[MATHSOC]
OUR AWARD WINNING
MATHEMATICS SOCIETY
INCLUDING STUDENT
FAMILY SCHEME

OUTSTANDING STUDENT
SATISFACTION
CONSISTENTLY HIGH SCORE
NATIONAL STUDENT SURVEY

BIRMINGHAM
THE HEART OF ENGLAND
A MODERN AND INSPIRING PLACE TO LIVE AND STUDY

RANKED IN THE
TOP 10
FOR
MATHEMATICS
IN THE GUARDIAN
UNIVERSITY LEAGUE TABLE

EXCELLENT EMPLOYMENT PROSPECTS
9 IN 10 OF BSC MATHEMATICS GRADUATES IN WORK OR FURTHER STUDY 6 MONTHS AFTER GRADUATION

SMALL GROUP TEACHING
WEEKLY TUTORIALS IN GROUPS OF UP TO 7 STUDENTS
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Welcome to the School of Mathematics

I am delighted you are considering studying mathematics here at Birmingham. We are immensely proud of our mathematics degree programmes and confident that you will find studying here both enjoyable and rewarding.

Choosing to study mathematics here in Birmingham will give you the opportunity to learn about the fascinating world of mathematics from enthusiastic and inspiring mathematicians working at the forefront of research. You will benefit from the wide range of expertise in the School of Mathematics giving you a good selection of options of advanced modules. Our degrees give you the opportunity to reach the cutting edge of research as well as seeing how mathematics touches our everyday lives by playing a key role throughout the physical sciences, engineering, economics and the social sciences.

At Birmingham, our teaching shapes the lives of inquisitive and confident young men and women, and our supportive mathematics community places the experience of students at the heart of our efforts. Alongside lectures and problem-solving classes, our weekly small group tutorials provide a friendly environment to get support and feedback on all aspects of the mathematics. We are immensely proud that our supportive learning environment has led to an excellent track record of student satisfaction.

Through studying mathematics here you will hone the ability to think about problems imaginatively and develop your analytical skills. Our degree also includes innovative modules designed to develop problem-solving and team-working skills. This will build up your ability to formulate and analyse a problem so that you can apply mathematics to solve it and then effectively communicate your solution. These skills are highly sought after by graduate employers so that our mathematics graduates have excellent employment prospects.

We hope that you choose to study mathematics here so you can find out why our School of Mathematics has an excellent reputation and benefit from everything we have to offer.

PROFESSOR PAUL FLAVELL
HEAD OF SCHOOL

I am a Pure Mathematician whose main research interest lies in Group Theory, which is the mathematical study of symmetry. One of the major scientific achievements of the last century was the Classification of the Finite Simple Groups. Simple groups may be regarded as the ‘atoms of symmetry’. A good analogy is with the periodic table in chemistry. However, this work is very long, complex and understood by only a few experts. One aspect of my research is to simplify this work and make it accessible to a wider audience. In addition to research, I am passionate about teaching. The most enjoyable hours of my week are when I am teaching my final-year modules on Number Theory.
Meet a selection of our academic staff

PROFESSOR DANIELA KUHN
I’m currently teaching Graph Theory and supervise PhD students.

My main research area is Combinatorics, in particular, Graph Theory. Graphs are very simple mathematical structures, but give rise to incredibly complex problems, that are often beyond the capacity of current computers to solve.

PROFESSOR JON BENNETT
I’m currently teaching first year Mathematical Analysis and supervise PhD students.

I am excited about the many ways in which Analysis has deep connections with seemingly very different aspects of mathematics, such as how the distribution of prime numbers is reflected in properties of infinite series, or how our mathematical understanding of wave propagation is intimately linked to subtle phenomena in geometry and combinatorics.

DR ROSEMARY DYSON, DEPUTY HEAD OF SCHOOL
I’m currently teaching Mathematical Modelling and Problem Solving, Mathematical Biology and supervise PhD students.

I’m interested in answering scientific questions using mathematics, particularly those involving biology and mechanics. At the moment I’m working on projects which include looking at how plants grow, and how to design efficient microfluidic devices to test properties of eg, DNA.

PROFESSOR CHRIS GOOD, DEPUTY HEAD OF SCHOOL
I’m currently teaching first-year Statistics and supervise PhD students.

I am interested in topological dynamics, in particular how intricate phenomenon can arise from repeatedly applying even very simple looking functions, for example even simple quadratic functions can behave chaotically.

DR ANDREW TREGLOWN
I’m currently teaching Combinatorics and Communication Theory. I supervise PhD students.

Networks arise in the modern world in a variety of places, from computer networks and the internet to biological networks. Graph Theory concerns the study of the mathematics underpinning such networks. As well as having applications outside of mathematics, graphs are also powerful tools for solving a range of problems within the subject.

DR SARA JABBARI
I’m currently teaching Differential Equations, organising summer projects and supervise PhD students.

Bacteria operate through networks of interacting genes, proteins and signals and I primarily work on nonlinear differential equation models of these complex networks to predict how they would behave if we were to alter them.
During my third year at the University of Birmingham, I took part in the ERASMUS exchange programme in which I spent the year studying Mathematics at Université Claude Bernard in Lyon, France. During my year I took a full course of classes and exams alongside French students. I believe that being exposed to different teaching styles and methods of learning helped me to become a better student in my final year. Alongside my Mathematics classes I was able to take classes in French, Anthropology and even Tennis as part of my course which I enjoyed as it allowed me to learn new things and meet new people.

Outside of class I really enjoyed meeting new people, socialising and enjoying everything that Lyon has to offer. I soon settled in to French life and enjoyed living like a local. In addition, I loved travelling with my new friends to towns and cities across France and beyond.

‘Since my classes were taught in French and I spoke French with all my friends I was able to really improve my French skills, which for me was a major benefit of the year. On top of this I now have a network of friends in France, across Europe and even further afield.’

MIRANDA ROBINSON, BSc in Mathematics with a Year Abroad
## Module structure of G100/G102/G141 (BSc) and G103 (MSci)

### Year 1
**Compulsory modules in Mathematics – 120 credits**
- Algebra and Combinatorics 1 (20)
- Mathematical Modelling and Problem Solving (10)
- Mechanics (10)
- Probability and Statistics (10)
- Real Analysis and the Calculus (30)
- Vectors, Geometry and Linear Algebra (20)
- Widening Horizons (20, G100/G103 only)
- Modern Language (20, G141 only)

### Year 2
**Compulsory modules in Mathematics – 80 credits (G100/G102/G103), 100 credits (G141)**
- Linear Algebra and Linear Programming (20)
- Mathematics in Industry (10)
- Multivariable and Vector Analysis (20)
- Numerical Methods and Programming (10)
- Real and Complex Analysis (20)
- Modern Language (20, G141 only)

**Elective modules in Mathematics – choose 40 credits (G100/G102/G103), 20 credits (G141)**
- Algebra and Combinatorics 2 (20)
- Differential Equations (20)
- Statistics (20)

### Year 3
**Compulsory module in Mathematics – 20 credits**
- Research Skills in Mathematics (20)

**Elective modules in Mathematics – choose 100 credits**
- Differential Equations (20)
- Nonlinear Programming and Heuristic Optimisation (20)
- Applied Statistics (20)
- Combinatorics and Communication Theory (20)
- Graph Theory (20)
- Integer Programming and Combinatorial Optimisation (20)
- Algebra and Combinatorics 2 (20)
- Applied Nonlinear Dynamical Systems (10)
- Continuum Mechanics (20)
- Medical Statistics (20)
- Methods in Partial Differential Equations (20)
- Metric Spaces and Topology (20)
- Modelling with Partial Differential Equations (10)
- Numerical Methods 2 (10)
- Perturbation Theory and Asymptotics (10)
- Statistics (20)
- Linear Analysis (20)
- Mathematical Finance (20)
- Number Theory (20)
- Quantum Mechanics and Electromagnetism (20)

### Year 4
**Compulsory modules in Mathematics – 40 credits**
- Project in Mathematics (40)

**Elective modules in Mathematics – choose 80 credits**
- Combinatorics and Communication Theory (20)
- Advanced Topics in Algebra (10)
- Advanced Topics in Analysis (10)
- Topics in Applied Mathematics (20)
- Topics in Combinatorics (10)
- Applied Statistics (20)
- Combinatorial Optimisation (10)
- Conic Optimisation (10)
- Continuum Mechanics (20)
- Further Mathematical Finance (10)
- Game Theory (10)
- Group Theory and Galois Theory (20)
- Heuristic Optimisation (10)
- Applied Nonlinear Dynamical Systems (10)
- Perturbation Theory and Asymptotics (10)
- Mathematical Finance (20)
- Graph Theory (20)
- Statistical Methods in Finance and Economics (20)
- Number Theory (20)
- Integer Programming (10)
- Mathematical Biology (10)
- Medical Statistics (20)
- Multicriteria Decision Making (10)
- Nonlinear Programming (10)
- Nonlinear Waves (20)
- Numerical Linear Algebra with Applications (10)
- Numerical Methods 2 (10)
- Reaction-Diffusion Theory (20)
- Linear Analysis (20)

120 credits per academic year
BSc/MSci Mathematics and Computer Science

(GG14/GI11/GGD4/GG41)

A degree in Mathematics and Computer Science will allow you to develop many of the skills you would gain from the corresponding Single Honours programmes, with the advantage of studying both of these closely related subjects.

Mathematicians use computers to solve complex equations, analyse large data sets and even to prove theorems. Computer scientists use mathematics to design efficient compression algorithms, to understand the semantics of programming languages and for the theory behind internet security systems. The BSc degree gives you a choice of modules in both Mathematics and Computer Science, with a chance to do project work in either subject.

First year
The first two years are carefully designed to allow you as much choice as possible in your final year. In Computer Science you study the foundations of computer science together with program design and programming techniques.

Second year
You take modules in advanced calculus and algebra, management mathematics, algorithms, data structures and logic. Your interests will develop towards either software engineering or the more mathematical themes that involve computation.

Third year
The third year offers you a choice of modules with the possibility of specialising in either Mathematics or Computer Science. Project modules, particularly in Computer Science, are encouraged.

Generic skills training, focusing on transferable skills and employability, is embedded throughout the modules from the outset, and will ensure that you are equipped with the ICT, presentation, team-working and problem-solving skills which will enhance your employability on graduation. Project and programming work in particular help to develop these skills.
## Module structure of GG14/GGD4 (BSc) and GI11/GG41 (MSci)

<table>
<thead>
<tr>
<th>Year</th>
<th>Compulsory modules in Mathematics – 60 credits</th>
<th>Compulsory modules in Computer Science – 60 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Real Analysis and the Calculus (30)</td>
<td>Vectors, Geometry and Linear Algebra (20)</td>
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<tr>
<td></td>
<td>Mechanics (10)</td>
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<tr>
<td></td>
<td>Compulsory modules in Computer Science – 60 credits</td>
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</tr>
<tr>
<td></td>
<td>Software Workshop (40)</td>
<td>Elements of Functional Computing (10)</td>
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<td></td>
<td>Data Structures and Algorithms (10)</td>
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<tr>
<td>Year 2</td>
<td>Compulsory modules in Mathematics – 60 credits</td>
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<tr>
<td></td>
<td>Algebra and Combinatorics 1 (20)</td>
<td>Linear Algebra (10)</td>
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<tr>
<td></td>
<td>Multivariable and Vector Analysis (20)</td>
<td>Probability and Statistics (10)</td>
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<tr>
<td></td>
<td>Compulsory modules in Computer Science – 40 credits</td>
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<tr>
<td></td>
<td>Team Project (20)</td>
<td>Professional Computing (10)</td>
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<td></td>
<td>Introductory Databases (10)</td>
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<tr>
<td></td>
<td>Elective modules in Computer Science – choose 20 credits</td>
<td>Models of Computation (10)</td>
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<tr>
<td></td>
<td>Computer Systems and Architecture (10)</td>
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<tr>
<td>Year 3</td>
<td>Compulsory module – 20 credits</td>
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<tr>
<td></td>
<td>Project in Mathematics OR Computer Science (20)</td>
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<tr>
<td></td>
<td>Elective modules in Mathematics – choose 40 credits (Project in Mathematics) OR 60 credits (Project in Computer Science)</td>
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<tr>
<td></td>
<td>Differential Equations (20)</td>
<td>Research Skills in Mathematics (20)</td>
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<td></td>
<td>Combinatorics and Communication Theory (20)</td>
<td>Statistics (20)</td>
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<td></td>
<td>Graph Theory (20)</td>
<td>Mathematical Finance (20)</td>
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<td></td>
<td>Algebra and Combinatorics 2 (20)</td>
<td>Number Theory (20)</td>
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<tr>
<td></td>
<td>Real and Complex Analysis (20)</td>
<td>Linear Programming (10)</td>
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<td></td>
<td>Numerical Method and Programming (10)</td>
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<td></td>
<td>Elective modules in Computer Science – choose 60 credits (Project in Mathematics) OR 40 credits (Project in Computer Science)</td>
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<tr>
<td></td>
<td>Compilers and Languages (10)</td>
<td>Machine Learning (10)</td>
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<td></td>
<td>Databases (10)</td>
<td>Networks (20)</td>
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<td>Distributed and Parallel Computing (10)</td>
<td>Operating Systems (20)</td>
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<td>Human-Computer Interaction (10)</td>
<td>Teaching Computer Science in Schools (10)</td>
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<td></td>
<td>Individual Study (10)</td>
<td>Neural Computation (10)</td>
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<td></td>
<td>Intelliget Data Analysis (10)</td>
<td>Principles of Programming Languages (10)</td>
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<td>Adv Aspects of Nature-Inspired Search/Optimisation (20)</td>
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<tr>
<td>Year 4</td>
<td>Compulsory modules – 40 credits</td>
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<td></td>
<td>Project in Mathematics OR Software Project in Computer Science (40)</td>
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<tr>
<td></td>
<td>Elective modules in Mathematics – choose up to 40 credits (Project in Mathematics) OR up to 60 credits (Project in Computer Science)</td>
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<tr>
<td></td>
<td>Mathematical Biology (10)</td>
<td>Modelling with Partial Differential Equations (10)</td>
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<td>Mathematical Finance (20)</td>
<td>Multicriteria Decision Making (10)</td>
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<td>Combinatorics and Communication Theory (20)</td>
<td>Nonlinear Programming (10)</td>
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<td>Graph Theory (20)</td>
<td>Numerical Linear Algebra with Applications (10)</td>
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<td></td>
<td>Continuum Mechanics (20)</td>
<td>Numerical Methods (10)</td>
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<td></td>
<td>Combinatorial Optimisation (10)</td>
<td>Topics in Applied Mathematics (10)</td>
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<td>Conic Optimisation (10)</td>
<td>Linear Analysis (20)</td>
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<td></td>
<td>Further Mathematical Finance (10)</td>
<td>Advanced Topics in Algebra (10)</td>
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<td></td>
<td>Game Theory (10)</td>
<td>Topics in Combinatorics (10)</td>
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<td>Applied Statistics (20)</td>
<td>Number Theory (20)</td>
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<td></td>
<td>Group Theory and Galois Theory (20)</td>
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<td>Heuristic Optimisation (10)</td>
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<tr>
<td></td>
<td>Elective modules in Computer Science – choose up to 40 credits (Project in Mathematics) OR up to 60 credits (Project in Computer Science)</td>
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<tr>
<td></td>
<td>Compilers and Languages, Extended (10)</td>
<td>Adv Aspects of Nature-Inspired Search, Extended (20)</td>
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<td></td>
<td>Cryptography (10)</td>
<td>Computer-Aided Verification, Extended (10)</td>
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<tr>
<td></td>
<td>Distributed and Parallel Computing, Extended (10)</td>
<td>Networks, Extended (20)</td>
</tr>
<tr>
<td></td>
<td>Individual Study in Computer Science (10)</td>
<td>Operating Systems, Extended (20)</td>
</tr>
<tr>
<td></td>
<td>Introduction to Neural Computation (10)</td>
<td>Principles of Programming Languages, Extended (10)</td>
</tr>
<tr>
<td></td>
<td>Nature-Inspired Search and Optimisation (10)</td>
<td>Teaching Computer Science in Schools, Extended (10)</td>
</tr>
</tbody>
</table>

120 credits per academic year
How do you know you are running your business as efficiently and profitably as possible? From designing the bidding rules for acquiring 4G phone licences, or the routing of delivery lorries, to cutting carpet roll efficiently, mathematics plays a key role in running businesses.

Two-thirds of your degree involves studying the mathematics, computing, and statistics used in analysing the types of problems thrown up in the business context. The rest of your time is spent in the Birmingham Business School studying the theory and practice of running a business, covering such subjects as economics, marketing and finance.

First year
The first year develops the basic techniques in mathematics, statistics and computing that you will need in later years. It also provides an introduction to business, finance and economics through modules given by the Birmingham Business School.

Second year
The second year introduces you to some of the more advanced areas of business mathematics, such as linear programming, allowing you to develop your particular strengths and interests in the third year. You also take modules in financial decision making, marketing and human resource management. It may be possible to switch from the BSc to the MSci, depending on your performance in Years 1 and 2.

Third year
The third year involves a mixture of compulsory and optional modules. You study topics such as game theory, mathematical finance, heuristic optimisation and supply chain management.

Generic skills-training, focusing on transferable skills and employability, is embedded throughout the modules from the outset, and will ensure that you are equipped with the ICT, presentation, team-working and problem-solving skills which will enhance your employability on graduation.

‘My Mathematics with Business Management programme is varied, which is something I really like. I get to enjoy mathematics just as I always have, through studying the core modules, whilst also learning skills and acquiring knowledge which will help me pursue a career in business. Modules I took over the first two years included Economics, Marketing, Finance, Human Resources and Business Organisations and Management. I am really enjoying it.’

JENNA DAVIES, Mathematics with Business Management
## Module structure of G1N2 (BSc) and G1NF (MSci)

### Year 1

**Compulsory modules in Mathematics – 80 credits**
- Algebra and Combinatorics 1 (20)
- Probability and Statistics (10)
- Real Analysis and the Calculus (30)
- Vectors, Geometry and Linear Algebra (20)

**Compulsory modules in Business Management – 40 credits**
- Business Organisation and Management (10)
- International Economy (10)
- Introduction to Economics (10)
- Introduction to Financial Analysis for Science and Engineers (10)

### Year 2

**Compulsory modules in Mathematics – 40 credits**
- Linear Algebra and Linear Programming (20)
- Multivariable and Vector Analysis (20)

**Compulsory modules in Business Management – 40 credits**
- Financial Decision Making (10)
- Global Marketing (10)
- Human Resource Management (10)
- International Economy (10)

**Elective modules in Mathematics – choose 40 credits**
- Numerical Methods and Programming (10)
- Algebra and Combinatorics 2 (20)
- Statistics (20)
- Mathematics in Industry (10)
- Mechanics (10)

### Year 3

**Compulsory modules in Mathematics – 40 credits**
- Game Theory and Computer Simulation (20)
- Integer Programming and Combinatorial Optimisation (20)

**Compulsory modules in Business Management – 40 credits**
- Corporate Finance (10)
- Innovation Management (10)
- Strategic Management (10)
- Supply Chain Management (10)

**Elective modules in Mathematics – choose 40 credits**
- Financial Mathematics (20)
- Number Theory (20)
- Algebra and Combinatorics 2 (20)
- Statistical Methods in Economics (20)
- Applied Statistics (20)
- Differential Equations (20)
- Combinatorics and Communication Theory (20)
- Nonlinear Programming and Heuristic Optimisation (20)

### Year 4

**Compulsory modules in Mathematics – 40 credits**
- Project in Mathematics with Business Management (40)

**Compulsory modules in Business Management – 40 credits**
- International and Industrial Economics (20)
- Small Business and Entrepreneurship (20)

**Elective modules in Mathematics – choose 40 credits**
- Combinatorics and Communication Theory (20)
- Multicriteria Decision Making (10)
- Statistical Methods in Finance and Economics (20)
- Non-Linear Programming 2 (10)
- Mathematical Finance (20)
- Further Mathematical Finance (10)
- Conic Optimisation (10)
- Heuristic Optimisation (10)

**120 credits per academic year**
Joint Honours and other degrees

Major/Minor and Joint Honours
At Birmingham we provide a wide range of Mathematics Joint Honours programmes. You can combine Mathematics with languages, certain arts subjects, computer science, physics, philosophy, music and business management.

The Mathematics half of the programme is carefully designed to give you access to as many topics in later years of the programme as possible. It will help you to develop many of the skills you would get studying just Mathematics, such as the ability to formulate and tackle problems, to think logically, to use technical language and to express complex ideas clearly and accurately. Combined with the complementary skills offered by your other studies, a Joint Honours degree makes you very attractive to employers.

Theoretical Physics and Applied Mathematics
UCAS Code: BSc — FG31; MSci — F3DG
There is a profound inter-relationship between applied mathematics and theoretical physics. One of many examples is the concept of a soliton, originally formulated for water waves, and which has since found extensive application in elementary particle physics. In addition to studying applied mathematics this degree programme will cover the core topics of both classical and quantum theoretical physics. Students should contact the physics admissions tutor about applying for this programme.

Mathematics and Music
UCAS Code: BA — GW13
As a Birmingham Mathematics and Music student, you will benefit from a rich tradition of music making and have access to outstanding facilities, including the Bramall Music Building, practice rooms, electro-acoustic music studios, early instruments, computer workstations and the Barber Institute Concert Hall and Library. Compulsory Mathematics modules in the first year are: Real Calculus and Algebra, Vectors, Geometry and Linear Algebra and Mechanics.

Mathematics and French Studies
UCAS Code: BA — GR11
You will study a range of modules across both subjects, giving you an excellent grounding for a wide range of careers. Compulsory Mathematics modules in the first year are: Real Calculus and Algebra, Vectors, Geometry and Linear Algebra and Mechanics. You will be attractive to employers as you are able to bring together expertise from more than one discipline.

Mathematics and Philosophy
UCAS Code: BA — GV15
Your Mathematics studies are designed to help you develop the ability to formulate and tackle problems, to think logically, to use technical language and to express complex ideas clearly and accurately. Compulsory Mathematics modules in the first year are: Real Calculus and Algebra, Vectors, Geometry and Linear Algebra and Mechanics.

The Department of Philosophy at Birmingham has a growing international reputation as a centre of excellence for research in analytic philosophy, especially in metaphysics and epistemology, philosophy of language and mind, and ethics and ethical theory.

FACT BOX
The University grew out of the radical vision of our first Chancellor, Joseph Chamberlain. Founded in 1900, Birmingham represented a new model for higher education. This was England’s first civic university, where students from all religions and backgrounds were accepted on an equal basis. It was a founder member of the National Union of Students.

The University of Birmingham was established by Queen Victoria by Royal Charter in 1900.
Set in the beautiful surroundings of lakeside parkland, the Vale Village is the University’s largest accommodation site, home to more than 3,500 students in eight residences, including the unique Green Community.
Research in the School of Mathematics

What is the relationship between determining whether your cereal remains crunchy and does not become soggy when lying in a bowl of milk, making chocolate Easter eggs, or in producing a uniform coating on your plasma TV screen or even determining the size of harmful pathogens in a sample of blood?

The School of Mathematics at Birmingham has an international research profile that is world-leading in many key areas of mathematics. Choosing a research-active Mathematics Department to study in is critical when you are selecting a university. It means that you will be taught by world-class experts in their chosen field, researchers of renown who are at the forefront of knowledge in mathematics. A university that has such research, is able to apply for grants and fund interesting and important mathematical investigations with collaborators across the world. Academics can incorporate their interests into the teaching they do and the projects they are able to set for undergraduates and also for postgraduate students. Opportunities for postgraduate experience will be greatly enhanced within the university and department. Many research intensive universities in the United Kingdom also have the distinction of being part of the elite ‘Russell Group’ of universities with all the benefits for networking and recognition that this offers. If you are a person who loves the quest and the challenge that studying Mathematics offers you, being part of a research-intensive university mathematics department will give you so many more options and you will thrive on the atmosphere that results.
The fascinating world of Pure Mathematics

Studying mathematics at school gives you a peek behind the curtain at the fascinating world of pure mathematics – at the University of Birmingham you’ll be able to discover much more!

We’re relying on pure mathematics in our everyday lives, but it is mainly hidden. For example, you may consider:
- How is your credit card number kept safe when you shop online? This is done with the RSA cryptosystem, which is a spectacular application of number theory.
- Have you ever wondered how you can get so much music on an iPod? The mathematics of the Fourier transform is used to compress the music file.

Our pure mathematics modules in the first two years focus on introducing the rigour and abstraction of pure mathematics. In your third and fourth year you’ll have the opportunity to make an in-depth study of a topic you find particularly interesting under the supervision of our leading researchers in algebra, analysis and combinatorics.

Algebra
Our research in algebra is focused on group theory and representation theory, which provide a powerful mathematical language to study symmetry. Symmetry is abundant in nature, so there are applications in group theory and representation theory in diverse areas of chemistry and physics.

The root system of type E8 is a highly symmetric configuration in 8-dimensional space, which governs one of the most intriguing symmetry groups – the Lie group of type E8. The image above is a 2-dimensional projection of this root system.

Analysis
Mathematical analysis is a fundamental branch of mathematics typically involving limiting processes. For example, we perform a limiting process when we differentiate or integrate a function, or sum an infinite series. At the heart of analysis is the study of partial differential equations, which provide mathematical descriptions of physical systems and is the focus of our research.

The Sierpinski triangle above is obtained by repeatedly removing the inside triangle. Using analysis you can understand what is meant when we say that its area is 0 and its dimension is approximately 1.585.

Combinatorics
Our research in combinatorics is focused on graph theory. Graphs are very simple objects which can be used to model surprisingly complex structures. For example, this includes the internet graph, social networks, and biological networks such as the brain. A graph consists of vertices, some of which are connected by edges as in the picture below.

A fundamental problem in the field is to decide whether a graph contains a Hamiltonian cycle, which is a circuit going through all the vertices exactly once. Can you find two Hamiltonian cycles in this graph?

DR SIMON GOODWIN
HEAD OF PURE MATHEMATICS

I’m a member of the algebra research group, and I specialise in the representation theory of algebraic groups and Lie algebras. My research involves an interaction of methods from geometry and combinatorics, and collaboration with mathematicians across the world.

I really enjoy sharing my enthusiasm for this subject when teaching the first- and second- year modules on algebra. In these modules we develop the theory of fundamental algebraic structures, like groups and rings, whilst seeing applications and motivation for this abstraction.
Applied Mathematics – understanding the real world

Applied Mathematics is about using mathematical language, theory and techniques to understand life, the universe and everything. Applications of mathematics covered in our degree programmes span fields including medical research, aerodynamics and body dynamics, how leopards get their spots, and pricing in finance.

In the first two years of your degree we concentrate on developing your mathematical and computational skills and introduce you to the fundamental techniques used in applications. In the third year, advanced modules introduce the key ideas of mathematical biology and medicine, fluid and solid mechanics, waves and diffusion in nature, and mathematical finance.

MSci students can proceed to study advanced level topics including:
- Viscous fluid mechanics
- Systems of chemical reactions
- Advanced computational mathematics

Applied Mathematics at Birmingham consists of research groups in Mathematical Biology, Nonlinear Systems, Fluid Mechanics and Numerical Analysis. We work on problems of vital industrial and societal importance such as:
- Human fertility
- Sustainable energy
- Oil recovery
- Ultrasound bubbles in medicine
- Cancer diagnosis and treatment
- Crop growth
- Antibiotic resistance
- Fluid mechanics in industry
- Hajj safety

All of these areas contribute directly to undergraduate research projects, so you too will have the opportunity to work on cutting-edge real-world problems with internationally recognised leaders.

Nonlinear Systems
The equations which describe most physical systems are nonlinear, involving quadratic and higher order terms in the unknowns. Nonlinear systems can exhibit highly complex behaviour such as chaos, pattern formation and solitary waves, but are notoriously difficult to analyse. Understanding nonlinear systems is vital due to the wide range of patterns and structures in nature which they give rise to, from the organised neural activity of the brain, to the Severn Bore surge wave.

Mathematical Biology
The Mathematical Biology group uses experimental data to create models to make testable predictions about the biological world, in particular problems associated with health care and the food supply. We specialise in a variety of areas across biology and healthcare technologies, investigating problems as diverse as enhancing crop yields, treating infertility, and preventing the rise in antibiotic resistance. Our research looks for answers that can have genuine impact on the real world.

Fluid Mechanics
The study of how liquids and gases behave in the real world under various different settings is termed fluid mechanics. Whether it is developing an efficient design for an aircraft wing or determining the size of liquid droplets produced when an ink-jet printer releases a column of fluid, fluid dynamics provides key answers to modern problems in engineering and science.

Numerical Analysis
Numerical Analysis concerns the development, justification, and implementation of algorithms for solving problems of continuous mathematics on the computer, for example mathematical models describing natural phenomena or social processes. These complex real-world models rarely have exact analytic solutions that are readily (and cheaply) obtainable. Therefore, in our research we design practical algorithms for finding approximate (and computable!) solutions to these models.

DR DAVE SMITH
HEAD OF APPLIED MATHEMATICS

I studied for my first degree in Oxford, then moved back to my home city of Birmingham for a PhD in biomedical fluid dynamics. I have just received a major £1M award to develop a new diagnostic device for male infertility using mathematical image analysis combined with imaging technology. As a member of the Mathematical Biology Research Group, my colleagues and I work on a range of systems in biomedicine including reproduction and development, biomechanics, pathogen detection, cancer research and antibiotic resistance.

As senior lecturer, I particularly enjoy communicating my enthusiasm for real-world uses of mathematics and building students confidence in developing and applying their mathematical abilities.
Optimisation – the key to efficiency

Optimisation is ubiquitous in facets of science, engineering and management. Mathematical Optimisation deals with problems related to the efficient use of resources, applying mathematically rigorous methods, algorithms and software within a business or engineering setting.

Typical problems are designing public transport timetables in a city, finding an optimal design of a bridge, or designing efficient distribution processes in supermarket warehouse. Finding the best solution to problems like these can often be highly complex and delicate. Mathematical Optimisation develops advanced techniques that are used to address these questions.

The essence of Mathematical Optimisation is the use of analytical reasoning, mathematical modelling and rigorous mathematical techniques, combined with the power of modern computers, to help managers and engineers make the best of their resources maximising output and minimising waste. The main focus of our research activity is on mathematical theory and methods applicable to managerial decision making; in particular, development of algorithms and software for large-scale nonlinear optimisation problems and development of theory and techniques of max-algebra.

Max-algebra is a rapidly evolving branch of mathematics providing theory and techniques for solving nonlinear problems, when arithmetical addition is replaced by the operation of maximum and arithmetical multiplication by addition. It is applied in manufacturing, transportation, allocation of resources and information processing technology.

Research is typically a mixture of theoretical investigation and practical application or industrial collaboration. Techniques developed here are used commercially, particularly the automotive and aircraft industries.

My teaching includes courses on various topics of mathematical optimisation. I supervise final-year undergraduate projects, MSc projects, as well as PhD students. My wide experience in development of optimisation software, as well as industrial applications of optimisation allows me to present the students with the latest development in the area, hot topics, and practical applications of the taught material.

My major research interest is in numerical optimisation (large-scale nonlinear semidefinite programming) and optimisation of materials and mechanical structures (topology and shape optimisation).
An outstanding campus with excellent facilities

Recent developments at the University of Birmingham enhance your student experience.

**University Sport Centre**

Our new, state-of-the-art sports centre sits on the corner of Bristol Road and Edgbaston Park Road, and will be a gateway to the University for students, staff and our local community.

The centre underlines the University of Birmingham’s commitment to sport at all levels. It is a home for our many sports clubs, allowing them to train and compete at the highest level. UBSport consistently finishes in the top three of British Universities and Colleges Sport (BUCS) league, where our sports teams compete with over 165 UK institutions.

It includes a new home for the University’s Hi Performance Centre, providing specialist facilities, expertise and support under one roof to sportsmen and women in the University, city and region. It helps our committed amateur sportspeople to improve their performance, and our most talented to win medals on the global stage. But at Birmingham we believe sport is for all, and from absolute beginner to world-class athlete, UBSport offers a range of opportunities for everyone to get involved with.

The centre specialises in rehabilitation from injury and illness, as well as meeting the fitness needs of competitive sports players, and the gym is one of the most extensive and advanced in the country thanks to both the quality and range of equipment but also the supporting expertise.

**The Main Library**

The new University main Library provides outstanding facilities for a new generation of students and researchers. It is also a cultural hub for the University and the city, with an exhibition and event space and cafeteria open to all on the ground floor.

Overlooking the centre of our beautiful campus, the new library is an inspirational place to study, with study and research desks near to the windows, allowing all users of the building to benefit from natural light and stunning views. Inside, careful attention has been paid to the efficient use of space, accessibility for all, and the 12km of open access shelving are arranged in such a way as to be far more intuitive to navigate.

The new, technology-rich Main Library houses a variety of learning spaces to cater for different modes of study. An increased number of study spaces, all with power points, allows students to work in the Library from their own devices. Flexible training rooms also are incorporated to enable us to develop the important academic skills support offered by Library staff. A state-of-the-art audio listening room and four video editing suite booths enhances the existing facilities already available on campus.

**Student Hub**

The new student services hub sees the interior of an entire block of the Aston Webb Building remodelled to house a number of student-facing teams which are currently scattered across campus.

This includes facilities for the Careers Network, Student Services and Registry, as well as a reception, information zone and a suite of one-to-one consultation rooms. The Hub also includes mixed social and learning spaces and a 250-seat lecture theatre.
Some fantastic options for your third year

Many of our students benefit from different options available.

Placement Year
A placement year is an excellent opportunity to gain work-related experience as a recognised part of your mathematics degree. Our placement scheme involves spending your penultimate year of study in full-time employment, giving you the opportunity to experience salaried work before you graduate, boosting your confidence and helping you develop a range of skills. Recent evidence indicates that employers are increasingly using placement years and internships to recruit graduates and so this is your chance to get a head start in the job market. Our award-winning Careers Network will provide you with support to help you identify and secure the right placement for you.

Erasmus and International Year
The University has more than 225 student exchange agreements under the Erasmus and International Exchange programmes, with partner universities in Europe, Asia, Australia, Latin America and North America. Approximately 350 University of Birmingham students travel abroad. Each year we welcome over 700 students to our campus as part of our Erasmus and International Exchange and Study Abroad programmes.

The School of Mathematics partners with universities in France, Germany and Spain. Subject to conditions, students can study mathematics and their degree will be classed as with study in Continental Europe. There is also the option of following an MSc programme with study in Continental Europe. For the BSc route, the year abroad is designed for students to experience life in another country, but for which the final mark obtained in examinations abroad will not contribute to the final degree classification.

You do not have to commit to this programme from the beginning of your degree. All students who achieve a minimum mark in their first year will be eligible to apply for the international year during their second year. You will be supported by the School to ensure that you select a programme that would enhance your personal educational interests and experience. This support continues while you are overseas; you remain an important part of our School while you are away and helping you to make the most of the year is part of our role.

Intercalated Year in Computer Science
From practical ICT to profound principles of computation, a solid grounding in Computer Science can be an important factor in making the most of your career potential. To respond to the demand from students and employers, the University runs an innovative one-year programme called ‘Intercalated Year in Computer Science’. It offers students from non-computing disciplines like mathematics the chance to gain in-depth knowledge of computing and enhance their work-based skills through the study of computer science. In the additional year you will study the core of computer science, and in your final year you will return to your home subject. You can sign up to programme during your second year of study and will be admitted if you fulfil the entry requirements.

The modules we offer:
- Software workshop
- Introduction to Computer Science
- Databases
- Human Computer Interaction
- Artificial Intelligence
- Data Structures
- Operating Systems and Networks
- Computer Graphics
- Principles of Programming Languages
- Neural Computation
Excellent career prospects

Mathematics students at Birmingham come from a wide variety of backgrounds and go into an equally diverse range of careers – there are very few jobs that a mathematics graduate cannot do!

Research has shown that a mathematics degree makes a bigger difference to average lifetime earnings than almost all other degrees. For example, a study by Universities UK showed that a mathematics graduate can expect to earn on average over a third more than a graduate in an arts subject.

Many mathematics graduates go into the financial sector, for example accountancy, actuarial work, management consulting and banking, and some go into more general areas of business and management. As a mathematics graduate you could also work in areas of industry where mathematics is applied, or in information technology. But it doesn't end there; recent mathematics graduates have pursued careers in areas such as fashion merchandising, medical statistics and transport engineering.

Alternatively you may want to use your degree as a springboard to other study. Many graduates go on to do a postgraduate teacher training course, or study for an MSc or PhD in a variety of subjects. They find their mathematical background is an excellent foundation for further study.

Some employers of mathematics graduates look for specific mathematical skills that have been attained during the degree. However, it is the transferable skills developed during the degree that are most attractive to the majority of employers. You will find that your skills and experience in problem solving, logical thinking and the accurate use of precise technical language open many employers’ doors. During a mathematics degree at Birmingham, you will also gain skills in communicating effectively, working in a team, and organising work on a project, all of which will make you appealing to graduate employers.

As you apply to university you may already have an idea of the career that you would like to pursue. In this case you will be able to choose your programmes to suit potential employers. However, if you are not sure what you want to do at this stage, then doing a mathematics degree will develop skills that will open up a wide range of possibilities for you.

At the School of Mathematics, we take the personal development and careers planning of our students seriously. Jointly with Careers Network, the University of Birmingham’s award-winning careers service, we have developed a structured programme to support mathematics students with their career planning, from when they arrive to when they graduate. Our aim is to help to ensure that our students achieve the future that they want.

Support that we offer in the School of Mathematics includes:
- Mathematics careers fair with graduate employers who are especially seeking mathematics graduates
- Employer-led workshops to assist at all stages of the graduate recruitment process
- CV and application form advice drop-in appointments with a careers adviser in the School of Mathematics
- Careers workshop for students each year
- Advice on extracurricular activities to develop the skills and experience that employers look for
- Help to find relevant work experience and placements in industry
- Fortnightly e-newsletter with careers events and vacancies
- Industry involvement in modules

This is complemented by many events organised by Careers Network including large university fairs with many graduate employers.

Putting all this together with the satisfaction you get from solving problems and understanding patterns in mathematics, shows that mathematics at Birmingham is an excellent investment in your future.
MathSoc host a variety of events throughout the year beginning in fresher’s week, with welcoming events for first years, right through until after exams, with an end of exam pub meal. Some of the society’s most popular events are detailed below.

**Family Scheme**
The MathSoc Family Scheme was launched in 2013 and has since been given an award for Idea of the Year. This scheme inside the School of Mathematics involves first-year undergraduate ‘children’ being able to gain both academic and non-academic advice from their allocated ‘parents’ in successive year groups.

**Volunteering Scheme**
A relatively new scheme for the society, this allows students to get involved with volunteering opportunities during their time at university. Each year the society nominates a charity to support, and throughout the year events are held in order to raise funds for the chosen charity. Events that have been organised to support the chosen charity have included cake stands and bowling. Members have also run the Coventry Half Marathon!

**Annual Spring Ball**
The annual spring ball is the highlight of the MathSoc calendar. This glamorous event takes place towards the end of the second semester and is a chance for students and staff to have a night-off and enjoy themselves before the upcoming revision period.

**Careers Evening**
During the first semester MathSoc organise a careers evening. The aim of this evening is to provide students with insight into what careers are open to a mathematics graduate. As well as inviting speakers from sectors that are well known to hire mathematics graduates, such as the finance sector or teaching, speakers are also invited from technology firms and the public sector that are keen to hire mathematics graduates.

**Sports Teams**
The society has two sports teams that members can participate in: an 11-a-side football team and a mixed netball team. The teams compete in the Intramural Leagues.

**MathSoc on Tour**
Normally run just before the start of semester two, MathSoc on Tour is a chance for our members to get to know each other outside of the university environment. This long weekend abroad gives students the opportunity to unwind and relax before the start of the next Spring Term.

Many other small events such as nights out and film nights are run throughout the year. MathSoc is a great way for students to instantly get involved with events going on in the department and make new friends when joining the University.

‘I found the MathSoc Family Scheme ensured freshers had a friendly face that they can go to for advice from the word go.’

CURTIS COLLINS, MSci Mathematics
Birmingham – a great place to live and study

Birmingham has a rich history, which makes the city a unique and inspiring place to come to study.

Come to do a mathematics degree at Birmingham and enjoy studying in one of Europe’s most exciting cities. Birmingham is changing fast. A massive £9 billion regeneration scheme over the past 20 years has reinvented the city, and this renaissance is set to continue. Plans to completely redevelop the east side of the city centre and establish new offices, shops and walkways, which will link Chamberlain and Centenary Squares, featuring are already underway. A part of those plans was the state-of-the-art Library of Birmingham which has been opened already. There are three key attractions to Birmingham: its culture and entertainment, the retail experience, and its location at the heart of some of the UK’s most beautiful countryside.

There is always something going on in Birmingham. In addition to a choice of cafés, restaurants and venues from across the globe, there are theatres, museums, cinemas, night-clubs and winebars in abundance. If you like a live entertainment, then take your pick from comedy clubs, local music gigs and top shows at Birmingham’s principal theatres. All the star names appear at the Barclaycard Arena, and the Royal Shakespeare Company is just an hour away by car. The Drum Arts Centre is an exciting venture, dedicated to presenting British African, Asian and Caribbean arts and cultural activities, while Star City is Birmingham’s biggest cinema with 30 screens, six of which are devoted to Bollywood films.

Shopping
Shopping areas include the famous Bullring, the ever-growing Jewellery Quarter, and The Mailbox with its designer stores and upmarket restaurants. Birmingham also hosts a range of markets, including the famous German market at Christmas.

If you are looking for some culture, then you’ll find plenty of art galleries – including the Birmingham Museum and Art Gallery – theatres, cinemas and music arenas.

Grand Central
Grand Central is located above Birmingham New Street Station and opened in 2015 housing 33 shops, 19 cafes and the flagship, John Lewis Store. New Street Station is newly developed and makes Birmingham easily accessible from North and South alike.

The heart of England
Located in the heart of the country, Birmingham has so much to offer visitors. With Warwickshire, the Malvern Hills and the Ironbridge Gorge all nearby, you are never more than a short drive from some of the UK’s most scenic countryside. Birmingham is at the centre of the motorway and rail network, with its own international airport – Birmingham is easily accessible from almost anywhere in the world. Forty per cent of our graduates choose to stay in the region following graduation, and for good reasons.

Birmingham is a confident, modern commercial centre and home to the largest financial district outside London, offering Birmingham graduates great opportunities.

‘I have loved every second of being at university here, Birmingham is such a great place. The University has been really welcoming and I enjoy my course so much!’

HEATHER COLLIS, MSci Mathematics
Graduate reflections

‘Doing a mathematics degree at Birmingham has been the best decision I have ever made and the support for students is fantastic.’

‘Birmingham was my first choice. The campus here is so magnificent and romantic – it’s like a little town in itself and you’ll seldom need to leave. I don’t think I would have done as well at my degree course without the inspiration of the surrounding architecture and greenery.’

‘I got lots of help for my studies, postgraduates helped a lot, and lecturers were always available during office hours, and most of them out of office hours as well. They always responded by e-mail very quickly.’

‘Support from the staff, particularly from my personal tutor, has been extremely helpful in the progression of my studies and in helping me settle into university life at the beginning. Extracurricular activities from student societies have also made my student experience loads of fun.’
Next steps towards applying to Birmingham

We look forward to receiving your application to study mathematics at Birmingham and to join our friendly mathematics community. Here are a few more details. If you have further questions, please do get in touch.

How do I apply?
You should apply through the Universities and Colleges Admissions Service (UCAS, www.ucas.ac.uk). The School Admissions Team is happy to provide help and advice should you wish to discuss your qualifications or find out more about the programmes before completing your UCAS form. Please find their contact details below.

When should I apply?
Demand for places is high and we advise all applicants to apply early. The deadline for applications through UCAS is in January for entry in September.

Can I study joint honours?
See page 12.

International Baccalaureate Diploma
Our standard offer is based on grades in Higher Levels (HL) with a minimum of 32 overall.

Sixth Term Examination Paper (STEP)
We do not require STEP however we may reduce your offer by one grade if you are studying it and achieved an A or better.

Extended Project Qualification (EPQ)
We do not require EPQ however we may reduce your offer by one grade if you are studying it and achieved an A or better.

International students
Applications are welcomed from overseas students with qualifications equivalent to our standard entry requirements.

Applicant Visit Day for Offer Holders
Reading a prospectus is not the same as coming to the University in person. Invitation only Applicant Visit days are held between October and March.

Should you be made an offer by the University of Birmingham you will be given the opportunity to join us for a visit day. You will meet current students and lecturers, tour the School and campus and see our student accommodation. This visit will be an ideal opportunity to ask questions about all aspects of the programmes and let you see all our stunning campus has to offer.

Fees and funding
For comprehensive information on fees and funding, please visit: www.birmingham.ac.uk/undergraduate/fees/index.aspx

Travel directions
By train
Birmingham is the only university in mainland United Kingdom to have its own railway station on campus, called ‘University Station’. The Station is a real asset to the University, making travel by train a convenient option for many. University Station is only two stops from Birmingham New Street where students and visitors can catch trains to locations all across the country. The journey between the University and Birmingham New Street takes approximately eight minutes. For all timetable information visit the National Rail website.

By car
Visitors are requested to park in any of the car parks below.

Car park locations
☐ North East Car Park (B15 2SA) Access via Pritchatts Road multi-storey, pay on exit
☐ North Car Park (B15 2SB) Access via Pritchatts Road, pay and display
☐ Pritchatts Road Car Park (B15 2CU) At the junction with Vincent Drive, pay and display

www.birmingham.ac.uk/documents/university/edgbaston-campus-map.pdf
### PROGRAMMES IN THE SCHOOL OF MATHEMATICS

<table>
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<tr>
<th>Single Honours</th>
<th>UCAS Code</th>
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<tbody>
<tr>
<td>BSc Mathematics</td>
<td>G100</td>
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<tr>
<td>BSc Mathematics with Industrial Year</td>
<td>G102</td>
</tr>
<tr>
<td>BSc Mathematics with a Year Abroad in Continental Europe</td>
<td>G141</td>
</tr>
<tr>
<td>MSci Mathematics</td>
<td>G103</td>
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<tr>
<th>Major/Minor</th>
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<tr>
<td>BSc Mathematics with Business Management</td>
<td>G1N2</td>
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<td>MSci Mathematics with Business Management</td>
<td>G1NF</td>
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<th>Joint Honours</th>
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<td>MSci Mathematics and Computer Science</td>
<td>GI11</td>
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<td>BSc Mathematics and Computer Science with Industrial Year</td>
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<tr>
<td>MSci Mathematics and Computer Science with Industrial Year</td>
<td>GG41</td>
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<td>BSc Theoretical Physics and Applied Mathematics</td>
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<td>MSci Theoretical Physics and Applied Mathematics</td>
<td>F3DG</td>
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<td>BA Mathematics and French Studies</td>
<td>GR11</td>
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<tr>
<td>BA Mathematics and Music</td>
<td>GW13</td>
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<tr>
<td>BA Mathematics and Philosophy</td>
<td>GV15</td>
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All prospective students must apply via UCAS (www.ucas.ac.uk). Applicants are considered for a place on the basis of the information given on their UCAS form. Please contact the Admissions Team for advice about specific qualifications, or about any aspect of becoming a student in the School of Mathematics.

The electronic version of this brochure is available online: [www.birmingham.ac.uk/mathematics](http://www.birmingham.ac.uk/mathematics)