficult to choose from among so many high-quality articles. Congratulations to J.M. Campbell for this lovely and inspiring work.

Jiyu Wang, 3rd year (entering 4th year), Specialized Honours Applied Mathematics
Supervisor: Dr Walter P. Tholen

Much of mathematics concerns the study of spaces, defined to be sets of points endowed with some structure, usually of an algebraic, geometric or numerical nature. The interaction of spaces of the same type, or category, is described by mappings between them that respect their structure in some natural way, and it is important to be able to compose such mappings consecutively. However, systemic limitations may prevent us from being able to evaluate such composite mappings exactly. Rather, we may be given only a distance function between a perceived composite mapping and any candidate for such a composite.

In a 2017 article, A. Aliouche and C. Simpson proposed the notion of *approximate categorical structure* in order to address the situation just described. It is based on a distance function which, rather than satisfying the classical triangle inequality (for the distances of three points in a plane, say), will obey only a tetrahedral inequality (concerning the areas of triangles forming a tetrahedron, say). Amazingly, they were still able to establish an appropriate replacement for a cornerstone of category theory, the so-called Yoneda embedding. Their result places their approximate categorical structure inside an ordinary one, in which composite mappings are given exactly.

In my research project I investigate to which extent the numerical values of the distance function used in the Aliouche-Simpson notion may be replaced by more general values, assumed to form a well-behaved lattice. For example, rather than given by a number, the distance of two points could be a distance distribution function itself, which would just tell us whether a random distance between the two points lies below a certain threshold. This approach has been successfully applied in other contexts and should help advance the

mathematical scope of the theory of approximate categorical structures.

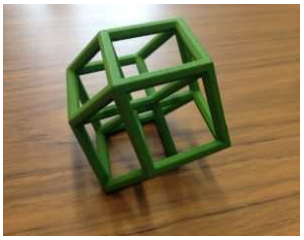
Experimental Math Space for Teaching and Learning

In 2018, an experimental math space for teaching and learning was created in the department. Supported by York University's Academic Innovation Fund (aifprojects.yorku.ca), this space will bring experiential education into mathematics classrooms at York. The first wave of experimental math pieces for this space include programmable robots, 3D printed surfaces, a vertical coupled water tank, a flexible link, a ball-beam balance and an inverted pendulum. These came from Lego, Quanser, Thingiverse and Shapeways. These objects and their mathematics will be explored in the department's geometry and applied mathematics courses. Many thanks to York student volunteers Gian Alix, Kaloyan Bankov, Louis Conforti, Emily Di Bratto, Gina Faraj, Spencer Hooks, and Kevin Yu for their time and efforts in setting up this space and its equipment. In addition, thank you to department members Steven Chen, Amenda Chow, Jane Heffernan and Andrew Skelton for their contributions to this space. To learn more, visit amchow.info.yorku.ca/experimental-math-space/.

3D printed Sierpinski pyramid from Thingiverse and Shapeways

3D printed Klein bottle from Thingiverse and Shapeways

Programmable Robot from Lego



3D printed hypercube from Thingiverse and Shapeways

Coupled Water Tank from Quanser 1

A Math Moment

Professor Jane Heffernan entertained the awardees and guests of the Undergraduate Students Award Ceremony with a small introduction to the field of Mathematical Epidemiology.

The basic Susceptible-Infected-Recovered model (first developed by Kermack and McKendrick) was discussed and extensions of this model were applied to specific diseases of interest, including measles, influenza, and HIV. The effects of waning immunity and memory cell generation against influenza were presented, optimal vaccination coverage levels were calculated, and new drug therapy effects were predicted.

Dr Heffernan ended with a discussion on complexity and uncertainty, and a need for more data to increase the power of more biologically relevant disease models.

PLEASE TELL US some news about yourself, comment on this Department of Mathematics and Statistics Newsletter, And suggest articles you would like to see in the future.

E-mail to: *mathstat@yorku.ca*
Mail to: *Newsletter*
Department of Mathematics and Statistics
N520 Ross, York University
4700 Keele Street
Toronto, Ontario M3J 1P3

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