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The PG Colloquium

Talks in 2010/2011 (organized by Eric Hall).

Summer 2011

○ **Smiles and smirks: options and local volatility models** (N. McWilliams) Monday 15th August at 16:00 in JCMB 4312

Abstract: In this talk, I will give a simple introduction to option pricing. The Black-Scholes formula opened a wide and extensive area in the financial world, but is not without its flaws. However, I will demonstrate how it can be extended to provide a more accurate description of real world prices. The talk will conclude with a basic application which, given the beauty of hindsight, would have produced some favourable results in practice.

○ **About Algebras** (R. Jenkins) Wednesday 29th June at 15:00 in JCMB 5326

Abstract: This is meant to be an introduction to some ideas in algebra, like what algebras and representations are about in general. But really, it's just going to be me explaining how I personally picture most of the stuff that you're `not supposed to picture'. In particular, I'll draw some sketches and use lots of loose, slightly irrelevant and distracting metaphors.

So for anyone who already knows about algebra it'll be way too easy and for anyone who has never seen the definition of

an algebra it wont be rigorous enough. It's more sort of aimed at people who have to learn what algebras are but never studied representation theory. And I promise to run under time.

- **Efficiency of Randomized Coordinate Descent Methods on Minimization Problems with a Composite Objective Function** (M. Takac) 23rd June 2011 at 15:00 in JCMB 5326

  Abstract: In this work we develop a randomized block-coordinate descent method for minimizing the sum of a smooth and a simple nonsmooth block-separable convex function and establish iteration complexity bounds. This extends recent results of Nesterov (Efficiency of coordinate descent methods on huge-scale optimization problems 2010), which cover the smooth case, to composite minimization, while improving the complexity and simplifying the analysis. In the smooth case we allow for arbitrary norms and probability vectors.

  Using both synthetic and real data, we demonstrate numerically that the method is able to solve various optimization problems with a billion variables. Such problems can be found, for example, in Compressed Sensing (lasso), Statistics (group lasso), Machine Learning (L1-regularized logistic or L2 loss function) and Engineering (truss topology design).

  For the L1-regularized least squares problem we implement a GPU-accelerated parallel version of our algorithm (CUDA) and observe speedups of up to two orders of magnitude when compared with an efficient serial code (C).

- **Quantum gravity and causal set theory** (N. Hustler) 16th June 2011 at 15:00 in JCMB 5326

  Abstract: I will give a brief overview of the problems associated with developing a quantum theory of gravity and proceed to talk about a novel and minimalist approach called causal set theory. The talk will not be at a technical level.

- **Backward Stochastic Differential Equations and G-expectation** (K. Wei) 9th June 2011 at 15:00 in JCMB 5326

  Abstract: My talk consists of two independent parts: BSDE and G-expectation. BSDE has different philosophy from the usual SDE and has many applications, such has control theory. It plays an important role in the analysis of modern financial mathematics. G-expectation is a sublinear expectation

proposed by prof. Shige Peng in about 2006 and it develops from the nonlinear phenomenon of utility function in the market. Based on it, we can develop the whole stochastic analysis of nonlinear case. I will not go very deep about them but try to give you a clear idea.

Spring 2011

- **5th MAXWELL INSTITUTE PG COLLOQUIUM** - 28th March 15:30-18:00 in the ICMS Newhaven Room

  a joint Colloquium between Edinburgh and Heriot-Watt

  - **Evaluation of evidence relating to traces of drugs on banknotes** (Amy Wilson, Edinburgh)

    Abstract: Banknotes can be seized from crime scenes as evidence of illicit drug use. Mass Spec Analytical Ltd. (MSA), an analytical chemistry company in Bristol, have developed a technique to analyse the levels of drugs on banknotes. They have collected data from banknotes seized in criminal investigations, as well as from banknotes from the general circulation. Some of the principles involved in analysing these data will be introduced, focussing on the likelihood of the data under each of two propositions: that a set of seized banknotes is associated with drug crime, and that these banknotes are from the general circulation. Models which we are developing will be outlined, alongside a presentation of some preliminary results.

  - **Extracting smooth patterns from data using truncated polynomials** (Viani Biatat, Heriot-Watt)

    Abstract: A fundamental purpose of Statistics is to summarize data in order to explore potential relation between variables, and a popular/useful tool to achieve this is found in linear/polynomial regressions. This approach turns out to be insufficient for a wide class of data. In this talk, I will start with basic principles and then describe how truncated polynomials can be used in various settings to extract smooth patterns from data when the standard linear/polynomial regression fails. I promise to make this talk very simple (with a lot of graphics) so that everyone can enjoy it.

- **Awards Ceremony** 24th March 2011 at 15:00 in JCMB 4312

A huge 'thanks' to everyone who helped to make this year's Colloquium a success!

- **Best talk** - Marina Iliopoulou for *The Heilbronn Problem*

- **Best use of pictures/movies/special effects in a talk** - Charlie Matthews for *Molecular Simulation for Fun and Profit*

- **Best non-math talk** - Bubacarr Bah for *Africa, the 'misunderstood' continent*

- **Best performance in a talk** - James-Michael Leahy for *A primer on number theory and L-functions*

- **Talk you wish you hadn't missed** - Stuart Murray for *GFD Gently*

- **Best baked-goodness** - Lisa Torlina for *Experimental Dessert with Berries*

- **Best effort at baked-goodness** - Pedro Munari for *Caterpillar cake, et al.*

- **Making Pictures: An Introduction to Realistic Image Synthesis** (Hari Sriskantha) 17th March 2011 at 15:00 in JCMB 4312

  Abstract: The development of algorithms which generate photorealistic images is an active field of research in computer graphics. Their applications are varied, ranging from the professional (such as simulations and computer-aided architecture) to the entertaining (such as video games and animation). The first half of the talk focuses on the physics and mathematics we need to consider when developing such algorithms, including the all-important 'rendering equation'. The second half then builds on this background to introduce two popular rendering methods: ray tracing and path tracing.

- **Molecular Simulation for Fun and Profit** (Charlie Matthews) 10th March 2011 at 15:00 in JCMB 4312

  Abstract: Molecular dynamics (MD) is a powerful and highly accurate modelling technique using for probing mechanical and thermodynamic properties of matter in almost any state. It's widely used in biochemistry (for modelling things like proteins or DNA) or materials science (potentially for the propagation of fractures or behaviour under pressure) and is often regarded as being like "the ultimate microscope". In this talk I will go over a few problems often encountered in Molecular Dynamics and how we can tackle them. There'll also be pretty pictures and videos showing examples of things that are done in industry.

- **Getting rid of unwanted singularities** (Dmitrijs Sakovics) 3rd March 2011 at 15:00 in JCMB 4312

  Abstract: When you work with non-trivial functions, they often turn out to have singular points. Sometimes the singularities of a function give you important insight into the function's structure, but usually they just get in the way. In this talk I will give you a basic idea of how algebraic geometers deal with these points and what spaces we end up with.

- **Vibration of the Millennium Bridge** (Wenjun Xia) 24th February 2011 at 15:00 in JCMB 4312

  Abstract: The famous vibration of the Millennium Bridge arouses the attention of scientists. The paper "Crowd synchrony on the Millennium Bridge" models this phenomenon. Last year in my spare time I helped one of my friends reproduce this model by using the system of ODEs and observed representations of graphs which showed synchrony. In this talk I'll discuss some research on the effect of the change of parameters on the outcome of the system

- The regularly scheduled talk for the 17th February 2011 was cancelled so as not to conflict with the **EwE Conference**. More information about outreach events can be found on the School of Maths outreach page.

- **The Heilbronn Problem** (Marina Iliopoulou) 10th February 2011 at 15:00 in JCMB 4312

  Abstract: During this talk, we will see the Heilbronn conjecture, a still open question in combinatorics/discrete harmonic analysis, and we will follow some steps leading to its formulation and to the belief that the conjecture is true. We will also prove together some of the basic results in the area, so be prepared for questions! :)

- **Africa, the 'misunderstood' continent** (Bubacarr Bah) 3rd February 2011 at 15:00 in JCMB 4312

  Abstract: The talk would endeavour to address the misconceptions and weird generalisations made about Africa. The first half of the talk will briefly touch on the geography, culture, politics and socio-economic development of the continent. The other half would be a general discussion with the audience. People are welcome to ask any question they have about Africa which I may or may not be able to respond to adequately.

The following article will be a good synopsis about Africa.

○ **LaTeX, Organization and YOU!** (Eric Hall and George Kinnear)
27th January 2011 at 15:00 in JCMB 6206

Abstract: We will discuss LaTeX editors, bibliography management software and version control systems. It will be a hoot.

See the PDF slides. Additional information about the software discussed can be found via the following links: TeXnicCenter Alpha, TeXShop, JabRef, BibDesk, Git, and GitX.

○ **Travel funding for a young mathematician** (Jesus Martinez)
20th January 2011 at 15:00 in JCMB 6206

Abstract: Due to the current financial crisis the amount of funding available for mathematics is going down in the UK. In particular the financial resources for postgraduate traveling are not ideal, making going abroad very difficult. In this talk I will try to address how to choose efficiently which conferences to apply to, identify sources of funding, write a strong application and a scientific report of the visit. Time permitting I will mention some (maybe personal) ethics regarding the use of public funds.

See the PDF slides.

Winter 2010

○ **4th MAXWELL INSTITUTE PG COLLOQUIUM** - 3rd December 2010 at 15:30-18:00 in the ICMS Newhaven Room

a joint Colloquium between Edinburgh and Heriot-Watt

○ **Henri Poincare: the last universalist** (Daniele Sepe, Edinburgh)

Abstract: Poincare's legacy in mathematics and theoretical physics is still huge today. In this brief talk I will try to pay tribute to his work by discussing a few problems that he studied in detail which are still relevant nowadays.

○ **Topological bits and pieces, fun and games** (Jenny Bloomfield, Heriot-Watt)

Abstract: As suggested by the title, this talk will be filled with fun and games involving Topology.

- **A primer on number theory and L-functions** (James-Michael Leahy, Edinburgh)

  Abstract: In this colloquium talk, we restrict our attention to rational primes, and explain how the Riemann Zeta Function can be applied to the study of the distribution of prime numbers. As a second example of an L-function, we briefly introduce Dirchlet characters and their associated Dirchlet L-functions. Moreover, we explain how the Dirchlet L-function can be used to study the distribution of primes in arithmetic progressions.

- **What's Remediation? An actuarial story** (Bryan Tope) 25th November 2010 at 15:00 in JCMB 4312

  Abstract: I am working on a project at the moment where errors in pricing funds for pension products may have caused customers to lose out financially. The fund pricing errors have been corrected but these customers have to be identified and the amount to cover their losses calculated. I go through the principles involved in this process, where the key idea is to keep things simple and steer clear of complicated calculations.

- **Combinatorial optimization: modelling aspects and solution techniques** (Pablo Gonzalez Brevis) 18th November 2010 at 15:00 in JCMB 4312

  Abstract: In this talk, and following Pedro's PG Colloquium of this week, I will introduce some of the approaches used to solve combinatorial optimization problems. The aim of the presentation is to show the variety and complexity of this class of problems which arise in many applications. Also, I will point out some good practices to take into account when modelling them. Problems involving wireless networks and sports will be addressed.

- **Maths, Computers and Operational Research** (Pedro Munari) 11th November 2010 at 15:00 in JCMB 4312

  Abstract: In this talk, I will present an overview of operational research, the discipline of applying appropriate analytical methods to decision making. Focusing on optimization techniques, I will summarize how the developments in mathematics and computer science have been essential to the progress of this discipline. Also, I will address some successful

case studies that show the importance of operational research to companies and customers as well.

- **Helioseismology** (Chris Foley) 4th November 2010 at 15:00 in JCMB 4312

  Abstract: The music of the sun, supposedly. Helioseismology is the study of the natural resonant oscillations, which are the visible manifestation of standing sound waves trapped in the solar(=sun) interior. Extrapolating from this, the helioseismologists like to call the sun a giant resonating musical instrument. The subject plays an important role in our understanding of the composition, structure and evolution of the sun and stars.

- **The Extremal Black Hole/CFT Correspondence** (Maria Johnstone) 28th October 2010 at 15:00 in JCMB 4312

  Abstract: I will describe how the entropy of an extremal black hole in a number of dimensions is given by the entropy of a quantum conformal field theory, and how this relationship fits into the AdS/CFT Correspondence, as outlined last week by Lisa.

- **The AdS/CFT correspondence: How is a black hole like a strange metal?** (Lisa Torlina) 21st October 2010 at 15:00 in JCMB 4312

  Abstract: I will give a brief introduction to a striking result from string theory known as the AdS/CFT correspondence, which states that there is a duality between quantum theories of gravity and quantum field theories with no gravity at all. I will explore some of the key features of this correspondence and how we can apply this to study condensed matter systems using black hole physics.

- **A Colloquium of Two Halves** (Andrew Stothers) 14th October 2010 at 15:00 in JCMB 4312

  Abstract: I will be giving a two part sport-related colloquium. The first half will be concerned with Motorsport; I will discuss the factors involved in setting up a racing car and the physical phenomena behind them. In the second half, I will (not explicitly) use a Mathematical model to discuss who really did the best (and worst), given their resources, in the last FIFA World Cup, and other interesting stats.

- **GFD Gently** (Stuart Murray) 7th October 2010 at 15:00 in JCMB 4312

Abstract: In geophysical fluid dynamics, many of the simplest models of natural phenomena can yield striking and surprisingly accurate results, despite being built up from a few basic assumptions and almost no empirical evidence. We will dip our toes in the shallow end of GFD by deriving one particular basic model of a real fluid process, and then take a look at a widely used numerical method used to simulate such systems (with some animated results). This should hopefully explain what Cumbrian turnips have to do with GFD.

- **Making your maths talks rock** (Julia Collins) 30th September 2010 at 15:00 in JCMB 6206

  Abstract: Communicating research mathematics is a difficult thing. Communicating it in a way that leaves your audience informed, inspired and still awake is something that few people can do very well. In this colloquium I will explain the "do"s and "don't"s of giving a talk, as well as offering some practical advice on presentation software. And if you think that your talks are already amazing, come along anyway and share your tips with the rest of us!

  See the PPT slides or the PDF version.

- **Maths Education in Scotland: a rough guide** (George Kinnear) 23rd September 2010 at 15:00 in JCMB 6206

  Abstract: Most of us will start teaching soon, and that will often involve contact with students who have come from High Schools here in Scotland. What can you expect them to know already? I'll give an overview of the education system here, then run through the maths syllabus that most students will have seen - it should seem pretty familiar to you! There will be lots of examples, including a demonstration of the mysterious "Scottish division" technique.

  See the PDF slides.

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