2019/0 - MTHA4001B PROBABILITY

Spring Semester, Level 4 module
(Maximum 100 Students)
UCU: 10 Organiser: Dr Davide Proment
MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:U

Probability is the study of the chance of events occurring. It has important applications to understand the likelihood of multiple events happening together and therefore to rational decision-making. This module will give you an introduction to the modern theory of probability developed from the seminal works of the Russian mathematician A.N. Kolmogorov in 1930s. Kolmogorov's axiomatic theory describes the outcomes (events) of a random experiment as mathematical sets. Using set theory language you will be introduced to the concept of random variables, and consider different examples of discrete random variables (like binomial, geometric and Poisson random variables) and continuous random variables (like the normal random variable). In the last part of the module you will explore two applications of probability: reliability theory and Markov chains. Aside of the standard lectures and workshop sessions, there will be two computer-lab sessions of (2 hours each) where you will apply probability theory to specific everyday life case studies. The only pre-requisites for this module are a basic knowledge of set theory and of calculus that you would have acquired during the Autumn semester. If you have done probability or statistic at A-level you will rediscover its contents now taught using a proper and more elegant mathematical formalism.

2019/0 - MTHB4007B PROBABILITY AND MECHANICS

Spring Semester, Level 4 module
(Maximum 100 Students)
UCU: 20 Organiser: Dr Davide Proment
MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:XX

IN TAKING THIS MODULE YOU CANNOT TAKE MTHA4001Y OR TAKE MTHA4004Y OR TAKE MTHB4006Y OR TAKE MTHB4009B
WHILE TAKING THIS MODULE YOU MUST TAKE MTHA4005Y OR TAKE ENV-4015Y OR TAKE MTHB4015Y

This module comprises two parts: "Probability" and "Mechanics" Probability is the study of the chance of events occurring. It has important applications to understanding the likelihood of multiple events happening together and therefore to rational decision-making. In the first part of this module, you will start by studying probability as a measurement of uncertainty, and looking at statistical experiments and Bayes' theorem. You will then consider both discrete and continuous probability distributions and the concept of expectation. Finally you will consider applications of probability, including Markov chains and reliability theory. Newtonian mechanics provides a basic description of how particles and rigid bodies move in

response to applied forces. In the second part of the module you will study Newton's laws of motion and how they can be applied to particle dynamics, vibrations, motion in polar coordinates, and conservation laws.

2019/0 - MTHD6021B MATHEMATICAL BIOLOGY

Spring Semester, Level 6 module
(Maximum 35 Students)
UCU: 20 Organiser: Dr Mark Blyth
MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:A
Exam Paper(hrs):

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA5002Y OR TAKE MTHB5007B

Mathematics finds wide-ranging applications in biological systems: including population dynamics, epidemics and the spread of diseases, enzyme kinetics, some diffusion models in biology including Turing instabilities and pattern formation, and various aspects of physiological fluid dynamics.

2019/0 - MTHD6025B CRYPTOGRAPHY

Spring Semester, Level 6 module
(Maximum 120 Students)
UCU: 20 Organiser: Dr Sinead Lyle
MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:B

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA5003Y

Cryptography is the science of coding and decoding messages so as to keep these messages secure, and has been used throughout history. In the past, encryption was mainly used by a small number of individuals in positions of authority. Nowadays the universal presence of the internet and e-commerce means that we all have transactions that we want to keep secret. The speed of modern home computers means that an encrypted message that would have been perfectly secure (that is, would have taken an inordinately long time to break) a few decades ago can now be broken in seconds. But as decryption methods have advanced, the methods of encryption have also become more sophisticated. Modern cryptosystems depend on mathematics, in particular Number Theory and Algebra. The most famous example of a public key cryptosystem, RSA, relies on the fact that it is 'hard' to factor a large number into a product of primes. In this course, we will look at the mathematics underpinning both classical and modern methods of cryptography and consider how these methods can be applied. You will compare material on symmetric key cryptography and public key cryptography. Examples of both will be given, along with discussion of their strengths and weaknesses, with the emphasis being on the mathematics. You will look at how prime numbers can be used in cryptography, with material on primality testing and factorisation. You will also define and

study elliptic curves in order to investigate the relatively new field of elliptic curve cryptography.

2019/0 - MTHD6032B MATHEMATICAL TECHNIQUES

Spring Semester, Level 6 module
(Maximum 80 Students)
UCU: 20 Organiser: Dr Paul Hammerton
MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:G

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA5004Y OR TAKE MTHB5006A OR TAKE MTHB5009A

We provide techniques for a wide range of applications, while stressing the importance of rigour in developing such techniques. The Calculus of Variations includes techniques for maximising integrals subject to constraints. A typical problem is the curve described by a heavy chain hanging under the effect of gravity. You will develop techniques for algebraic and differential equations. This includes asymptotic analysis, which provides approximate solutions when exact solutions can not be found and when numerical solutions are difficult. Integral transforms are useful for solving problems including integro-differential equations. This unit will include illustration of concepts using numerical investigation with MAPLE and/or MATLAB.

2019/0 - MTHD6033B FUNCTIONAL ANALYSIS

Spring Semester, Level 6 module
(Maximum 90 Students)
UCU: 20 Organiser: Professor Mirna Dzamonja
MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:E

BEFORE TAKING THIS MODULE YOU MUST TAKE MTHA5001Y AND TAKE MTHA5004Y

This course will cover normed spaces; completeness; functionals; Hahn-Banach theorem; duality; and operators. Time permitting, we shall discuss Lebesgue measure; measurable functions; integrability; completeness of L-p spaces; Hilbert space; compact, Hilbert-Schmidt and trace class operators; as well as the spectral theorem.

2019/0 - MTHE6004B GALOIS THEORY

Spring Semester, Level 6 module
(Maximum 60 Students)
UCU: 20 Organiser: Dr Robert Gray

MODULE - 40% PASS ON AGGREGATE
Module Type: Examination with Coursework or Project
Timetable Slot:C
Exam Paper(hrs):3

A prerequisite of this module is that you have studied the Algebra module. Galois theory is one of the most spectacular mathematical theories. It gives a beautiful connection between the theory of polynomial equations and group theory. In fact, many fundamental notions of group theory originated in the work of Galois. For example, why are some groups called "solvable"? Because they correspond to the equations which can be solved (by some formula based on the coefficients and involving algebraic operations and extracting roots of various degrees). Galois theory explains why we can solve quadratic, cubic and quartic equations, but no similar formulae exist for equations of degree greater than 4. In modern exposition, Galois theory deals with "field extensions", and the central topic is the "Galois correspondence" between extensions and groups.