MODULE SPECIFICATIONS

Mathematical Methods of Finance (Online Version)

Level M, Certificate Stage, 20 credits

Old code: 0570001 (until 2010/11)
New code: MAT00027M (from 2011/12)

Aims and Distinctive Features: This module provides the mathematical foundations underpinning Mathematical Finance. The topics covered are selected because of their importance in quantitative finance theory and practice. Probability theory and stochastic processes provide the language in which to express and solve mathematical problems in finance due to the inherent randomness of asset prices. The introduction of more advanced tools will be preceded by a brief review of basic probability theory with particular focus on conditional expectation. Then the module will proceed to present the theory of martingales and the study of three basic stochastic processes in finance: random walks, Brownian motion, and the Poisson process. An informal overview of Ito stochastic calculus will be given and first financial applications indicated. The material will be illustrated by numerous examples and computer-generated demonstrations. By the end of this module students are expected to achieve a sufficient level of competence in selected mathematical methods and techniques to facilitate further study of Mathematical Finance.

Learning Outcomes: By the end of this module students should
a) use the language and tools of probability theory with confidence in the context of financial models and applications;
b) acquire an understanding of stochastic processes in discrete and continuous time and be familiar with the basic examples and properties of such processes appearing in financial modelling;
c) recognise the central role of Ito stochastic calculus for mathematical models in finance, and show familiarity with the basic notions and tools of stochastic calculus, at an informal level.

Indicative Content:
2. Filtrations, partitions, their relationship, applications for modelling flow of information.
3. Definition and basic properties of stopping times.
4. Radon-Nikodym theorem (without proof).
5. Conditional expectation, conditional probability, dependence and independence.
7. Adapted processes, predictable processes.
9. Central Limit Theorem and its financial application (convergence of CRR prices to Black-Scholes formula).
11. Brownian motion as a limit of a symmetric random walk, properties of Brownian motion.
12. Stieljes integral, definition and basic properties.

Learning and Teaching Strategy: Lecture notes and interactive presentations recorded on CD/DVD in lieu of lectures, equivalent to 30 one-hour lectures, and 10 one-hour one-to-one online tutorials scheduled at regular intervals.
covering the three core modules comprising the Certificate Stage of the programme. Individual feedback and advice will be offered to students during scheduled online tutorials and via a VLE discussion forum. The final online tutorial will include a recorded online viva.

**Arrangements for Revision and Private Study:** Students are expected to contribute a considerable amount (of the order of 200 hours) of individual study time, including lecture notes, interactive CD/DVD presentations in lieu of lectures, exercises and assessed coursework assignments, library and textbook work. The final week (for Fast Track students) or two weeks (for Standard Track students) of the Certificate Stage preceding the online viva will be devoted to revision and no new material will be covered during that period.

**Assessment:** Four assessed coursework assignments comprising 100% of the final mark followed by a recorded online viva to authenticate the work submitted for assessment. The weightings of individual coursework assignments to be advised prior to commencing the Certificate Stage of the online programme. Marking will be based exclusively on written work submitted electronically for each assignment, whereas the online viva scheduled at the end of the Certificate Stage will serve to authenticate the work submitted for assessment but will not otherwise affect the marks. Assessed work will be routinely screened using online tools for the detection of unfair means such as unacknowledged copying of material or collusion.

**Recommended Texts:**
Discrete Time Modelling and Derivative Securities (Online Version)

Level M, Certificate Stage, 20 credits

Old code: 0570003 (until 2010/11)
New code: MAT00024M (from 2011/12)

Aims and Distinctive Features: The aim of the module is to explain in simple - namely discrete time - settings the fundamental ideas of modelling of financial markets and pricing of derivative securities using the principle of no arbitrage. Even the simplest of all models with only one time step allows several important notions to be illustrated. The module progresses with more complex models - involving many time steps and several stocks - which are developed along with the corresponding theory of pricing and hedging derivative securities such as options or forwards. Relatively simple mathematical considerations lead to powerful notions and techniques underlying the theory - such as the no-arbitrage principle, completeness, self-financing and replicating strategies, and equivalent martingale measures. These are directly applicable in practice, particularly in the continuous time limiting theory developed in a subsequent module. The general methods are applied in detail in particular to pricing and hedging European and American options within the Cox-Ross-Rubinstein (CRR) binomial tree model. The Black-Scholes model as the limit of CRR models is discussed to pave the way for continuous time theory.

Learning Outcomes: By the end of this module students should
a) understand the basic ideas, principles and assumptions for building simple discrete time financial models, and associated notions (portfolios, trading strategies, discounted prices etc);
b) be able to test a discrete-time model for the absence of arbitrage;
c) understand the notion of a derivative security and the common examples;
d) understand the principle of no arbitrage (NAP) for pricing derivatives;
e) understand the notions of self-financing and replicating strategies, and their role in pricing using the NAP;
f) understand the notion of an equivalent martingale measure and its use in pricing;
g) understand the notion of completeness of a market;
h) be able to apply the above theory to particular examples, especially European options, and explicitly calculate replicating (hedging) trading strategies, equivalent martingale measures and derivative prices, using Excel spreadsheets as well as hand calculation;
i) understand how to price and hedge American options in a discrete model and do explicit calculations.

Indicative Content:
1. Basic assumptions and definitions for discrete-time market models.
2. The 1-step binary model with 1 stock and bond: lack of arbitrage, completeness, replicating portfolios, risk-neutral probabilities, pricing derivatives.
3. Lack of arbitrage and incompleteness for more than binary branching.
5. Fundamental Theorem of Asset Pricing in discrete time.
6. Derivative securities - definitions and examples especially European options.
8. Specialisation to the 1 stock binomial (CRR) model; the Black-Scholes model.
9. Black-Scholes formula derived as a limit of the CRR pricing formula.
10. American options, pricing, hedging and optimal exercise time.

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**Arrangements for Revision and Private Study:** Students are expected to contribute a considerable amount (of the order of 200 hours) of individual study time in this module, including lecture notes, interactive CD/DVD presentations in lieu of lectures, exercises and assessed coursework assignments, library and textbook work. The final week (for Fast Track students) or two weeks (for Standard Track students) of the Certificate Stage preceding the online viva will be devoted to revision and no new material will be covered during that period.

**Assessment:** Four assessed coursework assignments comprising 100% of the final mark followed by a recorded online viva to authenticate the work submitted for assessment. The weightings of individual coursework assignments to be advised prior to commencing the Certificate Stage of the online programme. Marking will be based exclusively on written work submitted electronically for each assignment, whereas the online viva scheduled at the end of the Certificate Stage will serve to authenticate the work submitted for assessment but will not otherwise affect the marks. Assessed work will be routinely screened using online tools for the detection of unfair means such as unacknowledged copying of material or collusion.

**Recommended Texts:**
**Portfolio Theory and Risk Management (Online Version)**

Level M, Certificate Stage, 20 credits

Old code: 0570002 (until 2010/11)
New code: MAT00033M (from 2011/12)

**Aims and Distinctive Features:** Students are expected to acquire the skills and knowledge necessary to apply modern risk measures and management tools and to use portfolio theory to manage and balance investment risk and return. The main emphasis here is on employing the concept of diversification for management of stock investment. A more general approach involves utility functions and the construction of portfolios using expected utility optimisation. Portfolios of various derivative securities are powerful tools for risk management. Sophisticated needs of fund managers can be addressed by designing these portfolios. Students also need to demonstrate familiarity with pricing models along with their strengths and disadvantages.

**Learning Outcomes:** By the end of this module students should
a) recognize methods of measuring risk, understand the relationships between them and their relevance for particular applications;
b) understand the concept of diversification and be able to employ it to design and manage a portfolio of stocks;
c) understand the theoretical background of optimization schemes and be able to implement them to solve practical investment problems;
d) understand the advantages and disadvantages of Value at Risk (VaR), a widely accepted measure of risk; be able to compute VaR in practical applications;
e) be able to design a portfolio of financial instruments to meet the needs of managers concerned with risk management (in particular hedging risk).

**Indicative Content:**
1. Mean and variance as a measure of return and risk.
2. Risk and return of a portfolio of two assets, diversification. Construction of the feasible set, proof that the feasible set forms a hyperbola.
5. General case of many assets, risk-minimisation, efficient frontier and its characterisation (reduction to the two-asset case: Two-fund theorem).
9. Reconciliation of utility theory with mean-variance approach (quadratic utilities and normal distribution).
10. Attitude towards risk and utility functions. Risk aversion; Arrow-Pratt coefficient. Risk neutrality. Price-state vector and its relation to utility functions; risk neutral probabilities. Incomplete markets, risk minimizing and utility approach. Relation to CAPM. Problem with negative prices in CAPM.

13. Financial engineering - designing portfolios for specific investment purposes concerned with risk management. Developing a hedging strategy, pricing based upon the anticipated cost of the hedging strategy, implementing the strategy.


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**Arrangements for Revision and Private Study:** Students are expected to contribute a considerable amount (of the order of 200 hours) of individual study time in this module, including lecture notes, interactive CD/DVD presentations in lieu of lectures, exercises and assessed coursework assignments, library and textbook work. The final week (for Fast Track students) or two weeks (for Standard Track students) of the Certificate Stage preceding the online viva will be devoted to revision and no new material will be covered during that period.

**Assessment:** Four assessed coursework assignments comprising 100% of the final mark followed by a recorded online viva to authenticate the work submitted for assessment. The weightings of individual coursework assignments to be advised prior to commencing the Certificate Stage of the online programme. Marking will be based exclusively on written work submitted electronically for each assignment, whereas the online viva scheduled at the end of the Certificate Stage will serve to authenticate the work submitted for assessment but will not otherwise affect the marks. Assessed work will be routinely screened using online tools for the detection of unfair means such as unacknowledged copying of material or collusion.

**Recommended Texts:**
Stochastic Calculus and Black-Scholes Theory (Online Version)

Level M, Diploma Stage, 20 credits

Old code: 0571001 (until 2010/11)
New code: MAT00029M (from 2011/12)

Pre-requisites: Mathematical Methods of Finance (Online Version), Discrete Time Modelling and Derivative Securities (Online Version), or equivalent

Aims and Distinctive Features: The module enables students to acquire in-depth knowledge of the main features of Itô stochastic calculus as applied in mathematical finance, including:
- The role of the Itô integral and Itô formula in solving stochastic differential equations (SDEs);
- Martingale properties of the Itô integral and the structure of Brownian martingales;
- The mathematical relationships between wealth processes, investment strategies and option prices;
- Change of measure techniques and Girsanov theorem.
- Partial differential equation (PDE) approach, and in particular the Black-Scholes equation.
- Feynman-Kac representation of option prices.

The emphasis is on fundamental concepts which underlie the main continuous-time models of option pricing, principally the Black-Scholes model. Both plain vanilla (European) and exotic options (for example, barrier options) are dealt with, and the relationship between the approaches based on martingale theory and partial differential equations is explored. The module aims to equip students with a thorough understanding of the sophisticated mathematical results and techniques encountered in financial market modelling.

Learning Outcomes: By the end of this module students should
a) Be competent in calculations involving the precise mathematical details of the definition and construction of the Itô integral, and understand its structure and properties;
b) Demonstrate fluency in the use of the Itô formula in applications;
c) Be able to solve linear SDEs;
d) Have a thorough grasp of Black-Scholes methodology, both in its PDE and martingale formulations, and its application in deriving option prices in continuous-time models;
e) Have a clear understanding of the impact of the simplifying assumptions in the Black-Scholes model, and understand the role of the ‘Greek parameters’;
f) Be able to use measure transformations to price European options via expectations of martingale measures, and apply martingale calculus in pricing options and finding optimal trading strategies in complete models;
g) Be familiar with the Feynman-Kac formula and its use in representing the price of an option;
h) Be able to compare European and exotic options, and to discuss the differences between their pricing methodologies;
i) Have a working knowledge of the mathematical analysis of the American put option (time allowing).

Indicative Content:
1. Brownian Motion and its properties.
2. Development of the Itô integral in framework and its extension to a wider classes of integrands; isometry and martingale properties of the integral.
3. Itô calculus, Itô formula and its application to evaluating stochastic integrals.
5. Risk-neutral pricing: Girsanov's theorem and equivalent measure change in a martingale setting; representation of Brownian martingales.

6. Feynman-Kac formula.

7. The Black-Scholes model: assumptions and scope; delta-hedging; derivations of the Black-Scholes PDE and its solution via the heat equation and Brownian motion; role of the 'Greeks' as measures of model parameters; the Black-Scholes formula and simple extensions of the model.

8. Application of Girsanov's theorem to Black-Scholes dynamics; self-financing strategies and model completeness; derivation of the Black-Scholes formula via expectations; wealth processes and minimal hedges.

9. A choice of: barrier or lookback options in the Black-Scholes model; reflection principle for Brownian motion;

10. (optional, time allowing) Comparison of European and American options; dividend-paying stocks; path-dependence.

**Learning and Teaching Strategy:** Interactive presentations recorded on CD/DVD in lieu of lectures, equivalent to 30 one-hour lectures, and 10 one-hour one-to-one online tutorials scheduled at regular intervals covering the three core modules comprising the Diploma Stage of the programme. Individual feedback and advice will be offered to students during scheduled online tutorials and via a VLE discussion forum. The final online tutorial will include a recorded online viva.

**Arrangements for Revision and Private Study:** Students are expected to contribute a considerable amount (of the order of 180 hours) of individual study time, including interactive CD/DVD presentations in lieu of lectures, exercises and assessed coursework assignments, library and textbook work. The final week (for Fast Track students) or two weeks (for Standard Track students) of the Diploma Stage preceding the online viva will be devoted to revision and no new material will be covered during that period.

**Assessment:** Four assessed coursework assignments comprising 100% of the final mark followed by a recorded online viva to authenticate the work submitted for assessment. The weightings of individual coursework assignments to be advised prior to commencing the Diploma Stage of the online programme. Marking will be based exclusively on written work submitted electronically for each assignment, whereas the online viva scheduled at the end of the Diploma Stage will serve to authenticate the work submitted for assessment but will not otherwise affect the marks. Assessed work will be routinely screened using online tools for the detection of unfair means such as unacknowledged copying of material or collusion.

**Recommended Texts:**
Numerical and Computing Techniques in Finance (Online Version)

Level M, Diploma Stage, 20 credits

Old code: 0571002 (until 2010/11)
New code: MAT00031M (from 2011/12)

Pre-requisites: Mathematical Methods of Finance (Online Version), Discrete Time Modelling and Derivative Securities (Online Version), Portfolio Theory and Risk Management (Online Version), or equivalent

Aims and Distinctive Features: The aim of the module is to provide programming skills required for the implementation of mathematical models in quantitative finance. The focus will be on the C++ programming language, which is widely accepted as the main tool amongst practitioners in the financial community. The implementation of a given model rarely narrows down to the pricing of a single particular financial instrument. Most often it is possible to devise general numerical schemes which can be applied to various types of derivatives. The code should be designed so that it easily integrates with the work of other developers and can be modified by other users. The student will learn such skills by writing C++ programs designed for pricing various types of derivatives, starting from the simplest discrete time models and finishing with continuous time models based on finite difference or Monte Carlo methods.

Learning Outcomes: By the end of the module, students should:

- be able to write comprehensive C++ programs;
- be familiar with functions and function pointers;
- be able to implement non-linear solvers;
- be familiar with data structures and dynamic memory allocation;
- understand and have experience of using class and function templates;
- be familiar with standard numerical methods (finite difference, Monte Carlo) for solving representative problems;
- be able to price European and American options under the CRR model;
- be able to price American options by means of finite difference methods under assumptions of the Black Scholes model;
- be able to price barrier and Asian options by means of Monte Carlo simulation.

Indicative Content:

Numerical techniques

2. Pricing by backward induction.
3. Representative equations of Black-Scholes type and elementary finite difference approximations.
4. Basic concepts of consistency, convergence and stability.
5. Explicit and implicit difference methods.

C++ programming

9. Basic features: syntax, variables and their types, arrays, pointers, conditional statements and loops.
10. Functions and function pointers.
11. Classes.
12. Dynamic memory allocation.
13. Inheritance.
15. Templates.

**Learning and Teaching Strategy:** Interactive presentations recorded on CD/DVD in lieu of lectures, equivalent to 30 one-hour lectures, and 10 one-hour one-to-one online tutorials scheduled at regular intervals covering the three core modules comprising the Diploma Stage of the programme. Individual feedback and advice will be offered to students during scheduled online tutorials and via a VLE discussion forum. The final online tutorial will include a recorded online viva.

**Arrangements for Revision and Private Study:** Students are expected to contribute a considerable amount (of the order of 180 hours) of individual study time, including interactive CD/DVD presentations in lieu of lectures, exercises and assessed coursework assignments, library and textbook work. The final week (for Fast Track students) or two weeks (for Standard Track students) of the Diploma Stage preceding the online viva will be devoted to revision and no new material will be covered during that period.

**Assessment:** Four assessed computer-based coursework assignments comprising 100% of the final mark followed by a recorded online viva to authenticate the work submitted for assessment. The weightings of individual coursework assignments to be advised prior to commencing the Diploma Stage of the online programme. Marking will be based exclusively on written work submitted electronically for each assignment, whereas the online viva scheduled at the end of the Diploma Stage will serve to authenticate the work submitted for assessment but will not otherwise affect the marks. Assessed work will be routinely screened using online tools for the detection of unfair means such as unacknowledged copying of material or collusion.

**Recommended Texts:**
7. D. Yang, C++ and Object-Oriented Numeric Computing for Scientists and Engineers.
Modelling of Bonds, Term Structure, and Interest Rate Derivatives (Online Version)

Level M, Diploma Stage, 20 credits

Old code: 0571003 (until 2010/11)
New code: MAT00019M (from 2011/12)

Pre-requisites: Mathematical Methods of Finance (Online Version), Discrete Time Modelling and Derivative Securities (Online Version), or equivalent

Aims and Distinctive Features: The module introduces the probabilistic concepts and techniques necessary for modelling the dynamics of interest rates. The mathematical theory of interest rates is complex, since on the one hand it has to cover simultaneous random behaviour of a family of bonds indexed by maturity, and on the other hand be consistent with no-arbitrage restrictions. Additionally, to be realistic models have to be complex enough to enable the calibration of their parameters to real data. The complexity stems from the fact that in general interest rates depend on running time and maturity time, so are stochastic processes of two time variables, each with a very specific role. Discrete models will be constructed based on tree structures. For some special models a continuous time limit results in a stochastic differential equation of Ito type. In full generality the theory of partial stochastic differential equations is needed to investigate sophisticated models (this issue is only briefly outlined in the module). However, there is no such thing as the best or universally accepted model. Hence this module shows a variety of approaches and much time is devoted to the study of their relationships. One crucial issue is concerned with fitting the model to the data, called calibration. Pricing interest rate derivative securities is of great importance, since they represent a vast majority of the derivatives traded.

Learning Outcomes: By the end of this module students should
a) be able to construct arbitrage-free models of interest rates and the term structure of bond prices in the binary tree model and to price interest rate derivatives within such a model;
b) be able to price complex interest rate derivative securities, including American and exotic options, in a discrete setting with random interest rates of various maturities;
c) be able to price various derivative securities (such as caps, floors, swaps) written on bonds as underlying securities;
d) understand the features of various models describing the dynamics of interest rates and be able to see the connections between them, in both the discrete and continuous time frameworks;
e) demonstrate skills necessary for practical implementation of the techniques, in particular, be able to calibrate selected models.

Indicative Content:
1. The concept of the term structure of interest rates. Presentation of theories explaining the shapes of the term structure encountered in practice. Methods of constructing long horizon term structure (bootstraping, presentation of STRIPS).
Discrete and continuous time versions.


7. Derivative securities in models with random interest rates. Pricing interest rate options.

8. Pricing and hedging interest rate futures, caps, floors, collars, swaps, caplets, florlets, swaptions.

**Learning and Teaching Strategy:** Interactive presentations recorded on CD/DVD in lieu of lectures, equivalent to 30 one-hour lectures, and 10 one-hour one-to-one online tutorials scheduled at regular intervals covering the three core modules comprising the Diploma Stage of the programme. Individual feedback and advice will be offered to students during scheduled online tutorials and via a VLE discussion forum. The final online tutorial will include a recorded online viva.

**Arrangements for Revision and Private Study:** Students are expected to contribute a considerable amount (of the order of 180 hours) of individual study time, including interactive CD/DVD presentations in lieu of lectures, exercises and assessed coursework assignments, library and textbook work. The final week (for Fast Track students) or two weeks (for Standard Track students) of the Diploma Stage preceding the online viva will be devoted to revision and no new material will be covered during that period.

**Assessment:** Four assessed coursework assignments comprising 100% of the final mark followed by a recorded online viva to authenticate the work submitted for assessment. The weightings of individual coursework assignments to be advised prior to commencing the Diploma Stage of the online programme. Marking will be based exclusively on written work submitted electronically for each assignment, whereas the online viva scheduled at the end of the Diploma Stage will serve to authenticate the work submitted for assessment but will not otherwise affect the marks. Assessed work will be routinely screened using online tools for the detection of unfair means such as unacknowledged copying of material or collusion.

**Recommended Texts:**
Mathematical Finance Dissertation (Online Version)

Level M, Dissertation Stage, 60 credits

Code: MAT00026M

Pre-requisites: Completing the Certificate and Diploma Stages of the MSc in Mathematical Finance

Aims and Distinctive Features: Candidates for the MSc degree will submit a dissertation of around 60 pages on a selected topic in Mathematical Finance. Support and advice will be provided by individual dissertation supervisors and consultants.

Students submitting a dissertation will be expected to demonstrate the ability to absorb and analyse current research literature in mathematical finance and/or to apply their skills of implementation of mathematical models in concrete situations arising in financial engineering practice. Original contribution to research, while laudable, will not be required.

Learning Outcomes: By the end of this module students should
a) demonstrate an ability for in-depth independent research into a chosen topic in mathematical finance;
b) provide evidence in their dissertation of their ability to read and understand current research literature in this field;
c) where appropriate for the selected topic, develop and apply computer software to present a solution to the problem at hand;
d) present the outcome of their research and the background for the chosen topic in a self-consistent, clear, rigorous and accessible manner;
e) demonstrate the ability to locate and understand current literature in the selected area of their research;
f) present a critical approach emphasizing the strengths and limitations of the approaches, methods, and solutions studied.

Indicative Content: The choice of dissertation/project topics from a list provided by the department will be made by each student after consultation with the supervisor. Possible dissertation topics include but are not limited to the following:
Risk-Free and Risky Asset Models (term structure and advanced interest rate models, for example, Vasicek model, Hull-White model, Cox-Ingersoll-Ross model, Heath-Jarrow-Morton model, Markov chain model, portfolios of bonds an immunisation techniques, advanced mathematical models of stock prices);
Risk and Portfolio Management (market efficiency, efficient frontier, constrained portfolios)
Derivative Financial Instruments (Forwards and Futures, European and American options, valuation and replication strategies, Cox-Ross-Rubinstein and Black-Scholes pricing formulæ and their generalisations (transaction costs, incomplete markets, markets with friction), exotic options, 2nd generation options, exchange rate and index options, application of control theory in option pricing, numerical methods)
Optimisation Techniques (maximisation of utility, cost minimising, models involving consumption, linear programming, the simplex method, non-linear programming, Kuhn-Tucker theorem, application to option pricing in incomplete markets).

Examples of possible dissertation/project topics used previously for the campus-based MSc in Mathematical Finance:
Construction of martingale measures by maximizing entropy
Continuous time limit of the binomial model
Estimating volatility using ARCH models
Optimal investments using utility functions
Real options
Mean-VaR portfolio theory
Liquidity risk by means of VaR
Valuation of companies
Coherent risk measures
Capital structure
Optimal portfolios in Heath-Jarrow-Morton model
Conditional Value at Risk
Applications of change of numeraire for option pricing
Copulas in finance
Single factor short rate models
Modelling credit risk - structural approach
Credit risk - reduced form approach
Credit risk - probabilities of default
Computer simulations of interest rate models
Stochastic differential delay equations in finance
Methods of designing pension schemes
Fundamental theorem of asset pricing and its extensions
Implied volatility, volatility smile, stochastic volatility
Complete market models implied by call options
Monte Carlo valuation of American type derivative securities
Microscopic simulation of the stock market
Pricing weather derivatives by utility maximisation
Arbitrage pricing of mortgage-backed securities
Computer implementation of finite-difference option pricing schemes

Learning and Teaching Strategy:
- Students will select a topic from a list provided, but will also be encouraged to design their own topic subject to approval by the potential supervisor.
- Supervisory backup will be provided individually to each student on a regular basis by means of online sessions with the dissertation supervisor. Typically 6 one-hour sessions will be scheduled at regular intervals during the Dissertation Stage.
- Students are expected to submit their written work electronically on a regular basis prior to their scheduled supervisory sessions, which will be returned with comments by the supervisor or consultants.
- Students will be required to pass an online viva at the end of the Dissertation Stage.
- E-mail support will be provided by the supervisor and consultant.
- Further support to be provided through the VLE platform, proving file depository and other services.

Arrangements for Revision and Private Study: Students taking this module are expected to devote approximately 600 hours of work to the dissertation. Progress will be monitored in regular online supervisory sessions and by requiring students to submit electronic drafts of their work in advance of supervisory meetings. Oral presentation during the online viva will provide students with a further opportunity to present their dissertation work in addition to the thesis submitted and to address any questions that may arise in connection with this work.
**Assessment:** The completed dissertation to be read and assessed independently by two internal referees who will produce a joint report, to be approved by the External examiner. A recorded online viva at the end of the Dissertation Stage will serve to authenticate the work submitted for assessment, but in normal circumstances will not affect the mark assigned for written work, unless there is evidence emerging during the viva that the student fails to have thorough understanding of the work submitted.

**Recommended Texts:** As per topic description