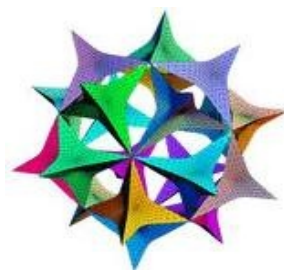


Mathematics and Statistics

Faculty of Science and Engineering, York University

Volume 1

Winter 2013



C
ON
ne
X
I_o



Neal Madras

The Chair's Perspective

I am delighted to welcome readers to this, the first annual newsletter of the Department of Mathematics and Statistics at York University.

In my twenty-five years at York, there have been many changes to Mathematics and Statistics at York. When I arrived in 1988, there was a Mathematics Department in the Faculty of Arts, Applied and Computational Mathematical Sciences in the Faculty of Science, and a Department of Computer Science and Mathematics in Atkinson College. The first two merged a couple of years later, and eventually merged with the Atkinson Mathematics group in 2007. The Department has grown and evolved over those years, as we created undergraduate programs in Statistics, Applied Mathematics, Computational Mathematics, and Mathematics for Education, and graduate programs and diplomas in Applied and Industrial Mathematics, Financial Engineering, and Mathematics Education. In the near future, we look forward to a new program in Mathematical Biology, and we are working with the newly formed Lassonde School of Engineering to redesign the engineering mathematics courses that will serve their projected growing enrolments. Our faculty members' research activities continue to deepen and diversify, spanning the range of mathematics and statistics, from pure to applied, with growing interdisciplinary activity in fields such as epidemiology, engineering, finance, physics, education, bioinformatics, and computer science.

We hope that you will enjoy this newsletter, and that it helps keep you up to date with events in the department and with news from former students and visitors. Please keep in touch, and let us know what you are doing!

Best wishes,

Neal Madras
Interim Chair

Departmentpedia

• New Member

Professor **Youness Lamzouri** is the newest member of the department. Youness has joined the Pure Mathematics section. Previously, Youness was an NSERC Postdoctoral Fellow at the Institute for Advanced Study in Princeton from 2009 to 2010 and a J.L. Doob Research Assistant Professor at the University of Illinois at Urbana-Champaign from 2010 to 2012. While there, he won the Canadian Mathematical Society's prestigious *CMS Doctoral Prize*. He received his PhD in 2009 from the University of Montreal under the supervision of Professor Andrew Granville. His research interests are in analytic number theory, more specifically on questions related to the Riemann zeta and L-functions and the distribution of prime numbers.



Youness Lamzouri

• Future Member

Professor **Ed Furman** proudly introduced his first son, Shawn, who was born on September 23, 2012 and weighed 4.14 kg. He continues to be a happy and healthy baby boy who smiles and coos a lot. Following in his father's Actuarial Science footsteps can't be that far behind.

• Honours

Lee Lorch has been named to the initial class of Fellows of the American Mathematical Society. *Congratulations, Lee!*

Neal Madras was named a 2012 Fellow of the Institute of Mathematical Statistics "for contributions to self-avoiding walks and related polymer models in statistical mechanics,

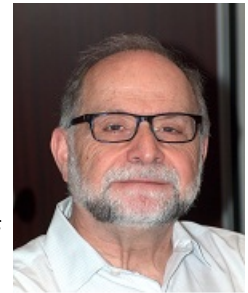


Lee Lorch

and to the convergence theory of Markov chain Monte Carlo algorithms". *Congratulations, Neal!*

• Transitions

Philip Olin retired, effective July 1 2012, and is now Professor Emeritus. He served one term as department Chair (1982–1985) and as Associate Dean of Arts (1992–1995), and was one of the original designers of the Math for Commerce BA program. Thank you for all you've done for us over the years, Phil, and enjoy retirement!

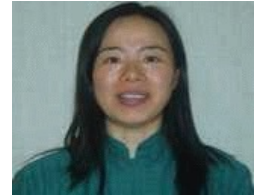


Phil Olin

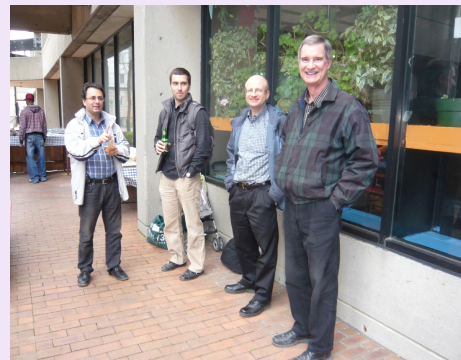
Jane Heffernan and **Wei Liu** were promoted to the rank of Associate Professor, effective July 1, 2012.



Jane Heffernan



Wei Liu



Left to right: Seyed Moghadas, Alexey Kuznetsov, Neal Madras and Peter Peskun

This photo was taken at the 2012 Departmental BBQ in April. For more photos check out the *News & Events* webpage where you'll also find upcoming seminars and colloquia and our Weekly Bulletin. math.yorku.ca

2011–2012 Undergraduate Student Awards

Our annual award ceremony was held on Wednesday, November 21, 2012 in the Senate Chamber.

Opening Remarks: Professor Neal Madras and Dean Donald Hastie, Faculty of Science and Engineering

Speaker: Professor Michael Zabrocki, "Combinatorics and Enumeration in Algebra"

CORS Diploma:

Guangyao He	Gregory Sanderson	Fei Yang
Xiaowen Zhang		

Mathematical Contest in Modelling:

Raya Albayda	Lorianne Donato	Shiyam Pillai
Coach: Jane Heffernan		

NSERC Summer Research Awards:

Prathayana Balendran	Kareem Kudus
Supervisor: Hanna Jankowski	Supervisor: Jane Heffernan

Putnam Competition Participants:

Alex Ashbourne	John Campbell	Nathan Gold
Felipe Posada	Tony Raad	
Coach: Richard Ganong		

Research at York (RAY) Program:

Jeremy Recoskie	Svetozar Valtchev
Supervisors: Jane Heffernan and Hanna Jankowski	Supervisor: Hongmei Zhu

Ray and Joe Abramson Award in Mathematics and Statistics:

Joanna Lee

George & Frances Denzel Award for Excellence in Statistics:

Prathayana Balendran	Bin Sun
Undergraduate	Graduate

Linda Herskowitz Award:

Japjeet Toor

Abe Karrass / Donald Solitar Mathematics Award:

Ioana Popa

Irvine R. Pounder Award:

Year 1 — Jeffrey Kay	Year 2 — Mihai Alboiu and John Campbell
Year 3 — Gabriela Gonzalez	Year 4 — Felipe Posada

Alice Turner Award:

Felipe Posada

George R. & Mary L. Wallace Award:

Actuarial Mathematics — Gabriela Gonzalez

Applied Mathematics — Svetozar Valtchev

Chair's Honour Roll:

Mihai Alboiu	Syed Asghar	Alexander Ashbourne
Ayokunle Ayodele	Prathayana Balendran	John Campbell
Tayla Ginzburg	Nathan Gold	Gabriela Gonzalez
Jiarong He	Karen Huynh Wong	Joseph Indovina
Lu Ji	Jeffrey Kay	Andy Koh
Yehoshua Komarovsky	Chung Kong	Aloka Kumaranayake
Stephen Lidderdale	Keyao Luo	Palaramanan Manickavasagar
Kai Yin Mar	Justin Miles	Ariella Morel
Ashley Ngo	Ninab Nissan	Dongwon Park
Shahab Pirnia	Ioana Popa	Felipe Posada
Siavash Pouyadel	Tony Raad	Jagdish Saggu
Gregory Sanderson	Stefana Sandu	Maxwell Serebryanny
Seyed Shams Shoaee	Pavel Shuldiner	Yuyao Song
Japjeet Toor	Luong Truong	Danny Tshitumbu
Svetozar Valtchev	Tuan Vuong	Shengyu Wu
Yan Xu	Li Zhang	Yiyi Zhang

New Alumni

The following individuals hold postdoctoral fellowships in the department this academic year:

Tristan Bice, Cesar Ceballos, Venkata Duvvuri, Kai Fu, Luiz Guidolin, Gerasim Iliev, Majid Jaber, Baisuo Jin, Qing Li, Felicia Magpantay, Dan Munther, Longxing Qi, Lerna Pehlivan, Juana Sanchez-Ortega, Yu-Hau Tseng, Xiang-Sheng Wang, Carl Wolfe, Juping Zhang, Hossein Zivaripiran.

At convocations in 2012, 79 students received undergraduate degrees in Mathematics and Statistics departmental programs. In addition, the following graduate degrees were awarded:

PhD in Mathematics and Statistics:

Dongdong He	Martin Merener	Yuanyi Pan
Yun Qiao	Yehuda Schwartz	Xiaoping Shi
Adnan Sljoka		

MA in Mathematics and Statistics:

Mahdis Azadbakhsh	Afshin Bayati Kermanshahi	Xiaoxi Duan
Weiming Hu	Luis Lazgare	Nimret Sandhu
Jianxi Su	Xiaoying Sun	Daniela Usvat
Hang Jing Wang	Laura Warren	Hai Zhang
Xian Zhang*	Atefeh Zahiriabaneh	

* also the Graduate Diploma in Financial Engineering

MSc in Applied and Industrial Mathematics:

Tripti Dutta

Hootan Habibkhani

Yong Yang

MA in Mathematics for Teachers:

Velisa Anusic

Grazia Barone

Sandra Kusic

Patrick McQuade

Ramnik Sharda

Kaya Tache-Green

A Conversation with Juris Steprāns



The *Fields Institute for Research in Mathematical Sciences* is a mathematics think-tank, sponsored by York and six other Ontario universities, and located on the campus of the University of Toronto.

Professor Juris Steprāns returned to York in 2010 after serving four years as Deputy Director of Fields. Connexio recently interviewed him about that experience, and about the relationship between Fields and York.

Connexio: Can you tell us something about Fields and the role of institutes like it?

Steprāns: People think of a mathematician as a lonely individual working away in a small room with pencil and paper. If that ever was the case, it certainly isn't now. Mathematicians collaborate widely, and research institutes like Fields now exist in many countries, to spark those collaborations. They bring together a critical mass of researchers from around the world, to accelerate research in emerging areas of mathematics. Fields started out 20 years ago with that as its goal, and it does that very well. But it has also expanded its role to include developments in unexpected areas such as mathematics education and industry/academic partnerships. There are mathematical startups regularly incubated in the institute. These days they're expanding into video conferencing and webcasting and the Institute may look



Juris Steprāns

very different ten years from now than it did at its inception.

C: So what is the relationship between Fields and York?

S: People at York have been involved with or organized many programs at Fields. The seminars and research projects there bring the world's best mathematicians to Toronto, which has a huge impact on York's research, and York's graduate students or postdoctoral fellows. Fields has a new summer program for undergraduates, to which York students have access.

C: As viewers of "Good Will Hunting" will know, the Fields medal is a sort of Nobel prize for mathematics. What's the relationship between the prize and the institute?

S: They're both named after John Charles Fields, a University of Toronto professor born in Hamilton, who was instrumental in reorganizing the world of mathematics after the first World War. He helped create and endow an international prize in mathematics, which was named the Fields medal after his death. The Institute was also named after Fields, as an early leader of

Canadian mathematics. Though there isn't a direct link between the medal and the institute, the institute has started running a "Fields medal symposium" each year, bringing a recent Fields medalist to the institute for a week-long program focusing on their work. This is donor-supported, and includes events for undergraduates.

C: You were back at Fields this past Fall, running a Set Theory program at

Fields called “Forcing and its Applications”. How was that?

S: It was great. We had almost all the young set theorists from around the world participating. It was very productive, with graduate students and postdocs working at the Fields blackboards till late every night. A wonderful experience, that we hope will really move the area forward.

C: That sounds marvellous. Thank you for sharing this with our readers.

Department Snapshots



Over the last few years *Club Infinity* has experienced many changes. Thanks to the work of past presidents, it has once again become an official club through York University and *Student Community and Leadership Development* (SCLD). By becoming a club through York and SCLD, they now receive funding to host events for club members and York undergraduate students.

With the help of their faculty liaison, Professor Hongmei Zhu, they are in the process of setting up an annual seminar for fourth-year mathematics/statistics students who intend to apply for graduate school. This will involve hands on help to answer questions and relieve the stress of the application process. Club Infinity will also begin developing a “How to Survive in Mathematics” workshop for incoming first-year students who are registered in a mathematics or statistics program at York. This workshop will give first-year students tips and tricks to do the best they can in their program through the help of the faculty and upper year mathematics and statistics students.

In the winter semester of the 2012–2013 academic year, Club Infinity will be hosting a talk given by the postdoctoral fellow Dr Dan Munther. The talk will be directed towards upper year mathematics students with an interest in

partial differential equations. This event will be a test run for the Club as they intend to host more of these events for undergraduates in the future. However, there is time to relax. A few pizza parties for members happen each semester and the usual celebration on March 14 (Pi Day) will find pie being served in the clubroom all day for members and faculty of the department.



The *COMAP Mathematical Competition in Modelling* (MCM) is a contest specifically for high school and undergraduate students that occurs every year in late January to mid-February. The contest this year took place from Thursday, January 31 to Monday, February 4 at which time two to three high school or undergraduate students develop solutions to interesting real world problems. In 2012 Raya Albayda, Lorianne Donato and Shiyam Pillai teamed up, and received an Honourable Mention for their solution to a problem asking them to develop a schedule providing an optimal mix of short and long term rafting/camping trips for a company managing a campground along a river. This puts the York team in the top 40% of teams, with 3,697 teams participating around the world. *Congratulations Raya, Lorianne and Shiyam!*



The *Statistical Consulting Service* (SCS) at York is among the most active in North America. It brings together faculty and graduate students from many programs — the Statistics Section in our Department, the Quantitative Methods Program in Psychology among others — so they can make their expertise available to all researchers at York. We had over 800 consulting sessions with clients last year. Our clients are mainly faculty members and graduate students doing research that requires advanced statistical methods. SCS

also offers workshops ranging from introductory courses on statistical packages to courses on advanced statistical methods.

Thanks to SCS, researchers at York have the opportunity to get expert advice in the use of advanced statistical methods appropriate for their research. Graduate students in all disciplines can take statistics workshops that are accessible to them and that allow them to make the best use of statistical methods for their theses and dissertations.

The Centre for Disease Modelling



The Centre for Disease Modelling (CDM) was founded at York University in 2009 with the goal of

bringing together international researchers, laboratories, and provincial and federal public-health agencies to address global public health concerns. The centre had its origins in 2003 during the SARS outbreak when a Canadian national project on “Transmission dynamics and Spatial Spread of Infectious Diseases: Modelling, Prediction and Control” was formed. The success of this team’s collaboration on studying the pandemic quickly grew into an international project under leadership from York University and with funding provided by the *Mathematics of Information Technology and Complex Systems* (MITACS).

Over the years, the CDM has developed innovative training programs in the “Mathematics of Infectious Diseases” that expose trainees to both theoretical frameworks in disease modelling and problem-driven applied research. Trainees have benefited from the CDM’s large offering of programs which includes internships, international exchanges, summerschools, workshops, seminars, and thematic programs.

Key topics of study at the CDM include:

- Modelling transmission dynamics and control of infectious diseases in high-risk and vulnerable population groups.
- Predicting spatiotemporal spread and evolution of zoonotic diseases with environmental changes.
- Incorporating a wide spectrum of human behaviour and health economics into disease models.
- Integrating surveillance and modelling for evidence-based decision-making in public health.
- Evaluating the emergence and spread of antimicrobial drug resistance.
- Integrating within-host micro-dynamics with between-host macro-dynamics.

The CDM is the host for four research laboratories: *Laboratory for Industrial and Applied Mathematics* (headed by Professor Jianhong Wu); *Modelling Infection and Immunity* (headed by Professor Jane Heffernan); *Laboratory of Mathematical Parallel Systems* (headed by Professor Huaiping Zhu); and *Agent-Based Modelling Laboratory* (headed by Professor Seyed Moghadas). These laboratories work collaboratively to train a future generation of leaders who will acquire professional skills and experiences to carry out world-class research, and link fundamental research to applications. These laboratories are very much interested to hear from their alumni, and know how the CDM influenced their career possibilities.

The spread of an infectious disease involves characteristics of the infectious pathogen, the host and the environment in which disease transmission takes place. The purpose of modelling infectious diseases, in relation to public health, is to evaluate the pathogen-host-environment interactions and determine optimal intervention strategies, such as preventive and therapeutic measures.

A Math Moment ...

Combinatorics and Enumeration in Algebra | Professor Mike Zabrocki

The following is a version of a presentation given by Professor Zabrocki on Wednesday, November 21, 2012, at the annual Department of Mathematics and Statistics Undergraduate Student Awards Ceremony.



While numerology may not be very scientific, it shares something in common with my field of study, algebraic combinatorics. Both in numerology and in mathematics, we identify numbers and notice that these numbers arise in very different places and then we try to explain the connections.

For instance, consider the following examples and try to guess the next number in the sequence.

1, 3, 6, 10, 15, ...

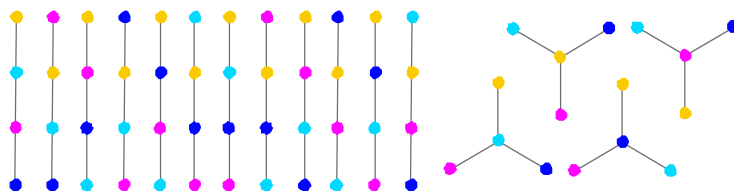
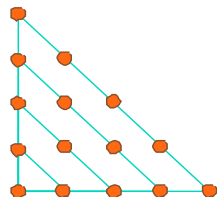
1, 2, 6, 24, 120, ...

1, 1, 2, 3, 5, 8, 13, ...

1, 3, 16, 125, 1296, ...

Each of the four sequences above has a name because they occur frequently in mathematics, and when they do arise within a construction or formula we look for the reasons why they occur. If you would like more information about these sequences there is an online database that is an ideal mathematical tool for looking up more information about them at <http://oeis.org/> called the *Online Encyclopaedia of Integer Sequences*. Go to this website, enter the first 5 entries, and the website displays details about these sequences such as formulas and references.

The first sequence lists the *triangular numbers*. The second lists the *factorial numbers*, which are numbers of permutations. The third lists the *Fibonacci numbers*. The fourth is the number of *labelled rooted trees*. I've included a picture showing a way of visualizing the 5th triangular number and the 3rd rooted tree number. If you tried to guess the next numbers in the sequence, I will tell you here that the next triangular and Fibonacci number is 21, the next factorial number is 720, and the next rooted tree number is 16807.



While the first three of these sequences are ones that you might come across in many mathematics classes, the last one is much harder to immediately recognize. It has a simple formula that you might see better if I write it as $2^0, 3^1, 4^2, 5^3, 6^4, 7^5, \dots$. The last sequence may be less familiar, but it is a far more interesting for a mathematician in my field. The relationship of this sequence with labelled rooted trees is attributed to A. Cayley from 1889.

I want to try to share with you a problem in my field that I have been looking at (on and off) over the last 20 years just because of this sort of numerology. It was one of the first problems that really got me excited about mathematics research and it still fascinates me today. In the early 90's, the sequence of rooted tree numbers appeared in algebra and a large number of people have tried very hard to explain the connection.

Consider the dimension of the space of polynomials in variables $x_1, y_1, x_2, y_2, y_3, \dots, x_n, y_n$ that are killed by all differential operators of the form

$$\partial_{x_1}^r \partial_{y_1}^s + \partial_{x_2}^r \partial_{y_2}^s + \dots + \partial_{x_n}^r \partial_{y_n}^s$$

for any $r+s > 0$. This space of polynomials is called the *diagonal harmonics*, and this space borrows its name because in physics the solutions to the equation

$$(\partial_{x_1}^2 + \partial_{x_2}^2 + \dots + \partial_{x_n}^2)f = 0$$

are called *spherical harmonics*.

For instance, if $n=2$, then the only polynomials which are killed by these operators are $1, x_1 - x_2, y_1 - y_2$ (hence the dimension is 3). With a bit of work it is possible to calculate that when $n=3$ there are 16 linearly independent polynomials which are killed by these operators. For $n=4, 5, 6$ computer evidence shows us that the dimensions of these spaces follows the sequence 125, 1296, 16807. Is this the number of labelled rooted trees? An ideal answer produces one polynomial for each labelled rooted tree. At this point our computer evidence stops because these spaces become too big to compute. Numerology fails us and we need to come up with a mathematical proof of this fact.

I believe we will soon be able to make explain the connection with the labelled rooted tree sequence, and even have an explicit formula for the number of polynomials at any given degree, but it has taken us more than 20 years to reach this point. At each step of progress in unravelling this problem we have uncovered beautiful new mathematics.

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

Visit the YU Department webpage: www.math.yorku.ca



Math Break

S	S	O	R	Y	T	L	U	C	A	F	T	E	E	C
S	H	R	O	O	M	S	B	G	C	A	T	R	I	A
A	R	N	D	K	E	Y	A	R	T	A	N	U	R	M
L	E	O	E	H	E	U	L	A	U	S	E	N	T	P
C	T	G	P	O	T	F	T	D	A	S	M	E	E	U
F	T	N	A	N	I	P	A	E	R	I	E	T	P	S
I	E	I	R	O	N	R	T	A	I	S	C	B	M	T
X	L	L	T	U	G	O	S	I	A	T	N	U	A	A
M	S	L	M	R	S	F	H	U	L	A	E	L	R	T
A	W	E	E	S	C	I	T	Q	U	N	M	L	K	S
N	E	D	N	O	H	L	A	O	M	T	M	E	S	T
T	N	O	T	R	A	E	M	L	N	S	O	T	O	A
U	R	M	E	A	I	S	D	L	I	H	C	I	N	F
P	N	T	H	P	R	O	M	O	T	I	O	N	E	F
S	D	R	A	W	A	I	N	C	S	P	M	A	L	G

ACTUARIAL
ALUMNI
ASSISTANTSHIP
AWARDS
BULLETIN
CAMPUS
CHAIR
CLASS
COLLOQUIA

COMMENCEMENT
DEPARTMENT
FACULTY
FIX
GRADE
HONOURS
LAMPS
MARKS
MATHSTATLAB

MEETINGS
MODELLING
NEWSLETTER
NTH
ONE
PETRIE
PROFILES
PROMOTION
PUTNAM

ROOMS
ROSS
STAFF
STATS
TENURE
UNDERGRADUATE

Connexio's Editorial Board: Yuejiao Fu, Seyed Moghadas, Tom Salisbury, Susan Rainey
Contributors: Alex Ashbourne, Jane Heffernan, Neal Madras, Georges Monette, Mike Zabrocki
