



# Mathematics

## Newsletter

2015 - 16

### Message from the Head, Philip Loewen



Department Head,  
Philip Loewen

#### Dear Friends, Colleagues, and Alumni:

What is Mathematics? A way of thinking? Of course. An art? Maybe, but linking our question to “What is Art” does little to simplify it! A tool? OK, but only if we acknowledge its astonishing versatility: Mathematics gives its adept users the power to explore, to understand, to decide, to explain, and to communicate. These are fundamental human activities, and therefore mathematics is deeply connected to people. The next few pages describe

some of the ways the UBC Mathematics Department is contributing to knowledge through teaching and research. I’ll use my first-ever chance to introduce the Newsletter by focusing on the human side.

Coffee with Anona was thoroughly enjoyable. We met in May 2016, in the Loafe Cafe--a most suitable venue, because it’s in the Robert H. Lee Alumni Centre. Anona Thorne is a double-alum, having earned a BA in Mathematics in 1991 followed by an MSc in Statistics in 1993. She had come to talk about creating a scholarship for current undergraduates. She shared a wonderful story about enjoying Math, and getting good advice about how to use her skills from Andrew Adler. Anona’s next steps led to a fulfilling career in the world of medical research. (For details, type her name into Google Scholar.) In collaboration with her husband, Anona wanted to celebrate the way Math had shaped her trajectory by encouraging someone at an earlier stage of the journey. The happy outcome is the Anona Thorne and Takao Tanabe Undergraduate Scholarship in Mathematics, to be awarded for the first time in the 2016/2017 winter session.

Thanks are due also to Stanley Grant, whose legacy includes an endowment to fund several scholarships for Math students at both the undergraduate and postgraduate levels.

The previous newsletter was introduced by Mike Bennett, who completed his term as Head in July 2015. Mike contributed immensely to the Department’s vitality, serving up a steady diet of well-considered decisions garnished with dry wit. In particular, Mike negotiated the hiring of 5 of the 6 outstanding new faculty profiled in these pages. After a well-earned period of study and administrative leave, Mike will resume his professorial duties in January 2017 with gusto -- and his colleagues’ ongoing appreciation.

Mary-Margaret Daisley, the Head’s Secretary, generously delayed her threatened retirement for one more year to support yet another

Head-to-Head transition. After 45 years in the Math Department, she was an incomparable source of facts, experience, and institutional memory. Her step into retirement at the end of August 2015 was a big loss to those of us left behind; it’s a privilege to express the gratitude of the whole department for Mary-Margaret’s outstanding service.

A number of other key people are continuing in their leadership roles: Leah Keshet (Associate Head for Faculty), Steph van Willigenburg (Associate Head for Research), Mark Mac Lean (Undergraduate Chair), and Dan Coombs (Graduate Advisor). I count it a privilege to join this group, whose priority is always to advance the cause of Mathematics. Spend a few minutes looking through these pages for details: you will find innovative teaching, prize-winning research, and a first-hand account of global impact. ■

### Contents

From the Head .....	<a href="#"><u>1</u></a>
New Faculty .....	<a href="#"><u>2</u></a>
Interview with Colin Clark .....	<a href="#"><u>3</u></a>
Undergraduate Report .....	<a href="#"><u>7</u></a>
BIRS Report .....	<a href="#"><u>11</u></a>
USRA .....	<a href="#"><u>12</u></a>
Graduate Student Report .....	<a href="#"><u>13</u></a>
Life After UBC .....	<a href="#"><u>14</u></a>
Outreach .....	<a href="#"><u>16</u></a>
MITACS .....	<a href="#"><u>18</u></a>
Awards & Honours .....	<a href="#"><u>19</u></a>
Staff News .....	<a href="#"><u>20</u></a>

Editors: Richard Froese, Roseann Kinsey,  
Brian Marcus

# New Faculty



**Colin Macdonald** joined us as an Assistant Professor in September, 2015. He received his PhD, “The Closest Point Method for Time-dependent Processes on Surfaces,” from SFU in 2008 under the supervision of Steve Ruuth. He was a co-winner of the Canadian Applied and Industrial Mathematics Society PhD prize for this work. He went on to a PDF

position at UCLA working with Stan Osher and then a tenured faculty job at Oxford before coming to UBC. He has general interests in scientific computation. The main theme has been the development of the closest point method for approximating the solution of partial differential equations on surfaces. This work has many applications, including image segmentation in computer graphics and the prediction of forest fire progress, as well as being mathematically interesting. ■



**Ben Williams** was hired as an Assistant Professor in the UBC Mathematics Department in 2015. He was born and educated in Ireland and obtained his Ph.D. from Stanford University in 2010 under Gunnar Carlsson. He held postdoctoral jobs at USC and UBC before taking his current position. Ben joins the small but

very active topology group in our department, which includes faculty members Alejandro Adem and Alexandra Pettet as well as several students and postdocs. Ben’s research interests encompass the application of homotopy-theoretic methods to problems in, or inspired by, algebra and algebraic geometry. This includes emerging topics such as motivic homotopy theory. His work has been published in a variety of high quality journals including *Inventiones Mathematicae* and *Geometry & Topology*. ■



**Anthony Wachs** joins us from IFP Energies Nouvelles in France, where he has worked professionally since completing his PhD at Grenoble in 2000. At IFPEN he worked as Scientific Advisor leading a research group focused at High Performance Computing of both multi-phase and non-Newtonian fluids, while also teaching regularly in Grenoble

and Paris. At UBC he is appointed jointly with Mathematics and the Chemical and Biological Engineering department. He is interested in a wide range of mechanics problems, covering granular flows, suspensions, non-Newtonian fluids, industrial flows, dealing with both mathematical and computational aspects. ■



**Elyse Yeager** earned her bachelor’s degree in mathematics from the University of Alaska, Fairbanks in 2006. She spent time as a Peace Corps volunteer in Africa teaching math and science and worked to fund and build improved facilities. Elyse earned her master’s degree in mathematics from West Virginia University in 2010. She

received her PhD in Combinatorics and a master’s degree in the teaching of mathematics from the University of Illinois in 2015. Elyse joined the UBC faculty in 2015 as an instructor. She is collaborating with Andrew Rechnitzer and Joel Feldman to produce problem sets for their (free) Math 100 textbook. ■



**Patrick Walls** received undergraduate degrees in mathematics and mechanical engineering at the University of Calgary. He earned a master’s degree from UBC studying with Julia Gordon and Nike Vatsal, and his PhD from the University of Toronto in 2013. He was a postdoctoral fellow and mathematics instructor in the Integrated

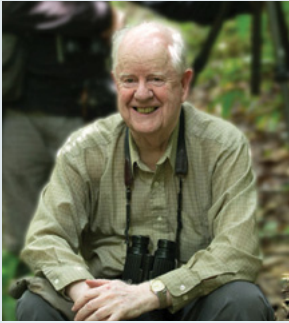
Science Program at McMaster University. He joined UBC as an instructor in 2015. In Winter 2015, Patrick redesigned Math 210 (Introduction to Mathematical Computing) using Python and Jupyter notebooks, with support from James Colliander and Ian Allison at PIMS. ■



**Joshua Zahl** received his PhD in harmonic analysis and discrete geometry under the supervision of Terry Tao at the University of California Los Angeles in 2013. From there he continued to the Massachusetts Institute of Technology for a postdoctoral position where he worked with Larry Guth. His research interests include classical

harmonic analysis, maximal functions, incidence geometry, additive combinatorics, discrete and computational geometry. He joined UBC as Assistant Professor of Mathematics in July, 2016. ■

# Interview with Alumnus Dr. Colin Clark



Dr Colin Clark

*Dr. Colin Clark's research in the economics of natural resources and behavioural ecology has led to many rewarding collaborations, as well as national and international honours. Most recently he was named one of two 2016 Fellows of the International Institute of Fisheries Economics & Trade (IIFET).*

*Colin is Professor Emeritus of Mathematics at The University of British Columbia. He is also a UBC alumnus, graduating with a B.A. in Mathematics and Physics in 1953.*

*In this interview, Colin shares the tale of his beginnings in Applied Mathematics and the invention of the field of Mathematical Bioeconomics.*

*Colin was interviewed in May 2016 by Cole Zmurchok, a PhD student in the Institute of Applied Mathematics.*

**CZ:** Congratulations on being named one of the 2016 Fellows of the International Institute of Fisheries Economics and Trade. The award recognizes a lifetime of work in fisheries economics, specifically for building a bridge between economics and biology. What is the field bioeconomics?

**Colin Clark:** I've worked in two branches of what you might call bioeconomics, but the one on fisheries is a combination of biological resources and the economics of exploiting or managing them. My first publication in this area, titled "The Economics of Overexploitation, appeared in Science in 1973. Eventually, I decided to write a book on this, using the title Mathematical Bioeconomics. So that's where the name came from, out of the blue!

**CZ:** How do biological models fit within economic models of fisheries?

**Colin Clark:** If you have some system involved in an economic study, the system itself has to have its own characteristics. Biological populations—let's be a little more explicit and take a particular population of fish like Fraser River Sockeye Salmon or Antarctic Blue Whales (whales are fish for this discussion)—will have its own dynamics. In most cases the biologists will have already developed a mathematical model for the population dynamics. For the Sockeye Salmon example, a well-known model is the Ricker Model, named for Canadian fisheries scientist, William Ricker. A one-species non-overlapping generation model of population dynamics is typically the kind of model that I use. Classically, the economists who are studying resources, such as fisheries, would also adopt these models. They needed to start somewhere, and they aren't going to make up the models. On top of the population model, you put in prices and costs and other economic parameters. That gives a bioeconomic model.

**CZ:** What sort of mathematical tools did you use to bridge the gap between economics and ecology?

**Colin Clark:** I was a complete tyro in this. I had done my PhD in differential equations, studying eigenvalue problems. That was my research area until the late 1960s. I remember going to Ralph James, the head of UBC Mathematics Department, and saying, "Ralph, I'm going to apply for a sabbatical, but I'm

going to use it to change fields!" I'll give him full credit, he cheerfully said, "Oh great! That's a super idea."

Off I went to the New Mexico desert for my sabbatical, where I had an NSF sponsored visiting appointment. I was interested in natural history and hiking and so I had an interest in nature. If you go hiking in British Columbia, you can't fail to notice what the forestry industry has done to the environment. In New Mexico I saw a book in the library by Kenneth Watt, a Canadian entomologist, with the title "Ecology and Resource Management." "Aha," said I, "this might be interesting." Sure enough, it described the Ricker model for a renewable resource, and described how you can come up with a management strategy called maximum sustainable yield. That's a famous triplet of letters in resource management—MSY. I clearly remember—this was a turnaround point in my life—that there was a footnote alongside the graph of MSY and equations. The footnote said: "the reader will note that there are no economic aspects to this model. Apparently no one had ever tried to insert economics." "Aha," said I, "this is for me!"

I was a pure mathematician, keep that in mind. I would be taking a different perspective than the ecologists, biologists, or maybe even the economists. Not consciously, but that was just my background. To get to the eureka moment, it didn't come immediately, but it took part of a day! I had written down the model, I needed to add the economics, but I knew nothing of Economics. Once as an undergraduate, I had taken a course in business math. It was a very easy course, but I enjoyed it. Most of the students were in the Business school. We learned about stocks and bonds and mortgages and annuities, and the one thing I remembered was when evaluating any asset, you took a discounted present value of future returns. That is, you estimate the discounted present value of stocks and bonds. So in the fishery model, instead of the actual year by year catch, I'll consider the discounted present value of today's and all future catches, which gives an infinite series. Injecting this economic idea into my model gave me a mathematical problem. I had a difference equation, say  $x_t = F(x_{t-1}) - c_{t-1}$  which is called the spawner-recruit model for fisheries. The spawners are the fish that escape from the fishery, and that escaped population subsequently determines influx of fish in the next



generation. This gave a dynamic equation and an objective function to maximize, leading to a mathematical problem, and not one with an obvious solution. I immediately tried to guess what the solution was—the MSY! Even if you discounted the future, you couldn't get any more than the maximum, right? Here's where the mathematician comes in and here's where the economist is tied up—I have to prove that! That's what we do.

I sat down to prove it. How do you prove it? You have to maximize a sum of infinitely many unknowns, not quite first year calculus. I started with the simplest case: only two periods. I came up with an equation for two periods,  $F'(s) = 1 + \delta$ ,  $\delta$  the interest rate. Where the MSY is  $F'(s) = 1$ .  $F(s)$  gives the stock recruitment as a saturating function of escapement  $s$  as the argument. Here's a 45-degree line. If you want to maximize, you want to pick an  $s$  so you stay at that  $s$  and maximize the catch, it's obviously where the slope is 1. This gives the MSY:  $F'(s) = 1$ . But then if you discount, with a two-period model where you discount next year, you get  $F'(s) = 1 + \delta$ . It's not the same solution! This was a surprise to me. I went on to prove it for 3 periods,  $n$  periods, and infinitely many periods. It still stayed the same. I rushed out of my office excited to see if someone would listen to me...

What's interesting about this is the following hypothetical situation: If the discount rate is sufficiently large, then the economic "optimum" is to exterminate the population and turn it into cash and put the cash into the bank at that interest (i.e., discount) rate. So I thought, well this is terrible, but at least I proved something!

My next reaction was, "of course, this must be extremely well known. I must have just rediscovered the wheel of resource economics." I went back to the library. It took me quite a while, but I never found anything quite like this in the literature. In fact, I found the opposite, I even found people saying that no matter what the discount rate was, the private owner of a resource would never over exploit their resource.

**CZ:** Would you call this eureka moment one of the most rewarding results?

**Colin Clark:** Well this is where it began, I wrote a paper on this result. Of course, if you're going to get this maximum just by calculus, there has to be a convexity assumption. If this stock recruitment relationship is convex, this solution is correct, but if it is not convex, then the solution may be different. That was what was in my paper, both the convex and non-convex cases, to put a bit of non-trivial mathematics in it. I was going in the completely wrong direction, as far as the economists and biologists were concerned! That was the beginning, but I was very economically naive.

**CZ:** That neatly summarizes your change from working in analysis to applications! After getting started in bioeconomics, how did your collaboration with economists begin?

**Colin Clark:** I came back from my sabbatical, and offered to give a colloquium talk on "The Economics of Conservation." In the front row of the audience were a bunch of guys I didn't recognize. I gave my talk, and after the talk there were questions, and one of these guys in the front row, a distinguished looking gentleman, stood up and said, "Professor Clark, I enjoyed

your talk very much, although it was somewhat over my head in details, but could you explain to me why the optimum escapement is always to the left of the MSY point? We've been studying this for 35 years and we know that this is wrong. The optimum is always to the right side." "It just turns out that it is always to the left, at least for my model. For a different model I can't say." Someone else asked if I could explain how the costs of exploitation were modelled. I repeated what I said in the beginning of the talk, that I didn't know how to put costs in, so I didn't! The whole front row burst out in laughter and sort of stomped out. That at least connected me with economists, but not in a very productive way. Somewhat later, I figured out how to put the costs in and wrote a paper on that. It went on to become a featured article in *Science*, called the Economics of Overexploitation. This paper launched my new career, and I got several hundreds of reprint requests.

“... I remember going to Ralph James, the head of UBC Mathematics Department, and saying, “Ralph, I’m going for a sabbatical, but I’m going to use it to change fields!” ...he says, “Oh great! That’s a super idea.”

Your question, however, was how did I start working with economists? If I had been less naive, I would have taken the opportunity at that colloquium to challenge the economists to put together my model and theirs, with costs in it, and see what happens, but it never entered my head. The next year, Economics Professor Tony Scott was giving a graduate course in resource economics, and I asked if I could sit in. He said, "Of course, provided you don't keep bothering us with mathematical technicalities!" Later he invited me to give a lecture on my own model (with costs included). Also auditing the course was Gordon Munro, a faculty member in economics. He had a fisheries problem that came to him when he was doing some unrelated work in Malaysia. The Malaysian government wanted to know something about subsidizing the fishery on a temporary basis and he had approached local fisheries economists to figure how they would handle it. They weren't able to help him, but after my talk Gordon came up to me and suggested that my method might work on his problem.

The story that Gordon always tells is that he explained the problem to me, and that I replied, "I don't see the solution

immediately, but I'll go home and work on it." Later that evening, I phoned Gordon and explained the solution. The next day, Gordon called me to thank me for my solution, but explained that it was wrong! He was right, I had made an error. I managed to fix it up, and we published the result. From then on, we've collaborated extensively. In fact, Gordon and I are both being honored at the IIFET meeting for doing work in this area.

**CZ:** Have you seen that your work has made an impact in the actual day-to-day management of renewable resources?

**Colin Clark:** I think so, but you're not going to see a direct link. Our result with the discounting and so on would predict that fishermen themselves would not necessarily be happy about an MSY-type solution. In the case of a severely depleted population, for example, returning to the MSY spawning population could take years if not decades. Not surprisingly the fisherman may not approve of this strategy. The fishermen are discounting. They are people! Everyone discounts the future; it isn't an evil. Well, maybe it is an evil, but everyone does it!

Returning to your question, I can happily report that fisheries management in BC has recently taken a new direction, based on ITQs (Individual Transferable Quotas). Gordon and I, along with our colleague Rashid Sumaila of the Fisheries School, recently analyzed this system, and reported that it is a resounding success, biologically and economically. I actually wrote a paper on the theory of ITQs back in 1980, which was published in JFRBC, the Journal of the Fisheries Research Board of Canada. Did this cause the change? Of course not, but maybe it had an influence.

One thing that I've learned, is to start with a simple model and then work on extending it in various ways. Go to the expert! Talk to the folks who are working in the field. They are the people who know! When I gave a solution to Gordon's Malaysian problem, he knew immediately that it was wrong because he knows economics and I don't. That was the major lesson I learned from all this: work with people in the field as much as possible. Learn to talk their language, and be sensitive to their viewpoints.

**CZ:** One of your other research interests is behavioural ecology. How did you get involved in behavioural ecology?

**Colin Clark:** That introduces another very important person in my life. His name is Marc Mangel. Marc is an incredible character! I first encountered him when he enrolled for my 4th year course on the Calculus of Variations and Optimal Control Theory. (Years later Marc told me that this was the most useful math course he had ever taken!) Marc was doing his Ph.D. on stochastic population models with Don Ludwig, when I took him on as a Research Assistant on a contract I had with NMFS, the National Marine Fisheries Service of the US, studying the effects of tuna schooling on the Tropical Tuna fishery. We were both tyros at actually developing original models (who isn't?) but we eventually succeeded to NMFS's satisfaction.

**CZ:** OK but what about Behavioral Ecology?

**Colin Clark:** Long story! Marc had become an expert on Search Theory while working after graduation for the US Navy, so we started thinking about search theory for fishermen. One

day I remember, we looked at each other and said "Hmm. Don't all predators have to search for their prey? What's the literature on that?" The Eureka question! There was a large literature on Optimal Foraging Theory, which had just started thinking stochastically (variance as well as means!), but hardly dynamically at all! Bingo! This led us ultimately to Behavioral Ecology.

But, you'll say, you were two mathematicians. Shouldn't you talk to Ecologists? Well, it took us a while, but I must say that, once the Ecologists realized we were interested (and interesting?) they swarmed to us for help. Marc's first empirical paper was on the egg-laying strategies of parasitic wasps, where a Stochastic Dynamic Programming model produced entirely new predictions, which matched the data much better than those of a standard model. This work generated many collaborations by Marc with entomologists in later years. My own first breakthrough was about fish again. Working with a grad student in Fisheries, Dave Levy, we came up with a completely new model and explanation for Diel Vertical Migration of juvenile sockeye salmon (Dave's Ph.D. project). Our paper was published in *The American Naturalist*, a leading journal in Ecology. Doing the research led to another Eureka moment, which neither of us will ever forget. I'll ask you to read the paper if you're interested.

Anyway, Marc and I got so excited about all this that we decided to write a book on it, *Dynamic Modeling in Behavioral Ecology*, Princeton University Press 1988. Meanwhile I have published papers with over 25 different co-authors, all Biologists or Ecologists. Marc likewise.

I should point out that my two branches of Bioeconomics do have one thing in common. Namely, both employ techniques of dynamic optimization, present value of net revenues for Economic models, and evolutionary fitness for biological models. But I do not like to think of myself as an expert in control theory "looking around" for applications. In both instances it occurred the other way around.

Cole, if you don't mind I'd like to return to Fisheries for a minute. You remember I mentioned my mistake in solving Gordon Munro's fisheries problem. The reason for the mistake was that the correct solution involved a delta function, which was not economically realistic. So we had to use the method of so-called Blocked intervals, as recently described by the (later) Nobel-prize winning mathematical economist Kenneth Arrow. This led to the correct solution.

Next, faced with the real-world problem of overcapacity of fishing fleets, Gordon and I developed a more complex model having two coupled state variables,  $x$ , the fish stock, and  $k$ , the fleet capacity. The two control variables were harvesting and investing in vessels. The resulting optimal control problem was just too hard for us. But miracle of miracles, a young mathematician named Frank Clarke had just joined the UBC Math department. A recent Ph.D. from the University of Washington, where he worked with Terry Rockafeller, Frank was already a world expert on non-smooth dynamic optimization problems, just what we needed.

Frank had just been working on a completely new method in optimal control theory which he called the Method of

Carathéodory. This was tailor made for proving results provided you could guess the solution in advance. If you could conjecture the result, and if you were right, his method would prove it. Amazing! I went and knocked on his door and explained our problem, plus our guess as to the solution. Eleven months later (after fixing up our almost-correct guess) we solved it. Frank had never worked 11 months on a problem in his life. Later he told me that the solution we gave was the most difficult, most rigorous solution of an optimal control problem ever! In any field! So now I'm working with really good mathematicians, really good economists, and really good biologists! What could be better? I had certainly learned my lesson—go to the experts!

**CZ:** What or who originally sparked your interest in mathematics?

“ . . . this was a turnaround point in my life— that there was a footnote alongside the graph of MSY and equations. The footnote said: “the reader will note that there are no economic aspects to this model.” Apparently no one had ever tried to insert economics. “Aha,” said I, “this is for me!”

**Colin Clark:** Well, I went to undergraduate school here at UBC. Originally I thought I'd be in chemistry, but I soon gave up on that. I was going to take engineering instead, but at UBC you couldn't enter the engineering faculty as a freshman, you had to take a year of sciences first. That was my plan. I actually signed up for engineering physics, which would have a lot of math, but never started. I remember being out here the week before classes looking at the schedule, and reading the classes I had to take. Rock identification. Drafting. I didn't want to take all these things. I went to the physics department and was advised to take honors math and physics. Upon graduation I decided to go into straight math, as it was much more conducive to my way of thinking. Later, I got my PhD at the University of Washington, so here I am in mathematics. In graduate school I worked in highly abstract areas—eigenvalue problems for the Schrodinger operator. Again, physics background but pretty abstract. I continued working in PDEs and related problems

for several more years, namely about 10 years. Eventually I switched to Economics and Biology. As my wife Janet puts it, I tend to jump around. If you jump often enough you'll eventually land on something good.

**CZ:** I have only two more questions. What is in the future for bioeconomics or resource economics? What do you see?

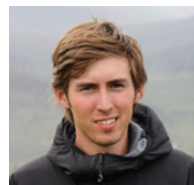
**Colin Clark:** Some of the fisheries management world is slowly going toward individualized quotas. They are regularly used in Australia and New Zealand, and coming in in some places in Europe. What is not being accomplished, and there doesn't seem to be much hope for, is control of international deep-sea fisheries. These fisheries lie outside the 200 mile zones of coastal states, and most are heavily over exploited. It's very hard to control a resource like a deep sea fishery, which isn't under any country's jurisdiction. No amount of mathematics or modelling is going to help that very much. Rashid Sumaila, a colleague at UBC, has a proposal. The best thing to do would be to close all deep sea fisheries entirely. That would only reduce the total catch by a few percent and probably in the long run would increase as the overfished populations recovered. I could point out that this apparently hopeless problem of international fisheries has a much more serious analogue called climate change. I have to say that I'm really, at the moment, pretty pessimistic about climate change. I think what we've done in fisheries is having an effect for fish populations such as the Fraser Sockeye Salmon which are more or less within Canada's jurisdiction. Gordon Munro has worked on fish populations that go between the 200 mile zones in more than one state, in particular by using game theory for many years. He's become an authority on game theoretic models of inter-zone fisheries problems. That's an active area of research. You know you need to do that right before sitting down at a table and negotiate what catches should be. It's not entirely academic.

**CZ:** The natural world has inspired a lot of your work, and you've already mentioned your birdwatching hobbies. What's your favourite birding spot?

**Colin Clark:** My Backyard! No, I can't decide. I've done a lot of tropical birding. I've done over 25 professionally guided bird tours over the years. My last one was to China. Not very tropical but interesting. I lead bird trips locally in the spring. For the last five years I've been leading a biweekly walk called “Follow the Bird Migrations” at Iona Island. You're welcome to come! They start on April 1.

I've always been interested in birding, but that and nature in general have been my driving motivation for most of my

research much of my life. I think, as far as it personally goes, I consider my main personal accomplishment to combine the mathematics with my other interests based on nature. I've been really lucky to do it. I've also been lucky in working with outstanding people in economics and ecology. ■



Cole Zmurchok



# Report from the Undergraduate Chair

Our undergraduate program is vast and undergoes continual evaluation and revision. Here are some statistics:

1. 2016 total enrolment is just under 19,000. This represents about a 19% increase since 2011.
2. Mathematics is one of nine departments in the Faculty of Science, but does 20% of its undergraduate teaching.
3. We have 474 BSC and BA students in our major specializations and 45 BASC students taking a Minor in Honours Mathematics.
4. We have about 9300 students registered in first year courses. We have the challenge of teaching students from Applied Science, Arts, Land and Food Systems, Forestry, Kinesiology, Sauder, and Science.

As all Faculties at UBC experience increases in undergraduate enrolment, we work to meet the needs of a wide range of students with varying interests in mathematics. We have a dedicated group of faculty who engage in the curriculum to ensure it meets the needs of these varied programs.

For a fuller appreciation of the scope of our teaching, please visit our undergraduate website: <http://www.math.ubc.ca/Ugrad/index.shtml>.

## Teaching and Learning Highlights

Maintaining effective courses is a continual process, with particularly high activity in the past few years. This work has been given a particular boost of energy by the addition of several new faculty members in the Mathematics Department whose focus is on educational leadership.

Since 2008, we have participated in the Carl Wieman Science Education Initiative (CWSEI), a Faculty-of-Science-wide program that has been lead by Dr. Costanza Piccolo for many years. While the Math-CWSEI initiative is in its last years, some of this work will continue through the department's relationship with Skylight (the Science Centre for Teaching and Learning). Our goal is to improve undergraduate education by implementing scientific, evidence-based approaches to teaching and learning and she will continue to provide leadership through her work in the department.

For example, we are interested in understanding the experiences of students in our first year calculus courses and determining the best ways we might support their success.

In the fall of 2015, we administered to every first-year differential calculus student a diagnostic test and a math attitudes and perceptions survey (MAPS). Our analysis of these data shows that the combination of the diagnostic and MAPS instruments provides a strong indication of which students are likely to struggle in these calculus courses. While we are looking to improve the predictive value by considering other factors, we now have a good indicator to tell us which students we might encourage to take up supplemental learning opportunities in

these courses. This is ongoing research led by Dr. Piccolo, and is strongly linked to our decisions about practical approaches to helping students succeed in first year.

We also participated in the PASS (Peer Assisted Study Sessions) pilot program in 2015 in MATH 110, a course designed for our students who are most challenged by taking a UBC calculus course. PASS sessions involve students meeting with peers and content experts to learn how to approach the course content through practical engagement with the course material. Early analysis of the data from PASS indicates that participation increases student likelihood of succeeding in MATH 110.

In addition to our research-based approaches to improving teaching and learning, several faculty members have been working on creating new open-source course materials for our first year courses. Andrew Rechnitzer and Joel Feldman have been working on course notes for MATH 100/180, which are freely distributed to students online, and together with Elyse Yeager, have put together a new problem book for MATH 100/180. (What is mathematics without good problems?)

Beyond first year, we work continually to update the curriculum of our courses.

Patrick Walls has taken on the challenge of revitalizing MATH 210, our introductory mathematical computing course. This course is part of our core computational requirement for students in the mathematical and statistical sciences. The new course is very popular and provides an excellent experience for math majors to learn about the central role of computation in mathematics.

Shawn Desaulniers has been working to develop a new approach to providing students in the NITEP program, UBC's indigenous teacher education program, with a solid grounding in mathematics from the perspective of the elementary school teacher. This is challenging work given the diversity of students and perspectives, but Dr. Desaulnier's enthusiasm is sure to make it a success.

The Mathematics Department has also been a core contributor to the Vantage One program for international students. Our work in Vantage One is led by Fok Leung, who has developed some exciting new approaches to teaching first year students. In addition to using these in Vantage, he will be trying these out in MATH 100 this coming fall.

There are many other exciting curriculum developments in some of our upper year courses, and I encourage you to explore our courses at the Undergraduate tab on our department website.

## Our Programs

The Mathematics Department offers Majors and Honours degrees to students in Science and Arts, with 226 Science and 248 Arts students specializing in Mathematics in 2016. In addition, there were 45 Applied Science students pursuing a

“Minor in Honours Mathematics.” About 120 students graduate each year with a degree in Mathematics.

Our programs are diverse, with many variants, including Combined Honours (e.g. some common ones are Physics/Math and Computer Science/Math), Double Majors, Combined Major, and a Co-op option. These options support a variety of directions after graduation, ranging from graduate school to a range of public and private sector jobs, and teaching careers. The Dual Degree Program in Mathematics and Education was created in 2008. This program allows prospective teachers to simultaneously take courses in these two disciplines, instead of first completing a Mathematics degree and then enrolling in Education. We also actively participate in two special programs for first-year students: Science One and the Coordinated Science Program.

## Our Excellent Students

We are fortunate to attract talented students at UBC:

- In May 2016, Ms. **Caroline Lemieux** won the Governor General’s Silver Medal as the top graduating student in the Faculty of Science. She earned a BSC in Combined Honours in Computer Science and Mathematics. She will begin her studies for the PhD in Computer Science at the University of California, Berkeley. Congratulations, Caroline!
- In May 2016, Mr. **Foster Tom** was awarded the Dr. R. D. James Medal in Mathematics. He earned a BSC in Honours Mathematics and will remain at UBC to study for a MSC.



Three prize winners  
Ian McDonald, Foster Tom, Caroline Lemieux

A number of scholarships and prizes are awarded to Mathematics students each year. Students who have won these awards in the past year are listed alphabetically below.

- **Christina Cheung** (1st year): James A Moore Major Entrance Scholarship
- **Pang Chieh Chiu** (4th year): Reginald Palliser-Wilson Scholarship
- **Chan Gwak** (3rd year): James A. Moore Memorial Scholarship

- **Caroline Lemieux** (4th year): Governor General’s Silver Medal, G. C. Webber Memorial Prize, Daniel Buchanan Scholarship in Mathematics
- **Ian Gordon McDonald** (4th year): Lorraine Schwartz Prize in Statistics and Probability, Daniel Buchanan Scholarship in Mathematics
- **Emmanuel Sales** (1st year): Ralph D. James Prize
- **Foster Tom** (4th year): Dr. R. D. James Medal in Mathematics, Reginald Palliser-Wilson Scholarship, Ron Riddell and Roy Douglas Memorial Scholarship.
- **Samuel Thrasher** (4th year): John Collison Memorial Scholarship in Mathematics
- **Emily Katherine Tyhurst** (3rd year): W. H. MacInnes Scholarship in Mathematics and Physics
- **Tianrui Xu** (4th year): John Collison Memorial Scholarship in Mathematics
- **Dong Xing Yin** (1st year): Entrance Scholarship in Mathematics

Our undergraduate students as a whole also have a strong involvement in the local mathematical community. Just a few of their activities are:

- Our Math Club sells final exam packages, supporting undergraduates in lower-level courses.
- Our undergraduates voluntarily lead the UBC Math Circle, bringing roughly 40 talented students from Metro Vancouver for weekly faculty presentations and work on challenging Math problems.

## Our Instructors and Staff

Teaching around 19,000 undergraduate students a year requires the hard work not only of the approximately 100 instructors who teach around 210 undergraduate course sections but also of our efficient staff.

In 2015/16, several members of the Mathematics Department won awards related to teaching and educational leadership. Matthew Coles and Vanessa Radzimski have won Killam Prizes for outstanding work as Graduate Teaching Assistants. Mark Mac Lean was the recipient of the Canadian Mathematical Society’s Adrien Pouliot Prize for excellence in teaching and contributions to mathematics education in Canada, particularly Aboriginal education. The Mathematics Department also annually awards teaching prizes to outstanding postdoctoral fellows and graduate students; see <http://www.math.ubc.ca/Dept/Awards/index.shtml> for these awardees, as well as for past winners of prizes.

Managing the needs, queries, and paperwork from many hundreds of students and our instructors is no small matter.

Our front office manager and course registration and scheduling expert and first year advisor, Margaret Ness, and our undergraduate program coordinator, Theresa Lee, are invaluable, effective, and ever-patient in their support of students and instructors. ~ Mark Mac Lean ■



Mark Mac Lean



## Governor General's Silver Medalists (from Math) in Science, 2000–2014

<i>Year</i>	<i>Name</i>	<i>Program</i>
2016	Caroline Lemieux	Combined Honours Computer Science and Mathematics
2014	Ron Estrin	Combined Honours Computer Science and Mathematics
2014	Behrooz Ghorbani	Combined Economics and Mathematics
2013	Ruiyuan Chen	Combined Honours Computer Science and Mathematics
2012	Connor Meehan	Combined Honours Physics and Mathematics
2011	Dennis Huang	Combined Honours Physics and Mathematics
2007	Tyler Dodds	Combined Honours Physics and Mathematics
2006	Dustin Tseng	Combined Honours Computer Science and Mathematics
2004	Max Metlitski	Combined Honours Physics and Mathematics
2003	Pascal Tomecek	Combined Honours Mathematics and Statistics
2002	Zheng Zhang	Combined Honours Computer Science and Mathematics
2001	Joseph Wong	Combined Honours Computer Science and Mathematics
2000	Scott MacLachlan	Combined Honours Computer Science and Mathematics

## Performance of UBC Team & Students in Putnam Competition

<i>Year</i>	<i>Team Rank</i>	<i>Students in Top 450 and Rank</i>
2015	63	Jeffrey Dawson (435)
2014	50	Paul Liu (283)
2013	32	Farzad Fallahi (183), Ursula Anne Lim (202)
2012	8*	Ruiyuan Chen (43), Karlming Chen (63), Eric Naslund (137)
2011	9*	Ruiyuan Chen (43), Karlming Chen (109)
2010	6	Mohammad Bavarian (45), Yuqi Zhu (126)
2009	11	Cedric Lin (49), Karlming Chen (147), Joel Fox (197)
2008	19	Cedric Lin (13), Farzin Barekat (46), Stanley Xiao (115)
2007	15	Cedric Lin (45), Joel Fox (205)
2006	11	Cedric Lin (17.5)
2005	13	Nima Kamoosi (57), Dustin Tseng (90)
2004	13	Daniel Brox (42), Dustin Tseng (53), Balin Fleming (142)
2003	10	Daniel Brox (29), Eva Koo (106), Dustin Tseng (118)

\* First in Canada



May 2016 Math Graduation Reception



# Mathematics Awards for Undergraduates

**Daniel Buchanan Scholarship in Mathematics:** As a memorial to Daniel Buchanan, Dean of the Faculty of Arts and Science (1928-1948), and Head of the Department of Mathematics (1920-1948), and in recognition of his teaching and research in Mathematics, Alumni and friends (through the UBC Alumni Fund), together with members of the Department of Mathematics, have endowed a scholarship of \$750. It is offered to the student who gains the highest standing in the third year of an Honours Course in Mathematics and proceeds to the final year in that course.

**John Collison Memorial Scholarship in Mathematics:** Scholarships totalling \$5,000 have been endowed in memory of John Collison by the Madison Group. The awards are offered to students who are either in the Honours Mathematics Option in any engineering discipline or in the combined Honours Program in Mathematics and Physics. Preference is given to students who participate in UBC varsity sports and/or have a serious interest in aeronautics. Eligible candidates must have completed Mathematics 301 (Applied Analysis) or equivalent. The awards are made on the recommendation of the Department of Mathematics.

**Entrance Scholarship in Mathematics:** Through the generosity of a UBC Mathematics alumnus, scholarships totalling \$15,000 are offered to students with exceptional ability and interest in Mathematics who are entering UBC Vancouver directly from high school. The awards are made on the recommendation of the Department of Mathematics.

**Dr. R. D. James Medal in Mathematics:** A medal plus a cash prize of \$150 recognizes the meritorious service and distinguished achievements of Dr. R. D. James as Head of the Department of Mathematics from 1948 to 1973. It is awarded to the student in the graduating class whose record and promise in Mathematics are considered by the Department of Mathematics to be the most outstanding.

**Ralph D. James Prize:** A prize of \$315 has been endowed by friends and colleagues in memory of Professor R. D. James, Head of the Mathematics Department from 1948 to 1973. The award is made on the recommendation of the Head of the Department of Mathematics to the student with the highest mark in Mathematics 121.

**W. H. MacInnes Scholarship in Physics and Mathematics:** A scholarship of \$1,500, the gift of Mr. W. H. MacInnes of Vancouver, is offered to the student obtaining highest standing in the second year and proceeding to the combined honours course in Physics and Mathematics.

**James A. Moore Memorial Scholarship:** A \$15,000 Scholarship is offered by The James A. and Donna-Mae Moore Foundation to a Canadian student entering third year pursuing a Combined Honours Degree in Mathematics and either Physics, Chemistry or Biology. Mr. Moore was an alumnus of UBC, Double Honours Baccalaureate Degree in Mathematics and Chemistry 1932, Master of Arts, 1939. An enthusiastic teacher and pioneer of the B.C. Community College System, he

dedicated his career to helping students realize their academic potential. The award may be renewed for an additional year or until the first undergraduate degree is obtained, whichever is the shorter period. The award may then also be renewed for an additional year if the recipient enrolls in the Faculty of Education to specialize in Mathematics and Science education after receiving a Combined Honours Degree from the Faculty of Science. The recipient cannot receive the James A. Moore Memorial Scholarship and the James A. Moore Major Entrance Scholarship concurrently. The award will be made on the recommendation of the Faculty of Science.

**Reginald Palliser-Wilson Scholarship:** Scholarships totalling \$3,400 have been endowed through a bequest by Joy Gertrude Palmer Helder for students majoring or honouring in Mathematics. The awards are made on the recommendation of the Department of Mathematics.

**Ron Riddell and Roy Douglas Memorial Scholarship in Mathematics:** Two scholarships of \$250 each have been endowed by friends, family and the Math Club in memory of Ron Riddell and Roy Douglas. One award of \$250 is offered to an honours student entering fourth year. The other award of \$250 is offered to a majors student entering fourth year. The awards are made on the recommendation of the Department of Mathematics.

**Lawrence Roberts Putnam Prize:** In memory of Dr. Lawrence Roberts, Associate Professor in the Department of Mathematics. A \$250 prize is awarded to any student who places in the top 200 on the Putnam contest for the first time.

**Lawrence Roberts Mathematics Entrance Scholarship:** A \$1,500 scholarship has been endowed through a bequest by Frances Roberts in honour of her son Lawrence Roberts. The award is offered to a student entering the Mathematics program from a B.C. secondary school outside the Lower Mainland or Greater Victoria. The award is made on the recommendation of the Department of Mathematics in consultation with the Major Entrance Scholarship Committee and is non-renewable.

**Lorraine Schwartz Prize in Statistics and Probability:** In memory of Dr. Lorraine Schwartz, Assistant Professor in the Department of Mathematics, 1960-65, a \$300 prize has been endowed by her friends and colleagues. It is awarded for distinction in the fields of statistics and probability to an undergraduate or graduate on the recommendation of the Departments of Mathematics and Statistics.

**G. C. Webber Memorial Prize:** A \$650 prize has been endowed as a memorial to G. C. Webber, through a generous donation from his wife, Mrs. Eva Webber. The award is made on the recommendation of the Department, to an outstanding student in Honours Mathematics. ■

**Entrance Scholarships:** We have two entrance awards for excellent Mathematics students. These are for incoming students (from Secondary School). The Moore award is a major entrance scholarship. There are additional entrance scholarships (to total \$15000) which will be awarded based on strength in Mathematics such as measured through significant participation in our UBC Math Circle or through Math Contests. No application is required for these.

**In Progress Scholarships:** There are a number of scholarships the Math department hands out each year to students based on criteria stated in the award. The students must have eligibility (which includes 75% average and no failed courses). In general, no application is necessary and the department chooses the winners. In one case, the John Collison award, potentially eligible students are emailed to see if they have any additional

information which addresses criteria in the award. Another award, a so called 'affiliation award', is available to members of the Knights of Pythias. If the student is eligible, they should apply. Mathematics and Applied Science students have preference for this award. There is no distinction between B.A. and B.Sc. students if we are considering Mathematics students.

**Bursaries:** These are awards based on financial need. Students must submit an general application to demonstrate financial need for bursaries. There are formulas that UBC uses and an attempt is made by UBC to meet bursary needs. There is one Bursary fund (Sherwood) targeted to Mathematics students and also Land and Food Systems students.

## Report from BIRS



Nassif Ghossoub

Established in 2003, the Banff International Research Station (BIRS) is a North American research infrastructure that addresses the imperatives of collaborative research and cross-disciplinary synergy, by facilitating intense and prolonged interactions among mathematical scientists from around the world. BIRS' unique infrastructure provides a creative environment for the exchange of

ideas, knowledge and methods within the mathematical sciences and their vast array of applications in science and engineering.

BIRS represents a new level of scientific cooperation in North America bringing together for the very first time Natural Sciences and Engineering Research Council of Canada (NSERC), NSF, Alberta Innovation and Consejo Nacional de Ciencia y Tecnología (CONACYT). This partnership provides new and exciting opportunities for North American faculty

and students and gives them access to their international counterparts at the highest levels and across all mathematical disciplines. All this has contributed to making BIRS a truly international and a remarkably collaborative venture: the only one of its kind in North America.

The BIRS quest to continuously improve and augment its program delivery achieved five important milestones since the last site visit by the NSF, NSERC, CONACYT and Alberta Innovation in 2010.

- In 2011, BIRS relocated its meeting space to the TransCanada Pipeline Pavilion, an extremely functional and elegant building at The Banff Centre, which is now used exclusively for BIRS scientific and research activities.
- In 2012, BIRS made its programs accessible to the world's scientific community in virtual space, via live video streaming and recordings, produced by a state-of-the-art automated production system.
- In 2013, BIRS joined its sister institutes all over the world in support of the "Mathematics of Planet Earth" initiative by selecting 10 workshops that address directly this important topic.
- In 2014, the Government of Mexico awarded an infrastructure grant of 43-million pesos, for the construction of a BIRS-affiliated research facility in Oaxaca, Mexico, so that an additional 25-30 workshops could be hosted every year. Just like BIRS, the new facility, Casa Mathematica Oaxaca (CMO) is located in a place of high culture.
- Operations of CMO-BIRS workshops commenced in June 2015, running 21 5-day workshops that year. Response to the new facility has been overwhelmingly positive. CMO is currently operating out of a temporary facility, but looks forward to announcing the construction of a new, permanent facility in the very near future! ■



Recent Advances in Actuarial Mathematics, October 25-30, 2015  
At BIRS-affiliated research facility in Oaxaca, Mexico



# USRA



Richard Antsee

A quote from a student: In the summer USRA program, students 'solve cool mathematics problems'. We run a seminar with 30 minute talks given by students. The students continue to impress me with their excellent presentation skills, many of whom have not had much experience

before. I enjoy hearing them share their Mathematics in our casual coffee/tea/soda sessions at UPPERCASE in the student union. 2015 had 11 USRA students as well as a number of other students including international visitors (three from England, one from France and one from the Dominican Republic). 2016 had 12 USRA students and 2 UBC international awards.

We have managed the hike to Black Mountain/Eagle Bluffs both in 2015 (10 participants) and 2016 (11 participants) both times with perfect weather and spectacular views including the two ravens at Eagle Bluffs. In 2015 the views would have been gone 3 days later when the wildfire smoke hit Vancouver. Cabin



Student hike to Black Mountain/Eagle Bluffs

Lake was typically cold but all the students who went in made it out and dried out on the hike back down the mountain. A former USRA student was inspired to repeat the hike to Eagle Bluffs one summers evening to see the fireworks display in English Bay from a unique vantage point. ■

## Summer 2015 USRA Recipients

<i>Student Name</i>	<i>Year/Program</i>	<i>Supervisor</i>	<i>Research Project</i>
Allman, Maxwell	2nd / BSc	Bluman	Symmetry Methods for Differential Equations
Bach, Eviatar	3rd / BSc	Keshet	Extending the CHASTE simulation library, comparing vertex dynamics and cellular Potts model
Blackner, Reily	3rd / BAsC	Frigaard	Displacement of Shear Thinning Fluids
Falahi, Farzad	3rd / BSc	Anstee	Families of Forbidden Congurations
Lee, Darrick	4th / BAsC	Rolfsen	Left-Orderability, Branched Covers and Representations
Louie, Christopher	4th/ BSc	Cytrynbaum	Simulations of Min Proteins
Simpson, Reginald	4th / BSc	Gordon	The Congruence Class of X in Quotients of Polynomial Rings of Integers, and Linear Recursive Sequences
Small, Timothy	3rd / BSc	Keshet	Using Quasi Steady-State Approximation Methods to Analyze a Non-linear Biological Motor Transport System
Sung, Ki Woong	3rd / BSc	Coombs	Cluster Analysis of Super Resolution Fluorescence Images
Tom, Foster	3rd / BSc	Pramanik	Sets Avoiding Images of a Given Sequence

## Summer 2015 - Other Summer Research Students

<i>Student Name</i>	<i>Year/Program</i>	<i>Supervisor</i>	<i>Research Project</i>
Stiyer, Rachel	2nd / BSc	Coombs	Molecular-Scale Simulation of Calcium Ions within Cardiac Tissue

# Graduate Student Report

The graduate program in the UBC Mathematics Department continues to provide a highly sought-after opportunity for young researchers in mathematics.

The number of newly admitted students per academic year:

Year	MSc	PhD	Total New
2014/15	16	12	28
2015/16	8	15	24

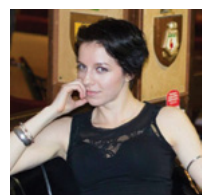
A warm congratulations goes out to the students that successfully completed their degrees:

Year	MSc	PhD	Total Grads
2014/15	8	15	23
2015/16	7	11	18

After two years serving as the Mathematics Graduate Committee (MGC) president, Maxime Bergeron stepped down to be succeeded by myself (Adela Gherga) and Ed Belk. As co-presidents of the MGC, our aim was to bring an increased sense of community to the graduate student body in the mathematics department. Our initiatives have included increased attention to the graduate student seminar, additional recruitment of graduate students to join the MGC, and the involvement of post-doctoral fellows in our various events and socials. Furthermore, our hope has been to extend graduate student socials to ones that are accessible to more students in the department. Such socials include weekday, end-of-term brunches in the mathematics building.

This year, the MGC focused on building the bi-weekly Graduate Student Seminar, encouraging both MSc. and PhD. students to present. Topics of the seminar ranged from accessible talks on Continued Fractions of Euler's Number (Ed Belk), all the way to Entropy in Information Theory (Thomas Hughes). We look forward to continuing to grow the graduate student seminar for the upcoming academic year, opening presentation opportunities to post-doctoral fellows in the department.

With a recently published study from Berkeley stating that over half of graduate students suffer from feelings of depression (\*Berkeley Graduate and Professionals Schools Mental Health Task Force), the MGC hopes to make strides in the upcoming academic year towards mental health and wellness. Initiatives will include beach days, health hikes, group yoga, paint nights, and other such activities that have been shown to improve mental health.



Adela Gherga

To become involved in the MGC or for any questions, please feel free to contact us at [mgc@math.ubc.ca](mailto:mgc@math.ubc.ca). ■

\*Berkeley Graduate and Professional Schools Mental Health Task Force, Student Mental Health Committee: Final Report. (Berkeley: N.p., 2005. Web. 27 July 2016).



Grad students studying fluid dynamics

## Graduate Student Fellowships

**NSERC Doctoral Awards:** Aaron Berk, Mallory Flynn, Thomas Hughes, and Frederic Paquin-Lefebvre.

**NSERC MSc Awards:** Julian Fortin, and Kristina Nelson.

**Four Year Fellowships:** Malcolm Bowles, Ahmet Alperen Bulut, Brian Chan, Hon To Hardy Chan, Curt DaSilva, Juan Fiallo, Adela Gherga, Daniel Gomez, Alistair Jamieson-Lane, Brett Kolesnik, Yu-Hsiang Liu, Alessandro Marinelli, Myrto Mavraki, Kateryna Melnykova, Frederic Paquin-Lefebvre, Mingfeng Qiu, Reza Sadoughianz, Pamela Sargent, Chen Wang, Ching Wong, Ka Wah (Tony) Wong, and Zichun Ye.

**Two Year Fellowships:** Xinyu Cheng, and Colin Gavin.

## Graduate Student Awards

**2014/15:** Congratulations to **Myrto Mavraki** on receiving the Master's Governor General's Gold Medal. This annual award is given to the Master's graduate student who achieved the most outstanding academic record in their graduating year.

A final congratulations goes out to **Cindy Blois** in winning the 2014/15 Killam Graduate Teaching Assistant Award. Well done, Cindy.

**2015/16:** A number of mathematics graduate students were the recipients of major awards in 2015-2016. Among them include **Tom Hutchcroft** and **Stilianos Louca** for the 2015 Graduate Research Awards. Current Ph.D. student **Matthew Coles** and M.Sc. alumni **Vanessa Radzimski** were winners of the 2015/2016 Killam Graduate Teaching Assistant Award. This marks the fourth year in a row that a graduate student in the mathematics department has won the award, but the first time in 20 years that two graduate students in math have won the award. Finally, we would like to congratulate **Tom Hutchcroft** on the momentous achievement of being named one of twelve 2016 Microsoft Research Ph.D. Fellows!

# New Alumni

## MSc Graduates

<i>Graduate</i>	<i>Thesis / Interest</i>	<i>Supervisor</i>	<i>Life After UBC</i>
Brassil, Matthew	An extension to the Hermite-Joubert problem	Reichstein	Continued to PhD Math, UBC
David, Jummy Funke	Mathematical epidemiology of HIV/AIDS and tuberculosis co-infection	Brauer	Continued to PhD Math, UBC
Flynn, Mallory	Diameter of the Infinite Variance Dynamic Configuration Model	Barlow	Continued to PhD Math, UBC
Frei, Spencer	A lower bound for $p_c$ in range-R bond percolation via SIR epidemic methods	Perkins	Continued to PhD Statistics, UCLA
Jana, Subhajit	Sup-norm problem of certain eigenfunctions on arithmetic hyperbolic manifolds	Silberman	Continued to PhD, ETH Zurich
Mather, Kevin	Regularity of Minimal Surfaces: A Self-contained Proof	Fraser/Kim	Unknown
Nevin, Joshua	A survey of results toward the class number problem for real quadratic fields	Ramdorai	Continued to PhD, Toronto
Tung, Shen-Ning	Fontaine's rings and p-adic L-functions	Ramdorai/Vatsal	Continued to PhD, Essen, Germany
Wei, Siqi	Cohomology of Groups and Brauer Groups	Ramadorai	Lecturer, Langara College

## PhD Graduates

<i>Graduate</i>	<i>Thesis / Interest</i>	<i>Supervisor</i>	<i>Life After UBC</i>
Bai, Fan	Vaccination models in infectious diseases	Brauer	NSF PDF, Texas Tech University
Blois, Cindy	Functional integral representations for quantum many-particle systems	Feldman	Lecturer, USC
Bruni, Carmen	Twisted Extensions of Fermat's Last Theorem	Bennett	Lecturer, Centre for Education in Mathematics and Computing, Waterloo
Chandgotia, Nishant	Markov Random Fields, Gibbs States and Entropy Minimality	Marcus	Postdoc, Tel Aviv University
Garcia Armas, Mario	Group Actions on Curves over Arbitrary Fields	Reichstein	Unknown
Garcia Ramos Aguilar, Felipe	Randomness and Structure in Dynamical Systems: Different Forms of Sensitivity and Equicontinuity	Marcus	IMPA Postdoc of Excellence, Universidade de São Paulo
Gou, Jia	Oscillatory dynamics for PDE models coupling bulk diffusion and dynamically active compartments: theory, numerics and applications	Li/Ward/Nagata	Postdoc, University of Minnesota
Hambrook, Kyle	Restriction theorems and Salem sets	Laba	NSERC Postdoc and Visiting Asst. Professor, University of Rochester
Kroc, Edward	Keakeya-type Sets, Lacunarity, and Directional Maximal Operators in Euclidean Space	Pramanik	Independent statistical consultant; Instructor, UBC Statistics Department
Lim, Tongseok	On the structure of optimal martingale transport in higher dimensions	Ghoussoub/Kim	Postdoc, Oxford
Lindstrom, Michael	Investigation into the feasibility and operation of a magnetized target fusion reactor: insights into mathematical modelling	Wetton	Postdoc, UCLA
Moyles, Iain	Hybrid asymptotic-numerical analysis of pattern formation problems	Wetton	Research Associate, University of Limerick, Ireland



<i>Graduate</i>	<i>Thesis / Interest</i>	<i>Supervisor</i>	<i>Life After UBC</i>
Stykwow, Maxim	Representation rings of semidirect products of tori by finite groups	Adem	Unknown
Tewari, Vasu	Operators on compositions and noncommutative Schur functions	van Willigenburg	Acting Asst. Professor, University of Washington
Thompson, William	Parametrization and multiple time scale problems with non-Gaussian statistics related to climate dynamics	Kuske	Position at NMI Gaming, Vancouver
Tomberg, Alexandre	Renormalisation group and critical correlation functions in dimension four	Slade	Data Scientist, Knowtions Research
Wong, Thomas	Enumeration problems in directed walk models	Rechnitzer	Postdoc, Dept. of Computer Science, University of Paris13
Yang, Wen	Some new results on the SU(3) Toda system and Lin-Ni problem	Wei	Postdoc, Center for Mathematical Sciences, National Taiwan University

## Postdoctoral Fellows

<i>Name</i>	<i>Supervisor</i>	<i>Years at UBC</i>	<i>Where To</i>
Ao, Weiwei	Wei	2	Associate Professor, Wuhan University
Barry, Anna	Kuske	2	Lecturer, University of Auckland
Bihlo, Alexander	Bluman	1	Assistant Professor, Memorial University of Newfoundland
Carchedi, David	Behrend/Bryan/Cautis	1	Assistant Professor, George Mason University, VA
Cheng, Man Chuen	Topology	3	Lecturer, Chinese University of Hong Kong
Devyver, Baptiste	Ghoussoub	1	Assistant Professor, Technion-Israel Institute of Technology
Dontsov, Egor	Peirce	2	Assistant Professor, University of Houston
Ganapathy, Radhika	Gordon/Silberman	2	Reader, School of Mathematics, Tata Institute of Fundamental Research, India
Hewitt, Duncan	PIMS	1	Research Fellow, University of Cambridge
Lee, Chia	Kuske	2	Statistical Researcher, AIR Worldwide, Boston
Levit, Anna	Probability	4	Fundamental Researcher, 1QBit, Vancouver
Maciejewski, Wes	CWSEI	2.5	Lecturer, University of Auckland, New Zealand
Peskin, Laura	Ollivier/Ramdorai/Vatsal	2	Postdoctoral Fellow, The Weizmann Institute of Science, Israel
Pinsky, Tali	Rolfesen/Souto	3	Postdoctoral Fellow, Tata Institute of Fundamental Research, India
Roe, David	Gordon	1	Postdoctoral Fellow, University of Pittsburg, PA
Wardil, Lucas	Huert	5	Postdoctoral Fellow, Universidade Federal de Ouro Preto, Brazil
Williams, Ben	Behrend	1	Assistant Professor, University of British Columbia
Yoon, Sungho	Frigaard	2	Unknown

# Outreach Activities

UBC Department of Mathematics and the Pacific Institute for the Mathematical Sciences are dedicated to increasing public awareness of the importance of mathematics in the world around us. We want young people to see that mathematics is a subject that opens doors to more than just careers in science. Many different and exciting fields in industry are eager to recruit people that are well-prepared in this subject.

The Mathematics Department at the University of British Columbia together with the Pacific Institute for the Mathematical Sciences (PIMS) organize multiple outreach events and activities each year (workshops, contests, summer camps, public lectures, etc.) to enhance mathematical opportunities throughout British Columbia. As mathematical scientists we are very much aware of the challenges faced by teachers and students in the dissemination and acquisition of mathematical knowledge. Our institutions are always happy to play a constructive role in finding ways to enhance opportunities for learners and educators as it is our view that mathematical scientists should play a key role in this process. We are also keen on working in partnership with organizations and individuals that share similar views.

## ***This year's activities:***

**UBC Math Workshops:** These workshops in Lower Mainland schools aim to excite Grade 6-12 students about mathematics by exposing them to interesting and challenging problems and interesting math people. In the case of Grade 12 students, careers and university programs in the mathematical sciences are also discussed. The workshops are conducted by faculty and student volunteers from the UBC Mathematics Department, and are coordinated by Melania Alvarez the UBC Dept. of Mathematics Outreach Coordinator. Over 97 workshops were conducted during the 2015/2016 academic year.

**Teacher's summer camp:** Last summer, during the month of July, we ran our first 4-week summer camp, 20 teachers attended this program. There were three-teacher teams from six schools, and two teachers who teach remedial students in elementary and secondary schools. It was important to have three-teacher teams per school so that teachers could further support each other as harbingers of positive change regarding the mathematical environment at their schools. We recruited the teachers by sending messages to the school principals around the lower mainland and we received 87 applications. We chose the teachers according to their school needs and their personal statement with their reasons to

wanting to attend this camp. The original plan included only 15 teachers per camp, we added 5 more. Three of those teachers teach at the Aboriginal focus school and we were able to cover their expense through Aboriginal dedicated grants.

The teachers came from the following schools:

- Sunnyside Elementary in Surrey
- Lord Kitchener Elementary in Vancouver
- Marlborough Elementary in Burnaby
- Aboriginal Focus School Macdonald Elementary in Vancouver
- Kitchener Elementary in Burnaby
- École Cedardale in West Vancouver
- Pathways to Education Community. This is not a school but a program to help increase the high school graduation rate.

The training touched on the following:

- How to go from the concrete, to pictorial to abstract.
- How to expose mathematics in the simplest and clearest way
- How to choose, and build word problems to teach a variety of mathematical ideas.
- How to use a variety of algorithms and heuristics for problem solving.

Throughout the academic year we scheduled a variety of activities with the participating schools.

This summer, from July 4 to 29, we will be delivering another Teacher's Summer Camp. Already 20 teachers have been recruited from over 80 applicants. Melania Alvarez (UBC Math/PIMS) and Cameron Moorland (SFU Math) are the camp instructors.

**School partnerships and mentorship program:** During the last eight years, we have developed a partnership with Britannia Secondary, Windermere Secondary, Templeton Secondary, VanTech Secondary, Kitsilano Secondary, Point Grey Secondary, Kitisilano Secondary, Killarney Secondary, Tupper Secondary and MacDonald Elementary in Vancouver, which have a large number of Aboriginal students and at risk students.

We have coordinated mentorship programs at Britannia Secondary, Templeton Secondary, Windermere Secondary, Point Grey Secondary, Kitsilano Secondary, Tupper Secondary, John Oliver Secondary, and MacDonald Elementary. during the 2015/2016 academic year more than 20 UBC undergraduate students went to Kitisilano Secondary, Windermere Secondary, MacDonald Elementary, and





Math Mania at Britannia Elementary

Britannia Secondary to support the mathematical learning of students at these schools. This program is coordinated by Melania Alvarez the UBC Dept. of Mathematics Outreach Coordinator.

**Math Mania during Experience Science Day:** Between 150 and 200 elementary school students from the Vancouver Downtown East Side attend experience Science day at UBC. Students participate in hands-on activities in a variety of science topics, including mathematics. As part of this event, the Mathematics Department together with PIMS offers Math Mania, where we present a variety of interactive mathematics demonstrations, puzzles, and games designed to demonstrate to children fun ways of learning mathematics. This event takes place twice a year at the UBC campus. This Math Mania event is coordinated by Melania Alvarez.

**Math Summer Camp for Indigenous Students:** Shawn Desaulnier together with Kseniya Garaschuk piloted a CMS/PIMS Math Camp, July 20-24, 2015. Students spend the morning exploring different branches of mathematics with members of our department: Richard Anstee, Fok Leung, and Patrick Walls. As well as Michael P. Lamoureux (from PIMS) and Mallory Flynn. Shawn Desaulnier and Kseniya Garaschuk also did some tutoring with Dogwood 25 and helped support Aboriginal students on campus.

**Math Spring Break Camp:** We were asked to offer a one week math camp at Windemere Secondary for students who had recently migrated to Canada and were having problems with their math. Twelve students attended this camp from March 14 -18, 2016. We did three hours of mathematical enrichment and instruction every morning and in the afternoon the students played a variety of sports. Students were provided with lunch and snacks. This was a joint partnership between the Vancouver Schools Board, the UBC Dept. of Mathematics and the Pacific Institute for the Mathematical Sciences. Melania Alvarez (UBC Math/PIMS) was the camp math instructor and Eileen Zhen (VSB) the camp coordinator.

In addition to problem solving sessions we are also invited to schools around the Lower Mainland for math enrichment sessions for students and professional development for teachers. We are always glad to show teachers, students and the public in general the wonders of mathematics. ■



Melania Alvarez

*Melania Alvarez*  
PIMS BC Education Coordinator

## PIMS-UBC Distinguished Colloquium, 2016-17

### Confirmed Speakers:

1. **Vladimir Sverak** (University of Minnesota)  
Field: PDE, fluid dynamics, calculus of variations.  
Date: September 23, 2016
2. **Laure Saint-Raymond** (ENS)  
Field: PDE, Statistics Mechanics  
Date: October 7, 2016
3. **Yakov Sinai** (Princeton University)  
Field: PDE, Statistics Mechanics  
Date: November 4, 2016
4. **Ken Ono** (Emory University)  
Field: Number Theory  
Date: November 21, 2016
5. **Fan Chung Graham** (UC San Diego)  
Field: Combinatorics  
Date: March 3, 2017
6. **Michel Brion** (University of Grenoble)  
Field: Algebraic and symplectic geometry  
Date: March 10, 2017
7. **Cedric Villani** (Henri Poincare Center)  
Field: Kinetic Theory, PDE  
Date: May 5, 2017
8. **Barry Simon** (California Institute of Technology)  
Field: Mathematical physics and analysis  
Date: May 23, 2017



# UBC-PIMS Distinguished Postdoctoral Fellowship

## 2015



**Ben Krause** received his Ph.D. in mathematics in 2015 from UCLA, under the supervision of Terence Tao. He received the 2015 Pacific Journal of Mathematics Dissertation Award, and was a UBC/PIMS distinguished postdoctoral fellow during the 2015-2016 academic year. He has recently been awarded a prestigious NSF postdoctoral fellowship, which supports his current term at UBC. He has already co-authored more than 15 papers which have appeared in prestigious, peer-reviewed journals. His current research interests encompass a variety of areas in analysis and ergodic theory, notably maximal and variational inequalities involving Carleson-type theorems and their fractal analogues. ■

## 2016



**Nguyen Lam** received his Ph.D. in Analysis and PDEs in 2014 under the supervision of Guozhen Lu at Wayne State University. He was a Postdoctoral Associate at University of Pittsburgh from 2014 to 2016, before joining the UBC Mathematics Department in 2016 as a UBC-PIMS Distinguished Postdoctoral Fellow. He is interested in geometric and functional inequalities and their applications in pdes, on both Riemannian and subRiemannian manifolds. He, his wife and his daughter are enjoying exploring beautiful Vancouver. ■

## News from Mitacs



As many of you know, I was appointed Scientific Director and CEO of Mitacs on February 1, 2015. It has been an interesting challenge to lead such a large and diverse organization, but fortunately we have excellent staff. Let me explain the current structure of Mitacs and the current and potential interactions that I see developing with the UBC Mathematics Department.

Mitacs is a national, not-for-profit organization with 25 offices across the country that has designed and delivered research and training programs in Canada for over 15 years. Working with 60 universities, thousands of companies, and both federal and provincial governments, Mitacs builds partnerships that support industrial and social innovation in Canada. Two of its main programs are a research internship program (**\*Accelerate\***) designed to increase deployment of highly educated graduates into the private sector, and an international student mobility program (**\*Globalink\***) which brings talented foreign students for research stays in Canada and also sends Canadian students abroad. Partner countries include France, Germany, Australia, China, India, Brazil, Mexico and Japan. Last year we funded over 3,000 internships and brought 750 **\*Globalink\*** students to Canada.

Mitacs can offer useful opportunities for mathematics graduate students. For example, the **\*Accelerate\*** internships provide a setting for experience in industry for both masters and PhD students while still working on research problems. Mitacs provides funding for the student and some support for the advisor. One of my students took this opportunity and is now gainfully and happily employed in the gaming industry (yes, he studied algebraic topology, which apparently was a big plus!). Recently I signed an MOU (Memorandum of

Understanding) with PIMS to streamline the adjudication of these internships for mathematics graduate students across all PIMS universities, in particular UBC. Similarly, **\*Globalink\*** can provide support to recruit a talented international undergraduate student to work with a faculty member for several weeks during the summer, on any kind of research. More information about these programs is available on the Mitacs website <http://www.mitacs.ca>.

Of course I am still very much involved with our department and currently have a good number of graduate students and postdocs. Whenever I meet people in government or industry I always remind them that I am a mathematician from UBC. Indeed my goal is to make clear why Mitacs (now just an acronym) is written with a capital M!

Please don't hesitate to contact me if you'd like to learn more about Mitacs and its programs. ~ Alejandro Adem ■

## Kevin Henriot



We are deeply saddened by the passing of **Kevin Henriot** who passed away in June 2016. Kevin grew up in France and obtained his Ph.D. in 2014 from the University of Montreal, in codirection with Universite Paris 7. He was a postdoctoral researcher at UBC during the term 2014-2016.

Kevin was an outstanding young mathematician with considerable achievements in several areas including number theory, harmonic analysis and geometric measure theory. His untimely loss will be felt by the mathematical community within UBC and beyond. ■

# Faculty Awards and Honours

**Alejandro Adem** and **Dong Li** have been announced as this year's winners of the Canadian Mathematical Society's major research prizes, the Jeffery-Williams Prize (for a senior researcher) and the Coxeter-James prize (for a junior researcher), respectively. The press releases are:

1. <https://cms.math.ca/MediaReleases/2015/jw-award>
2. <https://cms.math.ca/MediaReleases/2015/cj-award>

**Omer Angel** has been awarded the Rollo Davidson Prize from the Statistical Laboratory at the University of Cambridge.

The full citation is available at: <http://www.statslab.cam.ac.uk/Rollo/>

**Colin Clark** has been named 2016 Fellow of the International Institute of Fisheries Economics & Trade (IIFET). See IIFET Latest News and Press Release (PDF).

**Leah Edelstein-Keshet** is the winner of the CAIMS Research Prize for 2016.

“CAIMS is pleased to announce that the recipient of the CAIMS Research Prize for 2016 is Professor Leah Edelstein-Keshet, University of British Columbia.

Professor Leah Edelstein-Keshet is a world leader in the application of mathematical methods and analyses to biological problems. She has written highly original and impactful papers on the characterization of collective spatial organization of biological organisms and of cytoskeletal dynamics and cell motility. One key feature of her work is the development of novel mathematical models and sophisticated mathematical and computational analyses of biological phenomena on all scales, ranging from molecular to cellular to populations. Her modeling and analysis makes insightful predictions, and she collaborates with experimentalists to test these predictions in order to refine the models. She has been one of the globally recognized pioneers of this highly interdisciplinary and relevant approach to the modeling and study of biological processes. She has also developed novel mathematical models for important human diseases such as diabetes, Alzheimers disease, and cancer.”

**Leah Edelstein-Keshet** In February the Officers and Elected Directors of the Society for Mathematical Biology unanimously approved the Leah Edelstein-Keshet Prize to recognize the exceptional scientific contributions made by a woman in mathematical biology.

In the announcement online at <http://www.smb.org/publications/SMBnet/digest/v16/v16i08.html>, SMB President Schnell outlines UBC Mathematics Professor Edelstein-Keshet's outstanding scientific contributions and service.

**Nuno Freitas** was the recipient of the 2016 Jose Luis Rubio de Francia Prize for young researchers. See <http://www.fbbva.es/TLFU/tlfu/ing/noticias/fichanoticia/index.jsp?codigo=1732> for more detail.

**Nassif Ghoussoub** was named an officer of the Order of Canada for his scientific contributions to the study of differential equations and for advancing mathematics research and education in Canada.

**Nassif Ghoussoub** received an honorary degree from the University of Victoria.

See <http://www.mathtube.org/lecture/video/nassif-ghoussoub-receives-honorary-degree-university-victoria/> for more detail.

**Julia Gordon** and **Rachel Kuske** have been awarded NSERC Discovery Accelerator Supplements.

- **Julia Gordon**, for “Uniform estimates and asymptotics for p-adic orbital integrals and characters”
- **Rachel Kuske**, for “Stochastic nonlinear dynamics in the environment and biology”

**Colin Macdonald** and **Anthony Wachs** have been awarded NSERC Discovery Accelerator Supplements.

- **Colin Macdonald**, for “Numerical Computing on Evolving Domains”
- **Anthony Wachs**, for “Multi-scale modelling of reactive particulate flows”

More information about the program is available at: [http://www.nserc-crsng.gc.ca/Professors-Professeurs/Grants-Subs/DGAS-SGSA\\_eng.asp](http://www.nserc-crsng.gc.ca/Professors-Professeurs/Grants-Subs/DGAS-SGSA_eng.asp)

**Rachel Ollivier** has won the 2015 UBC Mathematics and Pacific Institute for Mathematical Sciences (PIMS) Faculty Award. The winner is invited to give a prestigious invited lecture. For further information: <https://www.pims.math.ca/scientific-event/160930-upmsfalro>

The UBC Math/PIMS Faculty Award is new this year; the plan is to award it annually. It was created by two founding donors, Anton Kuipers and Darrell Duffie, to recognize UBC researchers for their leading edge work in mathematics or its applications in the sciences.

**Malabika Pramanik** was the recipient of the 2016 CMS Krieger-Nelson prize for her outstanding research contributions. Details of Malabika's contributions are presented with the media release, at <http://cms.math.ca/MediaReleases/2016/kn-award.html>

As a winner, Malabika joins an impressive list of Canadian mathematical leaders, including our own Ailana Fraser, Rachel Kuske, Izabella Laba, Leah Keshet, and Cindy Greenwood. <https://cms.math.ca/Prizes/info/kn.html>

# Staff News



Verni Brown

In May of 2015, we said goodbye to our long-term Undergraduate Secretary **Verni Brown** when she retired from UBC. Verni joined us in July of 2002 and performed all her duties to a very high standard and always with diplomacy and patience. Her attention to detail was greatly valued by the department and her willingness to help train her replacement much appreciated.

Verni was and still is a very active walker on her free time with the Volkssport group in Vancouver and is happy to have more time to dedicate to these outings. In addition she has been doing some travelling with family and friends now she has the time to do so. We thank you Verni for all your hard work and dedication over the years. We miss you!

**Lee Yupitun** - As the Graduate Program Coordinator from 2002 – 2015, it was time for Lee to venture out of the Faculty of Science and into the Faculty of Applied Science. Lee is currently working in Environmental Engineering as the Administrator for the program. If you're ever walking down Main Mall and want to visit her, Lee's office is in the Kaiser Building.

**Jessica Trat** - After working in Math for 8 years, Jessica found an opportunity for growth and joined the Department of Botany as a Financial Processing Clerk. Her opportunity to grow has continued as Jessica was recently appointed as the Manager,



Mary Margaret Daisley

Staff Human Resources and Facilities in Botany.

**Mary Margaret Daisley** recently retired from the UBC Math Department, serving from September 1, 1971 to August 31, 2016 -- exactly 45 years. She served as Head's Secretary to many Heads over the years. She trained them, kept them on task,

and guided, with a steady hand, the transition from one Head to the next, always keeping the department running smoothly. At the latest Department Dinner, Philip Loewen read testimonials from a dozen faculty and staff members, praising M-M for giving us so much valuable advice and friendly encouragement.

From rescuing us with the rubber chicken when we locked ourselves out of our offices to always keeping track of important documents in her "random access filing system" to offering much-needed help to newcomers faced with the university and Canadian bureaucracy, M-M was always there when we needed her.

We all know that M-M is an avid dog lover. So, our only consolation from her departure is knowing that our loss will be the gain of our canine friends.

M-M, we will miss you lots!! We hope that you will remember us with us much fondness as we will remember you.



Faces of 2015-16 department dinners left to right: Andrew Rechnitzer, Rajiv Gupta, Richard Anstee, Afton Cayford, Philip Loewen, Shirin Boroushaki, Daniel Sheinbaum, Alma Hernandez-Torres, Martin Barlow, and Alejandro Adem

## Bad Math Joke

**Patient:** Doctor, my local Lipschitz condition is really bothering me. What do you suggest?

**Doctor:** I recommend a Dehn surgery.

[https://www.encyclopediaofmath.org/index.php/Lipschitz\\_condition](https://www.encyclopediaofmath.org/index.php/Lipschitz_condition)

[https://en.wikipedia.org/wiki/Dehn\\_surgery](https://en.wikipedia.org/wiki/Dehn_surgery)

### Please Tell Us

Please tell us some news about yourself, comments on this UBC Mathematics Newsletter, and/or any articles you would like to see in the future.

E-mail to: [newsletter@math.ubc.ca](mailto:newsletter@math.ubc.ca)