Department of Mathematics and Statistics

Syllabus for the undergraduate programmes owned by the department

Throughout this document, hyperlinks point to the module descriptions in the online UL Book of Modules

Mathematics Common Entry (LM124)

Semester 1
MS4021 Calculus 1 MS4131 Linear Algebra 1 CE4701 Computer Software 1 **Two from:** MS4101 Mathematics Laboratory AC4213 Financial Accounting EC4111 Microeconomics PH4051 Measure & Properties of Matter PH4131 Mechanics/Heat/Electricity/Magnetism CS4221 Foundations of Computer Science 1

BSc in Mathematical Sciences

Semester 1	**Semester 2**
Common Entry	MS4022 Calculus 2 MS4122 Further Linear Algebra MS4222 Introduction to Probability & Statistics CE4702 Computer Software 2 **One from:** AC4214 Accounting for Financial Decision Making EC4112 Macroeconomics CS4182 Foundations of Computer Science 2 PH4102 Wave/Light/Modern Physics
Semester 3	**Semester 4**
MS4043 Methods of Linear Analysis MS4035 Probability Models MS4403 Ordinary Differential Equations MS4613 Vector Analysis **One from:** CS4013 Object Oriented Development MB4005 Analysis	MS4014 Introduction to Numerical Analysis MS4034 Applied Data Analysis MS4303 Operations Research 1 MS4404 Partial Differential Equations MS4414 Theoretical Mechanics

BSc in Mathematical Sciences - Mathematics Stream

Semester 5	Semester 6
MA4617 Introduction to Fluid Mechanics MS4008 Numerical Methods for PDEs MS4045 Complex Analysis MS4105 Linear Algebra 2 **One from:** CS4416 Database Systems MS4215 Advanced Data Analysis MS4217 Stochastic Processes MB4017 Geometry	Co-op
Semester 7	**Semester 8**
MS4407 Perturbation Techniques and Asymptotics MS4627 Mathematics of Natural Phenomena **One from:** MS4417 Project 1 MS4037 Statistical Data Science Project 1 **Two from:** CS4178 Software Requirements and Modelling MS4027 Fundamentals of Financial Mathematics MS4117 Discrete Mathematics 2	MS4018 Dynamical Systems MS4408 Mathematical Modelling **One from:** MS4418 Project 2 MS4038 Statistical Data Science Project 2 **Two from:** CS4115 Data Structures and Algorithms MS4028 Stochastic Differential Equations for Finance MS4218 Time Series Analysis MS4508 Applied Partial Differential Equations MS4528 Mathematical and Statistical Models of Investments

BSc in Mathematical Sciences - Statistical Data Science Stream

Semester 5	Semester 6
MS4105 Linear Algebra 2 MS4214 Statistical Inference MS4215 Advanced Data Analysis MS4217 Stochastic processes **One from:** MA4617 Introduction to Fluid Mechanics MS4008 Numerical Partial Differential Equations MB4017 Geometry CS4416 Database Systems	Co-op
Semester 7	**Semester 8**
MS4037 Statistical Data Science Project 1 MA4007 Experimental Design **Three from:** MS4045 Complex Analysis MS4117 Discrete Mathematics 2 MA4617 Introduction to Fluid Mechanics (if not chosen in Year 3) MS4027 Fundamentals of Financial Mathematics CS4337 Big Data Management & Security	MS4038 Statistical Data Science Project 2 MA4128 Advanced Data Modelling MS4218 Time Series Analysis **Two from:** MS4018 Dynamical Systems MS4028 Stochastic Differential Equations for Finance MS4508 Applied Partial Differential Equations MS4528 Mathematical and Statistical Models of Investments CS4168 Data Mining

BSc in Mathematics and Physics (LM088)

Semester 1	**Semester 2**
Common Entry PH4131 Required for entry into LM088	MS4022 Calculus 2 MS4122 Further Linear Algebra MS4222 Introduction to Probability & Statistics PH4102 Waves/Light/Modern Physics PH4092 Semiconductor Devices
Semester 3	**Semester 4**
PH4041 Optics PH4171 Mechanics MS4043 Methods of Linear Analysis MS4613 Vector Analysis MS4403 Ordinary Differential equations	PH4072 Electromagnetism PH4132 Modern Physics PH4042 Thermal Physics MS4014 Introduction to Numerical Analysis MS4404 Partial Differential Equations
Semester 5	**Semester 6**
PH4061 Quantum Mechanics PH4021 Physics of Solids MA4617 Introduction to Fluid Mechanics MS4045 Complex Analysis **One from:** PH4161 Atomic/Molecular/Laser Physics MS4105 Linear Algebra 2 MS4035 Probability Models MB4017 Geometry	Co-op
Semester 7	**Semester 8**
PH4607 Solid State Physics 1 MS4407 Perturbation Techniques & Asymptotics PH4097 Project 1 **Select 1xMS + 1xPH** PH4081 Nanotechnology 1 PH4091 Physics of Modern Measurement MS4008 Numerical Methods for PDEs MS4627 Maths of Natural Phenomena	PH4608 Solid State Physics 2 MS4018 Dynamical Systems MS4408 Mathematical Modelling MS4098 Project 2 **One from:** PH4062 Nanotechnology 2 PH4018 Medical Instrumentation MS4508 Applied Partial Differential Equations

BSc in Financial Mathematics (LM058)

Semester 1	**Semester 2**
MS4021 Calculus 1 MS4101 Mathematics Laboratory MS4131 Linear Algebra 1 CE4701 Computer Software 1 **One from:** AC4213 Financial Accounting EC4111 Microeconomics	MS4022 Calculus 2 MS4122 Further Linear Algebra MS4222 Introduction to Probability & Statistics CE4702 Computer Software 2 **One from:** AC4214 Accounting for Financial Decision Making EC4112 Macroeconomics
Semester 3	**Semester 4**
MS4043 Methods of Linear Analysis MS4035 Probability Models MS4403 Ordinary Differential Equations MS4613 Vector Analysis FI4033 Finance	MS4014 Introduction to Numerical Analysis MS4034 Applied Data Analysis MS4303 Operations Research 1 MS4404 Partial Differential Equations MS4414 Theoretical Mechanics
Semester 5	**Semester 6**
MS4045 Complex Analysis MS4105 Linear Algebra 2 MS4214 Statistical Inference MS4215 Advanced Data Analysis MS4027 Fundamentals of Financial Mathematics	Co-op
Semester 7	**Semester 8**
MS4217 Stochastic Processes **One from:** MS4417 Project 1 MS4037 Statistical Data Science Project 1 **Three from:** MA4617 Introduction to Fluid Mechanics MS4008 Numerical Partial Differential Equations MS4117 Discrete Mathematics 2 MS4407 Perturbation Techniques and Asymptotics MB4017 Geometry	MS4028 Stochastic Differential Equations for Finance MS4528 Mathematical and Statistical Models of Investments MS4218 Time Series Analysis **One from:** MS4418 Project 2 MS4038 Statistical Data Science Project 2 **Two from:** MA4128 Advanced Data Modelling MS4018 Dynamical Systems MS4508 Applied Partial Differential Equations MS4408 Mathematical Modelling

Department of Mathematics and Statistics

Syllabus for the postgraduate programmes owned by the department

MSc Mathematical Modelling (12-months taught Masters)

Semester 1	Semester 2
Core modules: MS6011 Advanced Methods I MS6021 Scientific Computation **3 electives** to be chosen from the following list: 1. ME6001 Fundamentals of Continuum Mechanics 2. MS4627 Mathematics of Natural Phenomena 3. MS4407 Perturbation Techniques and Asymptotics 4. MS4008 Numerical Partial Differential Equations 5. MS4027 Fundamentals of Financial Mathematics 6. MS6061 Fundamentals of Statistical Modelling 7. MS4217 Stochastic Processes 8. MS6051 Statistical Inference for Data Science 9. MA4617 Introduction to Fluid Mechanics	**Core modules:** MS6012 Advanced Methods II MA6002 Mathematical Geoscience MA6012 Mathematical Biology and Physiology **2 electives** to be chosen from the following list: 1. MS6052 Inverse Problems for Partial Differential Equations 2. MS4018 Dynamical Systems 3. MS4408 Mathematical Modelling 4. MS4028 Stochastic Differential Equations for Finance 5. MS4528 Mathematical and Statistical Models of Investment 6. MS4218 Time Series Analysis 7. MS6022 Statistical Learning 8. MS6032 Networks and Complex Systems
Summer	
MS6003 Project (submission by late August, 30 ECTS credits)	

MSc Data Science and Statistical Learning (12-months taught Masters)

The entire programme is laid out in the table below, where it is important to note that there are two pathways available to students at the time of enrolment. Pathway A is the main statistical learning and data science route, designed for the majority of students who aim to gain skills in these areas. Pathway B is intended for students who have already studied substantial statistical data science content as part of a previous degree (e.g., UL mathematics graduates who followed the statistics route). The secondary pathway replaces two modules in the Autumn Semester and one module in the Spring Semester, to provide such students with new skills in mathematical modelling, machine learning, and ethics. However, the remaining seven modules and summer dissertation are common to both pathways.

Layout of modules where A = Pathway A, and B = Pathway B.

Autumn | Sep - Dec	**Spring | Jan - May**	**Summer | May - Aug**
[A] MS6051 Statistical Inference for Data Science [B] MS6021 Scientific Computation	[A] MS6022 Statistical Learning [B] IN6062 Data Governance & Ethics	[A/B] MS6013 Dissertation in Data Science & Statistical Learning
[A] MS6061 Fundamentals of Statistical Modelling [B] CE4051 Introduction to Data Engineering & Machine Learning	[A/B] MS5052 Quantitative Research Methods for Science, Engineering & Technology	
[A/B] MS6071 R for Statistical Data Science	[A/B] MS6032 Networks & Complex Systems	
[A/B] CS6401 Database Systems in Practice	[A/B] CS6502 Applied Big Data & Visualisation	
[A/B] EE6041 Text Analytics & Natural Language Processing	[A/B] CE6002 Artificial Intelligence and Machine Learning	

Professional Diploma in Data Analytics (two-semester, 30 credit programme, fully online)

The Professional Diploma in Data Analytics is a 30-credit two semester programme based on 4 x 6-credit modules and 2 x 3-credit micro-credentials, as follows:

Semester 1 (15 credits)

MA5021: Data Analytics with R (6 credits).

MA5011: Introduction to Predictive Analytics (6 credits).

- Option:

MN5151: Future Focused Professional Portfolio I (3 credits).
Or
PO6132: Introduction to Critical Thinking and Problem Solving (3 credits).

Semester 2 (15 credits)

MA5012: Advanced Predictive Analytics (6 credits).

MA5002: Statistical Learning with Applications (6 credits).

- Option

MN5152: Future Focused Professional Portfolio II (3 credits).
Or
TW6001: Writing for the Workplace (3 credits).