



DALHOUSIE  
UNIVERSITY

## CHASE REPORT

Department of Mathematics and Statistics

June 2017

# CONGRATULATIONS

## AWARD WINNERS

**Sir William Young Gold Medal in Mathematics**

*Shael Brown*

**Professor Michael Edelstein Memorial Graduate Prize**

*Ethan Lawler*

**University Medal in Statistics**

*Molly Hayes*

**Heller-Smith Scholarship**

*Kyle MacKeigen*

**Ralph & Frances Lewis Jeffery Scholarship**

*Jordan Barrett  
And  
Joshua Feldman*

**Field Prize in Statistics**

*Yannick MacMillan*

**Barry Ward Fawcett Memorial Prize**

*Moira MacNeil*

*Nicolas Banks*

**Ken Dunn Memorial Prize**

*Finlay Rankin*

**Undergraduate Research Awards**

*Jordan Barrett (Peter Selinger)  
James Eckstein (Dorette Pronk)  
Finlay Rankin (Keith Taylor)*

**Katherine M. Buttenshaw Prize**

*Cameron Rudderham*

**HONOURS STUDENTS**

**Waverly Prize**

*Erin Donovan*

**Honours - Mathematics**

**Emil and Stella Blum Award in Mathematics**

*Jeremy Peters*

*Jordan Barrett*

*Shael Brown*

*Ryan Cutcliffe*

*Felicia Halliday*

*Will Hamilton*

*Kyle MacQuin*

*Sean O'Neil*

*Sohraub Pazuki*

*Moira MacNeil (Co-operative)*

*Christopher Beeler (with Chemistry)*

*Lauren Utter (with Chemistry)*

*Juan Reyes (Honours Conversion with Physics)*

**Ellen McCaughin McFarlane Prize**

*James Eckstein*

## **Honours - Statistics**

*Qi Li*

*Xiaoyu Yang*

*Ziwei Jin (with Economics)*

*Molly Hayes (with Neuroscience)*

*Jacklyn Zhang (with Economics)*

*Kim Changhan (Honours Conversion with Economics)*

## **NSERC AWARD WINNERS**

**CGS – M** *Jordan Barrett*

**PGS – D** *Kim Whoriskey*

## **NEW KILLAMS**

*Kim Whoriskey*

## **KILLAM RENEWALS**

*Results had not been released at time of printing. The version on our website will be updated once results are known.*

## **PRESIDENT'S AWARD**

*Kim Whoriskey*

## **GRADUATE STUDENTS**

***October 2016 Convocation:***

### **Mathematics**

*Amal Alhaddad, MSc*

*Todd Mullen, MSc*

*Huda Chuangpishit, PhD*

*Neil McKay, PhD*

*Antonio Vargas, PhD*

### **Statistics**

*Chang Chen, MSc*

*Hao He, MSc*

*Li Li, MSc*

*Dong Lin, MSc*

*Chaoyue Liu, MSc*

*Bryan Maguire, MSc*

*Mary Roop, MSc*

*Chongci Tang, MSc*

*Hongyue Wang, MSc*

***June 2017 Convocation:***

### **Mathematics**

*Bassemah Alhulaimi, PhD*

*Dylan Day, MSc*

*Julien Smith-Roberge, MSc*

### **Statistics**

*Mary Brown, MSc*

## CHAIR'S MESSAGE

by Jeannette Janssen

Congratulations to all our graduates and prize winners. It takes talent and perseverance to complete a degree in Mathematics or Statistics. I am happy to see an accomplished group of students cross the stage on June 2. The prizes that will be handed out at our Award Ceremony testify to their excellence. In addition, our students have done well in math competitions, have had research papers accepted to peer-reviewed journals, have presented their work at conferences, and have won scholarships towards further study. Well done, graduates!

Congratulations to faculty members **Joanna Mills-Flemming** and **Joe Bielawski**, who were promoted to Full Professor. Congratulations also to **Peter Selinger**, who was awarded a Killam professorship. Peter's research on quantum computing languages continues to be recognized. His work has attracted ample funding, which has enabled him to bring young talent to Dalhousie as postdocs or graduate students. In addition, a new faculty member is expected to join Peter's group in the coming year.

**Lam Ho** will join our department this July as a Canada Research Chair. He will be the first full time CRC in our department. Lam Ho's research is in the development of statistical methods which can be applied to questions in phylogeny and infectious diseases. He will join the Centre for Comparative Genomics and Evolutionary Bioinformatics (CGEB), a prestigious group of Dalhousie scientists. Lam Ho's research fits with that of department members **Ed Susko**, **Hong Gu** and **Joe Bielawski**, who are also members of CGEB.

Three people with long-time associations with our department have seen their affiliation take on a more permanent form.

**Rob Noble** and **Ammar Sarhan** will start (continuing) instructor positions. **Toby Kenney** will start a position as a (tenure track) assistant professor. Toby has been instrumental in starting and running our Actuarial Science program; his efforts are starting to bear fruit, with the first generation of Actuarial Science Major and Honours students expected to graduate next year.

**Richard Nowakowski** and **Pierre Stevens** have announced their retirement. More about their careers will follow elsewhere in this report. Pierre's patience and dedication to the students will be missed. As a colleague, I will miss chatting with Pierre on diverse interesting topics; these conversations, often held standing in the hall way, could make my day. Richard has been a mentor to me as a researcher, teacher, and now also as Chair. I hope and expect that he will continue to be involved with our Graphs and Games group. Thank you, Richard!

In January, the department held a retreat, to take a longer view of our programs and priorities. An intense day of discussions led to a number of new ideas and initiatives. Some of these, such as the creation of a Certificate in Data Science and the addition of computer labs to some of our courses, are close to reality; others will take time to implement. The upcoming Unit Review will give another opportunity to contemplate and shape our future.

Finally, thank you to **Balagopal**, for keeping our computing equipment working well, and to **Angela**, for keeping our building in excellent shape. Thanks to **Maria** and **Ellen** for their part in running the office. Thanks to **Roman Smirnov** and

**Mike Dowd**, the Math and Stats directors, who helped make the Chair's job easier, and to Bruce, the former Chair, who has always been willing to give advice. And my very special thanks to **Queena**, whose efficiency, resourcefulness and dedication make the Chair's job easier, and the department run smoothly.

## MATHEMATICS DIVISION

By Roman Smirnov

As we near the end of the academic year that will culminate shortly in various Convocation ceremonies to be held in the Department and elsewhere on campus, it is the time to pause and reflect on the events that have brought us to this moment.

This year was especially busy for both the Faculty of the Mathematics Division and our students. Of course, by "busy" we do not mean just the number of Division meetings held, but rather the many decisions we have collectively made that when implemented will shape and strengthen our Division in the years to come.

Fully aware that plus ça change, plus c'est la même chose, the changes that we have been working on, in particular, what concerns our course offering, are those that will truly improve the quality and efficiency of teaching. Most of them will affect our first and second year Calculus and Linear Algebra courses, (that is MATH1000, MATH1010, MATH1500X/Y, MATH2001, MATH2002 and MATH2030, MATH2040, MATH2040 respectively). The work in this direction has been spearheaded by the (permanent, as of this year) Calculus and Linear Algebra committees, its output will be a more flexible and aligned course offering that

better reflects the realities and demands of today's higher education and job market.

Another change which makes all of us look forward to the future with confidence is something that we have not done in a long time, a very long time. I am talking about hiring new people. Currently, three hiring committees are busy selecting best candidates for several positions in the Department, including one tenure-track. We are all looking forward to welcoming our new colleagues and working with them.

**Dorette Pronk** and **David Iron** will continue working as the Mathematics Honours Coordinator, and the Mathematics Graduate Coordinator respectively next year. I wish to thank Jeannette Janssen and all of the Division members for their continuous help and support during this year. I am especially thankful to our Departmental Administrator Queena Crooker-Smith who has always been doing a fantastic job.

Last but not least, two of our most valued and esteemed colleagues have reached the age of retirement and decided to take this opportunity to continue personal growth.

Professor **Richard Nowakowski** has served the Department of Mathematics and Statistics, Dalhousie University and the community at large for 37 years, establishing himself as one the most valued, respected, and admired faculty members in the Department. While his retirement will be effective July 1, his extremely positive and treasured contributions to research and teaching will continue to impact our community well into the future.

**Pierre Stevens**, our beloved Learning Centre Coordinator, will also be retired as

of July 1 after many years of dedicated service rendered to the Department that has helped and inspired thousands of students.

Richard and Pierre will be missed and they leave a legacy of dedication, accomplishment, and teaching excellence. We wish them the very best as they enter the next phase of life and service.

### **STATISTICS DIVISION**

by Mike Dowd

A number of students completed their degrees in Statistics and graduated this year (in either the October 2016 or May 2017 convocations). Undergraduates that completed their Honours degree in Statistics were: Yike Hou, Qi Li, Xiaoyu Yang (concentrated honours), and Mary Hayes, Ziwei Jin, Guangrui Zhang, Changhan Kim (combined honours). The following students also graduated with an MSc in Statistics: Mary Brown, Chang Chen, Hao He, Li Li, Dong Lin, Chaoyue Liu, Bryan Maguire, Mary Roop, Chongci Tang, Hongyue Wang.

Congratulations to all. In the Statistics division NSERC Discovery Grants were awarded to **Mike Dowd** and **Hong Gu** in April 2017.

### **ACTUARIAL INAUGURATION**

By Toby Kenney

The Actuarial Science Inauguration event was held on Monday 24th April. It was attended by a mixture of students and actuaries, and featured talks by "prominent local actuaries Bill Black and Bonnie-Jeanne Macdonald". It provided a good opportunity to update the local actuarial community about our new program, and for

our current students to make contact with potential employers.

Meanwhile, we continue to develop the actuarial science programme. This year we doubled the university's total Actuarial Science graduates, with Thomas Maier becoming the programme's second graduate with a double major in Mathematics and Actuarial Science. There are also three students currently registered for honours in Actuarial Science in the coming years, so we still hope to double our total graduates in the programme every year!

### **AWARDS DAY SPEAKER**

David Robinson

David entered Dalhousie in 1984 and graduated in 1988 with a BSc Honours in Mathematics (recipient of the Sir William Gold Medal for 1988). After Dalhousie, David received a MSc in Mathematics from UBC and then pursued a PhD under Nassif Ghoussoub. In 1994, David left UBC before obtaining a PhD and entered the MSc Computer Science program at Dalhousie. In 1996, David started at MathResources Inc - a local software development company that provides services mainly to publishing companies in the US. With a brief interlude David has been at MathResources since 1996 and is now its Chief Technical Officer.

### **SCIENCE ATLANTIC CONGRATULATIONS**

Several of our students won prizes at the Science Atlantic meeting this weekend: The team of **Shael Brown** and **Josh Feldman** won second prize in the Math competition.

**Jordan Barrett** won first place for Best Oral Presentation - Mathematics.

**Josh Feldman** won the Science Atlantic Communication Award.

Congratulations! And thanks to all participating students for giving our department a good presence.



Canadian Applied *and* Industrial  
Mathematics Society  
Société Canadienne *de* Mathématiques  
Appliquées *et* Industrielles

### CAIMS 2017

The annual meeting of the Canadian Applied and Industrial Mathematics Society will be held at Dalhousie this summer from July 17th to the 21st. The major themes of this year's meeting are Numerical Analysis, Applied Partial Differential Equations, Data Analytics, Fluid Dynamics and Industrial Mathematics. Dalhousie organizers include **David Iron** and **Theo Kolokolnikov**. This conference will also include a public lecture.

Further information can be found at:  
<http://caims2017.caims.ca/caims2017/welcome2017.html>

### 10 YEARS LATER...

Under the heading "Hard to believe ..." I wrote in the 2007 Chase Report:

"At the banquet during the CMS Winter Meeting in Toronto in December 2006, Professor **S. Swaminathan (Swami)** received special recognition on the occasion of his 80th birthday in August 2006. He was also being recognized for his substantial services to the CMS over several decades, including, at present, technical editor for the CMS journals, editor

of the CMS Notes, and organizer of a special session at that conference. Among other things, Swami received a framed certificate of recognition, and a bottle of 'CMS' wine."

Well, it's now 10 years later, and although he has cut back on some of his activities, Swami still works for the CMS, most importantly as Assistant Technical Editor. In this capacity he has been providing the final level of quality control for the two CMS research journals. As (recent) former chair of the CMS Publications Committee I can attest to the importance of this level of quality.

Swami's "Service History" with the CMS shows a staggering 17 entries, and that's only since 1991, the beginning of history, as far as these records are concerned. This, by the way, was the year Swami officially retired!

We wish him many more years of good health and happiness.

- Karl Dilcher

### DISTINGUISHED LECTURE: OUR QUANTUM FUTURE



Dr. Jamie Vicary from the University of Oxford works on higher category theory and its applications in computer science and mathematics, particularly in areas related to quantum structures. He spent a

significant part of his summer in Halifax this past year. He was one of the featured lecturers for our AARMS Summer School, participated in the category theory conference, CT2016, and gave a very well-attended public lecture, entitled "Our Quantum Future", on Monday August 15.

We received help in advertising for this event from Alumni Relations, and the Ondaatje Auditorium was completely filled for the evening. Dr Vicary explained both the potential features and challenges in such a way that the audience engaged him in a very lively question and answer time after the lecture and I even received emails with requests for further appointments by a couple of members of the audience..

- Dorette Pronk

### A 5th and 50th ANNIVERSARY

A semi-official history of this department ("Mathematics at Dalhousie", 1990) was written by the late **Arnold Tingley**, who served as Department Head from 1966-1973, and subsequently became University Registrar, a position he held for a number of years. On p. 44 of this history one can read,

**"Hermann Brunner** Ph.D. (Zurich) served in the department from 1967 to 1980, rising from Assistant Professor to Professor. This was a very good appointment."

Following his years at Dalhousie, Hermann first moved to his native Switzerland, and then to MUN in St. John's, where he stayed until he retired and was given the rank of Professor Emeritus. Exactly 5 years ago, in the 2012 Chase Report, I wrote,

"Here I'd like to single out Hermann Brunner who, after an illustrious career and

32 years away, has just returned to our department."

And indeed, Hermann is still regularly seen in the department, as much as his extensive travels allow. Rather than repeat what I wrote in 2012, I invite the reader to see a brief biographical sketch on p. 7 of that Chase Report (<https://www.dal.ca/content/dam/dalhousie/pdf/faculty/science/math-stats/Chase2012.pdf>).

So, this is a double anniversary, and as I wrote 5 years ago, "We now wish him many more productive and happy years."  
- Karl Dilcher

### CT2016 Report By Dorette Pronk

During the second week of August our department and the Department of Mathematics and Computer Science at Saint Mary's University co-hosted Category Theory 2016, the annual international conference on Category Theory, just over ten years since we last hosted this conference in June 2006 (that time at White Point). The meeting space alternated between the two campuses on consecutive days and the beautiful summer weather made this a very enjoyable experience. The timing of the conference allowed our summer school students in category theory to attend without incurring additional travel expenses.



The meeting was scientifically a great success showcasing both the depth and breadth of current research in category theory, with both reports on breakthroughs in traditional areas of application such as homotopy theory and logic, and reports on new and unexpected areas of application such as hyper plane arrangements and Penrose tilings. The invited speakers this year were:

- John Bourke (Masaryk University)
- Nicola Gambino (University of Leeds)
- André Joyal (Université de Québec à Montréal)
- **Dorette Pronk** (Dalhousie University)
- Catharina Stroppel (University of Bonn)
- Dominic Verity (Macquarie University)

Our excursions included a guided tour of McNab's Island, a visit to the Citadel and a tour of the Halifax Harbour. The lobster banquet at the Shore Club in Hubbards was also one of the conference highlights.

### **Dr. Richard Nowakowski: some words of appreciation**



This year **Richard Nowakowski** turns 65, and as part of the celebrations CanaDAM 2017 is hosting 3 sessions in his honour. Richard obtained his Ph.D. in 1978 from the University of Calgary, under the supervision of Richard K. Guy and he began his career at Dalhousie University the following year.

Richard's program of research has greatly influenced two disciplines, graph theory and combinatorial game theory. He has published over 80 articles in graph theory and 23 in game theory. He has co-authors two books, one in combinatorial game theory, and other in the well-studied graph game of cops & robbers – a field study which he has created.

The Atlantic region has been greatly influenced by Richard. He has supervised over 25 graduate students and almost every university in Atlantic Canada has a faculty member that was supervised by Richard. This means that graph theory students in Atlantic Canada are familiar with at least 6 different graph products!

Richard's accolades span both his research and teaching career. He has been the recipient of NSERC Grants and awarded the title of University Research

Professor. He was given the 2008 CMS Adrien Pouliot Award for teaching excellence and he has been awarded a Dalhousie Faculty of Science teaching award. His teaching has gone beyond the university classroom to include working with NS Math Circles, the NS Math League and a variety of other math camps and outreach events. Though Richard is retiring this year, it is safe to say that he will still be actively involved in research. Happy Birthday and Happy Retirement, Richard!

- Danielle Cox

### **From Science to Art**

**Pierre Stevens**, Senior Instructor and Director of the Learning Centre in our department, will retire this summer. Pierre started his position in 1980. Under direction of Pierre, the Learning Centre has helped countless undergraduate students master the mathematical and statistical techniques that form the foundation of most scientific careers. Moreover, the Centre has given graduate students an opportunity to develop teaching skills, and to learn how to explain math and stats at an elementary level. Pierre developed and taught the course MATH 1000X/Y, where students learn the basics of Calculus at a slower pace, with an emphasis on modelling and applications. He also pioneered the development of on-line support material for first year courses.

Pierre and his wife, Mandy, have been collecting Inuit Art for a long time, and recently opened the Ukpik Inuit Art Gallery. We wish Pierre all the best in his retirement.

### **A SPECIAL BIRTHDAY**

On August 24, 2016, our colleague **Swami (S. Swaminathan)** celebrated his 90th birthday; in honour of this occasion, an event with two special invited speakers was organized for Saturday, October 22. Both speakers were emeritus professors and long-serving past members of this department, namely **Heydar Radjavi** and **Tony Thompson**, who now live in Waterloo and Vancouver, respectively. Heydar's talk was entitled "Revisiting Wielandt: Positivity and Effective Positivity", and Tony spoke about "A 60 year old problem". (The organizer, who was just past 60, decided not to take offence). Over 20 people, mainly former students and colleagues and current department members, were in attendance.

After the talks, several old friends and former colleagues shared their reminiscences with the audience, and the event closed with a lunch at the University Club. At lunch, we were also joined by Gretchen Smith, who had served the department, first as secretary, and then as Administrator for over 43 years, including most, if not all, the years that Swami, Heydar and Tony were active in the department.

- Karl Dilcher.

### **OTHER NOTABLE BIRTHDAYS**

Speaking of notable birthdays, two other Professors Emeriti turned 80 during this past year. **Peter Fillmore** reached this milestone on October 28th, 2016, with an appropriate party at his seaside residence in Bayswater. Although the time of the year was more advanced than even Peter's age, it was an unusually mild and sunny afternoon, making it a warm celebration

indeed. Peter also has a residence in the city, and is therefore a regular participant of the legendary Tuesday Lunches.

Next up was **Tony Thompson**, who celebrated his 80th birthday at his home on April 4th. Since Vancouverites know better than to mention their April weather to Nova Scotians, no relevant information is available. Incidentally, in spite of now living so far away, Tony has been spotted in Halifax this May 25th, in full academic regalia (obtained by dubious means), to attend his granddaughter Hannah's graduation from King's College, and in fact officially handing her the diploma in the Cathedral of All Saints.

## POSTDOCTORAL FELLOWS

**Israel de Souza Rocha** came to Dalhousie in September 2015 to work with **Jeannette Janssen**. Together with Nauzer Kalyaniwalla, Israel and Jeannette worked on the problem of linear embeddings of graphs. Israel presented this work at the bi-annual Discrete Mathematics conference of the Society of Industrial and Applied Mathematics, which was held in Atlanta, Georgia in June 2016. Israel also worked with Jeannette Janssen on an NSERC Engage project, working with a local company, performing graph-based data mining on data obtained from Instagram. Israel left Dalhousie in January 2017, and is now a post-doctoral fellow at the Czech Academy of Sciences in Prague.

**Christopher Duffy** is finishing a two-year position as AARMS post-doctoral fellow for Outreach. As part of this position, Chris helped organize and advertise various Outreach activities sponsored by AARMS. For the research component of his job, Chris worked with **Jeannette Janssen**. Chris and Jeannette worked on a version

of the Prisoner's Dilemma game played on a regular grid, to see how cooperative and defective strategies propagate. Chris presented this work at the bi-annual Discrete Mathematics conference of the Society of Industrial and Applied Mathematics, which was held in Atlanta, Georgia in June 2016, and also at the Workshop on Algorithms for the Web Graph (WAW), held in Montreal in 2016. Chris will soon start a tenure track position at the University of Saskatchewan.

**Daniele Gregoris**, has been working with Alan Coley this past year and is also becoming active in the Department with social as well as academic activities. Daniele will be leaving us soon as his AARMS post doc position is coming to an end. We wish him well in his future endeavours.

**Joep Evers** arrived in August from Netherlands by route of British Columbia where he had been working with Theodore Kolokolnikov in conjunction with Dr. Razvan Fetecau at Simon Fraser University.

**Alexis Bernadet** has been working with Peter Selinger since Nov 2015 but only arrived in the Department physically when he returned with Peter at the end of 2016 from Europe via the United States. He is working with Peter on the USAF contract.

**Peng (Frank) Fu** is also working with Peter Selinger on the USAF project. Frank arrived at the beginning of May and will be with us for 2 years.

Over the next few months there will be several new post docs and research associates arriving in the Department. We would like to extend our welcome for each as they arrive and settle in.

## VISITORS

### **Dorette Pronk**

Mark Johnson (Penn State - Altoona)  
 September 12-17  
 Kristine Bauer (University of Calgary)  
 October 23-28

### Colloquium Visitors:

Kabe Moen (The University of Alabama)  
 October 17  
 Scott Chapman (Sam Houston State  
 University) October 26-28

### **Karl Dilcher**

Larry Erickson of New Jersey is visiting Karl Dilcher, from May 4th until June 6th, 2017. This is Larry's 4th annual research visit, and by an interesting coincidence he will be attending the 4th consecutive Awards Day ceremony. His host can't decide whether it's the food, the speeches, or the company.

### **Jeannette Janssen**

Mahya Ghandehari visited in March 2017 to work with Jeannette Janssen. Maya is a former postdoc in our department, who worked both with Keith Taylor and with Jeannette. She is now a faculty member at the University of Delaware.

## **MATH KANGAROO CONTEST**

Dr. Lois Murray, Halifax Regional Representative, Canadian Math Kangaroo



The 2017 Canadian Math Kangaroo Contest was hosted at the Chase Building

on March 26th, 2017 marking the sixth time the contest was offered in Halifax. In Canada, this year, there were 45 contest sites at which a total of 5273 students, enrolled in grades 1 through 12 competed. Here at Dalhousie University there were 84 competitors, registered in grades 1 through 11, with many returning contestants in the mix. We shared the date with a regional Chess competition, hosted at Mt. St. Vincent University so a number of these students wrote the math contest early in the morning, then headed to Bedford for an afternoon of chess!

Contestants at Dalhousie fared very well: one Grade 4 student placed second in Canada; three students won National Gold medals; one student won a National Silver medal and two won National Bronze medals; and 20 other students achieved scores high enough to receive Regional ribbons. There will be a ceremony for these award-winning students and their supporters early in June to celebrate their successes.

I would like to thank: Fatemeh Bayeh and Fahimeh Bayeh for their generous efforts in helping set up the rooms and invigilation; Ian MacIntosh for help in setting up the rooms; and Lauren Atkinson for her help with registration. Students owe thanks to **Dr. Dorette Pronk** for her enthusiasm, for holding mathematics training sessions, for booking the rooms and presenting awards to winners.

– Submitted by Dr. Lois Murray, Halifax Regional Representative, Canadian Math Kangaroo.

## **THE MATH CHALLENGE CLUB**

Dorette Pronk

At about 5:05 on Mondays on the third floor of the Chase building the noise begins to

build. Over the course of the next two hours (including an important break for pizza) sounds of frustration and confusion mostly give way to understanding and appreciation. Voices from somewhere between 20 and 25 young students, of a variety of ages and mathematical ability, question, confuse, ponder and wonder at the Math Challenge Club.

Originally started as an outreach program with the aim of preparing young girls for mathematics competition, the Math Challenge Club has developed a reputation as a place for open learning, interesting extra-curricular mathematics and boisterous discussion (much to the chagrin of graduate students working late at the office). With minimal advertising, the program has grown by word of mouth from teachers and parents. At present, the weekly club attracts talented students from as early as grade four. Though some of these students are using these sessions to prepare to compete in provincial and national contests; for most of the students, it is a chance to see their friends, learn some cool mathematics and devour some pizza. And when the occasion arises to participate they rise to the challenge. Most of our students participated in the Math Kangaroo Competition. However, they enjoy it much more when there is a team competition. In April we surprised them with the possibility to participate in the Purple Comet! Math Meet one evening and they quickly divided themselves into team with names such as the Pi Pipers, the Mathemagicians and the Spanish Inquisition. After an evening of a lot of fun and hard team work, the Pi Pipers and the Mathemagicians ended up first among 32 participating teams from across Canada, and the Spanish Inquisition was close.

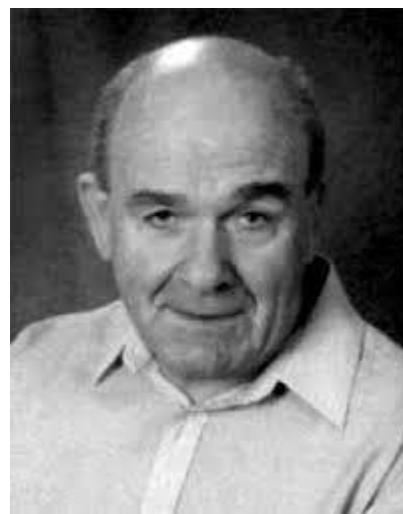
As spring gives way to summer, the Math Challenge Club will go the way of school

bells, attendance and recess. Though just as surely as the undergraduates invade again in September, so too will the third floor of the Chase building be invaded every Monday evening by budding (and noisy!) mathematicians.

The Math Challenge Club runs weekly from 5 - 7pm at Dalhousie University. For more information contact **Dr. Dorette Pronk** ([dorette.Pronk@dal.ca](mailto:dorette.Pronk@dal.ca))

### In Memoriam

We join family and friends in mourning the sudden and unexpected deaths of two former department members, who were both very influential in this department and beyond.



**Patrick Keast**, a former Department Chair (2003-2006), passed away at his home on Monday, July 25th, at the age of 73. Pat was born in Broxburn, Scotland, to parents John and Rose (Gorman) Keast on August 2nd, 1942. Pat attended Edinburgh University and then went on to complete a PhD in Mathematics at St. Andrew's University. In 1967 Pat married Kathleen Duffin whom he had met in high school.

In 1970 Pat and Kathleen immigrated to Canada, where Pat became a Professor of Mathematics at the University of Toronto and taught at Scarborough College. During this time Pat was an active member of the Scarborough Cycling Club -- a passion he enjoyed all his life.

In 1983, Pat moved with his family to Halifax where he joined the newly developing division of Computing Science within this department. After the Computing Science Division became part of the newly formed Faculty of Computer Science in the second half of the 1990s, Pat remained in our department until his retirement in 2007. During his long career Pat taught many undergraduate students, supervised numerous graduate students in both mathematics and computing science, maintained an active research program and held several administrative positions. He is remembered by the department as a well-loved, compassionate teacher and a kind, loyal and supportive colleague.

Pat was very active in the church communities of St. Pius X and St. Benedict's, especially through his work with the St. Vincent de Paul Society. He will be sadly missed by family, friends and the communities he was part of.

Pat is survived by his wife Kathleen and sons Liam (Brenda) and James (Stephanie) and his grandchildren Isaac, Kate and Ella. He is also survived by his brothers John (Kathy) and Ronnie (Margaret) and many nieces and nephews in Scotland. On August 2nd, 2016, Pat's 74th birthday, a funeral mass was held at St. Benedict's in Halifax, and his life was celebrated during a reception that followed.



**Jonathan Borwein** passed away suddenly on August 2nd, 2016, towards the end of a 4-month term as Distinguished Scholar in Residence at Western University in London, Ontario.

Jon was born in St. Andrews, Scotland, on May 20, 1951. He moved with his parents to London, Ontario, where he completed an Honours Mathematics degree at UWO in 1971. He then received his Ph.D. from Oxford (1974) as an Ontario Rhodes Scholar. Jon started his academic career here at Dalhousie, first as a postdoc (1974-1976), and then quickly moving through the ranks to Full Professor (1984).

With the exception of two years at Carnegie-Mellon University (1980-1982), Jon stayed at Dalhousie until 1991, when he moved to the C&O Department at Waterloo. In 1993, he became the Shrum Professor of Science and founded the Centre for Experimental and Constructive Mathematics (CECM) at Simon Fraser University. He later served as a CRC in Information Technology (2001-2004) at SFU, before returning to Dalhousie as a CRC in Distributed and Collaborative Research in the CS Faculty, with a cross-appointment in this department (2004-2009). During this time he also served as AARMS Director (2005-2007).

In 2009, Jon and his family moved to Australia, where he had accepted the position of Laureate Professor at the University of Newcastle. He also became the founding director of CARMA, a Research Centre at Newcastle, devoted to Computer-Assisted Research Mathematics and its Applications.

While in Australia, Jon maintained professional and personal connections with our department, where he still held an adjunct appointment. Only a month before his untimely death, he and his wife Judi visited Dalhousie, and he gave a Colloquium talk on visualization in mathematics, one of his research areas.

Jon was an innovative and prolific mathematician of international renown. Among numerous other honours, he was elected FRSC (1994) and Fellow of the Australian Academy of Science (2010), and he received two honorary doctorates. He was also elected Fellow of several professional associations and won various top research awards throughout his career. Further information about Jon's life and work can be found at <http://jonborwein.org>.

Jonathan Borwein is survived by his parents, Bessie and David Borwein of London; his wife Judith, three daughters Naomi, Rachel, and Tova; five grandchildren, Jakob Joseph, Noah Erasmus, Skye, Zoe and Taj; siblings Sarah and Peter, and sister-in-law Jennifer Moore. His funeral took place on August 10, 2016, in London, Ontario, and there was a memorial service in late September in Newcastle, NSW.

A scholarship fund was set up at Dalhousie in Jon's memory; for details, please see <http://jonborwein.org/2017/03/jonathan-borwein-scholarship-fund-instituted/>,

or write to [dicher@mathstat.dal.ca](mailto:dicher@mathstat.dal.ca).

While there were already several special sessions and commemorative talks at various conferences internationally, a special 5-day Commemorative Conference will be held in Newcastle, NSW, from September 25 - 29, 2017. Further details can be found at

[https://carma.newcastle.edu.au/meetings/i\\_bcc/](https://carma.newcastle.edu.au/meetings/i_bcc/).

- Karl Dilcher

## COMPUTING RESOURCES

by Balagopal Pillai

The department machine room operated without issues the past year. Webwork and Capa servers got virtualized the past year on new hardware and grade passback to Brightspace has worked without issues on webwork in the past term. More old servers got retired and consolidated as virtual machines on new hardware and thereby freeing up ups, cooling capacity and rack space. Tape backup moved to LTO-6 from LTO-4 and backup server was also virtualized.

## Atlantic General Relativity Meeting 2016

Sanjeev S. Seahra

The Atlantic General Relativity Conference 2016 (AGR16 conference) was held from June 23-24 at Dalhousie University. It was the latest in an annual series of meetings covering all aspects of classical and quantum gravity. Proceeding the formal AGR15 conference was the Atlantic General Relativity 2016 Workshop (AGR16 workshop) consisting of a series of introductory and advanced lectures organized by the AARMS Collaborative

Research Group (CRC) Mathematical and physical aspects of black holes.

For the AGR16 conference, there were 36 participants and 19 talks. Twenty-five participants were from the Atlantic region, two from elsewhere in Canada, and nine from outside Canada. The number of students and postdocs were 17 and 3, respectively.

The principal invited speaker for the conference was Cliff Burgess (McMaster University), who spoke about infrared divergences in cosmological inflation. In addition, three invited lecturers from the AGR16 workshop stayed on to give presentations in the conference: Jorge Zanelli (Universidad de Chile), James Lucietti (University of Edinburgh) and Jose Pereira (Universidade Estadual Paulista, Brazil). Topics covered by these speakers and by the other contributed talks included quantum fields in curved space, quantum gravity, exotic classical solutions of the Einstein equation, and alternative gravity models.

Further information about the meeting can be found at  
[www.math.unb.ca/~gravity/agr16](http://www.math.unb.ca/~gravity/agr16).

## NEW KILLAM PROFESSOR



### **Faculty of Science Killam Professor**

We are happy to announce that **Dr. Peter Selinger** has been awarded a Faculty of Science Killam Professorship. The award is effective July 1, 2017, and will be held for five years. The award is a highly competitive mark of distinction. It recognizes the outstanding contributions to his field of study made by Prof. Selinger.

## BOOKS FOR SALE

Last year in this space I mentioned a highly successful sale of surplus books that had been donated over the years by current and retired faculty members, and by alumni and departing students. In fact, hundreds of volumes were sold to mathematicians around the country, and dozens more around the world, and by the end of the year I was able to donate several thousand dollars each to this department and to the CMS.

About two months ago, another sale was advertised through the CMS, and it was even more successful; several hundred more volumes were again sold to mainly Canadian mathematicians, among them numerous graduate students. Over 1000 volumes still remain; they are catalogued at

<http://www.mathstat.dal.ca/~dilcher/oldbooks.html>

As always, I welcome further donations of mathematics, statistics and related books, including textbooks of any kind. Anything that is suitable for the library will be placed there. And in my experience, eventually most of the books find a good home, and as an extra bonus, two good causes will be supported. I thank all those who donated their books.

- Karl Dilcher

## AARMS REPORT

by Dorette Pronk

Our department has continued to have a very active and beneficial relationship with AARMS this past year. We hosted the AARMS Summer School as well as several AARMS sponsored conferences and workshops. We also had faculty members involved in several AARMS collaborative research groups (**Alan Coley** and **Rob Milson** with the CRG on the Mathematical and physical aspects of black holes, and **Dorette Pronk** with the CRG on IFS, Fractals, Invariant Measures and Applications).

We hosted three AARMS postdocs (Christopher Duffy, who has just left us for a tenure-track position at the University of Saskatchewan; Marzieh Bayeh and Joep Evers, who will both continue for another year), and were involved in several AARMS co-sponsored outreach activities such as the math camps and the math challenge club.

We will be looking to hire a new outreach postdoc this fall.

continued to be Program Director, while Melissa Huggan was Assistant Director. Our teaching assistants were Asmita Sodhi, Corey DeGagne, and Evangelia Aleiferi. The casual presenters were Bassemah Alhulaimi, Abdullah Al-Shaghay, Nicholas Banks, Marie B.Langlois, Ben Cameron, Hoda Chuangpisit, Chris Duffy, Joshua Feldman, Morgan Garnier, Amitabh Halder, and Sean O'Neil.

We had our usual week-long trips to the Tri-County Regional School Board and Cape Breton in the fall, with many other day trips to closer schools that term as well. It was then rather quiet in December through February as schools were on work-to-rule. While we were not going out, we took advantage of the time to develop new presentations, supplementary materials for existing presentations, and an operations manual. As soon as work-to-rule ended, we became very busy again, with most weeks seeing us going out 2-3 times. As of the end of May we have given 179 talks to approximately 4450 students, already beating numbers from last year, while a few more trips are scheduled for June.

## MATH CIRCLES

Svenja Huntemann, Program Director

Math Circles has again been very busy during the 2016/2017 year.

As in previous years the funding from Eastlink allowed us to visit many schools across the province. This year, we developed several new presentations for elementary schools and greatly increased the number of visits at that level.

We had a few changes in our team this year. **Dorette Pronk** took over as faculty advisor, and we would like to thank Richard Nowakowski for his years of guidance and advice. Svenja Huntemann

We again hosted the Math Discovery Days in the Learning Centre in late April/early May. Of the six scheduled sessions, we ended up leading five after one school had to cancel short notice. We still had around 200 students working on their problem solving skills and enjoying a snack break. Our monthly events were given by a nice mix of presenters from our team, faculty members (**Richard Nowakowski**, **Karl Dilcher**, **Robert Milson**), and outside presenters (David Wolfe, Danielle Cox, Erick Lee), with good attendance from students, parents, and teachers, including many new families.

As this year is wrapping up, we are preparing for some major changes in our leadership. Our very successful growth in the past few years unfortunately means that the administrative work is becoming too much for graduate students. Together with the department we have hired a postdoctoral fellow who as part of their position will be Program Director. The Assistant Director role will still be filled by a graduate student.

## HISTORY AND GENEALOGY

A wonderful resource in the history and genealogy of mathematics is the "Mathematics Genealogy Project" (<https://www.genealogy.math.ndsu.nodak.edu/>).

It was **Keith Johnson** who noticed last Fall that a fairly large number of Ph.D. graduates from this department were not listed in this database, although most of the more recent ones were. In almost all cases this was easily rectified, mostly with the help of a list of all graduates and their supervisors that was compiled by our retired colleague **W.R.S. (Dick) Sutherland** several years ago. Two large binders in the office, containing the title pages of all theses, were also very helpful.

However, we did run into one interesting challenge. Six of our earlier Ph.D. graduates had the late **Professor Michael Edelstein** (1917-2003) as their supervisor, including the department's very first Ph.D., Raymond Holmes (1970). Michael Edelstein was not listed in the database, but his daughter, Prof. Leah Keshet-Edelstein (UBC), found out from a copy of his thesis that his supervisor was Haim Hanani (1912-1991) at the Technion in Haifa, Israel. Michael Edelstein received his Ph.D. there in 1960. Now, Hanani also wasn't in the database, but we were able to

find out that he received his Ph.D. in 1938 at the Hebrew University, with a thesis (written in Hebrew) in Graph Theory. But who was Hanani's supervisor? By looking at the list of faculty at the time, it was our guess that it was Theodore Motzkin (1908-1970) who at the time was instrumental in developing Hebrew terminology in Mathematics, and later became a prominent mathematician in the U.S. However, we were unable to find a list of Motzkin's students.

We then wrote to the library at the Einstein Institute of Mathematics at the Hebrew University, and a very helpful librarian found out that Hanani's supervisor was actually the famous set theorist Abraham Fraenkel (1891-1965). This librarian was also kind enough to translate Hanani's acknowledgments for us, and it turned out that our first guess wasn't too far off: Hanani thanked Motzkin (in addition to Fraenkel) for his help with the thesis. But anyway, Fraenkel was listed in the genealogy database (his supervisor was Kurt Hensel in Marburg), and so we were able to link Michael Edelstein and his six Dalhousie Ph.D. students to the main "tree of mathematics".

We can recommend "playing" with the Mathematics Genealogy Project; it really does bring the history of mathematics to life.

- Karl Dilcher

## AARMS SUMMER SCHOOL 2016

Directors:

Geoffrey Cruttwell (Mount Alison University)

**Dorette Pronk** (Dalhousie University)



The 2016 AARMS Summer School was held from July 11 till August 5, 2016, at Dalhousie University and offered courses on applications of category theory, combinatorics and number theory, all at the beginning graduate level, although some were definitely more challenging than others. The school was supported financially through AARMS and CRM. This was our third and final year in this cycle of AARMS Summer Schools held at Dalhousie. The 2017 Summer School is held at UPEI.

The courses offered were the following:

- Higher Category Theory and Categorical Logic, Instructors: Dr. Peter Lumsdaine (Stockholm University) and Dr. Michael Shulman (University of San Diego)
- Quantum Computation and Topology, Instructor: Dr. Jamie Vicary (University of Oxford)
- Stable polynomials: with applications to graphs, matrices, and probability, Instructor: Dr. David Wagner (University of Waterloo)
- An Introduction to Special Functions and WZ Theory, Instructor: Dr. Armin Straub (University of South Alabama).

From July 4 to 8, the week before the official start date of the school, one of the directors, Dr. Geoffrey Cruttwell, taught a week of preparatory lectures in category theory to prepare students for the category theory courses in the summer school. These lectures were attended by 15 participants, some of whom were postdocs and some of whom were not taking the category theory courses during the actual school, but were interested in getting an introduction to category theory. This was their opportunity to get an introduction into a subject that is not offered at their home university.

The school itself was attended by 45 advanced undergraduate and graduate students and postdocs, from Canada, the US, Australia, Turkey, Ethiopia, Ghana, South Africa, Bosnia, Denmark and the Netherlands. This was our first year to sponsor students affiliated with AIMS (the African Institute for the Mathematical Sciences), which added further diversity to our student body.

Aside from daily lectures in the four subjects, the courses in quantum computing and number theory featured computer labs and the two category theory courses included tutorials, which were taught by TAs, who stayed in the mini-residences together with the other summer school participants: these renovated Victorian homes provide the students with a more home-like living space.

The courses generated a fair amount of activity in the department: local researchers and students joined the lectures and discussion groups formed of students and faculty. The students would work on assignments in groups during the afternoons or meet one on one with instructors, and could be found in various

locations in both the math and physics departments. (We used the classroom space in the physics department for the lectures, labs and tutorials.) The course instructors in category theory also took advantage of this time to do research together and to work with some of our local faculty on new research projects. And local researchers from math and physics would attend classes of interest.

Generally, the workload for the students was rather high and their own social activities were organized based on when assignments were due. However, most of them did not let the large workload hold them back from exploring the new country they were visiting.

We organized two excursions on the weekends: one to Cape Blomidon with Hall's Harbour and one to the South Shore (Blue Rocks, Lunenburg, Risser's Beach and Peggy's Cove). Both excursions were well attended and enjoyed by all who came along. The students talked one of our local graduate students, Darien DeWolf, into taking them on an additional hike to Cape Split and Darien used the fourth weekend to organize a workshop where most of the students gave a talk about their own research. This was quite interesting and encouraging to the students. We would recommend this for future summer schools as well.

The category theory community took advantage of the summer school and organized the annual category theory conference during the week following the summer school. It was good to see that most of the students stayed for the additional week of the conference, and a

large number of them presented their work during the meeting as well. We were impressed with the level of the work they

had done and were pleased to see the variety in their work. (They would normally not all have been at the meeting, due to the travel expenses.) However, this also shows that the background of the students in the school varied widely. For some of the students attending the school this was just their second category theory course (or the first one after some preliminary reading) and others had already been extensively involved in research. Since the courses were fairly demanding and doing a grad course in four weeks is challenging to start with, we decided to give students the option of receiving a certificate of participation rather than a grade if that grade would not have been to their normal standards.

Our final activity, after all exams were written, was a farewell lobster supper at the Saint Mary's Boat Club. We were grateful to receive the help from Christopher Duffy, the AARMS Outreach Postdoc, and Evangelia Aleiferi, one of our local graduate students, in organizing this. They did an excellent job and it was fun to introduce the students to another wonderful Maritime tradition. We hope to see most of these students back at future conferences and workshops and hope that they will want to return to do research here in Atlantic Canada.



## WORKSHOPS

**Games@Dal 2016, Aug. 10-13**  
 Organizers Melissa Huggan, S. Huntemann, U. Larsson and R. J. Nowakowski.

Talks were presented on the first day then the event turned into a workshop with subgroups working on different problems. For the Workshops, several problems were identified in advance and the participants divided into groups and worked on these problems. Participants were free, and encouraged, to wander between groups. Before lunch and at the end of each day, progress on each problem was discussed.

The Games@Dal Workshops differ from most other meetings in that it brings a diverse group of experts and students together to work on various aspects of important research topics in a free-flowing atmosphere. At the same time, students are also able to work with these top researchers and participate and contribute to research. The Workshop is very popular. (I have already received enquiries about the next Workshop from new potential attendees in Israel, France and USA.)

Fifteen people attended this event, including four students. Attendees come from Canada, USA, and Portugal. Another six people from Dalhousie attended the talks or parts of the Workshops. There are four papers in preparation and each of the students is a co-author.

Specifically, the papers are:  
 M. Fisher, M. Huggan, S. Huntemann, *Split-ends Nim*;  
 T. Khovanova, R. Nowakowski, *Nim on Ideals*;

K. Burke, T. Khovanova, R. Nowakowski, A. Rowland ,C. Tennhouse, *Hiding counterfeit coins*  
 A. Carvalho, N. McKay, R. Nowakowski, C. Santos, *Short Disjunctive Sum: a new approach*.

Talks: (August 10)  
 Neil McKay: Hereditary Transitive Games  
 Craig Tennenhouse: *PenFib Nim, a new conjoined game*  
 Carlos Santos with Richard Nowakowski & Alexandre Silva: *3-Player NIM with the 'Podium Rule'*  
 Israel Rocha with Urban Larsson: *Eternal Picaria*  
 Urban Larsson: *Hopeful windows and fractals in cellular automata and combinatorial games*  
 Tanya Khovanova: *Cookie Monster Game*

Participants:

Canada: Melissa Huggan\* Svenja Huntemann\*, Urban Larsson, Neil McKay\*, Rebecca Milley, Richard Nowakowski, Israel Rocha USA: Kyle Burke, Mike Fisher, Tanya Khovanova, Amelia Rowland\*, Simon Rubinstein-Salzedo Craig Tennenhouse Portugal: Alda Carvalho, Carlos Santos.

\*= student

## DAL- BEA MATH CAMP 2016 REPORT

by R.P. Gupta

The Dal-BEA Math camp for Black Students was held by the Department of Mathematics and Statistics, Dalhousie University and Black Educators Association, July 10-16, 2016.

BEA sends out posters to all Schools in Nova Scotia in the month of January. They are also posted on the Bulletin Boards of all Schools. Applications from Black

Students of grade 7-8 are solicited together with the recommendation from head of Mathematics and guidance counselor. Thirty Campers were selected, however, only twenty-eight attended the camp. Of the twenty-eight campers eighteen were female and ten male. They came from Junior high schools from all over Nova Scotia.

On Sunday, July 10, 2016, parents brought the campers to Howe Hall, where registration and a reception are held. The campers and their parents were told about the expectation and responsibilities. They stayed in Howe Hall under the supervision of four chaperons- , Liette Williams, Nzingga Millar, Cody Higgins and Joshua Lunda,. Mornings and two afternoons were devoted to the academic teaching. The instructors were: Mr. Gerry Clarke, Ms. Melina Kennedy, Mr. Preman Edward and Dr. Elham Roshanbin.

This year the focus for the Dalhousie and Black Educators Association Math Camp was logic. The instructors of the Math classroom and Computer Science classroom decided to work together when creating the curriculum. In the Mathematics classroom students were taught via lectures, student led discussions/activities, partner work, group work, games, and independent discovery. Throughout the week the students were introduced to new topics as well as building on topics and ideas that they were introduced to throughout the school year.

In the classroom we introduced the students to topics that they would later use to program and subsequently simulate or graph in the Computer Science classroom. These topics included playing the game 10 and NIM, where students discussed strategies on winning and looked at the

mathematics behind simple games that they play.

Also, students were introduced to the Fibonacci sequence via a hands on activity using the mating rituals of enclosed rabbits. These activities were well received by the students, they were interested in using math to “always win” in games. Thus allowing them to think about when they use mathematics in their everyday life and how the use of mathematics is important when thinking logically and solving problems.

The math teachers also wanted to enhance the educational experience by giving the students information that would help them in the upcoming school year. For some students, algebra and subsequently rearranging equations were new concepts. So, explaining these ideas in a different manner gave several students more clarity for the following school year. Also, explaining different tricks on how to multiply or divide large numbers quickly and mentally was a lesson that we found would increase the confidence students needed for the following school year.

We also introduced the students to ArithmeCodes and Sudoku’s allowing students to learn how we complete these puzzles and giving them opportunities to try on their own.

At the end of the week we found that the students were much more confident in the math classroom. Also, the students were given the tools to show that they are capable of being leaders in the classroom when they return to their respective school in September.

Monday afternoon the campers visited the Nova Scotia museum of Natural History where various scientific ideas and display were introduced .In the evening Ms.

Natasha Jackson, and Ms. Cinera States, third year medical student from Dalhousie University.

The 2016 BEA/DAL Math Camp was very successful. The campers were eager to learn more about coding program and how to problem solve using mathematics. The campers took part in several extracurricular activities, trip to the Nova Scotia Museum and the Africville Museum, they were given a historical tour of the property. The campers participated in a Q and A session which created some challenging questions for the tour guide. Campers enjoyed the bowling; they were able to apply their math skills on the score process. Discover Center the campers took part in several experimental activities. The chaperons were very pleased with Campers behavior and respect for the six days camp. Overall, the campers did an excellent job representing their schools and communities.

### **DALHOUSIE-CMS MATH CAMP July 3-8, 2016**

by Roman Smirnov

As always during the second week of July, last year the Department of Mathematics and Statistics at Dalhousie University hosted the Dal-CMS math camp, whose goals were to identify, stimulate and encourage mathematical talent among Nova Scotia high school students.

The camp was jointly sponsored by Dalhousie University and the Canadian Mathematical Society. It consisted of lectures and problem solving sessions conducted by Faculty members and graduate students from Dalhousie and Acadia Universities and also included extracurricular activities. The math camp

was organized by Marie-Andree B Langlois and Roman Smirnov. The following Faculty members and grad students volunteered to speak at the camp (with the titles of their respective talks in the parentheses):

**Karl Dilcher** (A Mathematical Mystery Tour: Large Numbers and Great Mathematicians),  
**Keith Taylor** (Infinite Processes),  
**Roman Smirnov** (George Polya: "How to Solve It"),  
**Richard Nowakowski** (Code-numbers for Games: How to Find Winning Strategies for Subtraction Games),  
Danielle Cox (Last One Standing),  
Lucas Mol (Party in Koenigsber - BYOG (Bring Your Own Graphs!)),  
Christopher Duffy (The Math Contest),  
Benjamin Cameron (Toads, Frogs, Magic, and Math),  
**Chelluri Sastri** (Pythagorean Triplets).

The students were chaperoned by Dario Brooks and Carmen Malinsoski. Last but not least, our great staff, Queena Crooker-Smith, Maria Fe Elder, Balagopal Pillai, and Ellen Lynch did a fantastic job, while helping us to organize the camp. This year's math camp is being organized by Caroline Cochran, Marie-Andree B Langlois and Roman Smirnov. It is co-sponsored by the AARMS, CMS and Dalhousie University, one day of the camp will be held at Acadia University.

Think about contributing to the camp as a volunteer speaker.

### **DMSGSA REPORT by Corey Degagne**

The Annual General Meeting of the Dalhousie Mathematics and Statistics Graduate Student Association culminated in the election of the executive members:

President: Corey DeGagné, Vice President (Internal): Jonathan Babyn, Master's in Mathematics: Kyle MacKeigan, Master's in Statistics: Ethan Lawler, and Doctorate in Statistics: Kim Whoriskey.

It was a successful year with events like our monthly coffee breaks, as well as a luncheon for Chinese New Year and Pi Day Trivia (which was a joint event held with the graduate Physics Society and the undergraduate math/stats society). We created a new weebly website to continue doing ticket sales for our exam review sessions online (which included new review sessions for math 1215 and 2030). We also had a December dinner at the Wooden Monkey, and we are hoping to have another one in August.

### **THE UNDERGRADUATE MATHEMATICS AND STATISTICS SOCIETY (DUMASS)**

by Sohraub Pazuki

2016/2017 Council Members:

President: Sohraub Pazuki

Vice President: Todd Best

Treasurer: Lindsay MacCormick

Communications: Timma Flanagan

Secretary: Morgan Garnier

DSS Reps: Josh Feldman and Dan White

The 2016/2017 school year unofficially began for DUMASS with the 2016 Canadian Undergraduate Mathematics Conference in June, this year held at the beautiful University of Victoria in Victoria, BC. As has become tradition in the past couple of years, Dalhousie had a very strong representation with six students attending and four of those giving talks at the conference. The six attendees were Amir Farrag, Brandon Elford, Kyle MacQuin, Lindsay MacCormick, Luke DeCoffe, and Sohraub Pazuki. We'd like to extend our immense gratitude, as always,

to the Dalhousie Math and Stats Department for funding the trip for all six students.

The 2017 conference will be held at the University De Montreal in Montreal, Quebec, and many undergraduate students have expressed interest in attending.

In September, DUMASS started the academic year with our annual Meet and Greet event. This event is historically very successful and this year was no different. Dozens of students were introduced to DUMASS for the first time and much interest was generated in the society. We continued to have events throughout the year every month or so, sometimes partnered with the Undergraduate Economics Society as a more board game-driven event. These events were successful and good times were had by all. In addition to our usual-style events, DUMASS also hosted other events throughout the year. We hosted a night at the Pong Social Club in downtown Halifax, an up-and-coming bar with a multitude of ping pong tables, which was a very enjoyable evening. We also partnered up with the Graduate Mathematics Society to celebrate Pi Day (March 14) with a trivia night at the Muse, a café/bar on campus. We closed out the school year with our annual Wine and Cheese event. Everything that night went extremely well, thanks in no small part to the wonder live music and array of complimentary hors d'oeuvres. Students always love an excuse to get dressed up and have a good time, and this night was no exception.

We would like to thank every member of the society and faculty who came out to our events this year, and for making them what they were. This society would be

nothing if not for the people who come out time and time again.

Finally, we would like to wish the 2017/2018 council the best of luck!

President: Lindsay MacCormick  
 Vice President: Morgan Garnier  
 Treasurer: Alison Patterson  
 Secretary: Madi Moffat-Wild  
 Communications: James Eckstein  
 DSS Reps: Finlay Rankin and Mason Maxwell

### MATHEMATICS COLLOQUIUM

Organizer: Dorette Pronk

April 6, 2017: Mayha Ghandehari (University of Delaware), *Derivatives on Coefficient Function Spaces of Lie Groups*

March 9, 2017: Clark Kimberling (University of Evansville), *Fractal Sequences, Fractal Trees, and Linear Recurrences*

March 13, 2017: **Richard Nowakowski** (Dalhousie University), *Additive Combinatorial Game Theory*

October 6, 2016: Varvara Shepelska (University of Manitoba), *Weak Amenability of Weighted Group Algebras*

October 17, 2016: Kabe Moen (University of Alabama), *When does a function belong to the union of Lebesgue spaces?*

October 24, 2016: Kristine Bauer (University of Calgary), *Calculus of Functors and the De Pham Complex*

October 27, 2016: Scott Chipman (Sam Houston State University), *Monthly Past, Monthly Present, and Monthly Future*

September 15, 2016: Mark Johnson (Penn State Altoona), *Wheeled Graphs and Generalized PROPs*

September 29, 2016: **Richard Nowakowski** and **Karl Dilcher** (Dalhousie University), *Richard K. Guy turns 100*

August 4, 2016: Laura Turner (SUNY at New Paltz), *Analytic Representations and Generality in the Late 19<sup>th</sup> Century*

August 10, 2016: L. Sunil Chandran (Indian Institute of Science), *Separation Dimension of Graphs and Hyper Graphs*

August 22, 2016: Martin Müller (University of Alberta), *Search, Knowledge and Simulations: Computer Go from the beginnings to AlphaGo*

July 7, 2016: Adam Clay (University of Manitoba), *Smooth Foliations of 3-Manifolds*

July 14, 2016: Peter Miller (University of Michigan), *Weakly Dispersive Internal Waves*

June 30, 2016: Jon Borwein (University of Newcastle), *Seeing Things by Walking on Numbers*

### STATISTICS COLLOQUIUM

Organizer: Ed Susko

The Statistics Colloquium for 2016/2017 featured the following speakers:

Jul 28, 2016 Patrick Brown (Department of Statistical Sciences, University of Toronto) *Geostatistics for Aggregated Data, and Making Maps in R: a Talk in Two Parts*

Sep 8, 2016 Todd A. MacKenzie (Department of Biomedical Data Science,

Dartmouth College) *Causal Estimation Using Instrumental Variables in Observational and Randomized Studies: Extensions to Right Censored Data*

Apr 12, 2017 **Toby Kenney** (Department of Mathematics and Statistics, Dalhousie University) *The Adequate Bootstrap - A New Method for Measuring Model Uncertainty*

Suggestions about speakers for the 2016/2017 Academic Term are encouraged.

### @CAT SEMINAR 2015/2016

Organizer: Bob Paré

August 23, 2016

Roald Koudenburg, *Hypervirtual double categories*

September 13, 2016

Mark Johnson (Penn State Altoona), *A concrete approach to higher homotopy operations*

September 20, 2016

**Richard Wood** (Dalhousie), *On an idea of Freyd and Street*

September 27, 2016

**Bob Paré** (Dalhousie), *The secret double life of graphs*

October 4, 2016

Jeff Egger (Sackville, NB), *Groupoid uniformities*

October 11, 2016

**Bob Paré** (Dalhousie), *The secret double life of graphs, revealed*

October 18, 2016

Evangelia Aleiferi (Dalhousie), *Cartesian double categories*

November 1, 2016

Geoff Cruttwell (Mount Allison), *Differential equations in tangent categories I*

November 8, 2016

Geoff Cruttwell (Mount Allison), *Differential equations in tangent categories II*

November 15, 2016

Darien DeWolf (Dalhousie), *Restriction monads and algebras*

November 29, 2016

Marzieh Bayeh (Dalhousie), *Orbit Class and Invariant Topological complexity*

January 10, 2017

**Dorette Pronk** (Dalhousie), *Bicategories of Fractions Revisited*

January 17, 2017

**Dorette Pronk** (Dalhousie), *Bicategories of Fractions Revisited (continued)*

January 24, 2017

Michael Lambert (Dalhousie), *A Categorical Approach to Wild and Undecidable Theories of Modules*

January 31, 2017

**Bob Paré** (Dalhousie), *The secret double life of graphs, exposed*

February 7, 2017

**Bob Paré** (Dalhousie), *Some properties of the double category of graphs*

February 28, 2017

Rory Lucyshyn-Wright (Mount Allison), *Introduction to commutants for algebraic theories*

March 21, 2017

Bob Rosebrugh (Mount Allison), *Universal updates for symmetric lenses*

March 28, 2017  
 Gabor Lukacs (Halifax), *On group-valued continuous functions*

April 4, 2017  
 Bob Raphael (Concordia), *On regrouping series to obtain absolute convergence*

## MATHEMATICS HONOURS SEMINAR

Organizer: Dorette Pronk

### Faculty and Graduate Student talks:

September 14, 2016 Dr. Karl Dilcher:  
*Some Small Talk on Large Primes*

September 21, 2016 Dr. David Iron:  
*Models of an Epidemic*

September 28, 2016 Dr. Keith Johnson:  
*From the Telegraph to fMRI and from Quantum Mechanics to High Precision Computing: a Brief History of Harmonic Analysis*

October 5, 2016 Dr. Dorette Pronk: *The History of Homology: Where Geometry and Algebra Meet Again*

October 12, 2016 Dr. Theo Kolokolnikov:  
*Math in Woodworking*

January 18, 2017 Dr. Rob Milson:  
*Classical Orthogonal Polynomials*

January 25, 2017 Dr. Genevieve Boulet:  
*Make a Difference: Be a Math Teacher*

February 1, 2017 Dr. Roman Smirnov: *The Mathematics of Elections*

February 8, 2017 Dr. Jason Brown: *All You Need Is Math - The Connections Between Mathematics and Music*

February 15, 2017 Dr. Jeannette Janssen:  
*List colourings, partial latin squares, and the Dinitz conjecture*

March 8, 2017 Dr. Clark Kimberling: *Beatty Sequences*

March 22, 2017 Dr. Peter Selinger: *Finite alternation in reversible boolean logic*

### Student talks:

October 26, 2016 Jordan Barrett: *The Power Index Game*

November 2, 2016 Kyle MacQuin: *Pattern Formation in an SIR Model with Hysteresis*

November 16, 2016 Moira MacNeil:  
*Distinct Maximal Intervals of Decrease of Node Reliability Polynomials*

November 30, 2016 Felicia Halliday: *The Irredundance Game*

March 1, 2017 Josh Feldman: *Popularity and Community: Using the Spatial Preferential Attachment Network to Model Infectious Processes*

March 29, 2017 Shael Brown: *A Categorical Framework for Computer Programs as Data Miners*

April 5, 2017 Sean O'Neil: *The Dynamics of Multi-Scalar Field Cosmological Models and Assisted Inflation*

## OUTSIDE TALKS

### Karl Dilcher

Derivatives and fast evaluation of the Witten zeta function, CMS Summer Meeting, Edmonton, June 26, 2016.

Generalized Fermat numbers: Some results and applications, 'Number Theory Down Under', Newcastle, NSW, Australia, Sept. 26, 2016.

On the polynomial part of a restricted partition function, Joint Mathematics Meetings, Atlanta, GA, Jan. 4, 2017.

Zeros and irreducibility of gcd-polynomials, Joint Mathematics Meetings, Atlanta, GA, Jan. 5, 2017.

Continued fractions and Stern polynomials, Joint Mathematics Meetings, Atlanta, GA, Jan. 7, 2017.

Gauss factorials, Jacobi primes, and generalized Fermat numbers, '3rd UICPAM-2017', Lahore, Pakistan, March 4, 2017.

### **Jason Brown**

Jason I. Brown, "*A Hard Day's Math: The Connections Between Mathematics and Music*", invited speaker, 2016 Learning Fair, Niagara-on-the-lake, August 25, 2016.

Jason I. Brown, "*Tell Me a Math Story - Motivating Mathematics Via Narratives*", invited speaker, 2016 Learning Fair, Niagara-on-the-lake, August 25, 2016.

Jason I. Brown, "*Applications of Graph Theory to Music*", 16th Haifa Workshop on Interdisciplinary Applications of Graphs, Combinatorics and Algorithms, 2016, University of Haifa, July 29, 2016 (invited speaker).

### **R. J. Nowakowski**

"*Absolute Game Theory: a new context for additive combinatorial games*", CMS Summer Meeting, Edmonton, 2016-06-26

"*Cricket Pitch*", Combinatorial Game Theory Colloquium, Lisbon, 2017-01-25

"*Art in Combinatorial Game Theory*", Public Lecture, Recreational Mathematics Colloquium, Lisbon, 2017-01-30

### **Jeannette Janssen**

"*Recognizing graphs formed by spatial random processes*", invited talk, workshop on Dynamic Networks, Isaac Newton Institute, Cambridge, England, December 2016.

"*Recognizing graphs with linear random structure*", workshop on Random Geometric Graphs and Their Applications to Complex Networks, Banff International Research Station (BIRS), November 2016.

**CHASE REPORT**

Is published for alumni and friends of the Department of Mathematics & Statistics, Dalhousie University.

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We welcome your suggestions and comments for future issues.