CHASE ANNUAL REPORT

Department of Mathematics and Statistics

Faculty of Science

2021 EDITION

DALHOUSIE UNIVERSITY

dal.ca/mathstat

Congratulations & Welcome to Our Alumni Family

Congratulations to all our graduates from the fall of 2020 and spring of 2021! We look forward to hearing from you. Please feel welcome to either drop us a line when you have a chance or stop in to say hello next time you are on campus.

GRADUATES & NEWEST ALUMNI

We are pleased to present the names of each person who convocated this academic year, a total of 117 people! Graduates, who are now members of our alumni family, are listed by fall 2020 and spring 2021. Each list is sorted by surname.

FALL 2020

First Name	Surname(s)	Program
Nick	Barreyre	Bachelor of Science Honours in Computer Science and Mathematics
Rui	Chen	Bachelor of Science Major in Statistics
Rongfeng	Cui	Bachelor of Science Honours in Computer Science and Statistics
Duncan	Duan	Bachelor of Science Major in Computer Science and Statistics
Molly	Hayes	Master of Science, Statistics
Wenqi	Jiang	Bachelor of Science Major in Economics and Statistics
Nicholas	Layden	Master of Science, Mathematics
Ang	Li	Bachelor of Arts Major in Mathematics and Economics
Justin	Makary	Master of Science, Mathematics
Azusa	Nakayama	Bachelor of Science Major in Mathematics
Jeremy	Peters	Master of Science, Mathematics
Lin	Wang	Bachelor of Science Major in Statistics
Xiaoxu	Wang	Bachelor of Science Major in Statistics and Economics
Zhengyuan	Wang	Bachelor of Science Major in Actuarial Science and Mathematics
Hao	Yu	Bachelor of Science Major in Statistics
Yang	Zhao	Bachelor of Science Major in Statistics and Economics

SPRING 2021

First Name	Surname(s)	Program
Kirk	Adams	Bachelor of Science Major in Mathematics and Chemistry
Ran	An	Bachelor of Science Major in Economics and Statistics
Eniola	Bakare	Bachelor of Science Major in Statistics
Caroline	Barton	Bachelor of Science Honours in Mathematics and Physics
Owen	Bennett-Gibbs	Bachelor of Science Honours in Mathematics and Physics
Kieran	Bhaskara	Bachelor of Science Honours in Mathematics
Jonathan	Bradet-Legris	Master of Science, Statistics
Rachel	Burke	Bachelor of Science Major in Mathematics and Chemistry
Han	Cao	Bachelor of Science Major in Statistics and Actuarial Science
Yifan	Chen	Bachelor of Science in Statistics
Yuhao	Chen	Bachelor of Science Major in Economics and Statistics

First Name	Surname(s)	Program
Eunice	Cho	Bachelor of Science Major in Actuarial Science
Miles	Cross-Whiter	Bachelor of Science Major in Statistics
Louise	Cullen	Bachelor of Science Honours in Mathematics
Qianwei	Dong	Bachelor of Science Major in Economics and Statistics
Robert	Earle	Bachelor of Science Honours Co-operative in Computer Science and Statistics
Felix	Fei	Bachelor of Science in Mathematics
Xuran	Feng	Bachelor of Science Honours Co-operative in Statistics and Actuarial Science
Stephen	Fitzgerald	Bachelor of Science Major in Statistics
Mackenzie	Frolic-Smart	Bachelor of Arts Honours in Sociology and Statistics
Ren	Gao	Bachelor of Science Major in Mathematics
Yue	Gao	Bachelor of Science Major in Statistics and Economics
Ian	George	Bachelor of Science Honours in Mathematics and Physics
Michelle	Guo	Bachelor of Science Major in Actuarial Science and Statistics
Yingwei	Guo	Bachelor of Science Major in Statistics
Zhengting	Guo	Bachelor of Science Honours in Actuarial Science
Yinxia	Hong	Bachelor of Science Major in Statistics
Di	Huang	Bachelor of Science Major in Economics and Statistics
Yulin	Huang	Bachelor of Science Major in Psychology and Statistics
Wanru	Jia	Master of Science, Statistics
Ling	Jiang	Bachelor of Science Major in Economics and Statistics
Yi	Jiang	Bachelor of Science Major in Economics and Statistics
Matthew	Keefe	Bachelor of Science Major in Actuarial Science
Victor	Lamoureux	Bachelor of Science Major in Mathematics and Philosophy
Brenda	Le	Bachelor of Science Major Co-operative in Mathematics
Chen Ning	Li	Bachelor of Science Major in Mathematics
Jingyu	Li	Bachelor of Science Honours in Statistics and Mathematics
Sarah	Li	Bachelor of Science Honours in Mathematics and Computer Science
Yatong	Li	Bachelor of Science Major in Statistics and Economics
Zhuang	Li	Bachelor of Science Major in Statistics
Haomu	Liu	Bachelor of Science Honours Co-operative in Statistics and Actuarial Science
Hong Liang	Liu	Bachelor of Science Major in Actuarial Science
Rongqin	Liu	Bachelor of Science Honours in Statistics
Aadil	Lodi	Bachelor of Science Major in Actuarial Science and Computer Science
Jingjing	Lu	Bachelor of Science Major in Statistics
Boren	Luan	Bachelor of Science Major in Statistics and Economics
Christine	Lunney	Bachelor of Science Major in Actuarial Science
Jiaxin	Luo	Master of Science, Statistics
Jiajun	Ma	Bachelor of Science Honours in Statistics and Economics
Carmen	Malinoski	Bachelor of Science Major in Economics and Mathematics
Etai	Markowski	Master of Science, Statistics

First Name	Surname(s)	Program
Vaughn	Menchions	Bachelor of Science Honours in Mathematics
Yinjie	Meng	Bachelor of Science Honours in Statistics and Economics
Aeriana	Narbonne	Bachelor of Science Major in Mathematics
Kemi	Olarotimi	Bachelor of Science Major in Neuroscience and Mathematics
Sean	O'Neil	Master of Science, Mathematics
Joel	Pace	Bachelor of Science in Mathematics
Hongdan	Pang	Bachelor of Science Major in Economics and Mathematics
Mia	Parenteau	Master of Science, Statistics
Anubhav	Pattanaik	Bachelor of Science Major in Actuarial Science
Olivia	Riesgo	Bachelor of Science Major in Statistics and International Development Studies
Zhourui	Shi	Bachelor of Science Major in Statistics
Richard	Sinal	Bachelor of Science Major in Actuarial Science
Jane	Sobey	Bachelor of Science Major in Mathematics
Kaiyuan	Song	Bachelor of Science Major in Mathematics and Statistics
Craig	Spence	Bachelor of Science Major in Statistics
Holly	Steeves	Doctor of Philosophy, Statistics
Haoran	Sun	Bachelor of Science Honours in Statistics and Economics
Ganrong	Tan	Bachelor of Science Honours in Computer Science and Statistics
Audrey	Turcotte	Bachelor of Science Major in Mathematics and Law, Justice & Society
Bruce	Wan	Bachelor of Science Major in Statistics
Chuhan	Wang	Bachelor of Science Major in Statistics and Economics
Jiachen	Wang	Bachelor of Science Honours in Statistics and Economics
Kyle	Wang	Bachelor of Science Honours in Mathematics and Statistics
Mengyao	Wang	Master of Science, Statistics
Rachel	Wang	Bachelor of Science in Mathematics
RuiDa	Wang	Bachelor of Science Major in Computer Science and Statistics
Wenke	Wang	Bachelor of Science Major in Economics and Statistics
Xiangyu	Wang	Bachelor of Science Major in Statistics
Yuexu	Wang	Bachelor of Science Honours in Statistics
Yurunyun	Wang	Bachelor of Science Honours in Statistics and Computer Science
Zhuoyuan	Wang	Bachelor of Science Major in Statistics
Ziwei	Wang	Bachelor of Science Honours in Statistics and Mathematics
Zixin	Wang	Bachelor of Science Major in Economics and Statistics
Guangzhong	Wei	Bachelor of Science Major in Economics and Statistics
Kim	Whoriskey	Doctor of Philosophy, Statistics
Zonglin	Wu	Bachelor of Science Honours in Statistics and Mathematics
Lucy	Yang	Bachelor of Science in Statistics
Yunming	Yang	Bachelor of Science Major in Statistics and Economics
Lingyu	Ye	Bachelor of Science Major Co-operative in Computer Science and Statistics
Xixi	Yi	Bachelor of Science Honours in Mathematics and Statistics
Tianyi	Zang	Bachelor of Science Major in Computer Science and Statistics
Ling	Zhang	Bachelor of Science Major in Actuarial Science and Statistics

First Name	Surname(s)	Program
Ruixuan	Zhang	Bachelor of Science Major in Ocean Sciences and Statistics
Wenyan	Zhang	Bachelor of Science Major in Statistics and Economics
Ziqi	Zhang	Bachelor of Science Honours in Statistics
Julie Ann	Zhao	Bachelor of Science Major Co-operative in Statistics
Yizhou	Zheng	Bachelor of Science Major in Statistics
Haiyang	Zhou	Bachelor of Science Honours in Actuarial Science
Jinglin	Zhou	Bachelor of Science Major in Statistics
Kaiyan	Zhu	Bachelor of Science Major in Statistics

DR. JULIEN ROSS' CONVOCATION ADDRESS

Hello everyone, my name is Julien Ross and I am speaking to you here in the name of the Department of Mathematics and Statistics at Dalhousie. So, on behalf of our department, congratulations to you all! We are very proud of our graduating class.

Completing a degree in mathematics, statistics, or actuarial sciences is no small task, made even harder by the circumstances. So I really hope that you are proud of yourselves and that you are celebrating.

This is very special to me because, like many of you, I joined Dalhousie in the fall of 2017. So it feels like a privilege to be congratulating you today and to wish you the best in all of your future endeavors. I hope that you are very excited for what lies ahead, that you will stay in touch, and that you will come back for a visit someday.

Department Awards

Congratulations to our 2020 – 2021 award earners! The names of this year's recipients are presented below along with some information about each of the 17 awards.

Sir William Young Gold Medal in Mathematics

This medal is awarded at convocation to the student who stands first among those taking 1st class honours in Mathematics. It is also known as the University Medal in Mathematics.

Recipient: **Kyle Wang**

University Medal in Statistics

This medal is awarded at convocation to the student who stands first among those taking 1st class honours in Statistics.

Recipient: **Ziwei Wang**

University Medal in Actuarial Science

This medal is awarded at convocation to the student who stands first among those taking 1st class honours in Actuarial Science.

Recipient: **Zhengting Guo**

Barry Ward Fawcett Memorial Prize

This monetary award goes to the student who has achieved the highest grade in MATH/CSCI 2113 (Discrete Structures II).

Recipient: **Kyle Wang**

Bernoulli Prize

This monetary award goes to the student registered in the Co-op Mathematics Program who has the best cumulative academic record, subject to the restrictions that the prize can be awarded only once to a given individual, and that the winner must have performed acceptably in all work term assignments.

Recipient: **Louise Cullen**

The Ellen McCaughin McFarlane Prize

This award is in the memory of Ellen McCaughin McFarlane, class of 1927 and goes to the student who has achieved the highest standing after completing year one of the honours program. This prize is a monetary award.

Recipient: **Jan Schrader**

The Dr. Emil and Mrs. Stella Blum Prize in Mathematics

This monetary prize is awarded to an Advanced Major or Honours Mathematics student who achieves the highest grade in second year Calculus.

Recipient: **Linh Dinh**

Erma Geddes Filmore Memorial Scholarship

This scholarship is awarded to a full-time BSc undergraduate student with the highest grade point average entering the second year of their degree with a declared major in Mathematics or Statistics. This scholarship is in memory of Erma Geddes Fillmore (Dalhousie BA, 1924) and was established by her family. Starting in 2021, this scholarship will be awarded in the fall term - once students have entered second year and have declared their major.

Recipient: **to be awarded in the fall of 2021**

Field Prize in Statistics

This monetary prize is awarded to the student with the highest academic standing who has completed their 3rd year of studies in Statistics. This award was endowed by Dr. Christopher Field and Mrs. Harriet Field.

Recipient: **He Yang**

Heller-Smith Foundation Graduate Scholarship in Mathematics & Statistics

This scholarship is awarded based on academic achievement. The scholarship was established to provide financial support and recognition to a graduate student.

Recipient: **Zhiyuan (Owen) Zhang**

The Katherine M. Buttenshaw Prize

This monetary prize is awarded to the student standing highest in the advanced Mathematics courses.

Recipient: **James Munday**

Ken Dunn Memorial Prize

This cash prize is awarded to a student who has completed the third year of an Honours program in Mathematics or Statistics, or a combined Honours program in Mathematics and Statistics.

Recipient: **Xiaoyu Jia**

The Peter and Anne-Ellen Fillmore Scholarship

This scholarship is awarded to a graduating math honours or major student from the Maritimes who plans to become a high school math teacher.

Recipient: **Vasso Karmas**

Professor Michael Edelstein Memorial Graduate Prize

This prize is awarded to a graduate student who shows great promise in the mathematical sciences.

Recipient: **Marcello Lanfranchi**

R.P. & Kamla Gupta Scholarship in Statistics

This scholarship is to recognize excellence in Statistics by providing one or more scholarships to undergraduate students enrolled in Honours Statistics.

Recipient: **Jie Yu**

The Ralph and Frances Lewis Jeffery Scholarship

This scholarship is awarded to two students who have each completed an honours degree in Mathematics, and who have maintained at least 2nd class standing during the first 3 years.

Recipients: **Caroline Barton & Owen Bennett-Gibbs**

Waverley Prize

This award goes to the student with the highest standing in MATH 1010 (Differential and Integral Calculus II).

Recipients: **Faleh Alazemi**

Reports, Reflections & News to Note

CHAIR'S REPORT

By Jeannette Janssen

Congratulations to all students graduating this Spring with a degree in Statistics, Mathematics, and Actuarial Science. Completing one of our degree programs is a considerable accomplishment. In addition, this generation of students finished their studies during a pandemic, in a period of uncertainty, and in an online learning environment that was unfamiliar to students and instructors alike. Students, I wish you all the best with your future plans, and I hope that you will keep in touch.

Awards. Congratulations also to our award winners. We are very proud of you; too bad that we could not honour you with an Awards Day ceremony because of the pandemic. A special shout-out to Kyle Wang, who, in addition to winning the Sir William Young Gold Medal in Mathematics and the Barry Ward Fawcett Prize, was also the winner of the University Silver Medal, which is awarded to the student who is judged to be the leading First Class Honours student among graduates of baccalaureate programs.

Thanks. What distinguished the 2020-2021 academic year the most was undoubtedly the change to online instruction and working from home. We all had to learn new skills in a hurry. As department Chair, I give a sigh of relief that the year passed without calamities. I thank everyone teaching this year for their resilience and creativity. Special thanks to the instructors and mentors involved with the 2020 summer term. The educational resources they developed are asset to the department and will enable us to continue offering our summer courses online. Extra-special thanks to our administrator Ann Bannon, who worked tirelessly behind the scenes to make sure everything was running smoothly. Thanks also to Balagopal Pillai for providing essential IT support, to Angela Myers for keeping our building clean and safe, and to Danielle Hill, Maria Fe Elder and Ellen Lynch for offering office support in virtual form.

Online activities. The closure of the Dal campus caused the cancellation of some of our regular activities, such as the summer math camps and the Awards day ceremony. Some other activities successfully transitioned to a new format. The Mathematics Colloquium (Suresh Eswarathasan), Statistics Colloquium (Lam Ho), and ATCAT Colloquium (Matt Amy) remained active in virtual form. Two seminar series broadened their reach under the umbrella of AARMS, namely the Analysis-Applied Math-Physics (AAMP) seminar, organized by Suresh Eswarathasan, and the Atlantic Graph Theory seminar, organized by Jason Brown and Danielle Cox from MSVU. The move to online teaching made possible an exchange of graduate and advanced undergraduate courses, facilitated by AARMS. Several of our students participated in courses offered at MUN and UNB, and students from across the Atlantic region took our 4000/5000 level courses. Finally, NS Math Circles, under the direction of Tom Potter, held its monthly events via zoom, and arranged for virtual classroom visits.

New faculty. Access to our beloved Chase building was limited this year. Thus, it may have gone unnoticed that a new faculty member joined us in January and taught his first course here in the Winter term. Theo Johnson-Freyd received his PhD from UC Berkeley in 2013. He served as an NSF postdoc and Boas Assistant Professor at Northwestern University from 2013–16 and then as a Senior Postdoctoral Fellow at the Perimeter Institute from 2016–20. He continues to hold a joint appointment with the Perimeter Institute. His research focuses on the interplay between mathematical physics (particularly quantum field theory) and higher algebra and category theory. Theo joined Dalhousie together with his husband Brian Gillis, who teaches Indigenous and American Literature in the English department.

Kudos. Toby Kenney was awarded Tenure and Promotion to Associate Professor. In their letters of support, the Faculty Committee and the Dean gave special praise to Toby's efforts in creating the Actuarial Science program; a program that continues to grow and thrive. Peter Selinger received a new 5-year grant from the U.S. Air Force Office for Scientific Research, entitled "Dependent Type Theory for Verified Quantum Software". Andrew Irwin received a 4-year grant from the Simons Foundation as part of a project to study changes in phytoplankton community structure along resource supply gradients in the Pacific Ocean; Andrew's role is to develop statistical models to test hypotheses of factors influencing these changes. Andrew is also part of a research project newly funded by the Ocean Frontier Institute, titled "North West Atlantic Biological Carbon Pump". Dorette Pronk successfully renewed her NSERC Discovery grant, and Theo Johnson-Freyd obtained his first DG. Of note, Theo also received an NSERC Accelerator supplement, which is awarded to provide resources to accelerate progress and maximize the impact of established, superior research programs. Asmita Sodhi, an instructor and PhD graduate from our department who has been teaching and managing the learning centre, was awarded a Change One Thing Challenge Grant from the Centre for Learning and Teaching for a proposal titled "Alternative assessment and applying concepts through projects in a first-year linear algebra course". Finally, Raja Milad, one of our PhD students, won second prize in a 3MT (three-minute-thesis) competition held on 29 May as part of the Ottawa Mathematics Conference. Her presentation was titled "Harmonic analysis on Affine groups". Sarah Meng Li, one of our undergrads, received the Dalhousie Board of Governors' Award. Finally, Keith Johnson, Keith Taylor and Keith Thompson were appointed Emeritus Professor.

Looking forward. The university is planning a gradual Return to Campus over the summer months, and a return to Face-to-Face instruction in the Fall term. It will be great to be able to meet and greet each other again in the hallways of Chase, and to see our students as persons instead of zoom squares. Likely, it won't be entirely "back to normal". There will be lasting changes, and I am convinced that many of these will be positive. This pandemic year has been a transformative experience for many of us. I look forward to seizing the opportunities and meeting the challenges of leading the department in a new post-pandemic reality.

GRADUATE PROGRAM

GRADUATE STUDENTS' ASSOCIATION REPORT

The Mathematics & Statistics Graduate Students' Association is a DSU Society that promotes the interests of graduate students in mathematics and statistics. The main goal of the society is to be a bridge between graduate students and the department and to help students by trying to pass their problems to the right people in the department. Also, the society promotes the interest of graduate students in mathematics and statistics by organizing seminars and workshops, and brings the student community closer by organizing non-mathematics activities and events. The Society will elect officials for the 2021/2022 academic year later this year. We would like to thank the out-going leadership for their work during a challenging year.

2020/2021 Executive:
President: **Catherine Antwi**
Vice President External: **Molly Hayes**
Vice President Internal: **Mia Parenteau**
MSc Statistics: **Vishal Sood**
PhD Statistics: **Claire Boteler**
MSc Mathematics: **Fahimeh Bayeh**

STATISTICS GRADUATE COORDINATOR NOTES

Contributed by Joanna Mills Flemming

Despite the challenges imposed by COVID-19, we saw several of our statistics graduate students successfully completely their programs during the Academic Year 2020-2021. This fall we are welcoming 6 new MSc students and 3 new PhD students and intend to offer all our graduate classes and seminars in person.

MATHEMATICS GRADUATE COORDINATOR NOTES

Contributed by Sara Faridi

The academic year 2020-21 was an unusual one. Graduate classes and seminars were fully online. Through an initiative of AARMS, Mathematics and Statistics departments in Atlantic Canada decided to open some of their graduate courses to all students in the region. This led to a rich offering of courses, and a diverse group of students for each class joining in from multiple time zones.

In 2020 we (virtually!) welcomed 7 Master's students: Dario Brooks, Isaac McMullin, Marcello Lanfranchi, Adam Lucas, Timothy Salamon, Deni Salja, Arvin Vaziry; and 2 PhD students: Justin Makary and Nick Layden.

Despite the challenging circumstances, we have had a successful year. Many students have completed their theses and will be graduating this summer. In September we will be welcoming 16 new graduate students from Canada and around the world, and we are looking forward to being back on campus again.

UNDERGRADUATE PROGRAM

DALHOUSIE UNDERGRADUATE MATHEMATICS AND STATISTICS SOCIETY (DUMASS)

by Kieran Bhaskara

2020/2021 Executive Council Members:

President: **Kieran Bhaskara**
Vice President: **Seoyeon (Cali) Park**
Treasurer: **Maya Velic**
Secretary: **Louis Bu**
Communications: **Rachel Beck**
DSS Rep: **Louise Cullen**

The Dalhousie Undergraduate Mathematics and Statistics Society is comprised of a group of dedicated students who volunteer their time to enhance the university experience of students in mathematical science programs. In ordinary years, we plan several events for students to be able to socialize and meet others in the department.

Unfortunately, the continuing pandemic has prevented us from organizing our normal society events. However, with the end of lockdowns in sight, we are looking forward to offering increased programming next year. In fact, I have heard that the incoming Executive Council are already hard at work planning events for the fall term, including a party to welcome everyone back to campus. They are also planning other fun events such as trivia and regular math/stat parties throughout the year!

This year's executive would like to congratulate all those students who are graduating this spring, and wish them all the best with their future endeavours. We would also like welcome our incoming executive, who look forward to meeting you all in the fall!

Incoming (2021/2022) Executive Council Members:

President: **Seoyeon (Cali) Park**
Vice President: **Rachel Beck**
Treasurer: **Lawrence Matsuoka**
Secretary: **Louis Bu**
Communications: **Hailey Wigmore**
DSS Rep: **Aliya Grant**

HONOURS PROGRAM

This year we had a total of 25 honours students in our three programs. Each student, their project and their supervisor is noted below.

MATHEMATHICS

Caroline Barton, supervisor(s): Jeannette Janssen, project title: The max-lpa algorithm for community detection in graphs

Owen Bennett-Gibbs, supervisor(s): Neil J. Ross and Matthew Amy , project title: Path-sums in quantum computing: a categorical perspective

Kieran Bhaskara, supervisor(s): Karl Dilcher, project title: Stern's triangle and related sequences

Louise Cullen, supervisor(s): Jason Brown, project title: The graph theoretic properties of classroom social networks

Ian George, supervisor(s): Jason Brown, project title: Tonal modulation and cadences in music: a mathematical approach

Sarah Li, supervisor(s): Neil J. Ross, project title: Improved synthesis of restricted Clifford+T circuits

Vaughn Menchions, supervisor(s): project title : Symmetries and the Geometrization of Ordinary Differential EquationsRob Milson, project title:

Aeriana Narbonne, supervisor(s): Neil J. Ross and Peter Selinger, project title: Mathematical simulation of stabilizer circuits: a mathematician friendly approach

Kyle Wang, supervisor(s): Sara Faridi, project title: Monomial resolutions with projective dimension 2 of path ideals of lines and cycles

Xixi Yi, supervisor(s): Roman Smirnov and Kunpeng Wang, project title: Derivation of a new production function from a mixed exponential logistic growth model

STATISTICS

Xuran Feng, Classification Methods to Predict Taxonomic Groups from Amino Acid Compositions, Supervisor: Ed Susko

Jingyu Li, Clustering Analysis of Surgeons from Surgical Data, Supervisor: Ed Susko

Haomu Liu, COVID-19 Data Analysis Combined SIR Model with Actuarial Applications, Supervisor: Toby Kenney

Rongqin Liu, A hidden Markov model for stock price prediction with economic indicators, Supervisor: Yonggan Zhao

Jiajun Ma, Gene Networks of Potato, Supervisor: Hong Gu

Yinjie Meng, The relationship between cell abundance and body size in marine zooplankton, Supervisor: Andrew Irwin

Haoran Sun, Multiple correspondence analysis, with application to a pediatric seizure data set, Supervisor: Bruce Smith

Jiachen Wang, Gene Networks of Potato, Supervisor: Hong Gu

Yuexu Wang, Gene Networks of Potato, Supervisor: Hong Gu

Yurunyun Wang, Learning with Dependent Data, Supervisor: Lam Ho

Ziwei Wang, Stochastic Models for Epidemics, Supervisor: Ed Susko

Zonglin Wu, Temperature and seasonal influence on marine zooplankton body size, Supervisor: Andrew Irwin

Ziqi Zhang, Using Statistical Regression and Classification Methods to Predict Human Body Temperature and Presence of Fever, Supervisor: Hong Gu

ACTUARIAL SCIENCE

Zhengting Guo: Conceptualizing the Impact of Climate Changes on Insurance Sector: Supervisor: Tobias Kenney

Haiyang Zhou : The use of Copulas for Joint-life Modelling : Supervisor: Tobias Kenney

MATHEMATICS DIVISION REPORT

By Peter Selinger, Director

I am supposed to write a director's report. But if I reported on the actual work of the director, it would be incredibly boring. I am sure you would not enjoy reading about how many edits to the calendar and timetable I made, how many spreadsheets I prepared, or how many transfer credits I approved. So instead, I'll try to tell you about some things that have been going on in the division this year.

As I am sure has already been amply acknowledged in these pages, this year has been a most strange one. It was the first (and hopefully only) year that fell entirely within the pandemic. After having moved our courses online on short notice in March 2020 and finishing that semester limping, rather than running, we have hopefully gotten much better at online teaching and learning! The summer already saw some very carefully planned and well-designed online courses, and in the Fall and Winter, we've rolled out our entire program in an online format.

I would like to congratulate all of our students, especially the ones who are graduating. You worked hard and finished a challenging year! Honours theses, Master's theses, and Ph.D. thesis have been written and defended, in many cases without ever seeing your supervisor face-to-face or even leaving your room! I would also like to acknowledge our class of first-year students, many of whom have not yet set foot at Dalhousie, and who perhaps don't even know why this is called the "Chase" report. We look forward to meeting you in person in the Fall!

We were lucky to welcome Theo Johnson-Freyd as a new assistant professor this year. He officially joined the department in January, but he's actually been in Halifax since last summer and already helped out around the department in the Fall.

The division has a new seminar, called the AAMP (Analysis, Applied Math, and Physics Seminar), organized by Suresh Eswarathasan and featuring many distinguished speakers from Canada and around the world. I am glad to see that this seminar has been off to such a successful start!

In addition to running the AAMP seminar, Suresh Eswarathasan is also the mathematics colloquium chair, and I admire his ability to attract so many excellent speakers. We've had a very busy colloquium this year. By contrast, when I was colloquium chair, we hardly had any talks at all.

Several members of the division were away for all or part of the year: Dorette Pronk and Roman Smirnov each enjoyed a well-deserved full-year sabbatical, whereas Karl Dilcher was on sabbatical in the Fall and Jason Brown in the Winter. Sarah Chisholm was on maternity leave, and her duties as learning centre coordinator, among many others, were admirably taken over by Asmita Sodhi in her absence. Keith Taylor retired at the end of last year, but he is still involved with the division and taught a reading course in the Winter. We are also grateful to Keith Johnson, who briefly came out of retirement in a moment of need, to take over the teaching of a course while we sorted out a work permit emergency. It was his first experience with online teaching, and he did so with grace and distinction.

For the first time this year, the role of director has been separated from the role of mathematics advisor. Julien Ross is now the mathematics advisor as well as the honours coordinator, and I am very grateful for the endless hours he spends every week, answering students' questions about what courses they should take. Jason Brown continues to be the coop coordinator for both Mathematics and Statistics. Sara Faridi is the graduate coordinator, and Theo Kolokolnikov chairs the division's curriculum committee. Asmita Sodhi and Suresh Eswarathasan are in charge of the CMS Math Camp, and Andrew Irwin is our departmental representative for Science Atlantic. Tom Potter is the director of Math Circles, which is overseen by David Iron as faculty advisor.

I would like to thank everybody, especially our amazing staff, Ann, Maria, Ellen, Danielle, and Balagopal, without whom none of the division's business would get done.

As this year winds down, and we send off our wonderful graduates to their exciting futures, I am looking forward to soon seeing the rest of you in the flesh. I even miss the Pizza Pizza in the LSC. Hopefully we'll soon be looking at something other than a computer screen!

STATISTICS DIVISION REPORT

By Michael Dowd, Director

The Statistics division had both an eventful, and an uneventful year. The Chase building and Dal facilities were largely closed, and our teaching moved online to accommodate COVID restrictions. It was challenging to effectively move our courses to an online format, and facilitate graduate student research. However, undoubtedly many innovations in instruction occurred that will influence our approaches in the future. Three new Statistics courses were offered, which were motivated by our modernizing the curriculum to include more on the topics of data science and computational statistics. These courses were: STAT 2430 Data Visualization; STAT 3450 Statistical Learning with R; and STAT 3740 Predictive Analytics. Research activities included grants from NSERC, MITACS, and the Simons Foundation, amongst others. Hector Baños and Chuck Bangley joined the division as postdoctoral fellows. A new faculty member, Orla Murphy, will join us July 1, 2021. CANSSI Atlantic is also ready to launch thanks to the efforts of Joanna Mills-Flemming.

ACTUARIAL SCIENCE

By Toby Kenney

The Actuarial Science program continues to grow, with another 4 honours students and 11 major students graduating this year. With student enrolment continuing to increase, particularly in the higher-level classes, we expect the number of graduates will continue to grow.

A new "predictive analytics" course was offered for the first time this year, with the aim of preparing students for the SoA Predictive analytics exam that was introduced in 2018. The new course was a success, and is expected to become a regular component of the departments course offerings in Actuarial Science.

REFLECTIONS

FROM THE CHASE REPORT OF 10 YEARS AGO

Dug up by Karl Dilcher

As far as the Chase Building is concerned, the 2011 Chase Report had some good news and some bad news to report:

This summer the inside renovations will continue, with most faculty offices on the 2nd and 3rd floors receiving new flooring and new paint jobs. For those offices it will be the first such renewal since the Department moved into the Chase Building in 1985.

The bad news was a flood disaster the previous year. To put things in perspective for younger department members: The Learning Centre used to be in the basement, and the space on the main floor now occupied by it was the departmental library, called the Agnes Baxter Reading Room. In 2008, the spaces were switched, and in 2013 the journal collection was integrated into the Killam Library. However, a good number of paper journals remain in the basement space. When the department library moved into the basement in 2008, we all thought that it was a perfectly safe place for our journals; after all, the lowest shelves were several inches above the floor. However, the unexpected happened on the night of July 23 of last year when there was a fairly insignificant fire in the greenhouse area of the 8th floor of the LSC. As a result, the sprinkler system was activated, as it should, but it led to the rupture of the water main which went through the tunnel attached to the Chase Building. This in turn resulted in the flooding of our basement with about a foot of water. Fortunately, our main computer servers were just high enough above the floor to avoid damage, but other electronic equipment in the machine room, in Balagopal's office, and in the temporary office in Room 007 was destroyed. The bulk of the damage, however, was sustained by the library, where all journal volumes on the lowest shelves ended up sitting in water. The library immediately sprang into action, and the following morning, a Sunday, about a dozen library personnel packed the soggy volumes into boxes and shipped them off for storage in a freezer. Since restoration is very expensive and few of the volumes are irreplaceable, they will likely be discarded and replaced by (mainly) electronic subscriptions. All drywall in the basement was also damaged and had to be repaired, and the renovations, much of it overseen by Gretchen, lasted into September.

The 2011 Chase Report also had a brief item on Sir William Young, after whom the University Medal in Mathematics is named. It is worth reprinting this. Sir William Young was a Nova Scotia businessman, lawyer, and politician. He was born in 1799 in Falkirk, Scotland and moved with his family to Nova Scotia in 1814. Like his father, Young entered politics in 1832. From1854 to 1857 he served as Attorney General of Nova Scotia, and in 1860 he served briefly as Premier before becoming Chief Justice, a position he held until his retirement in 1881. He died in Halifax in 1887. William Young contributed a great deal to the City of Halifax, and he was instrumental in negotiating use of the land for Point Pleasant Park from the Crown. He also contributed to Dalhousie College and served as chairman of the Board of Governors for thirty-six years (1848-1884). (A more complete biographical sketch can be found at **https://digitalexhibits.library.dal.ca/exhibits/show/lives-of-dal-volume-1/chapter-1-4/william-young**).

NEWS TO NOTE

OBITUARIES

Unfortunately, two people passed away over the last year and we would like to acknowledge each person.

PETER BORWEIN (1953 – 2020)

Contributed by Karl Dilcher

It is with great sadness that I inform you that our former colleague Peter Borwein passed away on Sunday, August 23, at age 67. Peter was a member of our department from 1980 to 1993.

Peter Benjamin Borwein was born in 1953 in St. Andrews, Scotland. In 1963 he and his family moved to London, Ontario, where his father David Borwein, also a well-known mathematician, took up a position at Western. In 1971 Peter began his studies at Western, and in 1974 he moved to UBC, where he received his MSc and PhD in 1976 and 1979, respectively. After a postdoctoral year at Oxford, Peter came to Dalhousie in 1980 as an Assistant Professor, and quickly moved through the ranks.

Dalhousie was not unknown to Peter at the time because his older brother Jon (1951-2016) had been here from 1974-1980 as a postdoc and then faculty member. Jon was back again from 1982 until 1991.

During his 13 years at Dalhousie, Peter was an active researcher, a popular and successful teacher and supervisor, and was also active in administrative matters. His joyful demeanour made it a pleasure to be around him. I had the honour to be the first of many postdocs Peter supervised, and working with Peter and Jon was a truly stimulating experience.

In 1993 Peter and his family moved to Burnaby, BC, where he joined his brother Jon, and where he spent the main part of his extremely active career.

At this time an obituary is not yet available, but below I copy a tribute written by one of his colleagues, Vesso, at SFU.

Peter will be missed by many; a great loss to Canadian mathematics.

Peter Borwein passed away yesterday, August 23rd with his wife at his side.

Peter was an exceptional person, a well-rounded intellectual, a creative and productive mathematician, an inspiring teacher, and a generous mentor.

Since 1993, when he and his brother Jonathan joined the SFU Department of Mathematics, Peter has contributed to our community in numerous ways: he and Jonathan established the Centre for Experimental and Constructive Mathematics (CECM), in the late 1990s he served as the PIMS SFU site director, and in the early 2010s was able to secure the funding of 11 million dollars for building and running the IRMACS Centre, a visionary project with the

purpose to, in Peter's words, “host any scientist who uses computers as a tool in their research.” Peter was the true heart and soul of the IRMACS Centre.

Peter has nearly 200 scientific publications, including several books, to his credit. Peter's research interests spanned Diophantine and computational number theory, classical analysis and symbolic computation. He had a central interest in scientific collaboration and computational experimentation technologies. For example, the Bailey-Borwein-Plouffe (BBP) formula is still one of the major tools in calculating digits of the number Pi.

Peter was a member of the several editorial boards, including "Ramanujan Quarterly" and "Electronic Transactions on Numerical Analysis."

Peter was a recipient of the Chauvenet Prize and the Hasse prize 1993 (with Jonathan Borwein and David H. Bailey) and a co-recipient of the 1996 CUFA/BC Academic of the Year Award.

On a personal note, Peter was my friend, mentor, and a role model. On Saturday, March 13, 2004, Peter was the first speaker in the "A Taste of Pi" series of talks and activities. Appropriately, the title of his talk was "A VERY LARGE Piece of Pi."

Peter was born in St. Andrews, Scotland, on May 10, 1953.

Due to COVID the family will not be having a ceremony in the near future but hope for one in the Spring/summer of next year.

PREMAN EDWARDS

Contributed by Jeannette Janssen

I am sad to report that Preman Edwards has passed away. Preman was an enthusiastic math teacher who taught for many years in the BEA Black Math Camp held annually in our department. He is also a graduate of our department. Below is a link to his obituary in the Chronicle Herald.

https://www.thechronicleherald.ca/obituaries/preman-jeyaretnam-edwards-43772/

POST-DOCTORAL FELLOWS

Dr. Charles Bangley earned his PhD at East Carolina University in 2016 and completed a postdoctoral fellowship with the Smithsonian Environmental Research Center in 2020. He is currently a postdoctoral fellow working on the Fundy Ocean Research Centre for Energy Risk Assessment Program and the Apoqnmatulti'k project. His research is focused on the development of predictive species distribution models from acoustic telemetry and associated environmental data.

Dr. (Sofie) Yuan Yan completed her doctorate in 2018 from King Abdullah University of Science and Technology (KAUST), Saudi Arabia. She has been working with Joanna Flemming for the CANSSI-CRT project "Towards Sustainable Fisheries: State Space Assessment Models for Complex Fisheries and Biological Data", since January 2019. Her research interests include spatio-temporal processes, data transformations, depth for functional data and application in fisheries science.

Dr. Shahideh Kiehbadroudinezhad received her doctorate in 2017 from UPM University in Malaysia. She is a MITACS postdoctoral fellow in our department, supervised by Joanna Mills Flemming, from January 2020. Her research interests include density estimation and propagation modeling.

Dr. Hector Baños joined the division during the winter term as a postdoctoral fellow. He will be working with Edward Susko and Andrew Roger (Biochemistry and Molecular Biology) as part of a Moore-Simons funded project entitled New phylogenomic models and methods to resolve the prokaryote to eukaryote transition

Dr. Matthew Amy completed his doctorate in 2019 from the University of Waterloo, Canada. He has been an AARMS postdoctoral fellow in our department, working with Julien Ross and Peter Selinger, since November 2019. His research interests include formal mathematical models of quantum computation and their application to the practical problems of quantum programming and compilation.

Dr. Bram Westerbaan received his doctorate in 2019 from Radboud University in the Netherlands. He was an AARMS postdoctoral fellow in our department, supervised by Peter Selinger, from January until April 2021. His research interests include von Neumann algebras and quantum computation.

Dr. Elias Krainski was an OFI (Ocean Frontier Institute) postdoctoral fellow, supervised by Mike Dowd.

Dr. Franziska Broell was an MITACS Accelerated Entrepreneur postdoctoral fellow, supervised by Mike Dowd.

Dr. Martin Szyld got his PhD in 2015 from the University of Buenos Aires, Argentina, where he also worked as a postdoctoral fellow with Eduardo Dubuc. He is working now as a postdoc with Dorette Pronk in the following projects: "The Grothendieck construction for double categories" (together with her and M. Bayeh), "Colimits of bicategories" (together with her and P. Bustillo), and "Fibrations of double categories" (together with her, G. Cruttwell, and M. Lambert).

BOOKS WANTED AND FOR SALE

by Karl Dilcher

As I mention every year in the Chase Report, I keep, and have catalogued, a large number of surplus books that have been donated over the years by current and retired faculty members, alumni and departing students. Over the last few years, around 1,500 volumes were sold to mathematicians around the country and dozens more around the world. I was able to donate the sizeable income from these sales back to our department and to the CMS.

Almost 2,000 volumes still remain; they are catalogued at:

http://www.mathstat.dal.ca/~dilcher/oldb ooks.html.

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

A related initiative is what I informally call the Calculus Textbook Preservation Project. I'm keeping one copy of each edition of each calculus textbook that I can get my hands on; they are hidden in the basement. Quite surprisingly, without much effort on my part, this collection has grown to about 500 volumes. For this initiative too, I welcome any further volumes, once circumstances make book donations easier.

SUMMARY OF COLLOQUIA& SEMINARS

Everyone who is interested is welcome to attend our discussions and seminars:

- Departmental Colloquium – Mathematics
- Departmental Colloquium – Statistics
- Honours Seminar (Mathematics)
- Number Theory Seminar
- Atlantic Category Theory & Algebra Seminar (ATCAT)
- Dalhousie-AARMS Analysis-Applied Math-Physics Seminar
- Graph Theory Seminar
- Relativity Seminar

Additional information on the colloquia and seminars is available on the Department website:

https://www.dal.ca/faculty/science/math-stats/news-events/colloquium.html

We would like to highlight the two colloquia series.

MATHEMATICS COLLOQUIA

Organizer: Suresh Eswarathasan

The 2021 colloquium schedule is online at **https://www.mathstat.dal.ca/~sureshe/Colloquium.html** .

STATISTICS SEMINARS

Organizer: Lam Ho

This year the Seminar has moved online. The list of the talks are here: **https://www.mathstat.dal.ca/~lho/seminar/**

Additionally, Claire Boteler organized a Student Seminar (as part of our Seminar) featuring lessons learned by experienced statisticians. David J. Thomson (Department of Mathematics and Statistics, Queen's University) presented in October 2020 and the title is "An Accidental Statistician".

DEPARTMENT HOSTED MEETINGS & COMPETITIONS

SCIENCE ATLANTIC CONFERENCE

Submitted by Julien Ross

Several of our students attended the Science Atlantic Annual Conference for Mathematics, Statistics, and Computer Science. Caroline Barton gave a talk. Xiaoyu Jia and Vaughn Menchions placed in first and second, respectively, at the mathematics competition.

Affiliated Organizations & Societies Updates

The Department participates in four organizations related to mathematics and statistics:

- Canadian Mathematical Society (CMS)
- Atlantic Association for Research in the Mathematical Sciences (AARMS)
- Candian Statistical Sciences Institute (CANSSI)
- Statistical Society of Canada (SSC)

We are pleased to share updates from some of these organizations.

ATLANTIC ASSOCIATION FOR RESEARCH IN THE MATHEMATICAL SCIENCES (AARMS)

Submitted by David Langstroth

The past year has been challenging. So many AARMS activities have been cancelled, deferred or moved online. At the same time, the pandemic introduced uncertainties into our funding structure as governments and universities grapple with their own budgets and try to re-establish priorities.

We are therefore grateful to have received significant funding for 2021/22 from the NSERC Discovery Institutes Support Program (DIS). This will enable AARMS, in the year ahead, to support our existing programs and to roll out some new ones. We are making a further application to this program for 5 years of funding to start in 2022/23.

What to look out for in the year ahead:

- Enhanced support for our postdoctoral fellowship program. The AARMS contribution will rise to $25,000 and we expect to be able to fund more fellowships.
- Enhanced support for our Collaborative Research Group program. We are now accepting Letters of Intent from researchers wishing to apply for up to $50,000/year for CRGs to start in September. Please see our website for details.
- New Graduate Student Scholarships.
- New Junior Researcher Travel Support fund (assuming we get to travel again soon!).
- New Doctoral Thesis Award.

Watch your email for announcements, or check out our programs on our website: **www.aarms.math.ca**

CANADIAN STATISTICAL SCIENCES INSTITUTE (CANSSI)

Submitted by Janna Mills-Flemming

CANSSI Atlantic will be launched in July of 2021.

Community Outreach

CMS MATH CAMP (SUMMER 2020)

By Suresh Eswarathasan

The 2020 & 2021 Math Camps were cancelled due to the pandemic with hopes of restarting in summer 2022.

NS MATH CIRCLES

By Tom Potter

Math Circles for Chase Report, 2020-2021 year

Despite challenges presented by the pandemic, Nova Scotia Math Circles has been busy during the 2020—2021 academic year. We were able to continue our outreach to students across Nova Scotia by adapting to online learning formats, while simultaneously focusing on professional development to allow us to continue to offer excellent educational opportunities.

This year we had lots of change in our program at the personnel level: Dr. Mayada Shahada left to pursue a post-doctoral position, while Tom Potter became interim program director of Math Circles. Tom is currently pursuing a Ph.D. in mathematics at Dalhousie and was a presenter and content developer for Math Circles for two years prior to taking on this role. Dr. David Iron was our faculty advisor this year and helped by giving Tom feedback and support through challenges faced this year. Our department administrator, Ann Bannon, was also a tremendous help and support for the program through this period of change. Several students in our department joined or continued with Math Circles: Heesung Yang continued as a presenter and content developer for Math Circles, and Mozhgan Saeidi from Computer Science continued as a presenter: it is Heesung's second year with us, and Mozhgan's third. Dario Brooks joined us as a presenter, and Justin Makary initiated our monthly events by giving the first workshop and helping organize it. Just recently, Sarah Li has joined our team as a presenter.

We shifted our approach this year from School Visits to Class Visits. By the end of May we reached 1084 students through virtual class visits, with 45 class visits, and we have a very busy schedule planned for June. We have (virtually) visited public and private schools in the HRM, in Annapolis Valley, and in the Colchester County district. Now that we have done the hard work of adapting to a new format, it will be easier going forward to reach a larger number of students and broaden our outreach to include more communities. We also look forward to resuming our in-person activities as soon as possible.

Each of our eight online Monthly evening events attracted a mix of participants from students, parents, and teachers. These events were given by presenters from our team, enthusiastic undergraduate and graduate students, department alumni, and post-doctoral researchers in our department. A total of 158 students joined us via Zoom or Teams, and we have one more event planned for June. Our Presenters this year were Justin Makary, Tom

Potter, Heesung Yang, Sarah Li, Dr. Frank Fu, Dr. Asmita Sodhi, Dr. Matthew Amy, and Mozhgan Saeidi. We again thank our volunteers for giving these fun workshops.

This year we added two exciting new presentations to our repertoire, Candy Game and Pascal's Triangle. We also expanded our training to facilitate moving to the online format, and to master the growing number of presentations. We created a guide for presenting virtually, to ensure our presentation quality remains high, and have made improvements to our existing presentations. We updated our operations manual and our website, created all new webforms with spam protection, and participated in the WISEatlantic STEM Spotlight Series and Partnerships Workshop.

Future goals include resuming in-person activities and week-long trips, developing, and implementing an advertising strategy, doing more to reach underrepresented groups, reaching a more geographically diverse audience across the province, recruiting French-speaking presenters, continuing to expand our training and professional development, and much more!

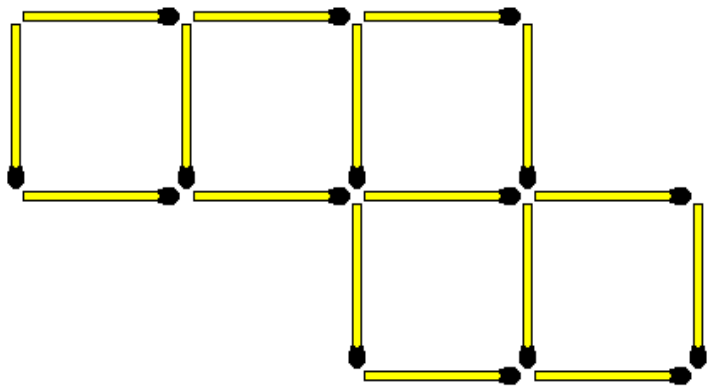
This year, Math circles celebrates its seventh year of funding with Eastlink. We are very grateful to Eastlink for their generous donation, and to everyone who helped make our program a success again this year!

Thanks again to everyone who helped make this year a great success! Keep up to date with our events at www.nsmathcircles.com and via our Twitter account **@NSMathCircles**.

FUN MATH PROBLEMS:

A PROBLEM FROM OUR BOTHERSOME BRAINTEASERS PRESENTATION:

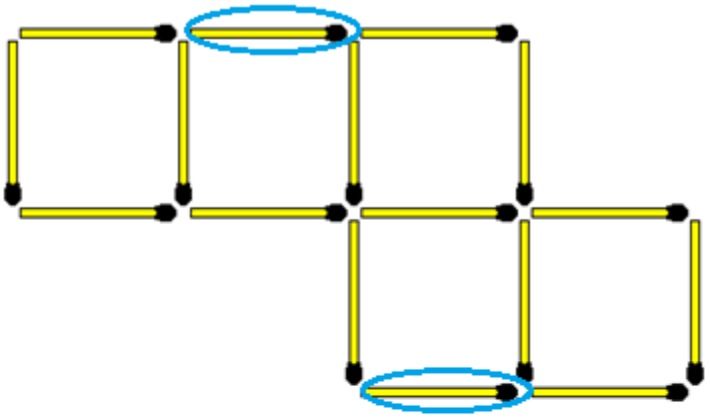
Turn these 5 squares of side length 1 into 4 squares of side length 1, by moving exactly 2 matchsticks.

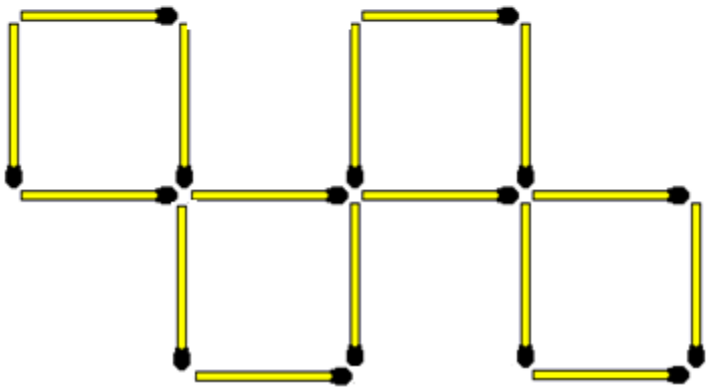


SOLUTION(S) AT END OF THIS REPORT

SOLUTIONS:

PUZZLE SOLUTION TO MATH CIRCLES PROBLEM:





The Chase Annual Report is published for students, alumni and friends of the Department of Mathematics and Statistics, Dalhousie University.

Your suggestions and comments are welcomed for future issues.

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This edition of the Chase Annual Report was compiled and edited by

Ellen Lynch, Faculty Support Secretary and

Ann Bannon, Administrator

The cover photo is a picture of the east-side entrance to the Chase Building. We look forward to returning to campus and the Chase Building this later this year.