Mathematics with Languages BSc (Hons)

COURSE DETAILS

- A level requirements: ABB
- UCAS code: G19R
- Study mode: Full-time
- Length: 3/4 years

KEY DATES

- Apply by: 25 January 2023
- Starts: 25 September 2023

Course overview

Studying Mathematics at Liverpool is an excellent foundation for a wide range of careers. And combining Mathematics with another subject widens your options even further. Choose to do a Year Abroad and truly experience what it is like to live in another country, learning the language, gaining fluency and immersing yourself in the culture.

INTRODUCTION

Mathematics is a fascinating, beautiful and diverse subject to study. It underpins a wide range of disciplines; from physical sciences to social science, from biology to business and finance. At Liverpool, our programmes are designed with the needs of employers in mind, to give you a solid foundation from which you may take your career in any number of directions.

A Mathematics degree at the University of Liverpool is an excellent investment in your future. We have a large department with highly qualified staff, a first-class reputation in teaching and research, and a great city in which to live and work. You will see a broad range of degree programmes at Liverpool.

By choosing this programme you will study Mathematics (75%) and a language (25%). If you choose to do a year aborad, you will study for two years at Liverpool, then you will be well prepared for the third year spent at a university abroad. There, you will absorb the culture and experience living abroad and gain further fluency in the relevant language. The fourth year is spent back in Liverpool studying Mathematics and communication/translation skills.

At Liverpool, French, Spanish, German, Italian and Chinese may be taken from A level or as a beginner's language where no previous qualifications in the language are necessary. You can also take up Basque, Catalan or Portuguese from beginner level only.

In the first year our vibrant language modules at advanced level will both refresh and extend your knowledge of the target language. If you are a beginner, our fast-moving programme will quickly take you to A level standard during the course of your first year.

WHAT YOU'LL LEARN

- Problem solving
- Strong communication skills
- Teamwork
- Fluency in a foreign language
- Presentation skills

Course content

Discover what you'll learn, what you'll study, and how you'll be taught and assessed.

YEAR ONE

Students must select three MATH modules and one language module each semester.

Students who combine a 75% Mathematics component with a 25% language component without a year abroad, and who follow the beginner's pathway or intermediate pathway within the language component, are not allowed to choose MATH1** modules in their second year or MATH2** modules in their final year.

COMPULSORY MODULES

CALCULUS I (MATH101)

Credits: 15 / Semester: semester 1

At its heart, calculus is the study of limits. Many quantities can be expressed as the limiting value of a sequence of approximations, for example the slope of a tangent to a curve, the rate of change of a function, the area under a curve, and so on. Calculus provides us with tools for studying all of these, and more. Many of the ideas can be traced back to the ancient Greeks, but calculus as we now understand it was first developed in the 17th Century, independently by Newton and Leibniz. The modern form presented in this module was fully worked out in the late 19th Century. MATH101 lays the foundation for the use of calculus in more advanced modules on differential equations, differential geometry, theoretical physics, stochastic analysis, and many other topics. It begins from the very basics – the notions of real number, sequence, limit, real function, and continuity – and uses these to give a rigorous treatment of derivatives and integrals for real functions of one real variable.

INTRODUCTION TO LINEAR ALGEBRA (MATH103)

Credits: 15 / Semester: semester 1

Linear algebra is the branch of mathematics concerning vector spaces and linear mappings between such spaces. It is the study of lines, planes, and subspaces and their intersections using algebra.

Linear algebra first emerged from the study of determinants, which were used to solve systems of linear equations. Determinants were used by Leibniz in 1693, and subsequently, Cramer's Rule for solving linear systems was devised in 1750. Later, Gauss further developed the theory of solving linear systems by using Gaussian elimination. All these classical themes, in their modern interpretation, are included in the module, which culminates in a detailed study of eigenproblems. A part of the module is devoted to complex numbers which are basically just planar vectors. Linear algebra is central to both pure and applied mathematics. This module is an essential pre-requisite for nearly all modules taught in the Department of Mathematical Sciences.

MATHEMATICAL IT SKILLS (MATH111)

Credits: 15 / Semester: semester 1

This module introduces students to powerful mathematical software packages such as Maple and Matlab which can be used to carry out numerical computations or to produce a more complicated sequence of computations using their programming features. We can also do symbolic or algebraic computations in Maple. These software packages have built-in functions for solving many kinds of equations, for working with matrices and vectors, for differentiation and integration. They also contain functions which allow us to create visual representations of curves and surfaces from their mathematical descriptions, to work interactively, generate graphics and create mathematical documents. This module will teach students many of the above-mentioned features of mathematical software packages. This knowledge will be helpful in Years 2, 3 and 4 when working on different projects, for example in the modules MATH266 and MATH371.

CALCULUS II (MATH102)

Credits: 15 / Semester: semester 2

This module, the last one of the core modules in Year 1, is built upon the knowledge you gain from MATH101 (Calculus I) in the first semester. The syllabus is conceptually divided into three parts: Part I, relying on your knowledge of infinite series, presents a thorough study of power series (Taylor expansions, binomial theorem); part II begins with a discussion of functions of several variables and then establishes the idea of partial differentiation together with its various applications, including chain rule, total differential, directional derivative, tangent planes, extrema of functions and Taylor expansions; finally, part III is on double integrals and their applications, such as finding centres of mass of thin bodies. Undoubtedly, this module, together with the other two core modules from Semester 1 (MATH101 Calculus I and MATH103 Introduction to linear algebra), forms an integral part of your ability to better understand modules you will be taking in further years of your studies.

OPTIONAL MODULES

NEWTONIAN MECHANICS (MATH122)

Credits: 15 / Semester: semester 2

This module is an introduction to classical (Newtonian) mechanics. It introduces the basic principles like conservation of momentum and energy, and leads to the quantitative description of motions of bodies under simple force systems. It includes angular momentum, rigid body dynamics and moments of inertia. MATH122 provides the foundations for more advanced modules like MATH228, 322, 325, 326, 423, 425 and 431.

NUMBERS, GROUPS AND CODES (MATH142)

Credits: 15 / Semester: semester 2

A group is a formal mathematical structure that, on a conceptual level, encapsulates the symmetries present in many structures. Group homomorphisms allow us to recognise and manipulate complicated objects by identifying their core properties with a simpler object that is easier to work with. The abstract study of groups helps us to understand fundamental problems arising in many areas of mathematics. It is moreover an extremely elegant and interesting part of pure mathematics. Motivated by examples in number theory, combinatorics and geometry, as well as applications in data encryption and data retrieval, this module is an introduction to group theory. We also develop the idea of mathematical rigour, formulating our theorems and proofs precisely using formal logic.

INTRODUCTION TO STATISTICS USING R (MATH163)

Credits: 15 / Semester: semester 2

Students will learn fundamental concepts from statistics and probability using the R programming language and will learn how to use R to some degree of proficiency in certain contexts. Students will become aware of possible career paths using statistics.

Programme details and modules listed are illustrative only and subject to change.

YEAR TWO

At most one of MATH122, MATH142 and MATH163 may be taken if not already taken in year one.

OPTIONAL MODULES

VECTOR CALCULUS WITH APPLICATIONS IN FLUID MECHANICS (MATH225)

Credits: 15 / Semester: semester 1

To provide an understanding of the various vector integrals, the operators div, grad and curl and the relations between them. To give an appreciation of the many applications of vector calculus to physical situations. To provide an introduction to the subjects of fluid mechanics and electromagnetism.

COMPLEX FUNCTIONS (MATH243)

Credits: 15 / Semester: semester 1

This module introduces students to a surprising, very beautiful theory having intimate connections with other areas of mathematics and physical sciences, for instance ordinary and partial differential equations and potential theory.

LINEAR ALGEBRA AND GEOMETRY (MATH244)

Credits: 15 / Semester: semester 1

Linear algebra provides a toolbox for analysing phenomena ubiquitous in many areas of mathematics: linear maps, or linearity in general. In all of these situations it is essential to first identify the kind of objects which are mapped or behave in a linear way. To cover the many different possibilities the concept of an abstract vector space is introduced. It generalizes the real vector spaces introduced in MATH103 (Introduction to Linear Algebra) and the calculational techniques developed there can still be used. Applications of ideas from Linear Algebra appear in Geometry (MATH201, MATH349), in Algebra (MATH247, MATH343), in solving Differential Equations (MATH201, MATH221), which in turn model many physical systems (MATH323, MATH324), in Physics, especially Quantum Mechanics (MATH325, MATH421), in Biology (MATH335, MATH426) and in Statistics (MATH363).

STATISTICS AND PROBABILITY I (MATH253)

Credits: 15 / Semester: semester 1

Analysis of data has become an essential part of current research in many fields including medicine, pharmacology, and biology. It is also an important part of many jobs in e.g. finance, consultancy and the public sector. This module provides an introduction to statistical methods with a strong emphasis on applying and interpreting standard statistical techniques. Since modern statistical analysis of real data sets is performed using computer power, a statistical software package is introduced and employed throughout.

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DIFFERENTIAL EQUATIONS (MATH221)

Credits: 15 / Semester: semester 2

Differential equations play a central role in mathematical sciences because they allow us to describe a wide variety of real-world systems and the mathematical techniques encountered in this module are useful to a number of later modules; this is why MATH201 is compulsory for a number of degree programmes. The module will aim to stress the importance of both theory and applications of ordinary differential equations (ODEs) and partial differential equations (PDEs), putting a strong emphasis on problem solving and examples. It has broadly 5 parts and each part contains two types of equations: those that can be solved by specific methods and others that cannot be solved but can only be studied to understand some properties of the underlying equations and their solutions. The main topics are first order ODEs, second order ODEs, systems of ODEs, first-order PDEs and some of the most well-known second-order PDEs, namely the wave, heat and Laplace equations.

NUMERICAL METHODS FOR APPLIED MATHEMATICS (MATH226)

Credits: 15 / Semester: semester 2

Most problems in modern applied mathematics require the use of suitably designed numerical methods. Working exactly, we can often reduce a complicated problem to something more elementary, but this will often lead to integrals that cannot be evaluated using analytical methods or equations that are too complex to be solved by hand. Other problems involve the use of 'real world' data, which don't fit neatly into simple mathematical models. In both cases, we can make further progress using approximate methods. These usually require lengthy iterative processes that are tedious and error prone for humans (even with a calculator), but ideally suited to computers. The first few lectures of this module demonstrate how computer programs can be written to handle calculations of this type automatically. These ideas will be used throughout the module. We then investigate how errors propagate through numerical computations. The focus then shifts to numerical methods for finding roots, approximating integrals and interpolating data. In each case, we will examine the advantages and disadvantages of different approaches, in terms of accuracy and efficiency.

CLASSICAL MECHANICS (MATH228)

Credits: 15 / Semester: semester 2

This module is concerned with the motion of physical bodies both in everyday situations and in the solar system. To describe motion, acceleration and forces you will need background knowledge of calculus, differentiation, integration and partial derivatives from MATH101 (Calculus I), MATH102 (Calculus II) and MATH103 (Introduction to Linear Algebra). Classical mechanics is important for learning about modern developments such as relativity (MATH326), quantum mechanics (MATH325) and chaos and dynamical systems (MATH322). This module will make you familiar with notions such as energy, force, momentum and angular momentum which lie at the foundations of applied mathematics problems.

METRIC SPACES AND CALCULUS (MATH242)

Credits: 15 / Semester: semester 2

This is a foundational module aimed at providing the students with the basic concepts and techniques of modern real Analysis. The guiding idea will be to start using the powerful tools of analysis, familiar to the students from the first year module MATH101 (Calculus I) in the context of the real numbers, to vectors (multivariable analysis) and to functions (functional analysis). The notions of convergence and continuity will be reinterpreted in the more general setting of metric spaces. This will provide the language to prove several fundamental results that are in the basic toolkit of a mathematician, like the Picard Theorem on the existence and uniqueness of solutions to first order differential equations with an initial datum, and the implicit function theorem. The module is central for a curriculum in pure and applied mathematics, as familiarity with these notions will help students who want to take several other subsequent modules as well as many projects. This module is also a useful preparation (although not a formal prerequisite) for MATH365 Measure theory and probability, a very useful module for a deep understanding of financial mathematics.

COMMUTATIVE ALGEBRA (MATH247)

Credits: 15 / Semester: semester 2

The module provides an introduction to the theory and methods of the modern commutative algebra (commutative groups, commutative rings, fields and modules) with some applications to number theory, algebraic geometry and linear algebra.

STATISTICS AND PROBABILITY II (MATH254)

Credits: 15 / Semester: semester 2

This module provides an introduction to probabilistic methods that are used not only in actuarial science, financial mathematics and statistics but also in all physical sciences. It focuses on discrete and continuous random variables with values in one and several dimensions, properties of the most useful distributions (e.g. geometric, exponential, and normal), their transformations, moment and probability generating functions and limit theorems. This module will help students doing MATH260 and MATH262 (Financial mathematics). This module complements MATH365 (Measure theory and probability) in the sense that MATH365 provides the contradiction-free measure theoretic foundation on which this module rests.

FINANCIAL MATHEMATICS (MATH260)

Credits: 15 / Semester: semester 2

Mathematical Finance uses mathematical methods to solve problems arising in finance. A common problem in Mathematical Finance is that of derivative pricing. In this module, after introducing the basic concepts in Financial Mathematics, we use some particular models for the dynamic of stock price to solve problems of pricing and hedging derivatives. This module is fundamental for students intending to work in financial institutions and/or doing an MSc in Financial Mathematics or related areas.

OPERATIONAL RESEARCH (MATH269)

Credits: 15 / Semester: semester 2

The term "Operational Research" came in the 20th century from military operations. It describes mathematical methods to achieve the goal (or to find the best possible decision) having limited resources. This branch of applied mathematics makes use of and has stimulated the development of optimisation methods, typically for problems with constraints. This module can be interesting for any student doing mathematics because it concentrates on real-life problems.

Programme details and modules listed are illustrative only and subject to change.

YEAR THREE

An optional year abroad, you can find more information here.

YEAR FOUR

This is year three if you choose not to take a year abroad.
Choose six optional modules plus 30 credits of language modules.

OPTIONAL MODULES

FURTHER METHODS OF APPLIED MATHEMATICS (MATH323)

Credits: 15 / Semester: semester 1

Ordinary and partial differential equations (ODEs and PDEs) are crucial to many areas of science, engineering and finance. This module addresses methods for, or related to, their solution. It starts with a section on inhomogeneous linear second-order ODEs which are often required for the solution of higher-level problems. We then generalize basic calculus by considering the optimization of functionals, e.g., integrals involving an unknown function and its derivatives, which leads to a wide variety of ODEs and PDEs. After those systems of two linear first-order PDEs and second-order PDES are classified and reduced to ODEs where possible. In certain cases, e.g., `elliptic' PDEs like the Laplace equation, such a reduction is impossible. The last third of the module is devoted to two approaches, conformal mappings and Fourier transforms, which can be used to obtain solutions of the Laplace equation and other irreducible PDEs.

CARTESIAN TENSORS AND MATHEMATICAL MODELS OF SOLIDS AND VISCOUS FLUIDS (MATH324)

Credits: 15 / Semester: semester 1

This module provides an introduction to basic concepts and principles of continuum mechanics. Cartesian tensors are introduced at the beginning of the module, bringing simplicity and versatility to the analysis. The module places emphasis on the importance of conservation laws in integral form, and on the fundamental role integral conservation laws play in the derivation of partial differential equations used to model different physical phenomena in problems of solid and fluid mechanics. Some knowledge of Vector Calculus (e.g. MATH225 Vector calculus with applications in fluid mechanics) is useful.

QUANTUM MECHANICS (MATH325)

Credits: 15 / Semester: semester 1

The development of Quantum Mechanics, requiring as it did revolutionary changes in our understanding of the nature of reality, was arguably the greatest conceptual achievement of all time. The aim of the module is to lead the student to an understanding of the way that relatively simple mathemactics (in modern terms) led Bohr, Einstein, Heisenberg and others to a radical change and improvement in our understanding of the microscopic world.

RELATIVITY (MATH326)

Credits: 15 / Semester: semester 1

Einstein's theories of special and general relativity have introduced a new concept of space and time, which underlies modern particle physics, astrophysics and cosmology. It makes use of, and has stimulated the development of modern differential geometry. This module develops the required mathematics (tensors, differential geometry) together with applications of the theory to particle physics, black holes and cosmology. It is an essential part of a programme in theoretical physics. Together with MATH325 (Quantum mechanics) it covers the basics of modern theoretical physics. Possible follow up modules in theoretical physics are MATH423 (Introduction to string theory), MATH425 (Quantum field theory) and MATH431 (Introduction to modern particle theory). MATH326 is essential for students who consider doing a project on black holes or cosmology. Students following a pure mathematics or applied mathematics pathway might be interested in MATH326 because of its applications of differential geometry, and take it together with MATH349 (Differential geometry).

NUMBER THEORY (MATH342)

Credits: 15 / Semester: semester 1

Number theory begins with, and is mainly concerned with, the study of the integers. Because of the fundamental role which integers play in mathematics, many of the greatest mathematicians, from antiquity to the modern day, have made contributions to number theory. In this module you will study results due to Euclid, Euler, Gauss, Riemann, and other greats: you will also see many results from the last 10 or 20 years.Several of the topics you will study will be familiar from MATH142 (Numbers, groups, and codes). We will go into them in greater depth, and the module will be self-contained from the point of view of number theory. However, some background in group theory (no more than is in MATH142) will be assumed.

GROUP THEORY (MATH343)

Credits: 15 / Semester: semester 1

The module provides an introduction to the modern theory of finite non-commutative groups. Group Theory is one of the central areas of Pure Mathematics. Being part of Algebra, it has innumerable applications in Geometry, Number Theory, Combinatorics and Analysis, but also plays a very important role in Theoretical Physics, Mechanics and Chemistry. The module starts with basic definitions and some well-known examples (the symmetric group of permutations and the groups of congruence classes modulo an integer) and builds up to some very interesting and non-trivial constructions, such as the semi-direct product, which makes it possible to construct more complicated groups from simpler ones. In the final part of the course, the Sylow theory and its applications to the classification of groups are considered.

DIFFERENTIAL GEOMETRY (MATH349)

Credits: 15 / Semester: semester 1

Differential geometry studies distances and curvatures on manifolds through differentiation and integration. This module introduces the methods of differential geometry on the concrete examples of curves and surfaces in 3-dimensional Euclidean space. The module MATH248 (Geometry of curves) develops methods of differential geometry on examples of plane curves. This material will be discussed in the first weeks of the course, but previous familiarity with these methods is helpful. Students following a pathway in theoretical physics might find this module interesting as it discusses a different aspect of differential geometry, and might take it together with MATH326 (Relativity). MATH410 (Manifolds, homology and Morse theory) and MATH446 (Lie groups and Lie algebras).

APPLIED PROBABILITY (MATH362)

Credits: 15 / Semester: semester 1

To give examples of empirical phenomena for which stochastic processes provide suitable mathematical models. To provide an introduction to the methods of probabilistic model building for dynamic events occurring over time. To familiarise students with the usual techniques in the area of probability modelling.

LINEAR STATISTICAL MODELS (MATH363)

Credits: 15 / Semester: semester 1

This module follows on directly from MATH263 (Statistical Theory and Methods I), extending the work there on linear regression and analysis of variance, and then going beyond these to generalised linear models. The module emphasises applications of statistical methods, while the companion module MATH361 (Theory of Statistical Inference) focuses on more theoretical aspects. Statistical software is used throughout as familiarity with its use is a valuable skill for those interested in a career in a statistical field. It is helpful, though not essential, to have taken MATH264 (Statistical Theory and Methods II).

STATISTICAL PHYSICS (MATH327)

Credits: 15 / Semester: semester 2

Statistical Physics is a core subject in Physics and a cornerstone for modern technologies. To name just one example, quantum statistics is informing leading edge developments around ultra-cold gases and liquids giving rise to new materials. The module will introduce foundations of Statistical Physics and will develop an understanding of the stochastic roots of thermodynamics and the properties of matter. After successfully completing this module students will understand statistical ensembles and related concepts such as entropy and temperature, will understand the properties of classical and quantum gases, will be know the laws of thermodynamics and will be aware of advanced phenomena such as phase transition. The module will also develop numerical computer programming skills for the description of macroscopic effects such as diffusion by an underlying stochastic process.

GAME THEORY (MATH331)

Credits: 15 / Semester: semester 2

In this module you will explore, from a game-theoretic point of view, models which have been used to understand phenomena in which conflict and cooperation occur and see the relevance of the theory not only to parlour games but also to situations involving human relationships, economic bargaining (between trade union and employer, etc), threats, formation of coalitions, war, etc.

NUMERICAL METHODS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (MATH336)

Credits: 15 / Semester: semester 2

Many real-world systems in mathematics, physics and engineering can be described by differential equations. In rare cases these can be solved exactly by purely analytical methods, but much more often we can only solve the equations numerically, by reducing the problem to an iterative scheme that requires hundreds of steps. We will learn efficient methods for solving ODEs and PDEs on a computer.

COMBINATORICS (MATH344)

Credits: 15 / Semester: semester 2

Combinatorics is a part of mathematics in which mathematicians deal with discrete and countable structures by means of various combinations, such as permutations, ordered and unordered selections, etc. The seemingly simple methods of combinatorics can raise highly non-trivial mathematical questions and lead to deep mathematical results, which are, in turn, closely related to some fundamental phenomena in number theory

THE MAGIC OF COMPLEX NUMBERS: COMPLEX DYNAMICS, CHAOS AND THE MANDELBROT SET (MATH345)

Credits: 15 / Semester: semester 2

A “dynamical system” is a system that changes over time according to a fixed rule. In complex dynamics, we consider the case where the state of the system is described by a single (complex) variable, and the rule of evolution is given by a holomorphic function. It turns out that this seemingly simple setting leads to very rich, subtle and intricate problems, some of which are still the subject of ongoing mathematical research, both at the University of Liverpool and internationally. This module will provide an introduction to this fascinating subject, and introduce students to some of these problems. In the course of this study, we will encounter many results about complex functions that may seem “magic” when compared with what might be expected from real analysis. A highlight of this kind is the theorem that every polynomial is “chaotic” on its Julia set. We will also see how this “magic” can help us understand phenomena that at first seem to have no connection with complex numbers at all.

TOPOLOGY (MATH346)

Credits: 15 / Semester: semester 2

Topology is the mathematical study of space. It is distinguished from geometry by the fact that there is no consideration of notions of distance, angle or other similar quantities. For this reason topology is sometimes popularly referred to as 'rubber sheet' geometry. It was introduced by Poincaré, under the name of analysis situs, in 1895 and became one of the most successful areas of 20th century mathematics. It continues to be an active research area to this day, and its insights and methods underlie many areas of modern mathematics. More recently, new applications of topological ideas outside mathematics have been developed, in particular to provide qualitative analysis of large data sets. This module introduces the basic notions of topological space and continuous map, illustrating them with many examples from different areas of mathematics. It also introduces homotopy theory, the study of paths in a space, which has become one of the most fundamental areas of modern mathematics.

APPLIED STOCHASTIC MODELS (MATH360)

Credits: 15 / Semester: semester 1

Stochastic processes are ways of quantifying the dynamic relationships of sequences of random events. Stochastic models play an important role in elucidating many areas of the natural and engineering sciences. They can be used to analyse the variability inherent in biological and medical processes, to deal with uncertainties affecting managerial decisions and with the complexities of psychological and social interactions, and to provide new perspectives, methodology, models and intuition to aid in other mathematical and statistical studies. This module is intended as a beginning course in introducing continuous-time stochastic processes for students familiar with elementary probability. The objectives are: (1) to introduce students to the standard concepts and methods of stochastic modelling; (2) to illustrate the rich diversity of applications of stochastic processes in the science; and (3) to provide exercises in the applications of simple stochastic analysis to appropriate problems. The module is complementary to MATH362 (Applied probability), in which discrete-time processes are studied. Those who plan to go on to MSc study in financial mathematics will find this module a very useful preparation for modules such as MATH481 (Interest rate theory), MATH482 (Stochastic modelling in finance), MATH483 (Stochastic analysis and its applications) and MATH484 (Advanced numerical analysis for financial mathematics).

THEORY OF STATISTICAL INFERENCE (MATH361)

Credits: 15 / Semester: semester 2

This module introduces fundamental topics in mathematical statistics, including the theory of point estimation and hypothesis testing. Several key concepts of statistics are discussed, such as sufficiency, completeness, etc., introduced from the 1920s by major contributors to modern statistics such as Fisher, Neyman, Lehmann and so on. This module is absolutely necessary preparation for postgraduate studies in statistics and closely related subjects.

MEDICAL STATISTICS (MATH364)

Credits: 15 / Semester: semester 2

MEASURE THEORY AND PROBABILITY (MATH365)

Credits: 15 / Semester: semester 2

This module is important for students who are interested in the abstract theory of integrating and in the deep theoretical background of the probability theory. It will be extremely useful for those who plan to do MSc and perhaps PhD in Probability, including financial applications. If you plan to take level 4 module(s) on Financial Mathematics next year, MATH365 can be very helpful.

MATHEMATICAL RISK THEORY (MATH366)

Credits: 15 / Semester: semester 2

To provide an understanding of the mathematical risk theory used in practise in non-life actuarial depts of insurance firms, to provide an introduction to mathematical methods for managing the risk in insurance and finance (calculation of risk measures/quantities), to develop skills of calculating the ruin probability and the total claim amount distribution in some non - life actuarial risk models with applications to insurance industry, to prepare the students adequately and to develop their skills in order to be exempted for the exams of CT6 subject of the Institute of Actuaries (MATH366 covers 50% of CT6 in much more depth).

NETWORKS IN THEORY AND PRACTICE (MATH367)

Credits: 15 / Semester: semester 2

MATH367 aims to develop an appreciation of optimisation methods for real-world problems using fundamental tools from network theory; to study a range of 'standard problems' and techniques for solving them. Thus, network flow, shortest path problem, transport problem, assignment problem, and routing problem are some of the problems that are considered in the syllabus. MATH367 is a decision making module, which fits well to those who are interested in receiving knowledge in graph theory, in operational research, in economics, in logistics and in finance.

MATHEMATICAL BIOLOGY (MATH335)

Credits: 15 / Semester: semester 1

In the current age of big data, mathematics is becoming indispensable in order for us to make sense of experimental results and in order to gain a deeper understanding into mechanisms of complex biological systems. Mathematical models can provide insights that cannot be gained through experimental work alone. This module will focus on teaching students how to construct and analyse models for a wide range of biological systems. Mathematical approaches covered will be widely applicable.

NETWORKS IN MATHEMATICAL BIOLOGY (MATH338)

Credits: 15 / Semester: semester 2

Networks are familiar to us from many real-world systems such as the internet, power grids, transportation and biological networks. The underpinning mathematical concept is called a graph an it is no surprise that the same issues arise in each area, whether this is to identify the most important or influential individuals in the network, or to prevent dynamics on the network (e.g. epidemics) or to make the network robust to the dynamics it supports (e.g. power grids and transportation). In this module, we learn about different classes of networks and how to quantify and describe them including their structures and their nodes. Much of our detailed understanding of networks and their features will come from analysis of idealised random networks which nevertheless are often good representations of those seen in the real world. We will consider real-world biological applications of network theory, in particular focusing on epidemics.

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HOW YOU'LL LEARN

Your learning activities will consist of lectures, tutorials, practical classes, problem classes, private study and supervised project work.

In Year 1, lectures are supplemented by a thorough system of group tutorials and computing work is carried out in supervised practical classes. Key study skills, presentation skills and group work start in first-year tutorials and are developed later in the programme. The emphasis in most modules is on the development of problem solving skills, which are regarded very highly by employers.

Project supervision is on a one-to-one basis, apart from group projects in Year 2.

HOW YOU'RE ASSESSED

Most modules are assessed by a two and a half hour examination in January or May, but many have an element of coursework assessment. This might be through homework, class tests, mini-project work or key skills exercises.

LIVERPOOL HALLMARKS

We have a distinctive approach to education, the Liverpool Curriculum Framework, which focuses on research-connected teaching, active learning, and authentic assessment to ensure our students graduate as digitally fluent and confident global citizens.

Careers and employability

A mathematically-based degree opens up a wide range of career opportunities, including some of the most lucrative professions.

Typical types of work our graduates have gone onto include as an actuarial trainee analyst in the audit practice, a graduate management trainee risk analyst and as a trainee chartered accountant on a graduate business programme. Employers value mathematicians' high level of numeracy and problem solving skills.

There are excellent career opportunities in organisations with international interests. Spending a year abroad will greatly enhance your employability and intercultural skills. Research from Universities UK tells us that students who spend time studying abroad during their degree programme are more likely to be in further education or employment 6 months after graduating, earn higher than average salaries and are more likely to graduate with a 2:1 or First Class degree.

87.5% **OF MATHEMATICAL SCIENCES GRADUATES GO ON TO WORK OR FURTHER STUDY WITHIN 15 MONTHS OF GRADUATION.**

Discover Uni, 2018-19.

Some recent employers of our graduates are:

- Aston University
- Baker Tilly
- Barclays Bank plc
- Deloitte
- Marks and Spencer
- Venture Marketing Group
- Wilson Henry Partnership

PREPARING YOU FOR FUTURE SUCCESS

At Liverpool, our goal is to support you to build your intellectual, social, and cultural capital so that you graduate as a socially-conscious global citizen who is prepared for future success. We achieve this by:

- Embedding employability within your curriculum, through the modules you take and the opportunities to gain real-world experience offered by many of our courses.
- Providing you with opportunities to gain experience and develop connections with people and organisations, including student and graduate employers as well as our global alumni.
- Providing you with the latest tools and skills to thrive in a competitive world, including access to Handshake, a platform which allows you to create your personalised job shortlist and apply with ease.
- Supporting you through our peer-to-peer led Careers Studio, where our career coaches provide you with tailored advice and support.

Fees and funding

Your tuition fees, funding your studies, and other costs to consider.

TUITION FEES

Tuition fees cover the cost of your teaching and assessment, operating facilities such as libraries, IT equipment, and access to academic and personal support. Learn more about tuition fees, funding and student finance.

UK fees **Also applies to Channel Islands, Isle of Man and Republic of Ireland**	
Full-time place, per year	£9,250
Year in industry fee	£1,850
Year abroad fee	£1,385

International fees	
Full-time place, per year	£23,300

*Fees stated are for the **2023-24** academic year.*

ADDITIONAL COSTS

We understand that budgeting for your time at university is important, and we want to make sure you understand any course-related costs that are not covered by your tuition fee. This could include buying a laptop, books, or stationery.

Find out more about the additional study costs that may apply to this course.

SCHOLARSHIPS AND BURSARIES

We offer a range of scholarships and bursaries to help cover tuition fees and help with living expenses while at university.

Scholarships and bursaries you can apply for from the United Kingdom

Select your country or region for more scholarships and bursaries.

Entry requirements

The qualifications and exam results you'll need to apply for this course.

Your qualification	Requirements About our typical entry requirements
A levels	ABB You may automatically qualify for reduced entry requirements through our contextual offers scheme. If you don't meet the entry requirements, you may be able to complete a foundation year which would allow you to progress to this course. Available foundation years: • Mathematical Sciences BSc (Hons) (Foundation, 4 year route with Carmel College) BSc (Hons)
GCSE	4/C in English and 4/C in Mathematics
Subject requirements	A level Mathematics grade A. A level in relevant language required for advanced level, no language required for beginners level. Applicants must have studied Mathematics at Level 3 within 2 years of the start date of their course. For applicants from England: Where a science has been taken at A level (Chemistry, Biology or Physics), a pass in the Science practical of each subject will be required.

Your qualification	**Requirements** About our typical entry requirements
BTEC Level 3 National Extended Diploma	Applications considered. Relevant when combined with A level Mathematics grade A. A level in relevant language required for advanced level
International Baccalaureate	33 including 6 at Higher Level in Maths, and 6 in relevant language for advanced level
Irish Leaving Certificate	H1, H2, H2, H2, H3, H3 including Mathematics at H1 and relevant language at H2 for advanced level.
Scottish Higher/Advanced Higher	Advanced Highers accepted at grades ABB including grade A in Mathematics.
Welsh Baccalaureate Advanced	Accepted at grade B, alongside A level Mathematics at grade A and A level in relevant language at grade B for advanced level
Access	45 Level 3 credits in graded units in a relevant Diploma, including 39 at Distinction and a further 6 with at least Merit 15 Distinctions are required in Mathematics A level in relevant language required for advanced level
International qualifications	Select your country or region to view specific entry requirements. Many countries have a different education system to that of the UK, meaning your qualifications may not meet our direct entry requirements. Although there is no direct Foundation Certificate route to this course, completing a Foundation Certificate, such as that offered by the University of Liverpool International College, can guarantee you a place on a number of similar courses which may interest you.

ALTERNATIVE ENTRY REQUIREMENTS

- If your qualification isn't listed here, or you're taking a combination of qualifications, contact us for advice
- Applications from mature students are welcome.

THE ORIGINAL REDBRICK