



**Swansea University
Prifysgol Abertawe**

**FACULTY OF SCIENCE AND
ENGINEERING**

**POSTGRADUATE STUDENT
HANDBOOK**

MSC (FHEQ LEVEL 7)

**MATHEMATICS AND
COMPUTING FOR FINANCE
DEGREE PROGRAMMES**

**SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2022-23**

DISCLAIMER

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

The 22-23 academic year begins on 26 September 2022

Full term dates can be found [here](#)

DATES OF 22-23 TERMS

26 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

SEMESTER 1

26 September 2022 – 27 January 2023

SEMESTER 2

30 January 2023 – 09 June 2023

SUMMER

12 June 2023 – 22 September 2023

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism, Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance [here](#) and further information [here](#). You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity. You should also refer to the Faculty of Science and Engineering proof-reading policy and this can be found on the Community HUB on Canvas, under Course Documents.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

This has been a challenging period for everyone. The COVID-19 pandemic has prompted a huge change in society as well as how we deliver our programmes at Swansea University and the way in which you study, research, learn and collaborate. We have been working hard to make sure you will have or continue to having an excellent experience with us.

We have further developed some exciting new approaches that I know you will enjoy, both on campus and online, and we cannot wait to share these with you.

At Swansea University and in the Faculty of Science & Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone. Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic staff, administrators, and your fellow students - I'm sure you will find many friendly helping hands ready to assist you.

We all know this period of change will continue and we will need to adapt and innovate to continue to be supportive and successful. At Swansea we are committed to making sure our students are fully involved in and informed about our response to challenges.

In the meantime, learn, create, collaborate, and most of all – enjoy yourself!

Professor Johann (Hans) Sienz
Interim Pro-Vice Chancellor/Interim Executive Dean
Faculty of Science and Engineering



Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
School of Mathematics and Computer Science	
Head of School: Professor Elaine Crooks	
School Education Lead	Dr Neal Harman
Head of Mathematics	Professor Vitaly Moroz
Mathematics Programme Director	Dr Kristian Evans
Year Coordinators	Year 0 – Dr Zeev Sobol Year 1 – Dr Noemi Picco Year 2 – Professor Jiang-Lun Wu Year 3 – Dr Grigory Garkusha Year 4/MSc – Professor Chenggui Yuan

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 9am-5pm.

The **Student Support Team** provides dedicated and professional support to all students in the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 and 01792 6062522 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to other resources:

<https://myuni.swansea.ac.uk/fse/coe-student-info/>

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via <http://ifindreading.swan.ac.uk/>. We've removed reading lists from the 22-23 handbooks to ensure that you have access to the most up-to-date versions. Access to print material in the library may be limited due to CV-19; your reading lists will link to on-line material whenever possible. We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under “Modular Terminology” on the following link -

<https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-info-taught-students/your-programme-explained/>

MSc (FHEQ Level 7) 2022/23
Mathematics and Computing for Finance
MSc Mathematics and Computing for Finance

Coordinator: Prof C Yuan

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
CSCM41 Introduction to Programming in Java 15 Credits Mrs S Safari	MA-M59 Financial Mathematics in Continuous Time 15 Credits Prof E Lytvynov
MA-M58 Financial Mathematics in Discrete Time 15 Credits Dr I Rodionova	
Dissertation	
MASM08 Mathematics and Computing for Finance Project 60 Credits Prof C Yuan/ Refer To Dept	
Total 180 Credits	

Optional Modules

Choose exactly 75 credits

MA-M02	Numerics of ODEs and PDEs	Prof IM Davies	TB2	15
MA-M08	Machine Learning	Prof B Lucini	TB2	15
MA-M45	Cashflows and Interest Rates	Dr Z Sobol	TB1	15
MA-M46	Assurance and Annuity	Dr Z Sobol	TB2	15
MA-M49	Probability and Statistics for Finance	Prof J Wu	TB1	15
MA-M64	Markov Processes and Applications	Prof J Wu	TB1	15
MA-M65	Risk and Survival Models	Dr DL Finkelshtein	TB2	15
MA-M86	Calculus of Variations	Prof V Moroz/Prof ECM Crooks	TB2	15

CSCM41 Introduction to Programming in Java	
Credits: 15 Session: 2022/23 September-January	
Pre-requisite Modules:	
Co-requisite Modules:	
Lecturer(s): Mrs S Safari	
Format: 10 hours lecture, 20 hours lectures in lab environment, 10 hours lab.	
Delivery Method: On-campus/virtual lectures and lab sessions.	
Module Aims: This intensive course provides a solid introduction to the Java programming language and development process.	
Module Content: Introduction to Programming. Introduction to Java. Basic structures of programming. Functions (static methods). The Object-Oriented paradigm: objects, classes and methods. Various I/O methods, and input/output via command-line. Basic correctness for programming (precision, finding and correcting errors). Aspects of exception handling and defensive programming.	
Intended Learning Outcomes: Students will be able to: Use variables, expressions and control structures, together with elementary input/output facilities. Understand and properly use functions, static as well as non-static ones (methods). Understand the foundations of classes, with methods and constructors, complete the foundations of basic programming. Understand the fundamental concepts of correct and precise programming. Design and implement working Java programs in a modular maintainable style to the standard required in a Masters degree. Read code written by others, and to identify errors and bugs and to correct them.	
Assessment:	Examination 1 (50%) Coursework 1 (20%) Coursework 2 (20%) Laboratory work (10%)
Resit Assessment:	Examination (Resit instrument) (100%)
Assessment Description: Standard Computer Science format unseen examination, duration 2hrs. Coursework 1 and 2 - practical assignments.	
Moderation approach to main assessment: Second marking as sampling or moderation	
Assessment Feedback: Outline solutions provided along with group and individual analytical feedback for courseworks. Examination feedback summarising strengths and weaknesses of the class. Individual feedback on submissions from lecturer and/or demonstrators in laboratory sessions.	
Failure Redemption: Resit examination or resubmit coursework as appropriate.	
Additional Notes: Created March 2015. Only available to Masters students who are not majoring in Computer Science.	

MA-M02 Numerics of ODEs and PDEs

Credits: 15 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof IM Davies

Format: 33 hours of traditional lectures, narrating and expanding upon the online notes.
11 hours of Matlab support and examples classes (alternating weekly)

Delivery Method:

The in-person lectures will focus on developing the theory and the implementation of that theory into practice. Weekly formative homework will supplement the understanding of key properties of methods and their behaviour (good or bad). The weekly Matlab worksheets will enable students to work the methods 'for real' as opposed to the 'toy problems' that can be worked by hand (and calculator).

Module Aims: This module is focused on numerical schemes suitable for the approximate solution of ODEs and PDEs. Whilst the methods may look different the underlying principles and convergence issues are remarkably similar. Many standard algorithms will be presented along with an analysis of their behaviour.

Module Content: - ODEs;

- overview of LMMs, weak instability, strong stability, boundary value problems.

- PDEs;

- finite difference representation of partial derivatives, explicit and implicit finite difference schemes, consistency, stability,

- convergence, finite element methods, finite difference methods for elliptic problems, iterative methods, non-flat boundaries.

Intended Learning Outcomes: At the end of this module students should be able to:

- 1) determine the properties of a linear multistep method
- 2) demonstrate a systematic understanding of appropriate methods for solving BVPs
- 3) analyse the nature of finite difference schemes
- 4) demonstrate extensive familiarity with algorithms suitable for numerical solution of PDEs

Assessment: Examination 1 (80%)

Coursework 1 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Component 1 is a written, closed-book examination at the end of the module.

Component 2 is formed of a number of coursework assignments during the semester.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall

feedback on the cohort performance, and some individual comments on their work.

For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance.

Further, individualised feedback, can be provided upon request.

Failure Redemption: closed book examination in August combined with existing coursework component

Additional Notes: This module is not available to students who have previously taken MA-302.

Available to visiting and exchange students.

MA-M08 Machine Learning

Credits: 15 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof B Lucini

Format: 44 hours consisting of a mixture of lectures and computer lab classes

Delivery Method: Lectures supported by regular computer lab sessions.

Module Aims: The module introduces basic concepts of machine learning and some of its popular methods in a practical manner from a mathematical perspective.

Module Content: - Concept of learning, linear perceptron

- Types of learning: supervised learning, reinforcement learning and unsupervised learning

- Use of probability in learning and noisy data

- VC dimension, generalization, complexity, bias-variance tradeoff

- Linear classification, linear regression, logistic regression, gradient descent and stochastic gradient descent

- Overfitting, regularization, cross validation

- Support vector machines, kernel methods

- Decision trees, random forests

- K-means clustering and mixture models

- Neural networks

Intended Learning Outcomes: At the end of this module, students should be able to:

- 1) Critically analyse the feasibility of approaches to machine learning .
- 2) Demonstrate a comprehensive understanding of the fundamental mathematical ideas behind the standard approaches to machine learning.
- 3) Apply a broad range of machine learning techniques to data sets using appropriate programming languages.
- 4) Analyse the strengths and weaknesses of a wide range of different approaches to machine learning.
- 5) Determine appropriate methods to apply to given data sets.

Assessment: Examination (60%)

Assignment 1 (40%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Component 1 is a written, closed-book examination at the end of the module.

Component 2 is formed of a number of coursework assignments during the semester.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work.

For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance.

Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary examination.

Additional Notes: Delivery of teaching will be on-campus. Continuous assessment will be submitted online.

Available to visiting and exchange students.

MA-M45 Cashflows and Interest Rates

Credits: 15 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr Z Sobol

Format: 40 hours: 30 hours of lectures and 10 hours of examples classes.

Delivery Method: The module will be delivered on Bay Campus, with a mix of lectures and example classes underpinned with weekly formative homework.

Module Aims: This module covers a detailed analysis of cashflows and interest rates with actuarial applications.

It covers material relating to sections 1, 2 and 3 of the Institute and Faculty of Actuaries CM1 syllabus.

Module Content: i) Data Analysis

ii) Actuarial Modelling

iii) Generalised Cashflows

iv) Interest Rates

v) Present and Accumulated values

vi) Interest Functions

vii) Term Structures

viii) Equation of Value and applications

ix) Project Appraisal

Intended Learning Outcomes: At the end of this module, the student should be able to:

- 1) analyse and critically evaluate a selection of actuarial models,
- 2) analyse real world problems using specialist techniques and actuarial models,
- 3) demonstrate a systematic understanding and advanced skills in generalised cashflow models and their use,
- 4) demonstrate advanced skills with interest rates and interest functions in a range of settings,
- 5) analyse complex business scenarios using the equation of value.

Assessment: Examination (80%)
Coursework 1 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Component 1 is a written, closed-book examination at the end of the module. Component 2 is composed of a number of coursework assignments spread through the term.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work.

For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance.

Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary examination.

Additional Notes: Available to visiting and exchange students.

MA-M46 Assurance and Annuity

Credits: 15 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: MA-M45

Lecturer(s): Dr Z Sobol

Format: 40 hours: 30 hours of lectures and 10 hours of examples classes

Delivery Method: The module will be delivered on Bay Campus, with a mix of lectures and example classes underpinned with weekly formative homework.

Module Aims: This module covers the actuarial pricing structure of life assurance and annuity contracts, including a variety of payment and premium structures as well as two-life policies. It covers material related to sections 4, 5 and 6 of the Institute and Faculty of Actuaries CM1 syllabus.

Module Content: i) Assurance and annuity contracts

ii) Payments – means and variances

iii) Two life policies

iv) Multiple transitions

v) Multiple decrements

vi) Future loss

vii) Gross premiums and reserves

viii) Death strains

ix) Future cashflows

Intended Learning Outcomes: At the end of this module, a student should be able to:

- 1) critically evaluate a range of assurance and annuity contracts,
- 2) demonstrate advanced skills with payments under various assurance and annuity contracts,
- 3) calculate using advanced techniques cashflows contingent upon the nature of transitions,
- 4) demonstrate advanced skills calculating gross premiums and reserves for assurance and annuity contracts and projecting future cashflows for a variety of typical contracts.

Assessment: Examination (80%)
Coursework 1 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Component 1 is a written, closed-book examination at the end of the module.

Component 2 is formed of a number of coursework assignments during the semester.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall

feedback on the cohort performance, and some individual comments on their work.

For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance.

Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary Examination.

Additional Notes: Module available to visiting and exchange students.

MA-M49 Probability and Statistics for Finance

Credits: 15 **Session:** 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof J Wu

Format: 20 hours: 10 hours of practical workshops and 10 hours of PC labs.

Delivery Method: The module will be delivered using a flipped approach with material provided via Canvas for students to prepare for regular workshops and PC labs.

Module Aims: This module provides an applied introduction to the theories of probability and statistics with a particular focus on applications from finance and insurance. It takes a practical approach and focuses on the use of the programming language R in statistical analysis.

It covers material related to the syllabus for CS1 from the Institute and Faculty of Actuaries.

Module Content: 1) Probability theory: basic probability spaces, probability measures, random variables, distributions, moment & cumulant generating functions, expectations, independence, joint distributions, conditional distributions, conditional expectations, Bayes formula, central limit theorem.
2) Statistical Analysis: Sampling and populations, parameter estimation, maximum likelihood estimators, confidence intervals, hypothesis testing.
3) Regression: Linear regression, generalised linear models.
4) Bayesian statistics: Prior and posterior distributions, Bayesian estimators.

The programming language R will be used throughout the module.

Intended Learning Outcomes: After completion of the module, the student should be able to;

- 1) demonstrate a systematic understanding of probability theory,
- 2) critically evaluate the application of a broad selection of probability distributions in financial modelling,
- 3) demonstrate advanced skills in testing statistical hypotheses in both parametric and non-parametric settings,
- 4) demonstrate a systematic understanding of regression techniques,
- 5) analyse and investigate large, incomplete, and contradictory data sets using specialist techniques,
- 6) autonomously analyse statistical data using statistical software,
- 7) analyse statistical output and communicate outcomes in an appropriate manner.

Assessment: Examination (70%)
Assignment 1 (20%)
Assignment 2 (10%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Exam: a written, closed-book examination at the end of the module to assess students understanding of theoretical of probability and statistics, their ability to model and analyse real world financial problems, their ability to interpret statistical analyses and their understanding of R use.

Assignment 1: is composed of several coursework assignments spread through the term to build skills in problem solving and statistical analysis.

Assignment 2: is a computing test held under controlled conditions at the end of the module to assess their skills in programming in R and interpreting R output for real world problems.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments and computing test, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work.

For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance.

Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary Examination

Additional Notes: Available to visiting and exchange students. Not available to students on MSc Mathematics.

MA-M58 Financial Mathematics in Discrete Time

Credits: 15 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr I Rodionova

Format: There be weekly delivery, with each week have 3 lectures and 1 examples class.

Delivery Method: The module will be delivered on Bay Campus, with a traditional mix of lectures and example classes underpinned with weekly assessments of a formative/summative mix.

Module Aims: This module will introduce students to section 1 of the Institute and Faculty of Actuaries (IFoA) CS1 syllabus, section 3 of the IFoA CS2 syllabus and sections 4 and 6 of the IFoA CM2 syllabus.

This module serves as an introduction to the theory of martingales and their applications to a discrete-time dynamics of a financial market containing a bank account and several kinds of stocks. Special attention is paid to the applications of the theory of martingales to the absence of arbitrage in a discrete-time financial market and pricing and hedging of the options.

Module Content: - A first encounter with stochastic processes, filtration, the natural filtration of a stochastic process;
- Conditional expectation;
- Martingales, including submartingales and supermartingales;
- Stopping times and hitting times, optional sampling, optional stopping;
- Discrete time financial market, self-financing trading strategies;
- Discounted price processes, equivalent martingale measures and arbitrage opportunities;
- Contingent claim, European, American and Asian options, valuation and hedging, complete and incomplete markets;
- The binomial (Cox-Ross-Rubinstein) model;
- The Black-Scholes discrete-time pricing formula.

Intended Learning Outcomes: At the end of this module students should be able to:

- 1) Demonstrate a comprehensive knowledge of the theory of martingales;
- 2) Be able to systematically apply the optional stopping theorem to practical examples;
- 3) Demonstrate a comprehensive understanding of the main concepts of discrete-time models of financial markets;
- 4) Be able to systematically apply the theory of martingales to study of financial markets;
- 5) Demonstrate a comprehensive knowledge of the binomial model.

Assessment: Examination (80%)
Assignment 1 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Component 1 is a written, closed-book examination at the end of the module. Component 2 is formed of a number of coursework assignments during the semester.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work. For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance. Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary Examination.

Additional Notes: Available to visiting and exchange students

MA-M59 Financial Mathematics in Continuous Time

Credits: 15 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: MA-M58

Lecturer(s): Prof E Lytvynov

Format: There be weekly delivery, with each week have 3 lectures and 1 examples class.

Delivery Method: The module will be delivered on Bay Campus, with a traditional mix of lectures and example classes underpinned with weekly assessments of a formative/summative mix.

Module Aims: This module will introduce students to sections 3, 4 and 6 of the Institute and Faculty of Actuaries CM2 syllabus.

This module serves as an introduction to the Black-Scholes model for the continuous-time dynamics of a financial market containing a bank account and several kinds of stocks. This theory is based on stochastic (Itô) calculus for Brownian motion. Special attention is paid to the applications of stochastic calculus to the absence of arbitrage in a financial market and pricing and hedging of the options.

Module Content: - Introduction to Brownian motion;
- Stochastic integral with respect to Brownian motion;
- Itô process and Itô formula;
- Product rule for Itô processes (integration by parts formula);
- Stochastic differential equations;
- Models of a financial market in continuous time;
- European call and put options, American call and put options;
- Put-call parity and other model-independent results;
- Self-financing trading strategies;
- Equivalent martingale measures and arbitrage opportunities;
- Attainability and completeness;
- Pricing and hedging of an option;
- The Black-Scholes pricing formulas for European call and put options;
- The Black-Scholes partial differential equation;
- Dividend-paying stocks;
- The Garman-Kohlhagen pricing formulas;

Intended Learning Outcomes: At the end of this module students should be able to:

- 1) Systematically work with the Itô stochastic integral with respect to Brownian motion;
- 2) Demonstrate a comprehensive understanding of Itô's formula and be able to apply it for the purposes in financial mathematics;
- 3) Demonstrate comprehensive understanding of the main notions related to financial markets in continuous time;
- 4) Demonstrate understanding of the completeness of a financial market, hedging and pricing of attainable options with the help of the equivalent martingale measures;
- 5) Be able to derive the Black-Scholes partial differential equation by using stochastic calculus.

Assessment: Examination (80%)
Assignment 1 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Component 1 is a written, closed-book examination at the end of the module. Component 2 is formed of a number of coursework assignments during the semester.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work. For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance. Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary Examination.

Additional Notes: Available to visiting and exchange students

MA-M64 Markov Processes and Applications

Credits: 15 **Session:** 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof J Wu

Format: There be weekly delivery, with each week have 3 lectures and 1 examples class.

Delivery Method: The module will be delivered on Bay Campus, with a traditional mix of lectures and example classes underpinned with weekly assessments of a formative/summative mix.

Module Aims: The module will introduce students to section 3 of the Institute and Faculty of Actuaries CS2 syllabus. This module serves as an introduction to the theory of Markov processes, in both discrete and continuous times. A special attention is drawn to the theory of Markov chains and Markov jump processes (including the Poisson process) and their applications.

Module Content: - Stochastic processes, filtration, conditional expectation, independence.

- Stochastic process with prescribed finite-dimensional distributions.
- Kolmogorov's existence theorem.
- Markov semigroups of kernels.
- Markov processes.
- Markov chains.
- Poisson process.
- Markov jump process.
- Brownian motion, continuity of paths.

Intended Learning Outcomes: At the end of this module students should be able to:

- 1) demonstrate a comprehensive knowledge of the theory of stochastic processes, in particular, Markov processes;
- 2) demonstrate comprehensive understanding of Kolmogorov's construction of stochastic processes;
- 3) design and systematically employ Markov chain models;
- 4) derive and systematically use Kolmogorov's differential equations for Markov processes;
- 5) demonstrate comprehensive knowledge of the construction and basic properties of Brownian motion and Poisson processes.

Assessment: Examination (80%)
Assignment 1 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Component 1 is a written, closed-book examination at the end of the module. Component 2 is formed of a number of coursework assignments during the semester.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work. For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance. Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary Examination.

Additional Notes: Available to visiting and exchange students

MA-M65 Risk and Survival Models

Credits: 15 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: MA-M64

Lecturer(s): Dr DL Finkelshtein

Format: There be weekly delivery, with each week have 3 lectures and 1 lab/examples class.

Delivery Method: The module will be delivered on Bay Campus, with a traditional mix of lectures and lab/example classes underpinned with weekly assessments of a formative/summative mix.

Module Aims: This module will introduce students to sections 1, 2 and 4 of the Institute and Faculty of Actuaries CS2 syllabus.

The module covers insurance risk modelling based on loss and compound distributions, time series and their applications, survival models and the estimations of their distributions and transition intensities, and future mortality projection.

Module Content: - Loss distributions

- Compound distributions
- Risk modelling
- Copulas
- Extreme value
- Concepts of time series
- Applications of time series
- Survival models
- Estimation of lifetime distributions
- Maximum likelihood estimation
- Estimation of transition intensities
- Graduation
- Mortality projection

Intended Learning Outcomes: Learning Outcomes:

At the end of this module students should be able to:

- fit statistical distributions to datasets and calculate the goodness of fit,
- demonstrate a comprehensive understanding of copulas (both Gaussian and Archimedean),
- explain the central concepts and properties of time series (AR, MA, ARMA, ARIMA),
- develop appropriate deterministic forecasts from time series data,
- describe and systematically apply a two-state model, in the case of a single decrement,
- describe and systematically apply the Cox model for proportional hazards,
- derive maximum (partial) likelihood estimates for various quantities,
- calculate graduation estimates of transition intensities (or probabilities) and specify their properties.

Assessment: Examination (70%)
Assignment 1 (20%)
Assignment 2 (10%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Component 1 is a written, closed-book examination at the end of the module.
Component 2 is formed of a number of coursework assignments during the semester.
Component 3 is a lab test during the semester.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work.
For the lab test, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work.
For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance. Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary Examination.

Additional Notes: Available to visiting and exchange students

MASM08 Mathematics and Computing for Finance Project

Credits: 60 Session: 2022/23 September-June

Pre-requisite Modules:

Co-requisite Modules: MA-M72; MA-M92

Lecturer(s): Prof C Yuan, Refer To Dept

Format: 12

Delivery Method: On campus

Module Aims: A research project selected from an area of expertise of a member of staff in the Department of Mathematics. It will enable the students to develop an enquiring, analytical critical and creative approach to problem identification and solution. The project will typically focus on a subject area covered within one of the taught modules in the MSc scheme.

Module Content: The student will study an area of mathematics related to the content of the taught part of the MSc scheme, drawing together material from different published sources, and their own investigations, to produce a substantial written report on the topic.

Intended Learning Outcomes: At the end of this module, the student should:

be skilled in the synthesis of information and ideas;

be confident in independently evaluating alternative approaches;

be accurate in reporting on their own work, and work of others;

be able to engage with professional and academic workers in the Mathematics of Finance.

Assessment: Project (100%)

Assessment Description: Project

Moderation approach to main assessment: Universal non-blind double marking

Assessment Feedback: Lecturer feedback

Failure Redemption: Project

Additional Notes: Dissertation for the MSc Mathematics and Computing for Finance scheme.

Each student will be assigned a member of staff as a supervisor who will help to choose the topic to be studied, and guide the student. Each student will be required to produce a word-processed thesis of 15,000-20,000 words, based on topics covered in the taught part of the MSc scheme, and on published research in the field.