**Submittee:** Tiina Hohn
**Date Submitted:** 2010-06-22 10:34
**Title:** North-South Dialogue in Mathematics and the Alberta Colleges Math Conference 2010
**Event Type:** Conference-Workshop

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**Location:**
City Centre Campus of Grant MacEwan University in Edmonton

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**Dates:**
April 29th and 30th, 2010

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**Topic:**
Dialogue in all things in mathematics in Alberta.

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**Methodology:**
Presentation talks and workshops. Public lecture. Poster displays.

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**Objectives Achieved:**
This meeting was the 10th annual gathering of mathematicians in Alberta to share some research results, pedagogical ideas and experiments, visit and network. We plan to meet again in 2011.

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**Organizers:**
Hohn, Tiina, Department of Math and Stats, Grant MacEwan University

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**Speakers:**
Friday Afternoon Key Note: My Mathematical Reminiscences, by Dr. Hugh Williams (University of Calgary). Abstract: Throughout my career I have had the privilege of learning a lot of fascinating mathematics and associating with a number of very interesting mathematicians. In this talk, which is intended for a general audience, I will discuss the development of computational number theory from the perspective of a few defining problems and the personalities of the mathematicians, whose work had a significant impact on the current status of these problems. // Thursday Evening Event: "Congo Bongo": An application of mathematical induction to a seemingly unsolvable problem, by Dr Andy Liu (Department of Mathematical Sciences, University of Alberta). Abstract: An expedition into Congo unearthed a treasure chest in the shape of a regular octagon. At each corner was a bongo drum. The inscriptions on the chest said that each drum contained a genie who was either right side up or upside down. The chest would open if and only if all eight were right side up or all eight were upside down. Up to four drums might be hit at the same time. When a drum was hit, the genie inside would change from right side up to upside down, or vice versa. However, after each round of hitting, the chest would spin round and round about its vertical axis, so that it could not be determined which drums had just been hit. Apparently, the sequence of hits which would open the chest had

been recorded, but this itself was placed inside the chest. How could the chest be opened? Your undergraduate and graduate students may have some fun trying to solve this problem before coming to the talk. // Thursday Workshop: TRADITIONAL APPROACH TO TRIGONOMETRY, by Dr. Ion Bica (Grant MacEwan University). Abstract: This workshop will be a mini-lecture on the classic approach in solving trigonometric problems. Many trigonometric problems require a creative approach rather than straightforward computation by hand or by computer. In this mini-lecture I want to emphasize the creative aspect of trigonometry through some fun examples. // Friday Presentations: Introductory Calculus Courses: The Modelling Approach, by Dr. Petr Zizler (Department of Mathematics, Physics, and Engineering, Mount Royal University, Calgary). Abstract: Introductory calculus courses can be roughly divided into two categories. The first category is aimed at honours mathematics students and the courses have all the mathematical rigour and proofs needed. The second category is intended for non-honours students. Here the content must be watered down and the mathematical proofs are severely restricted if not removed altogether. In our presentation we report on an experimental delivery of two consecutive introductory calculus courses at Mount Royal University in Calgary, where we have adopted the modeling approach for motivating the subject. The audience for these courses are the Bachelor of Science students at MRU. // A Cryptographic Application of Generalized Lucas Functions, by Dr. Eric Roettger (Department of Mathematics, Physics, and Engineering Mount Royal University, Calgary). Abstract: The goal of public-key cryptography is to securely exchange a key by use of a public channel without the users previously communicating with one another. In 1976 Whitfield Diffie and Martin Hellman had an idea how to do this by exploiting mathematically difficult one-way problems. DH key exchange relies on the discrete log problem. While RSA, the first working public key cryptosystem, has security based on the believed difficulty of integer factorization. This talk will present a new public-key cryptosystem based on some new functions that were developed to generalize the Lucas functions. // Entropy Maximizing Measures from Heteroclinic Points, by Brady Killough (Department of Mathematics, Physics, and Engineering Mount Royal University, Calgary). Abstract: We consider the class of hyperbolic dynamical systems known as Smale spaces. A key feature of such spaces is the existence of local coordinates on which the dynamics are expanding/contracting. The expanding (contracting) set naturally gives rise to a notion of unstable (stable) equivalence. A Smale space also possesses a unique invariant probability measure that maximizes entropy, known as the Bowen measure. Bowen constructed this measure as a limit of measures supported on periodic points. In this talk, we will present an alternative construction of this measure. We construct measures supported on (finite) sets of points which are stably equivalent to one given point, and unstably equivalent to another (heteroclinic points). The limit of these measures recovers the Bowen measure. // Some problems in the border between Number Theory and Logic, by Dr. Carlos Videla (Mount Royal University, Calgary). Abstract: I will present some open problems about algebraic extensions of the rational numbers motivated by problems from Logic, starting with the classical results of Julia Robinson. // Regime-switching of the SIR endemic model: averaging, merging, and diffusion approximation, by Dr. Mariya Svishchuk (Mount Royal University, Calgary). Abstract: The basic SIR endemic model with coefficients dependent on some stochastic process that switches the regiment is being investigated. We consider averaging, merging, and diffusion approximation of this model in random environment. // Efficient and Accurate Numerical methods for solving the system of two-dimensional Burgers' equations, by Wenyuan Liao (University of Calgary). Abstract: A fourth-order compact finite difference method is developed to solve the system of two-dimensional Burgers' equations. The new method is based on the two-dimensional Hopf-Cole transformation, which transforms the system of two-dimensional Burgers' equations into a linear heat equation. The linear heat equation is then solved by an implicit fourth-order compact finite difference scheme. A compact fourth-order formula is also developed to approximate the boundary conditions of the heat equation, while the initial condition for the heat equation is approximated using Simpson's rule to maintain overall fourth-order accuracy. Numerical experiments have been conducted to demonstrate the efficiency and high-order accuracy of this method. // BC Math Challengers, Presented by David Leeming (Professor Emeritus, University of Victoria). Abstract: First, there will be a brief history of this long-established Competition for grade eight and nine students in certain regions of BC. It is a

multi-stage competition and there will be a description of each stage. For those students who excel in the regional competition, there is a Provincial event about a month later. There will also be an overview of the organization and funding of this program and its benefits to students and potential benefits to other groups. // Scaling Parameters, Multiple Integrals, Iterated Integrals, and All That, by Dr William Freed (Concordia University College). Abstract: The ability to design closed, parameterized n-dimensional subregions of R^n is a basic mathematical skill. This can be done for a large class of 2n-sided figures and invertible transformations of them. Each such region can be parameterised by interpolating between opposite sides. The resulting scaling parameters give it a natural looking parameterization; functions with desired properties related to the region can then be readily be designed. Multiple integrals over the region can always be evaluated by iterated integrals which have the nicest possible limits of integration. Computational details and graphics designing details are discussed and illustrated. Computer algebra systems work hand-in-hand with the mathematics to make these computations routine and reduce the distinction between difficult and easy problems. // Developing a Moore Method Course in Number Theory for Distance Delivery, by Burton Voorhees (Center for Science, Athabasca University) and Sandra Law (Center for Learning Design and Development, Athabasca University). Abstract: There has been a growing movement to develop courses using inquiry based learning methods and, in mathematics, this has centered around modifications of the Moore method. Until now, the Moore method and its various modifications have been used only in class room teaching with a strong dependence on a skilled instructor. In this presentation we first present the basics of this method of instruction, and then describe how we are modifying it to present a course in number theory that will be delivered at a distance. Three aspects of this are how the course material itself is to be presented to students, the instructions students are given on how to work through the material and how they will be graded, and the technological tools that are, or will soon be available in order to enhance this form of content presentation. // Martingales in Banach lattices, by Dr. Hailegebriel Gessesse (University of Alberta). Abstract: A sequence of contractive positive projections (E_n) on a Banach lattice F is said to be a filtration if E_n E_m = E_{n \wedge m}. A sequence (x_n) in F is a martingale if E_n x_m = x_n whenever n \leq m. Denote by M = M (F;(E_n) the Banach space of all norm uniformly bounded martingales. We provide several sufficient conditions for the space M of bounded martingale on a Banach lattice F to be a Banach lattice itself. We also present examples in which M is not a Banach lattice. It is shown that if F is a KB-space and the filtration is dense then F is a projection band in M. // Ricci flow of the RP^3 geon, by Dr. Eric Woolgar (University of Alberta). Abstract: Perelman's completion of the proof of the Poincare conjecture relies on Hamilton's Ricci flow. On a compact 3-manifold, Ricci flow (with surgery) causes the homotopy groups to ``become extinct'' in finite time, causing the topology to simplify as the flow proceeds. In particular, embedded minimal spheres tend to collapse under the Ricci flow. We ask whether the same effect occurs for noncompact 3-manifolds, including a model popular in gravitational physics and known as the RP^3 geon. We are able to prove collapse of minimal spheres whenever the curvature of the initial manifold obeys a certain bound. When this bound is violated, numerical evolution appears to confirm that collapse still occurs. We compare our results to purely numerical work of Hsuain and Seahra which appears at first glance to lead to a different conclusion. This is joint work with Tracey Balehowsky. // Teaching a large class of Introductory Linear Algebra, by Hadi Kharaghani (University of Lethbridge). Abstract: I will share my experience of teaching a large class of introductory linear algebra. Students seem to appreciate having access to the taped lectures and asking questions from their classmates. I used "Tegrity" to tape my lectures and let students use "Chat Rooms" to chat with each other on the "Blackboard" on the night that the assignments were due the next day. // THE SECONDARY BIFURCATION OF A NOISY AEROELASTIC MODEL, by Dr. Cristina Anton (Grant MacEwan University). Abstract: This talk will present a numerical study of the stochastic phenomenological bifurcations of a two-degree-of-freedom noisy aeroelastic system oscillating in pitch and plunge, with a cubic non-linearity in pitch. In addition to a Hopf bifurcation, the deterministic aeroelastic model has also secondary bifurcations characterized by jumps in the limit cycle oscilations amplitudes and frequencies. Here we study the stochastic phenomenological P-bifurcations corresponding to the deterministic secondary bifurcation. The study of the phenomenological bifurcations concerns the

qualitative changes of the density of the stationary distribution associated with the system, i.e of the time independent solution of the corresponding Fokker-Planck equation. Understanding the secondary bifurcation is important because some aircrafts are operated beyond the flutter speed (e.g. the F-16), and for some systems the secondary bifurcation may occur for flow velocities not very much larger than the flutter velocity. A stochastic analysis in this case is useful for validating the mathematical model and studying the uncertainties in the limit cycle oscillations. // Diameter and curvature for polytopes: intriguing analogies, by Dr. Yuriy Zinchenko (University of Calgary). ABSTRACT: We highlight intriguing analogies between the diameter of a polytope and the largest possible total curvature of the associated central path. We prove continuous analogues of the results of Holt and Klee, and Klee and Walkup: we construct a family of polytopes which attain the conjectured order of the largest curvature, and prove that the special case where the number of inequalities is twice the dimension is equivalent to the general case. We show that the conjectured bound for the average diameter of a bounded cell of a simple hyperplane arrangement is asymptotically tight for fixed dimension. Links with the conjecture of Hirsch, Haimovich's probabilistic analysis of the shadow-vertex simplex algorithm, and the result of Dedieu, Malajovich and Shub on the average total curvature of a bounded cell are presented.

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**Links:**

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**File Uploads:**
Additional Upload 1: http://www.pims.math.ca/files/final_report/Brief_Summary.pdf

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