Speakers, Titles, and Abstracts

Friday, May 8	*morning*

7:30–8:45 AM: *Breakfast*

8:15–8:45 AM: *Registration*

8:45–9:00 AM: *Welcoming remarks*

9:00–9:50 AM:

Richard Guy (University of Calgary) Room: C640
A Triangle has Eight Vertices (but only one centre)

Quadration regards a triangle as an orthocentric quadrangle. Twinning is an involution between orthocentres and circumcentres. Together with variations of Conway's Extraversion, these give rise to symmetric sets of points, lines and circles. There are eight vertices, which are also both orthocentres and circumcentres. Twelve edges share six midpoints, which, with six diagonal points, lie on the 50-point circle, better known as the 9-point circle. There are 32 circles which touch three edges and also touch the 50-point circle. 32 Gergonne points, when joined to their respective touch-centres, give sets of four segments which concur in eight deLongchamps points, which, with the eight centroids, form two harmonic ranges with the ortho- and circum-centres on each of the four Euler lines. Corresponding points on the eight circumcircles generate pairs of parallel Simson-Wallace lines, each containing six feet of perpendiculars. In three symmetrical positions these coincide, with twelve feet on one line. In the three orthogonal positions they are pairs of parallel tangents to the 50-point circle, forming the Steiner Star of David. This three-symmetry is shared with the 144 Morley triangles which are all homothetic. Time does not allow investigation of the 256 Malfatti configurations, whose 256 radpoints probably lie in fours on 64 guylines, eight through each of the eight vertices.

10:00–10:30 AM: *Coffee break*

10:30–11:20 AM:

M. Ram Murty (Queen's University) Room: C640
Consecutive Squarefull Numbers

A number n is called squarefull if for every prime p dividing n, we have p^2 also dividing n. Erdos conjectured that the number of pairs of consecutive squarefull numbers $(n, n+1)$ with $n < N$ is at most $(logN)^A$ for some $A > 0$. This conjecture is still open. We will show that the abc conjecture implies this number is at most N^e for any $e > 0$. We will also discuss a related conjecture of Ankeny, Artin and Chowla on fundamental units of certain real quadratic fields and discuss its connection with the Erdos conjecture. This is joint work with Kevser Aktas.

10:30–10:50 AM:

Claude Laflamme (University of Calgary and Lyryx Learning) Room: B650
Open Educational resources and provincial initiative

Open texts are becoming increasingly available, and their use increasingly encouraged by provincial governments and educational institutions. We will present various open texts that are available for first year Mathematics & Statistics courses, and provide information on how these can be adapted when needed and how to obtain other material to support your courses.

11:00–11:20 AM:

Peter Zizler (Mount Royal University) Room: B650

Not-A-Proof in Mathematics

A rigorous proof in a non-honors mathematics course is a huge challenge. As a result cookbook recipes are often given. In order to provide some vital mathematical reasoning, we propose an introduction of a Not-A-Proof in our courses. In our talk, we give few examples of these and solicit feedback from the experts.

11:30–11:50 AM:

Farzad Aryan (University of Lethbridge) Room: C640

On Quadratic Divisor Problem

Let $d(n) = \sum_{d|n} 1$. This function is known as the divisor function. Consider the following shifted convolution sum

$$\sum_{an-m=h} d(n)d(m)f(an,m),$$

where f is a smooth function that is supported on $[x,2x] \times [x,2x]$ and oscillates mildly. In 1993, Duke, Friedlander, and Iwaniec proved that for every $\varepsilon > 0$

$$\sum_{an-m=h} d(n)d(m)f(an,m) = \text{Main Term}(x) + O(x^{0.75+\varepsilon}).$$

Here, we improve (unconditionally) the error term to $O(x^{0.61})$, and conditionally, under the assumption of the Ramanujan-Petersson conjecture, to $O(x^{0.5+\varepsilon})$.

Allysa Lumley (University of Lethbridge) Room: B650

Fun With Math

Fun with Math is an extracurricular program that we provide free of charge for interested students between the ages of 13-18. During the semester topics range from counting problems and probability to concepts from group theory and graph theory, all of which are presented in a concrete fashion. Students often discover interesting mathematical concepts with minimal prompting and develop new problem solving skills which can be applied to coursework and beyond. We will explain the goals and philosophy of the program and invite you to participate in one of the activities occurring at Fun With Math.

12:00–12:20 AM:

Nathan Ng (University of Lethbridge) Room: C640

Bounds for additive divisor sums

Let k be a natural number greater than 2 and $d_k(n)$ denotes the k-th divisor function. It equals the number of k-tuples $(n_1,\ldots,n_k) \in \mathbb{N}^k$ such that $n_1 \cdots n_k = n$. Let h be a natural number, $x > 0$, and $D_k(x,h) = \sum_{n \le x} d_k(n)d_k(n+h)$ denotes an additive divisor sum. In this talk we establish a lower bound of the correct order of magnitude for $D_k(x,h)$. In addition, we shall discuss upper bounds for this sum and the conjectured asymptotic formula for $D_k(x,h)$. This is joint work with Mark Thom.

Wanhua Su (MacEwan University) Room: B660

Some Challenges in Teaching Higher Level Statistics Courses

I have taught quite a few 200- and 300-level statistics courses in the past five years at MacEwan University and have encountered some challenges such as calibrating the difficulty of material and motivating students. In this talk, I would like to share some of my experience and my approaches to address these two issues.

12:30–2:00 PM: *Lunch*

Friday, May 8	*afternoon*

2:00–2:50 PM:

Doug Wiens (University of Alberta) Room: C640

Robustness of Design: A Survey

When an experiment is conducted for purposes which include fitting a particular model to the data, then the 'optimal' experimental design is highly dependent upon the model assumptions - linearity of the response function, independence and homoscedasticity of the errors, etc. When these assumptions are violated the design can be far from optimal, and so a more robust approach is called for. We should seek a design which behaves reasonably well over a large class of plausible models. I will review the progress which has been made on such problems, in a variety of experimental and modelling scenarios - prediction, extrapolation, discrimination, survey sampling, dose-response, etc.

3:00–3:20 PM:

Habiba Kadiri (University of Lethbridge) Room: C640

New bounds for $\psi(x;q,a)$

The prime number theorem in arithmetic progressions establishes that, for a and q fixed coprime integers, then $\psi(x;q,a)$ is asymptotic to $\frac{x}{\phi(q)}$ when x is large. We discuss new explicit bounds for the error term

$$\left|\frac{\psi(x;q,a)-\frac{x}{\phi(q)}}{\frac{x}{\phi(q)}}\right|,$$

which provide an extension and improvement over the previous work of Ramaré and Rumely. Such results depend on the zeros of the Dirichlet L-functions: a numerical verification of the Generalized Riemann Hypothesis up to a given height and explicit zero-free regions. We use the latest results of respectively Platt and Kadiri. In addition our method makes use of smooth weights. This is joint work with Allysa Lumley.

Linglong Kong (University of Alberta) Room: B660

Robust Designs for Nonlinear Quantile Regression

We give methods for the construction of designs for regression models, when the purpose of the investigation is the estimation of the conditional quantile function, and the estimation method is nonlinear quantile regression. The designs are robust against misspecified response functions, and against unanticipated heteroscedasticity. The methods are illustrated by examples. This is joint work with Doug Wiens.

Vincent Bouchard (University of Alberta) Room: B650
Flipping and blending the first year calculus sequence

Student-centered learning philosophies, such as blended learning and the flipped classroom model, have a lot to offer for first-year university education. In this talk I will report on my experience teaching a new blended and flipped version of the first-year calculus sequence (both Calculus I in Fall 2014 and Calculus II in Winter 2015) at University of Alberta. I will describe the structure of the course, and give some examples of online material and face-to-face activities. I will emphasize the numerous positives, from both my perspective and the feedback that I received from students, but will also highlight the challenges that I faced, especially with respect to finding appropriate in-class activities in a large classroom setting. Part of the reason for me to give this talk is to start a dialogue and hear about your ideas on how to improve this teaching model for first-year calculus!

3:30–3:50 PM:

Amy Feaver (The King's University) Room: C640
A theorem on norm-Euclidean rings of integers

We call a number field norm-Euclidean if its ring of integers is Euclidean with respect to the absolute value of its field norm. In this talk I will present a theorem which provides a necessary condition for a number field to be norm-Euclidean. We will look at applications of this theorem in the context of multiquadratic number fields, and discuss future directions for this research.

Zhichun Zhai (University of Alberta) Room: B660
Robust Designs for Model-Based Survey Sampling

Survey sampling is one of the most satisfying and useful fields of statistics. Robustness to incorrectly specified models is important in model-based survey sampling. The model-based survey sampling will be introduced. Recent results on robust model-based stratified sampling designs will be discussed . This is joint work with Douglas P. Wiens.

Simon St. Jean (Saskatoon) Room: B650
Student Learning in the Tutorial: Observations on Teaching Several Formats of Calculus Lab

At the university level, a course can be supplemented with a required lab or tutorial component. Students are further exposed to the course material and are given the opportunity to ask questions. During my university studies, I instructed several first and second year calculus labs. I taught using three distinct models of instruction with the goals of high lab attendance and an increase in student learning. In this presentation, I discuss these lab models and my observations on the effectiveness of each design to reach these goals.

4:00–4:20 PM:

Jeff Bleaney (University of Lethbridge) Room: C640
Application of Elliptic Nets in Solving Certain Diophantine Equations

An elliptic net is an n-dimensional array which satisfies the recurrence relation

$$W_{\mathbf{p}+\mathbf{q}+\mathbf{s}}W_{\mathbf{p}-\mathbf{q}}W_{\mathbf{r}+\mathbf{s}}W_{\mathbf{r}}+W_{\mathbf{q}+\mathbf{r}+\mathbf{s}}W_{\mathbf{q}-\mathbf{r}}W_{\mathbf{p}+\mathbf{s}}W_{\mathbf{p}}+W_{\mathbf{r}+\mathbf{p}+\mathbf{s}}W_{\mathbf{r}-\mathbf{p}}W_{\mathbf{q}+\mathbf{s}}W_{\mathbf{q}}=0.$$

This concept was first introduced by Kate Stange in 2008, as a generalization of elliptic divisibility sequences. We look at how elliptic nets can be used to study Diophantine equations of the form

$$Y^2 = X^3 + dZ^{12},$$

under the condition that $d \mid Z$.

Rui Hu (University of Alberta) Room: B660

Robust designs for model discrimination

We construct robust experimental designs to aid in the discrimination between two possible nonlinear regression models. Especially, when each of these two models might be only approximately specified, robust "maximin" design is proposed. The rough idea is as follow. We impose neighborhood structures on each regression response to describe the uncertainty in the specifications of the true underlying models. We determine the least favorable members of these neighborhoods which minimize the Kullback–Leibler divergence. Our optimal designs are those maximizing this minimum divergence. Two particular cases are investigated and in each case sequential approaches are studied. This is joint work with Doug P. Wiens.

Pamini Thangarajah (Mount Royal University) Room: B650

Projects in Undergraduate Linear Algebra Classes

Final projects are part of the curriculum in several of our mathematics courses and in-class presentations play a role in many classes as well. We will discuss some linear algebra projects and our experiences with undergraduate research in mathematics.

4:30–5:00 PM: *Coffee break*

5:00–5:50 PM:

M. Ram Murty (Queen's University) Room: PE250

Measurement, Mathematics and Information Technology (Public Lecture)

In this talk, we will highlight the importance of measurement, discuss what can and cannot be measured. Focusing on the measurement of position, importance, and shape, we illustrate by dicussing the mathematics behind, GPS, Google and laser surgery. The talk will be accessible to a wide audience.

6:30–8:00 PM: *Dinner*

Saturday, May 9	*morning*

7:30–8:45 AM: *Breakfast*

9:00–9:50 AM:

Rob Craigen (University of Manitoba) Room: C640

It's All in the Follow Through – what research in math education says ... and doesn't say

We'll be examining a few classic cases of how educational research has been handled that explain a lot about how we got where we are in public school math education today.

10:00–10:20 AM: *Coffee break*

10:20–11:00 AM:

Michael Cavers and Joseph Ling (University of Calgary) Room: C640

Multiple-choice tests and the student-weighted model

We discuss a model of multiple choice testing known as the "student-weighted" model. Students are given the freedom to assign relative weights to individual questions representing their belief in the correctness of their response. The confidence weighting for each question is taken into account when calculating their overall score. We experimented using this method in two first year Calculus courses at the University of Calgary in 2014. In this talk we will describe our experience while using this model. The session is meant to be interactive allowing for participants to share ideas and their experiences with different multiple-choice models.

11:05–11:25 AM:

Vladimir Troitsky (University of Alberta) Room: C640

Which topics in Alberta K-12 Math Curriculum are needed for University math?

11:30–12:20 PM:

Peter Zvengrowski (University of Calgary) Room: C640

A topological look at the vector (cross) product in three dimensions

The vector product (or cross product) of two vectors in 3-dimensional real space $\mathbb{R}^3$ is a standard item covered in most every text in calculus, advanced calculus, and vector calculus, as well as in many physics and linear algebra texts. Most of these texts add a remark (or “warning”) that this vector product is available only in 3-dimensional space.

In this talk we shall start with some of the early history, in the nineteenth century, of the vector product, and in particular its relation to quaternions. Then we shall show that in fact the 3-dimensional vector product is *not* the only one, indeed the Swiss mathematician Beno Eckmann (a frequent visitor to Alberta) discovered a vector product in 7-dimensional space in 1942. Furthermore, by about 1960 deep advances in topology implied that there were no further vector products in any other dimension. We shall also, following Eckmann, talk about the generalization to r-fold vector products for $r \geq 1$ (the familiar vector product is a 2-fold vector product), and give the complete results for which dimensions n and for which r these can exist.

In the above work it is clear that the spheres S^3, S^7 play a special role (as well as their “little cousin” S^1). In the last part of the talk we will briefly discuss how these special spheres also play a major part in the recent solution of the Kervaire conjecture by Hill, Hopkins, and Ravenel, as well as their relation to the author’s own research on the span of smooth manifolds.

12:30–2:00 PM: *Lunch*

Saturday, May 9	*afternoon*

2:00–3:30 PM: **Discussion:** *Calculus Sequence in Alberta*

2:00–3:30 PM: **Discussion:** *Exploring the Alberta K-12 Mathematics Curriculum*

3:30–4:00 PM: *Coffee break*