MATHEMATICS AND STATISTICS

Canterbury
ACADEMIC EXCELLENCE AND INSPIRATIONAL TEACHING

Much of science is based upon the application of mathematics. It provides the theoretical framework for physical sciences, for statistics and data analysis, as well as for computer science.

New discoveries within mathematics affect not only science, but also our general understanding of the world we live in. At Kent, we aim to provide stimulating and relevant programmes that reflect all of these aspects of mathematics.

World-leading research
Our students benefit from the most up-to-date knowledge in the field. In the most recent Research Assessment Exercise, the statistics group was ranked within the top ten in the country; research in applied mathematics was judged to be of international quality and in pure mathematics, a large proportion of research was ranked as internationally excellent.

Inspirational teaching
Kent is ranked as one of the top 20 universities in the UK in The Guardian University Guide 2015 and 22nd for Mathematics in The Complete University Guide 2015.

Our programmes are designed to ensure that you get a solid grounding in mathematics in your first year. You can then move on to cover modern abstract and computational techniques in your subsequent years of study, with many opportunities to specialise in areas of mathematics and statistics that are of particular interest to you.

We offer a large choice of project and dissertation topics in the final year of study. Recent topics include the group theory of the Rubik's Cube, maths and dyslexia, Black-Scholes equation, infant mortality in developing countries, computational molecular biology, and the lottery.

A supportive community
Mathematics can be a challenging subject and we help you to get the most out of your studies by providing a supportive learning environment. Our programmes offer high contact hours per module and, for compulsory Stage 1 modules, there is small group tutorial support as well as peer mentoring support. Our academic staff are available to advise and support you throughout your studies but also encourage you to take responsibility for your own learning. Our School promotes a friendly community with an active staff-student consultative committee and a School Society run by, and for, the students.

Choice of programmes
Kent’s programmes reflect the diversity of mathematics today, with a full range of degree programmes on offer including Mathematics and Accounting and Finance,
and Mathematics with Secondary Education. If you don't yet have the qualifications to enter the three-year programme, you can take a Foundation Year as part of your degree. See p10 for details.

**Year in industry**

On our three year programmes you may choose to spend an additional year working on a placement with an industrial or business organisation, either in the UK or abroad. This gives you the opportunity to put your academic skills into practice and get some paid work experience. It also gives you an idea of your career options and greatly enhances your CV. Prior experience of working in industry is always popular with employers and some Kent students return to work full-time for their placement company. Recent placements have included corporations such as IBM, management consultancies, government departments such as the Ministry of Defence and HM Revenue and Customs, actuarial firms and banks.

**Professional recognition**

Graduates in Mathematics and Accounting & Finance may receive exemptions from the Institute of Chartered Accountants examinations. Graduates in Mathematics and Statistics may be eligible to receive Graduate Statistician status (GradStat) from the Royal Statistical Society. Graduates in Mathematics with Secondary Education (QTS) gain Qualified Teacher Status (QTS).

“I found my course challenging and also very interesting. My statistics professor was brilliant; he really brought the subject to life.”

Michael Smith
Mathematics graduate
SUPERB STUDENT EXPERIENCE

Set in 300 acres of parkland, the Canterbury campus is a stunning environment in which you benefit from a multicultural learning environment as well as the University’s first-class facilities.

Excellent study resources
The study resources on campus are excellent. The Templeman Library has a vast range of publications, including e-books and e-resources. Kent’s expert librarians can help you to make the most of these to find the information you need.

As a student of Mathematics you are given access to professional mathematical and statistical software such as Maple, MATLAB and Minitab in various modules throughout your degree. Staff at the School of Mathematics, Statistics and Actuarial Science use these packages in their teaching and research.

International community
Kent offers an incredibly diverse and cosmopolitan campus with students representing 149 nationalities on campus. We also have strong links with universities and research centres around the world.

Beautiful green campus
Our campus is set in a stunning location. It has plenty of green and tranquil spaces, both lawns and wooded areas, and is set on a hill with a view of the city and Canterbury Cathedral.

Kent has a reputation for being a very friendly university and everything you need on campus is within walking distance. The campus has its own cinema, theatre, and even a student nightclub. There are many restaurants, cafés and bars on campus and a sports centre and gym. Other facilities include a general store, an off-licence, a bookshop, a bank, a medical centre and a pharmacy.

Attractive location
From campus, it’s a 25-minute walk or a short bus-ride into Canterbury, a lovely city with medieval buildings, lively bars and atmospheric pubs, as well as a wide range of shops. The attractive coastal town of Whitstable is also close by and there are sandy beaches further down the coast. London is under an hour away by high-speed train.

“A beautiful city, friendly people and an excellent education – my three years in Canterbury have been fantastic!”

Suraya Rahmat
Mathematics graduate
Andrew Paul is in his second year, studying Mathematics.

Why did you choose Kent?
The University is well known for its great maths department, that was the main thing. There is a dedicated Year in Industry programme which can contribute to your degree, which wasn’t offered at many other universities. In the current economic climate, any work experience is valuable. The university also has great sport and entertainment facilities and is set on a lovely green campus with views over Canterbury.

What is the level of support like in your studies?
The School of Mathematics and the University are very supportive. The induction week was helpful, particularly getting used to the computer system and finding my way around the library. It was also a great opportunity to meet fellow students and academic staff. All the lecturers are approachable and they are brilliant at responding to emails.

Your School has Stage 1 tutorial support, how does that work?
For some modules you have example classes. This is your opportunity to work on questions and put the theory into practice. Postgraduates help to run these classes and are available to give support if you’re having problems. They won’t tell you the answer, but they’ll give you a hint to help you find a solution.

What part of your studies have you enjoyed the most so far?
My favourite would have to be calculus, looking at different methods of differentiation and integration. I love learning how to solve different types of differential equations. Maths is a much broader subject than you would think. It’s only when you get to university that you realise how many different topics you can study.

What are the academic facilities like at Kent?
I’m a big fan of the library. As well as traditional books there are digital copies you can access free on computers. I think Kent has one of the highest computer-to-student ratios of any university in the UK, meaning you can always find a computer. One of the best things at the library is the use of free netbooks. This means you don’t have to bring your laptop out, if you’re afraid of losing it.

What is the accommodation on campus like?
I really like being in Darwin College, I share a kitchen with nine other people. It’s a decent size – my room is bigger than the one I have at home – and it’s really useful for maths students because it’s only a 30-second walk to lectures. I get on really well with my flatmates and I will be living with them off campus next year.

What is the social life on campus like?
The sporting facilities are fantastic, especially the refurbished gym. There are hundreds of societies for nearly any hobby you can think of. I play badminton twice a week through the Badminton Society; you can play seriously or just have fun with friends, it’s a great way to meet new people. There are multiple bars and restaurants on campus, which are well priced. We also have a cinema and a night club, so there really is something for everyone.

Where do you think you might spend your year in industry?
I’d like to go into a large well-known company one that, hopefully, prospective employers would recognise and respect. I’ve started researching different companies, such as IBM, but most applications don’t appear until the summer. Obviously I want the placement to be maths-related so that I can get the most out of the experience.

What advice would you offer someone thinking of coming to Kent?
It’s really important to look at several universities to see where you feel most at home. For me, that was definitely Kent. Doing maths at university is different from GCSE or A level; it’s not just a progression, it’s a different way of learning. You’ll soon realise it’s a much broader subject than you first thought, with so many different topics to explore. If you have a passion for mathematics, then definitely visit Kent on one of its Open Days.
A SUCCESSFUL FUTURE

Kent equips you with the essential skills to give you a competitive advantage when it comes to getting a job. Kent is consistently in the top 20 in the UK for graduating starting salaries.

Wide range of careers
Many career paths can benefit from the numerical and analytical skills you develop during your studies. In recent years, graduates in mathematics and statistics have gone on to a wide range of destinations. They have pursued successful careers in medical statistics, the aerospace industry, software development, teaching, actuarial work, civil service statistics, chartered accountancy and the oil industry. Others have gone on to do further academic work, including research at postgraduate level and beyond.

Gain transferable skills
Studying for a degree is not just about mastering your subject area. Nowadays, employers are looking for a range of key transferable skills and you are encouraged to develop these within your degree. Dealing with challenging ideas, thinking critically, and the ability to present your ideas clearly are important skills that you gain at Kent. Communication skills, both writing and presenting, are incorporated into all of our degree programmes.

Professional experience
Students who choose to take a Year in Industry (see p10) often find that this extra experience enhances their job prospects. They gain work experience and new skills, and get an insight into the professional pathways available.

A large number of our students also develop professional skills and gain hands-on experience through Kent’s wide range of volunteering opportunities.

Careers advice
The Careers and Employability Service can give you advice on how to choose your future career, how to apply for jobs, how to write a good CV and how to perform well in interviews and aptitude tests. It also provides up-to-date information on graduate opportunities before and after you graduate.

More information
For more information on how Kent helps you to develop your employability, visit the website at www.kent.ac.uk/employability

IMPRESSIVE CAREER PROSPECTS
Six months after graduation in 2013, less than 6% of Kent graduates were without a job or went on to a further study opportunity.
Becky Callaghan studied Mathematics at Kent. She graduated in 2012 and was employed as a Safety Intelligence Analyst for the Rail Safety and Standards Board.

Why did you choose to come to Kent?
I lived in Canterbury and my Dad used to work at the University, so I knew it well. I have always loved the campus as the surroundings are beautiful. Kent is also known for being a good University, and I knew lots of people who went to it and loved it. On the Open Day I met some people who I got on really well with, and so I could really picture myself there.

What attracted you to the course?
I enjoy problem solving and working with numbers. It’s also such a useful subject to understand as it opens so many doors for you. But to be really honest, I have always loved maths and couldn’t imagine studying any other subject at University!

What was your degree course like?
It was really fun sometimes, and really hard at other times. You’ve got to love maths to do the degree! I was constantly challenged, which I liked, and the lecturers were really good at explaining things. You can tell they’re passionate about their subject. There’s a great choice of modules too.

How did your degree course lay the foundations for your chosen career path?
I didn’t realise how much you could do with a maths degree until I graduated and was looking for jobs. I have gone down the route of being an analyst and my degree has given me loads of skills for this. For example, I now have a much better understanding of using computer programs, especially mathematical ones. This really helps with any job, but especially as an analyst. Also, doing independent work, such as my dissertation, gave me confidence in my mathematical work and understanding.

How do the skills you gained at Kent help you in your present career?
Apart from the abundance of mathematical skills I have gained, it has also given me confidence to work with others, make friends, do presentations, think more logically in general and also how to plan and pace myself when working.

What social activities did you get involved with during your time at Kent?
I liked to go to the library café in between lectures with my friends. We especially liked going to the Rutherford bar in the evenings, and sometimes we would go to a comedy night in the Attic [now the Venue]. The Gulbenkian Theatre is a great place to go. It’s a lovely café for lunch, and it has good shows or films in the evenings.

How did your career progress after graduation?
I got a job pretty much straight after graduation with the Rail Safety and Standards Board, where I could use the analytical skills I had learnt at University to make the railway safer for passengers.

What are your future plans?
When I first graduated, I was thinking seriously about doing a PhD but I decided I wanted to get into the workplace and have some experience before going back to studying. However, I still hope one day to do a PhD.

What advice would you give to someone thinking of coming to Kent?
Choose your subject carefully. It should be one that will give you a good job afterwards as well as being something you enjoy. If you like maths, I would recommend it. The course is brilliant, the lectures are fantastic and there are so many opportunities out there for you once you’ve finished. Don’t just do a subject for the sake of it or for the ‘uni experience’ – do a subject that will give you a future.
CHOOSING YOUR PROGRAMME

There is a range of programmes on offer, so you can choose the degree that reflects your interests. Here is a brief explanation of what the different degree programmes offer.

Mathematics
This three-year programme provides a broad understanding of many areas of mathematics, which makes it a good base for many careers. Students can choose options to specialise in pure mathematics or applied mathematics; the modules offered reflect the research interests of the lecturers.

Mathematics and Statistics
This programme, also studied over three years, is for students who want to specialise in statistics, perhaps with a view to a career as a statistician. Graduates in Mathematics and Statistics may be eligible to receive Graduate Statistician status (GradStat) from the Royal Statistical Society as a first step to a career as a Chartered Statistician.

Mathematics and Accounting & Finance
The study of mathematics provides an excellent basis for the applied techniques of accountancy and finance. In this three-year joint honours programme you split your studies equally between the two related disciplines. The degree provides various exemptions from the examinations of the Institute of Chartered Accountants. For more details you can order the subject leaflet or download a pdf at www.kent.ac.uk/studying/leaflets.

MMath in Mathematics
This new four-year degree programme is for students who have a desire to gain a broad knowledge of mathematics, to explore a range of real-life applications and develop a deep interest in some particular mathematical topic. It provides you with a broad range of skills that are highly sought after by employers and opens up a variety of careers.

You gain a suitable depth of knowledge to enter postgraduate studies at doctorate level in mathematics and other closely related subjects.

MMathStat in Mathematics and Statistics
This new four-year programme is for students who have a strong interest in pursuing a deeper study of mathematics and statistics than would be covered by a three-year degree programme, and who wish to explore a range of real-life applications. It provides you with a broad range of skills that are highly sought after by employers and opens up a wide variety of career opportunities. You gain a depth of suitable knowledge to enter postgraduate studies at doctorate level in statistics and other closely related subjects.

Mathematics with Secondary Education
This three-year degree programme is run in partnership with Canterbury Christ Church University. You gain all the skills and knowledge you need to teach mathematics up to A level and gain Qualified Teacher Status (QTS) as well as a degree.

Year in Industry
On all of our three-year programmes, except Mathematics with Secondary Education, you may choose to spend an additional year working on a placement with an industrial or business organisation. This allows you to hone your theoretical skills by applying them to real-life situations. It also gives you a clearer idea of career options and greatly enhances your CV.

The Year in Industry takes place between your second and final years of full-time study and counts towards your final degree result. A Placement Officer is on hand to assist you before and throughout your placement.

Mathematics with a Foundation Year
This four-year programme is for students who do not have enough experience to go directly into degree-level studies. It covers the mathematical skills you need to enter Stage 1 of the degree. Overseas students who need to improve their English can also do a foundation course that includes language tuition.
STUDYING AT STAGE 1

Stage 1 represents the first year of full-time study.

Each week you have about 16 hours of lectures and classes. Modules which involve programming or working with computer packages usually include practical sessions. Most modules are assessed by examination and coursework. At Stage 1 the marks do not count towards your final degree result.

All students take these modules:
- Calculus and Mathematical Modelling
- Proofs and Numbers.

Students of Mathematics, Mathematics with Secondary Education and the MMath take:
- Exploring Mathematics
- From Geometry to Algebra
- Matrices and Probability
- Statistics.

Mathematics and Statistics and MMathStat students take:
- Exploring Mathematics
- Matrices and Probability
- Statistics.

They also choose two modules from:
- Business Economics
- Economics (counts as two modules)
- From Geometry to Algebra (counts as two modules)
- Managers and Organisations.

Mathematics and Accounting & Finance students take:
- Matrices and Probability
- Statistics
- Introduction to Business Modelling
- Economics (counts as two modules).

Modules: Stage 1 Business Economics
This module introduces you to the core economic principles and how these can be used in a business environment to aid decision-making and behaviour.

Calculus and Mathematical Modelling
The first part of this module takes a calculus approach to mathematical analysis and provides rigorous proofs of various fundamental results in classical analysis. In the second part, calculus techniques are used to solve differential and difference equations; numerous applications are discussed.
STUDYING AT STAGE 1 (CONT)

From Geometry to Algebra
The concept of symmetry is one of the most fruitful ideas through which mankind has tried to understand order and beauty in nature and art. This module develops the concept of symmetry in geometry and discusses links with the fundamental notion of a group in algebra.

Introduction to Business Modelling
Topics covered in this module include basic spreadsheet functionalities and an introduction to common spreadsheet features. You learn data management facilities such as sorting, filtering, data forms and pivot tables, what-if analysis and an introduction to basic financial analysis and how to carry this out using spreadsheets; compound interest, discounting, net present value, internal rate of return, loans and mortgages.

Managers and Organisations
This module introduces you to theories of management, beginning with classical management styles through to contemporary management concepts.

Matrices and Probability
This module introduces the main concepts in elementary probability theory, and lays the foundations for the Statistics module which follows, and the more advanced treatment in the Probability and Inference module in the second year. You are introduced to matrix algebra and the ideas of linear spaces starting with the systematic solution of systems of linear equations.

Proofs and Numbers
Numbers and proofs are central notions in modern mathematics that have found applications in many other sciences and also in our everyday life. For instance, the security of our mobile phones relies on the properties of integers. In this module, you are introduced to some of the fundamental results in number theory, and gain an appreciation of the concept of proof in mathematics.

Statistics
This module introduces you to the basic concepts of statistics. The material is related to real data at every stage and MINITAB is used to provide statistical computing facilities for all the material studied. Data description and data summary are studied, followed by an introduction to the main methods of inference. Most material is based on the Normal, t, and F distributions, but some simple non-parametric procedures are also covered.

DID YOU KNOW?
According to The Guardian University Guide 2015, 85% of Mathematics students at Kent were satisfied with the quality of their course.
STUDYING AT STAGE 2

Stage 2 is your second year of full-time study. Marks count towards your final degree result.

All students take these modules:
• Analysis
• Linear Algebra.

Mathematics students take:
• Probability and Inference
• Functions of Several Variables
• Groups and Rings
• Mathematical Techniques and Differential Equations.

They also choose three additional modules from:
• Computational Mathematics
• Functions of Several Variables
• Groups and Rings
• Linear Programming and its Applications
• Mathematical Modelling
• Mathematical Techniques and Differential Equations
• Number Theory
• Regression.

Mathematics and Statistics and MMathStat students take:
• Computational Mathematics
• Probability and Inference
• Regression.

They also choose three modules from:
• Functions of Several Variables
• Groups and Rings
• Linear Programming and its Applications
• Mathematical Modelling
• Mathematical Techniques and Differential Equations
• Number Theory
• Probability and Inference
• Regression.

MMath students take:
• Functions of Several Variables
• Groups and Rings
• Mathematical Techniques and Differential Equations
• Probability and Inference.

They also choose two optional modules from:
• Computational Mathematics
• Mathematical Modelling
• Number Theory
• Regression.

Modules: Stage 2

Analysis
The concept of a limit is basic to calculus and, unless this concept is defined precisely, uncertainties and paradoxes will creep in. Based on the foundation of the real number system, this module develops the theory of convergence of sequences and series and the study of continuity and differentiability of functions. The notion of Riemann integration is also explored.

Computational Mathematics
This module introduces you to the methods, tools and ideas of numerical computation. In application, mathematics frequently generates specific instances of standard problems for which there are no easily obtainable analytic solutions. Examples might be the task of determining the value of a particular integral, or of finding the roots of a certain non-linear equation. Numerical computations are almost invariably contaminated by errors, so it is important to understand the source, propagation and magnitude of these errors.

CONTINUED OVERLEAF
STUDYING AT STAGE 2 (CONT)

Financial Accounting I
You are introduced to the principles and practices of financial accounting in this module, and the discipline within accountancy, which is concerned primarily with recording financial events and preparing and interpreting financial reports for parties outside the organisation. A computer-based learning package supports your study of double entry book-keeping.

Functions of Several Variables
This module builds on the Analysis module from the first term, generalising the concepts from functions from \( \mathbb{R} \) to \( \mathbb{R} \) to functions from \( \mathbb{R}^n \) to \( \mathbb{R}^n \). This involves learning about the topology or \( \mathbb{R}^n \); open, closed and compact sets. You then consider convergence of sequences and continuity, differentiability and integrability of functions in this higher dimensional setting. This leads to new concepts, including partial derivatives, line and surface integrals and changes of co-ordinate systems.

Groups and Rings
Groups are sets with a single binary operation. They arise as symmetry groups in contexts from puzzles like Rubik’s cube to chemistry, where they help list molecules with a given number of atoms involved. In contrast, rings have two binary operations, generalising the arithmetic of integer numbers. This part of algebra has many applications in electronic communication, in particular in coding theory and cryptography.

Linear Programming and its Applications
You cover the broad areas of modelling linear programming applications which can arise in management, finance, business, and marketing. Here, the word ‘programming’ refers to planning rather than computer programming.

Mathematical Modelling
This module includes the study of vector algebra and products of vectors. You study Newton’s laws for a single particle and various applications, including motion in a central force field, motion in a plane and in three dimensions; motion of a particle in a rotating frame of reference; simple harmonic motion, twisted curves and the Serret-Frenet formulae.

“I was surprised to find how much responsibility I was given within my placement. Being given a significant role in the team makes you feel a lot more involved, as opposed to being given odd tasks that no one seems to care about.”

James Smith
Mathematics with a Year in Industry
Mathematical Techniques and Differential Equations
Most physically interesting problems are governed by ordinary, or partial, differential equations. It is examples of such equations that provide the motivation for the material covered in this module. It provides a firm grounding in mathematical methods for solving differential equations and determining the properties of solutions. The module is invaluable to students who later take Stage 3 options in asymptotics, numerical analysis or differential equations.

Number Theory
Number theory plays a central role in our everyday life by protecting the privacy of our communications, bank transfers, and so on. This module gives an all-round introduction to the concepts, results and applications of number theory.

Operations Management
In this module, you develop the ability to use appropriate techniques of analysis and enquiry within Operations Management and learn how to evaluate alternatives and make recommendations.

Principles of Finance
You gain an understanding of the concepts and principles underlying the investment and financing decision process. Short-term decisions are dealt with first, together with relevant costs, one of which is the time value of money. This leads on to long-term investment decisions, which are examined using the economic theory of choice.

Probability and Inference
This module develops the techniques introduced in Stage 1 probability and statistics, and lays the foundation for several Stage 3 statistics modules. The probability component is mainly concerned with how to find probability distributions of functions of random variables, an essential skill in proving standard statistical results and in applying probability and statistics in novel situations. The study of sampling distributions, which underpins much of statistical inference, provides a bridge to the statistical part of the module.

Regression
You are introduced to the theory and practice of regression, and associated linear model techniques. Quite often experiments and research aim to express a response variable $y$ as a function of some other (explanatory) variables. For example, $y$ might be the yield of a chemical process and the explanatory variables might be temperature and pressure. Knowing the relationship would enable $y$ to be predicted for particular values of temperature and pressure.

Statistics for Insurance
You study aspects of statistics which are particularly relevant to insurance in this module. Some topics, such as risk theory and credibility theory, have been developed specifically for actuarial use. Other areas, such as Bayesian statistics and generalised linear models, have been developed in other contexts but now find applications in actuarial fields.

You study the following modules at Canterbury Christ Church University:

Introduction to Professional Placement
You gain first-hand experience through a mentoring scheme with mathematics teachers in local schools in this 10-credit module. On placement, you experience classes from Key Stages 3 and 4, with responsibilities linked to the role of teaching assistant. A block school experience consolidates the learning that has taken place during the year, and is the foundation for the Level 3 education courses.

Mathematics Learner and Teacher
This 20-credit module introduces you to the knowledge and skills that are necessary to become effective teachers of mathematics and the standards required to be awarded qualified teacher status (QTS). You learn about the requirements and implications of national curriculum documentation and how this affects your professional practice as a student teacher.
STUDYING AT STAGE 3

Stage 3 is your third year of full-time study. Your marks at this stage count towards your final degree result.

Mathematics students choose one of the following modules:
• Dissertation
• Mini-projects.

They also choose six modules from:
• Analysis of Variance
• Applied Stochastic Modelling and Data Analysis
• Calculus of Variations
• Complex Analysis
• Discrete Mathematics
• Elements of Abstract Analysis
• Games and Networks
• Groups and Representations
• Nonlinear Systems and Mathematical Biology
• Numerical Solution of Differential Equations
• Orthogonal Polynomials and Special Functions
• Polynomials in Several Variables
• Practical Multivariate Analysis
• Stochastic Processes
• Time Series Modelling and Simulation
• Topology.

They also choose four modules from:
• Business Finance (counts as two modules)
• Calculus of Variations
• Complex Analysis
• Discrete Mathematics
• Elements of Abstract Analysis
• Games and Networks
• Groups and Representations
• Nonlinear Systems and Mathematical Biology
• Numerical Solution of Differential Equations
• Orthogonal Polynomials and Special Functions
• Polynomials in Several Variables
• Practical Multivariate Analysis
• Stochastic Processes
• Time Series Modelling and Simulation
• Topology.

Mathematics with Secondary Education (QTS) students take:
• Individual Project in Mathematics
• Reflective Professional Practice
• Professional Investigation.

Mathematics and Accounting & Finance students take Management Accounting and choose four optional modules from:
• Analysis of Variance
• Applied Stochastic Modelling and Data Analysis
• Calculus of Variations
• Complex Analysis
• Discrete Mathematics
• Elements of Abstract Analysis
• Games and Networks
• Groups and Representations
• Nonlinear Systems and Mathematical Biology
• Numerical Solution of Differential Equations
• Orthogonal Polynomials and Special Functions
• Polynomials in Several Variables
• Practical Multivariate Analysis
• Stochastic Processes
• Time Series Modelling and Simulation
• Topics in Modern Applied Mathematics (counts as two modules)
• Topology.

MMath students take Starting Research in the Mathematical Sciences and choose a further seven modules from:
• Calculus of Variations
• Complex Analysis
• Discrete Mathematics
• Elements of Abstract Analysis
• Groups and Representations
• Nonlinear Systems and Mathematical Biology
• Numerical Solution of Differential Equations
• Orthogonal Polynomials and Special Functions
• Polynomials in Several Variables
• Practical Multivariate Analysis
• Stochastic Processes
• Time Series Modelling and Simulation
• Topics in Modern Applied Mathematics (counts as two modules)
• Topology.

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such as generalised linear models, that go beyond the standard normal distribution linear model, and allow response variables to be binary, counts or ordinal data. Half of the teaching sessions are devoted to learning the computing language R for basic data handling and for fitting various types of regression model. This is important for later parts of the MMathStat programme.

Analysis of Variance
This module builds on the study of linear models covered in Regression. It is a fundamentally important method for the statistical analysis of data and is used in biological, medical, psychological, sociological and industrial research. In computing classes you explore the analysis of variance facilities of the statistical package R.

Applied Stochastic Modelling and Data Analysis
This module introduces you to a range of atypical data sets, drawn from areas such as ecology, biology, genetics and psychology.

Auditing
You gain an understanding of the underlying concepts of the auditing process and the modern practice of auditing. This module considers the overall objectives and the theory of an audit of private sector organisations, with special attention to four fundamental concepts: independence, evidence, reporting and responsibility. It looks at the way in which the profession has responded to criticism, including those made by the judiciary. You also look at the legal duties and liabilities of auditors, the role of the auditor in detecting fraud and errors, and regulation.

Business Finance
You gain a greater understanding of the underlying concepts and principles of investment, financing and dividend decisions, in a theoretical and practical context. You look at the financial system of the country, including the major players in the market. Major theories of the stock market are examined, including portfolio theory, the capital asset pricing model and the efficient market hypothesis, which all help to explain share price valuation and behaviour. You undertake a small portfolio project in which you have a notional £200,000 to invest.

Calculus of Variations
In this module definite integrals involving one or more unknown functions are considered. It is required to determine these functions so that the definite integral takes maximum or minimum values. This topic has connections with many others, such as differential equations, differential geometry and dynamical systems, and sets forth the basic theory. The module also explores various applications.

Complex Analysis
This module is concerned with complex functions, that is functions which are defined for, and assume, complex values. Their theory follows a different development from that of real functions, is remarkable in its directness and elegance, and leads...
to many useful applications. Topics include: complex numbers; domains and simple connectivity; integration and Cauchy’s theorem; singularities and residues, and applications.

**Discrete Mathematics**
Recently, with the rapid developments in IT, in particular in electronic communication systems, some quite surprising new applications have been found for discrete mathematics (as opposed to continuous mathematics, which is based on calculus). Thus methods for the encoding of information to safeguard against eavesdropping or distortion by noise have involved using some basic results from modular arithmetic, polynomial algebra and the theory of finite fields. The module provides a self-contained introduction to this general area.

**Dissertation**
This module provides an opportunity to explore and research a topic in mathematics or statistics that is of interest to you. Under the guidance of a supervisor, you engage in self-directed study to produce a dissertation.

**Elements of Abstract Analysis**
You build on the key analytical concepts of sequences, series, limits and continuity developed in any first course on Real Analysis, and place them in the more general context of metric spaces. You look at fundamental notions of metric spaces, such as compactness and completeness. Metric space theory underpins much of modern analysis and its applications. You use techniques and theorems from metric spaces to discuss elements of Hilbert space theory. The module emphasises formal definitions and proofs, and enables you to place your previous knowledge of analysis in a much wider context.

**Financial Accounting 2**
This module provides you with a thorough understanding of financial accounting techniques at an advanced level, with an appreciation of the regulatory and social environment within which financial reporting takes place. It includes a rigorous examination of the principles which underpin the financial reporting process. As far as possible, coverage of these areas is integrated so that, for example, the nature of the financial reporting environment is explored within the context of the technical issues and problems with which it must cope.

**Futures and Options Markets**
In this module, you cover international investment banks’ products and strategies. You focus on those that involve the description and analyses of the characteristics of more commonly used financial derivative instruments, such as forward and future contracts, swaps, and options involving commodities, interest, and equities markets. Modern financial techniques are used to value financial derivatives. The main emphasis is on how financial institutions and traders value, replicate, and arbitrage the financial instruments and how they encourage their clients to use
derivative products to implement risk management strategies in corporate applications.

**Games and Networks**
Among the topics you study in this module are: combinatorial optimisation (the shortest path problem, the minimal spanning tree problem, flows in networks, scheduling theory, computational complexity); theory of games (matrix games – pure strategies, matrix games – mixed strategies, bimatrix games, n-person games and multi-criteria decision theory).

**Groups and Representations**
Groups arise naturally in many areas of mathematics, as well as in chemistry and physics. A way to approach groups is by representing them as matrices, in which explicit computations are easy. This approach has been fruitful in developing our understanding of groups over the last century. This module introduces you to the main ideas and notions of groups and representations. It has a strong computational strand: a large part is devoted to explicit computations of representations and character tables (a table of complex numbers associated to any finite group).

**Individual Project in Mathematics**
This module provides you with an opportunity to explore and research a topic in mathematics or statistics that is of interest to you. Under the guidance of a supervisor, you engage in self-directed study to produce a dissertation.

**Management Accounting 1**
One of the most important factors for a management accountant is to ensure that they provide relevant information for management activities such as decision making, planning and control. In this module, you develop an understanding of the concepts, techniques and problems encountered in management accounting. We emphasise the need to examine managerial issues in the context in which they arise and to appreciate the interrelationship of different approaches and disciplines in their resolution.

**Mini-projects**
Professional mathematicians and statisticians employ a wide variety of skills when working on any one problem. This module gives you an

“After encountering some personal difficulties which affected my studies, the School’s Student Adviser and my lecturers helped me to catch up and get back on track. It really made a difference to me and now I feel much more confident about my exams.”

Kezia Huttlestone
Mathematics and Statistics
Stage 2 student
and thus numerical solutions are an invaluable way to obtain information about the underlying physical system. You study ordinary differential equations (ODEs) and different numerical methods are introduced, error growth is studied and initial value and boundary value problems are investigated. You also cover the numerical solution of partial differential equations (PDEs).

Orthogonal Polynomials and Special Functions
These are useful mathematical functions with remarkable properties and applications in mathematical physics and other branches of mathematics. Closely related to many branches of analysis, they have important applications to recent problems in areas such as quantum mechanics, mathematical statistics, combinatorics and number theory. This module illustrates the theory and gives an insight into various applications, including recent developments in this field. It uses aspects of mathematics and computation through the use of MAPLE.

Polynomials in Several Variables
This module provides a rigorous foundation for the solution of systems of polynomial equations in many variables. In the 1890s, David Hilbert proved four groundbreaking theorems that prepared the way for Emmy Noether’s foundational work in the 1920s on ring theory and ideals in abstract algebra. The module develops Hilbert’s theorems and the essential canon of ring theory in the context of polynomial rings. It takes a modern perspective on the subject, using the Groebner bases developed in the 1960s together with ideas of computer algebra pioneered in the 1980s.

Practical Multivariate Analysis
Many statistical problems in biology and psychology, for example, are multivariate, in that more than one measurement is made on each individual under study. For instance, we may be given scores on several different tests, or the levels of several chemicals in the blood. Some statistical techniques for analysing multivariate data are extensions of standard univariate techniques. Other techniques are concerned with the relationships between variables; they lead, in conjunction with modern computing techniques, to a wide variety of descriptive and exploratory tools.

Starting Research in the Mathematical Sciences
This module provides an opportunity to study a topic in mathematics or statistics through independent study. It develops the basic skills needed for carrying out research in the mathematical sciences, such as communication skills, written and spoken, and problem-solving skills.

Stochastic Processes
A stochastic process is one that develops in time according to probability rules, for example models for reserves in insurance companies, queue formation, the behaviour of a population
of bacteria, and the persistence of an unusual surname through successive generations.

**Mathematics and Statistics**

of fields, ranging from economics to engineering, and methods of analysing time series constitute an important area of statistics. This module focuses on various time series models, including some recent developments, and provides modern statistical tools for their analysis. In addition, simulation methods are studied. These methods are becoming increasingly important tools; simulation models can be easily designed and run on modern PCs. Various practical examples are considered to help you tackle the analysis of real data.

**Topics in Modern Applied Mathematics**

Each year, you study three topics. In 2013/14 these were: Applied Analysis: Asymptotics; Mathematics of Quantum Physics and Lie Groups and Lie Algebras.

**Topology**

This module introduces you to point-set topology, a topic that is relevant to many other areas of mathematics. You look at the concept of topological spaces and related constructions. In an Euclidean space, an ‘open set’ is defined as a (possibly infinite) union of open ‘epsilon-balls’. A topological space generalises the notion of ‘open set’ axiomatically, leading to some interesting and sometimes surprising geometric consequences. For example, you encounter spaces where every sequence of points converges to every point in the space, and see why, for topologists, a doughnut is the same as a coffee cup. You also look at famous objects, such as the Moebius strip or the Klein bottle.
STUDYING AT STAGE 4

Stage 4 is only for students following the MMath and MMathStat programmes. Marks at this stage count towards your final degree result.

Choices of modules at Stage 4 are constrained by choices you made earlier and availability (not all modules run every year).

MMath students take the module Dissertation for MMath Mathematics.

A further six modules are selected from:
• Algebraic Curves in Nature
• Applied Algebraic Topology
• Applied Differential Geometry
• Asymptotics and Perturbation Methods
• Basic Differential Algebra
• Diagram Algebras
• Geometric Integration
• Introduction to Functional Analysis
• Introduction to Lie Groups and Algebras
• Mathematics and Music
• Nonlinear Analysis and Optimisation
• Nonlinear Waves and Solitons
• Poisson Algebra and Combinatorics
• Principles of Data Collection
• Quantum Physics
• Stochastic Models in Ecology and Medicine
• Symmetries, Groups and Invariants.

MMathStat students take:
• Analysis of Large Data Sets
• Bayesian Methods
• Computational Statistics

• Dissertation for MMathStat Mathematics and Statistics
• Probability and Classical Inference.

Two further modules are selected from:
• Algebraic Curves in Nature
• Applied Algebraic Topology
• Applied Differential Geometry
• Asymptotics and Perturbation Methods
• Basic Differential Algebra
• Diagram Algebras
• Geometric Integration
• Introduction to Functional Analysis
• Introduction to Lie Groups and Algebras
• Mathematics and Music
• Nonlinear Analysis and Optimisation
• Nonlinear Waves and Solitons
• Poisson Algebra and Combinatorics
• Principles of Data Collection
• Quantum Physics
• Stochastic Models in Ecology and Medicine
• Symmetries, Groups and Invariants.

Analysis of Large Data Sets
This module considers statistical analysis of data where many variables are collected for each observation. In these data sets, we are interested in understanding the relationships between the variables. Topics covered include definition of descriptive statistics, such as covariance and correlation matrices, principle component analysis, factor analysis, cluster analysis and variable selection for regression with many explanatory variables.

Applied Algebraic Topology
There is growing interest in applying the methods of algebraic topology to data analysis, sensor networks, robotics and so on. This module develops the necessary elements of algebra and topology, and investigates how these techniques are used in various applications.

Applied Differential Geometry
Modern differential geometry has made a huge impact in the development of nonlinear mathematical physics. Differential geometry is at the centre of the analysis of pattern recognition, image processing and computer graphics. This module introduces you to the basics of differential geometry.

Asymptotics and Perturbation Methods
You are introduced to methods used in the evaluation of solutions of ordinary differential equations. These are widely used in the study of physically significant differential equations.

Modules: Stage 4

Algebraic Curves in Nature
In this module, you study plane algebraic curves and the way that they arise in applications to other parts of mathematics and physics. Examples include the use of elliptic functions to solve problems in mechanics and algebraic curves used in cryptography.
equations, which arise in applied mathematics, physics and engineering.

**Bayesian Methods**
Bayesian inference plays a central role in modern statistical analysis. This module covers the basis of Bayesian statistics and introduces the main theoretical and computational tools necessary to address Bayesian inference.

**Basic Differential Algebra**
This module is a rigorous, example-led introduction to computer algebra. The main applications discussed are the analysis of singularities and the simplification of nonlinear differential systems.

**Computational Statistics**
This introduces a range of atypical data sets, drawn from areas such as biology, genetics and psychology. Each of the examples can be described by a suitable stochastic model, making use of the known background to the data, and built on the axioms of probability theory. Fitting models to data is traditionally accomplished by the method of maximum likelihood. Typically, this involves numerical optimisation. This is only feasible using a computer, so integral to the module is the use of the MATLAB integrated computer package. You gain experience of running a range of computer programs for modern methods of statistical analysis.

This module provides you with an enviable grasp of the utility and power of modern statistics for describing real-life situations. No previous experience of MATLAB is necessary.

**Diagram Algebras**
These play an important role in integrable quantum spin chains, the quantum counterparts of the classical statistical mechanical models. This module gives various perspectives on diagram algebras, from algebra and statistical mechanics.

**Dissertation for MMath Mathematics**
This is an opportunity to conduct self-directed study through an in-depth exploration on a subject of mathematics of your choice. You demonstrate your ability to develop a coherent account of a topic in mathematics and further develop your skills in the written presentation of mathematics. You are supported by a supervisor throughout the year.

**Geometric Integration**
The equations studied in this module are ordinary differential systems, especially Hamiltonian. You study numerical solutions of these systems that preserve specific qualitative and geometric properties.

**Introduction to Functional Analysis**
This module introduces one of the main areas underpinning research in analysis today and has applications in many sciences. As well as giving the main definitions and theorems in the area, you focus on applications, in particular to differential equations and in approximation theory. Basic knowledge of normed spaces and Hilbert spaces is useful.

**Introduction to Lie Groups and Algebras**
You are introduced to Lie groups and explore some applications in this module. Lie groups depend on a finite number of real or complex parameters, such as the group of rotations and translations. They play a fundamental role in the mathematical modelling of physical and mathematical geometric notions. In particular, they arise in the study of computer graphics, symmetries, conservation laws and classical and quantum field theories.

**Mathematics and Music**
Digital audio has fundamentally changed the way music is made, distributed and shared. It is so pervasive that most of the music we hear is digitally stored and
processed. Music engineering is a modern application of classical mathematics, the mathematics that is used to study quantum systems, functional approximation for numerical schemes and modern image processing.

**Nonlinear Analysis and Optimisation**
This module introduces you to max-plus (or tropical) algebra and develops the connection with nonlinear Perron-Frobenius theory. It builds on standard linear algebra and analysis modules. Applications are illustrated by practical problems in combinatorial optimisation and game theory.

**Nonlinear Waves and Solitons**
This module looks at nonlinear phenomena and shows how mathematics can provide a qualitative description of real world nonlinear waves, such as those seen in oceans, shallow water, and optical fibres. Applications include the understanding of tsunamis, freak waves, shock waves, and soliton solutions of some famous integrable partial differential equations that have arisen from standard modelling processes.

**Poisson Algebra and Combinatorics**
You are introduced to the main ideas and notions of Poisson algebras and their quantisations. You study the totally positive matrices used in statistics, game theory, mathematical economics and mathematical biology. There is a strong computational strand and a large part is devoted to explicit computations of symplectic leaves of Poisson algebras and algorithmic methods in total positivity.

**Principles of Data Collection**
You explore the important roles that statisticians play in planning data collection. Well-planned studies can help to ensure that key questions of interest can be addressed unambiguously and can improve the precision of the conclusions of the study. The two main types of study you consider are sample surveys and designed experiments.

**Probability and Classical Inference**
This module looks at advanced statistical theory and builds on the second year Probability and Inference module MA629. The topics covered include general theories of hypothesis testing and general methods of estimation, which are important for working with complex statistical models.

**Quantum Physics**
Quantum mechanics underpins much of our understanding of the real world. Many ordinary devices are a practical application of the theory of quantum mechanics, such as DVD players, computers and mobile phones. There are exciting opportunities for its application in other areas, notably secure communications.

**Stochastic Models in Ecology and Medicine**
This module deals with the analysis of data collected on wild animals, in particular estimating how long wild animals live and the sizes of mobile animal populations. Probability models allow the assessment of environmental changes, such as global warming. The medicine element considers the estimation of survival for human beings, but human data can be censored so methods are presented for graphically representing data and fitting standard probability models.

**Symmetries, Groups and Invariants**
In this module, you study certain configurations with symmetries as they arise in real world applications. Examples include knots described by ‘admissible diagrams’ or chemical structures described by ‘colouring patterns’. Different diagrams and patterns can describe essentially the same structure, so the problems of classification up to equivalence arises. This is solved by attaching ‘invariants’, which are put in ‘normal form’ to distinguish them.
VISIT THE UNIVERSITY

Come along for an Open Day or a UCAS Visit Day and see what it is like to be a student at Kent.

Open Days
Kent runs Open Days during the summer and autumn. These provide an excellent opportunity for you to discover what it is like to live and study at the University. You can meet academic staff and current students, find out about our courses and attend subject displays, workshops and informal lectures. We also offer tours around the campus to view our sports facilities, the library, and University accommodation.

For further information and details of how to book your place, see www.kent.ac.uk/opendays

UCAS Visit Days
If you apply to study at Kent and we offer you a place (or invite you to attend an interview), you will usually be sent an invitation to one of our UCAS Visit Days. You can book to attend through your online Kent Applicant Portal. The Visit Day includes presentations in your subject area, guided tours of the campus, including University accommodation, and the opportunity to speak with both academic staff and with current students about your chosen subject. For further information, see www.kent.ac.uk/visitdays

Informal visits
You are also welcome to make an informal visit to our campuses at any time. The University runs tours of the Canterbury and Medway campuses throughout the year for anyone who is unable to attend an Open Day or UCAS Visit Day. It may also be possible to arrange meetings with academic staff, although we cannot guarantee this. For more details and to book your place, see www.kent.ac.uk/informal

Alternatively, we can provide you with a self-guided tour leaflet, which includes the main points of interest. For more details and to download a self-guided tour, go to www.kent.ac.uk/informal

More information
If you have any further queries on how to choose your degree, our admissions procedures, how to prepare for your studies or would like information about the University of Kent’s facilities and services, please contact us.
T: +44 (0)1227 827272
Freephone (UK only): 0800 975 3777
www.kent.ac.uk

DID YOU KNOW?
Kent offers many scholarships and bursaries. For details see www.kent.ac.uk/ugfunding.
Terms and conditions: the University reserves the right to make variations to the content and delivery of courses and other services, or to discontinue courses and other services, if such action is reasonably considered to be necessary. If the University discontinues any course it will endeavour to provide a suitable alternative. To register for a programme of study, all students must agree to abide by the University Regulations (available online at: www.kent.ac.uk/regulations/).

Data protection: for administrative, academic and health and safety reasons, the University needs to process information about its students. Full registration as a student of the University is subject to your consent to process such information.
COME AND VISIT US

We hold Open Days at our Canterbury and Medway campuses.

For more information, see:
www.kent.ac.uk/opendays