



The University of
Nottingham

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Mathematics@Nottingham

School of Mathematical Sciences Newsletter 2014



Your future starts here

Sanaa Chaudhry preparing for a seminar
in the Mathematical Sciences Building.

Great opportunities

Communicating mathematics, research bursaries, study abroad and much more

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Our academics are at the forefront of exciting research

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Hello and welcome

The University of Nottingham is a great place to study mathematics, and we thank you for your interest in our school. Mathematics underpins many of the major developments in science, engineering and society, and our lecturing staff are involved in research of an international quality that covers a very broad variety of topics in mathematical sciences.

This cutting-edge research experience ensures that you will learn the very latest, most relevant mathematics from experts who are leaders in their subject areas. At the same time our staff are very approachable and will take a very strong interest in your personal and academic development, with regular personal tutorials held throughout your degree.

The large amount of support that we provide will help make your transition to university easier, and will continue throughout your studies. Our superb building offers excellent facilities for study, and is situated in a prime position on the beautiful University Park Campus. We offer many opportunities for you to develop your interests, including the option to study abroad as part of your degree. Our graduates are highly employable and a degree in mathematics from The University of Nottingham is very well regarded.

We understand that it is a difficult decision to choose where to study for your degree, and there are numerous factors to consider. Nottingham will provide an excellent environment for you, both in terms of academic opportunities and as part of a vibrant and exciting city. We have put together this newsletter to give further insight into our activities within the school.

If you have any questions, please contact us using the details on page 12. Good luck with your decision making and we look forward to welcoming you onto campus soon.

Professor Ian Dryden

Head of the School of Mathematical Sciences

News

New maths course at our China Campus

Our BSc Mathematics with Engineering course is now being offered at our campus in Ningbo, China. It can be taken as a three- or four-year course, depending on your entry qualifications, with your first year or two years spent in China and your last two years in the UK.

The course offers a mathematical education with an emphasis on the practical application of mathematical ideas, while also providing an opportunity to study engineering across a range of disciplines.

The combination of mathematics, engineering and computing appeals to a wide range of employers.

News

See us on iTunesU and YouTube



You can find The University of Nottingham on the education iTunes store, iTunesU, and our maths students now have access to free educational video and audio podcasts.

Find out more at www.nottingham.ac.uk/itunesu

The University also has its own YouTube Education channel, which includes several mathematical playlists. The videos and screencasts there include sessions of general interest and selected mathematics lectures as given to our students, along with other useful resources.

Find out more at www.youtube.com/nottmuniversity

News

Former research fellow turned film-maker

Andrzej Dragan, a former postdoctoral fellow in the School of Mathematical Sciences and award-winning photographer, has moved into the world of cinema and is about to release his first movie. He collaborated with approximately 40 artists including Waldemar Pokromski, the acclaimed make-up artist behind Schindler's List.

'Heirarchy Lost' tells the story of a scientist who makes an amazing discovery. Andrzej not only conceived the story, developed and wrote the script, but also directed and produced the film. One of our academic staff members, Dr Ivette Fuentes, was also involved in helping him with the story and script. You can find out more about the film on the dedicated Facebook page: www.facebook.com/HierarchyLost

Student profile

“I enjoy the variety of subjects taught on this course. It takes maths to a completely new level and it is interesting to learn about the applicability of maths to everyday life. I like learning about the computer programs used throughout the course, and also the interactive example classes provided by the lecturers. The variety of learning techniques makes the course interesting and, in turn, enjoyable.”

Priya Lanka
MMath Mathematics

Find out more about Priya's experience at
www.nottingham.ac.uk/mathematics/profiles



Scan here with
your smartphone
for more student
profiles.

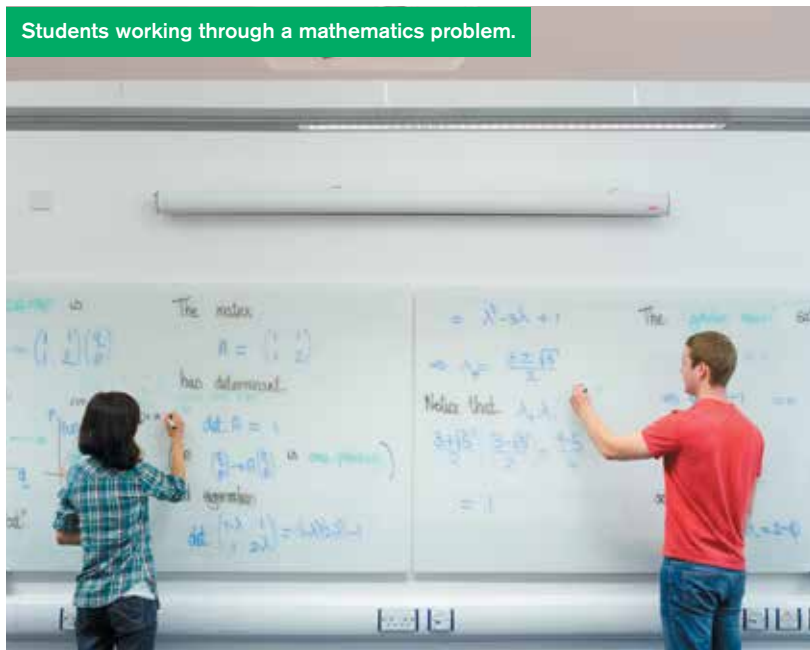
Priya prepares to see her personal tutor in
the Mathematical Sciences Building.

Your Teaching Officer is here to help



Chris Robson

Students working through a mathematics problem.



The School of Mathematical Sciences has its own Teaching Officer, Chris Robson. Chris' role is to support the first-year degree students with their studies in the three core modules: Analytical and Computational Foundations, Calculus and Linear Mathematics.

"I support students by holding three drop-in classes a week, as well as having individual appointments with students. The drop-in sessions may involve revision lessons on topics that students have found difficult, going over solutions to tests, coursework and set problems or just giving individual help. I email all of the students each week to let them know what the agenda will be.

Individual appointments can be made, particularly for students who are struggling or have missed some lectures through illness or other problems. It might involve a weekly meeting or just one or two sessions to get the student back up to speed. My door is open and students are always welcome to drop in with a quick question; often all you need is a minute of my time to get you going again with a problem.

Being successful in your first year involves hard work, but it is made much easier if you use all the help that is available, which means not just your lecturers, tutor and myself, but also your fellow students. We encourage you to work in groups and share your problems and knowledge. Not only do you benefit from the help that you receive, but others will also benefit by clarifying their thoughts and perhaps finding aspects that they hadn't fully understood.

Bridging the gap between A level and university

The questions that I am asked most frequently are "What are the differences between A level and degree level maths?" and "What should I do before starting university?"

The aspect that students find most difficult initially is proof. At A level your teachers may have glossed over the proofs since they are rarely examined, but at university, proof is an important part of both learning and examinations. To get some idea of what is involved, I would suggest looking at the 'Core Topics in University Mathematics' videos on The University of Nottingham YouTube channel. They cover some first-year topics and can be found at tiny.cc/mathscoretopics

It is important for you to do some maths over the summer holidays, so that you are ready to start your course and don't have too much revision to do in the first few weeks. If you haven't studied complex numbers or matrices, try to learn something about them from a further maths textbook before you arrive."

Chris Robson
Teaching Officer

How does your garden glow?

Nature's ability to create iridescent flowers has been recreated by mathematicians at The University of Nottingham.

The team of researchers have collaborated with experimentalists at the University of Cambridge to create a mathematical model of a plant's petals which will help us learn more about iridescence in flowering plants and the role it may play in attracting pollinators.

An iridescent surface appears to change colour as you alter the angle you view it from. It is found in the animal kingdom in insects, inside sea shells and in feathers, and is also seen in some plants. Iridescence in flowers may act as a signal to pollinators such as bumble-bees, who are crucial to crop production.

Understanding how petals produce iridescence to attract pollinators is a major goal in plant biology. An estimated 35% of global crop production depends on petal-mediated animal pollination but a decrease in pollinator numbers across the world has started to limit the odds of pollination and reduce crop production rates.

Flowers and the animals that pollinate plants interact at the petal surface. The surfaces of many petals have regular patterns, produced from folds of the waterproof cuticle layer that covers all plant surfaces. These patterns can interfere with light to produce strong optical effects including iridescent colours, and might also influence animal grip.

Rea Antoniou Kourounioti, a PhD student in the School of Biosciences, said: "We provide a first analysis of how petal surface patterns might be produced. Our team of researchers combined experimental data with mathematical modelling to develop a biomechanical model of the outer layers of a petal or leaf. We used this to demonstrate that mechanical buckling of the outermost, waxy cuticle layer, can create the ridge patterns observed in nature on petals and leaves. Learning more about how iridescence is produced is important for pollination of crops and also for other types of patterning in biology."



Understanding how petals produce iridescence to attract pollinators is a major goal in plant biology.

Communicating mathematics



The Communicating Mathematics module gives students the opportunity to gain experience of teaching maths.

Communicating Mathematics is a third-year module available for students on the BSc and MMath Mathematics courses that gives students the opportunity to gain first-hand experience of teaching mathematics to school children.

Students work at local schools alongside practising maths teachers and take on a range of responsibilities from classroom assistant to leading a self-originated mathematical activity or project, in order to improve their skills in communicating maths.

The module aims to help students develop their ability to work with pupils in a classroom situation, learn how to prepare lesson plans and teaching materials and lead a classroom in mathematical activity. This helps them to develop their communication and presentation skills as well as their ability to think logically and analytically, all useful skills.

Sadiq Sumar is currently studying the Communicating Mathematics module and goes into a local school once a week. Here he reflects on the module so far:

“So far this term I have been placed in lessons to build up an idea of what I believe to be the role of the teacher in the school. I write a log every week describing my experiences and evaluating the lessons: what was taught well, what could have been explained more thoroughly and the general success of the lesson.

I help out with worksheet-based activities and group work, and during the latter weeks of term I also planned and executed a lesson with a year seven group studying fractions. After this I was able to evaluate my own performance as a teacher, where I could look at ways to improve, and conceive new ideas and new approaches for the same topics.

My main contact within the school is the head of the maths department – he designates which lessons I teach in. I am gaining an insight into what makes a good classroom and learning the ability to teach, plus the valuable skill of how to keep a classroom full of young people interested. Also, improving on my organisational, communication and leadership skills will stand me in good stead for anything I decide to pursue in the future.

The module itself is very self-evaluative and I try to take the necessary steps to ensure I am developing an understanding of the issues within teaching. I believe that academically, teaching will allow me to take a broader view on what I study as well as finding different ways to understand and explain a topic. Personally, the soft skills I will gain such as improving my confidence, assertiveness, decisiveness and organisational and communication skills are priceless attributes in being successful in the future.”



Elizabeth researched brain connectivity to find a way to classify different diseases affecting the brain.

Student researches brain connectivity

Mathematical sciences student Elizabeth Ho recently received a vacation bursary from the Wellcome Trust enabling her to spend time during the holidays carrying out research into modelling brain connectivity.

The aim of Elizabeth's research was to investigate whether or not the brains of individuals with the same disease share the same topology. The project involved fitting statistical models to real data involving healthy individuals and patients with chronic tinnitus.

Brain connectivity analysis allows us to understand how various regions of the brain interact with one another. Although graph theory has provided insights into the infrastructural properties of a given subject's brain, comparing brain networks across subjects and groups of subjects remains a significant challenge. This project was concerned with a class of network models and statistical methods to enable a systematic comparison of brain networks across subjects, and the application of these to some real brain imaging data.

The results obtained suggested that Exponential Random Graph models can fit brain imaging data very well, although more research is needed to find an algorithm which will allow hospitals and researchers to aid the diagnosis of diseases based on brain imaging data, such as resting-state functional magnetic resonance imaging (fMRI) data. The latter is the subject of ongoing research.

Elizabeth said: "I was interested in the research experience and this was the perfect opportunity for me as it was also a topic I was interested in. I was familiar with my supervisor's work and it provided me with a chance to improve my computing skills.

The scholarship itself was interesting and filled with a million things to learn, but I enjoyed every bit of it as it challenged me to explore certain aspects of maths that were beyond the boundaries of what my curriculum and modules had taught me.

It gave me a clearer idea of what a research career would be like and allowed me to experience what studying for a post-doctorate qualification would entail.

The most interesting part of the project for me was seeing the different patterns on the brain; it was even more fascinating that statistical models could fit the networks so well. Learning all these new models was indeed an experience, especially how the models came about initially from social network patterns."

Graduate profile



Name: Stephanie Hind
Course: BSc Mathematics and Management Studies
Graduated: 2010
Now: Auditor at PKF Cooper Parry

“After graduating, I joined a graduate scheme as an audit trainee at Cooper Parry, an East Midlands-based accountancy firm. The graduate scheme lasted for three years and during that time I took exams to obtain the ACA accounting qualification.

As an auditor I visit clients' premises and check and approve financial information in order to determine that the companies' results reflect a true and fair position.

I found out about the graduate scheme by attending career fairs and researching accountancy companies on the internet. I attended presentations put on by the school and workshops at the University's Careers and Employability Service. During my final two years I took part in the Nottingham Advantage Award and completed mock interviews as part of this, so was able to prepare myself for the working world.

I am able use the analytical, communication and project management skills I learnt at University in my day to day work. I took a joint honours degree which meant I always had to think about the two

different subjects and manage my time effectively, a valuable skill to take into the working world.

In the maths half of my degree I learnt about NPV (net present value) and I use this in my day to day work. On the management side I completed some accountancy modules and have also been able to use this knowledge in my current position.

At Nottingham I was part of the Maths Society, the Latin, Ballroom and Salsa Society and the Chocolate Society. Being involved with societies lets you meet other people and network which is a good skill to have once you start work.

I really liked the campus at Nottingham and there were always events happening around the University, and within the school they had the Maths Society so you could integrate with peers outside of lectures and problems classes.

The University of Nottingham allowed me to learn and develop as an individual, get a good degree and make some friends for life.

In the future I still see myself within the accounting profession and want to become an FCA (Fellow Chartered Accountant).”

Staff profile

Meet our staff

Dr Stephen Cox is an Associate Professor and Reader in Applied Mathematics - here he talks about what he enjoys most about mathematics and the research projects he is involved with.

“I did a mathematics degree at the University of Oxford, then a PhD in Applied Mathematics at the University of Bristol. After my PhD I did three post-docs: two in Adelaide, Australia and one at Cornell University, USA. Then I worked for nine years at The University of Nottingham, starting out as a lecturer then getting promoted to senior lecturer, before moving to the University of Adelaide for three years. Finally, in 2006, I moved back to The University of Nottingham as an associate professor and reader, where I've been ever since.

I love the fact that mathematics can be applied to almost any aspect of life and give new insights. My specialism is applied mathematics, which is an enormously broad area. I started out specialising in fluid mechanics (How do you predict the

weather? How do you mix two paints together – efficiently?) and now mostly work in applications of mathematics to electronic engineering. I tend to interact with engineers quite a lot – they have interesting practical problems which give rise to interesting mathematical problems. That's where I come in. There's a great sense of satisfaction when a fairly abstract mathematical calculation ends up telling you something new that's of practical interest.

I enjoy teaching. Nottingham attracts very good students and it can genuinely be great fun to interact with them. There's nothing better than a difficult question from a good student, especially when the question makes me re-examine a subject I've been teaching for a while!

I also love doing my research, especially in collaboration with academics from other disciplines and other countries. There is a real challenge in convincing non-mathematicians that mathematics can be useful to them. I've worked with mathematicians and engineers from many countries, most recently from Singapore and South Africa. I've recently made trips to both countries – these were academically fruitful and culturally fascinating.

One of my current research projects involves what are called class-D amplifiers. These are very efficient little amplifiers that are present in phones, tablets, laptops, and so on – any mobile electrical device where battery life is important. My research so far has focused on trying to tweak the design to reduce the distortion generated by the amplifier, so it delivers the best sound quality.

One of the highlights of my research was accidentally inventing a new design for a class-D amplifier, based on just doing the mathematics. After some initial scepticism, my collaborator – a professional designer of class-D amplifiers – built a prototype, and it really did work!”

Dr Stephen Cox
 Associate Professor and Reader in Applied Mathematics

Study abroad

I was attracted to the School of Mathematical Sciences at Nottingham because of its high ranking in the league tables, the new facilities available within the school and the fact that students are encouraged to study abroad. My year spent abroad has been the highlight of my course.

When I was applying for my year abroad, I met with the study abroad coordinator in the school to decide where I wanted to go. I was then required to submit an application to the school which outlined why I wanted to go and what I hoped to get out of the experience.

The study abroad team were a great help with providing information on bursaries. The Erasmus grant is offered to all students who study abroad in the EU; I received this as well as my normal student loan, so I was able to do everything that I wanted to do during my time abroad.

I studied French at A level so my choices were Paris, Besancon and Bordeaux. I decided on the University of Bordeaux and studied there for nine months. The modules I studied were similar to the ones we study in the UK, but the style of teaching and all round university life was very different. I was also able to take an astronomy module which was fascinating, as well as some sports modules.

I had my own ambitions of what standard of French speaking I wanted to achieve. All foreign students are automatically enrolled on a free, year-long French course paid for by the university and after taking a test you are put in a class which suits your language ability. I found these classes a great way to meet other students from a variety of countries.

The international office at Bordeaux was brilliant at looking after us. The staff organised trips to the beach, vineyards, and small cultural visits around Bordeaux. These trips were a fantastic opportunity to meet other students.

There were hundreds of foreign students in Bordeaux, all there to have a similar experience. I met some special people, who I will definitely be seeing in the future.

I was also in constant contact with the study abroad coordinator back in the UK throughout the year. They offered brilliant support not only for academic issues but also general well-being; it was good to know that there was support from Nottingham.

My time in Bordeaux was incredible; it's such a cliché but it was definitely the best year of my life. I met some amazing people and had loads of great experiences. I was proud of how much my French improved and I learnt how important it is to try new experiences and not be afraid. Academically, studying maths in French has made my final year in Nottingham seem a lot easier because there isn't the language obstacle. I would highly recommend doing a year abroad!

Toby Green

BSc Mathematics with International Study

My favourite memory

My favourite memories are of the ski and surf trips I did with the university. I went on about 10 ski and surf trips – it was the easiest way for me to meet like-minded people and I met a couple of my closest friends surfing. On one of the trips about 40 students and two teachers went to the Pyrenees for a week. The snow conditions were the best in years. We stayed in a huge lodge next to the piste, ate a lot of cheese, drank wine and I fell in love with snowboarding.



Toby spent nine months studying at the University of Bordeaux in France.

Become a student ambassador

At Nottingham you can apply to become a student ambassador and you could be an ambassador within the School of Mathematical Sciences.

The student ambassador scheme is a great, flexible way to earn money as you can fit it around your studies and only commit to the work hours you sign up for.

Student ambassadors represent the school at events including open days and visit days, and can also get involved with activities to help raise awareness among school children about maths at university. Student ambassador duties include leading visitors on tours of the campus, answering their question and helping them enjoy their time here, as well as talking to young people about making the transition to higher education, raising their aspirations and assisting University staff with setting up and closing down events.

Find out more at:
www.nottingham.ac.uk/currentstudents/studentopportunities

“Being an ambassador enables you to share your experience of university and student life with prospective students, as well as giving them the chance to find out what they want to know about studying at Nottingham. It’s also a great opportunity to gain confidence and to develop your communication skills.”

Rachel Carrington
MMath Mathematics (second year)



Left: An ambassador helping visitors to solve the Rubik's cube in a drop-in session at an open day.

Below: An ambassador taking visitors on a tour of University Park Campus.



Quieter and smoother next generation cars



Controlling noise and vibration will help reduce noise pollution levels and improve driver and passenger comfort.

Car journeys will become even smoother and quieter as a result of major new research which aims to cut noise and vibration in the next generation of vehicles.

Academics from within the School of Mathematical Sciences at The University of Nottingham and from Nottingham Trent University are working in collaboration with Jaguar Land Rover and industrial partners in Germany to develop software which will enable car manufacturers to accurately predict how a new model would respond to high levels of structural vibration caused by air resistance.

Dr Gregor Tanner from the School of Mathematical Sciences at The University of Nottingham and Dr David Chappell from Nottingham Trent University are responsible for a new theory called dynamical energy analysis, which aims to reduce excess vibration and noise in vehicles in the mid-high frequency range. This is typically a problem for manufacturers as it is not able to be properly modelled by existing techniques.

The €1.9 million study would allow them to identify any unwanted noises and address them at the design stage, dramatically cutting costs by removing the need to develop an expensive physical prototype.

Controlling and minimising vibration and shaking would give manufacturers a crucial and competitive advantage in the push for lower noise pollution levels and enhanced driver and passenger comfort. Avoiding high levels of vibration would also work to reduce wear and tear on the vehicle, saving motorists on repair costs.

The aim is to create the first ever simulation tool to model the precise structural vibrations of a vehicle over the whole range of frequencies audible to humans.

The researchers hope to be able to provide a robust and detailed analysis of any vehicle's vibrations on a very fine scale, taking into account the materials and intricate couplings between different components. This simulation would be implemented into the existing computer aided engineering toolkit, used by the automotive industry to reduce development time and cost, while improving safety, comfort and durability of vehicles.

Engineers would enter the model's parameters into the system to see a detailed visualisation of the car they are modelling – they could then see how the vibration levels would affect the vehicle itself, and how noisy the vehicle would be.

The range of existing techniques to address noise and vibration issues are considered inadequate by experts and are not suitable for frequencies above 500Hz – meaning manufacturers cannot currently predict how a vehicle will respond to this type of force.

It's all about MathSoc

MathSoc is the society for students in the School of Mathematical Sciences. The society brings together students from across all the courses within the school and, as you will see, puts on a range of talks, social events and even has its own sports teams for everyone to get involved with. Here is an idea of just some of the things MathSoc get up to over the year.

Talks

We hold regular talks by lecturers about their research or an area of mathematics they are particularly interested in. Previous talks have been on topics such as quantum theory, elliptic curve cryptography, medical imaging and mathematics in sport, plus many more. The talks are quite informal and are a great way to broaden your interest in mathematics and find out where it could take you in the future. We are also holding joint talks with the IMA (Institute of Mathematics and its Applications), the first one of which was by Richard Pinch (Head of Mathematics Graduates at GCHQ) on modern cryptography.

Working in schools

We have been working with the University's Student Volunteer Centre and the Careers and Employability Service to set up a new programme specifically for maths students to help out in schools. We now have 16 students regularly going into local primary and secondary schools helping out in maths lessons. These kind of opportunities are all very good experience, and look great on your CV.

Sports

We enter a rugby, football and netball team into the inter-mural sports competitions which involves weekly matches as well as the occasional training session. It is very informal and everyone is welcome!



Socials

This is where the fun begins! Our socials are a great way to meet people on the course as well as have some fun with the ones you already know. Over the year we have bar crawls, boat parties, pub quizzes, fancy dress, and a few other alternative events.

Joining MathSoc

All students within the School of Mathematical Sciences can join MathSoc and by joining you will receive all the information about upcoming events and opportunities available to you. The team also get regular emails from other organisations about opportunities specifically for maths students which they will pass on.

MathSoc is run entirely by students and every year a new group take over. This might be something you would like to get involved with at university and it is a great way to build up skills that would look great on your CV.

For further information please contact
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