H9FQM: Financial and Quantitative Modelling

Module Code:	H9FQM
Long Title	Financial and Quantitative Modelling APPROVED
Title	Financial and Quantitative Modelling
Module Level:	LEVEL 9
EQF Level:	7
EHEA Level:	Second Cycle
Credits:	5
Module Coordinator:	COLETTE DARCY
Module Author:	CORINA SHEERIN
Departments:	School of Business
Specifications of the qualifications and experience required of staff	

Learning Outcomes	
On successful completion of this module the learner will be able to:	
#	**Learning Outcome Description**
LO1	Identify and analyse spreadsheet modelling techniques applied to a financial modelling environment.
LO2	Implement elementary control structures (conditional statements and loops) in a high-level programming language such as VBA, MATLAB and R will be covered.
LO3	Apply these programming techniques to solve a variety of financial modelling problems.
LO4	Apply matrix algebra techniques to solve financial problems.
LO5	Use Monte Carlo simulation in financial modelling, with an emphasis on derivative valuation and risk measurement.

Dependencies
Module Recommendations
No recommendations listed
Co-requisite Modules
No Co-requisite modules listed

Entry requirements	There are no additional entry requirements for this module. The programme entry requirements apply.

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Module Content & Assessment

Indicative Content

Spreadsheet Modelling
History and use of spreadsheets. Principles of spreadsheet model design. MS Excel Functionality Financial Functions Statistical Functions Lookup Functions Array Function Identifying and managing errors in MS Excel Use of the Solver add-in.

Visual Basic for Applications (VBA)
Automation of tasks using macros; recording macros. Modifying recorded macro code. Simple VBA programs; functions and subroutines Control structures: If then else Select case For Next Loops While Loops Data structures in VBA: Data types Arrays Application of control / data structures to solve financial problems: Implementing VBA code for the Black Scholes Option Pricing Model Forward Price / Value Function Determining the Internal Rate of Return using a While loop with interval bisection. Implementing a Cox Rubenstein Tree to value American Option Error handling and debugging

Matrices Applied to Finance
Recap on matrices; matrix structure, addition, subtraction, and multiplication. Vectors, matrices as operators on vectors. Representation of data in matrix form, computation of covariance matrices. Application of matrices and vectors to portfolio management; determination of a portfolio standard deviation. Positive definite matrices; prevalence in finance. Cholesky decomposition; application to Monte Carlo Simulation. Identity Matrices and Inverse Matrices Solving simultaneous equations with matrices Eigenvectors and Eigen Values Orthogonal Matrices Singular Value Decomposition Principal Component Analysis

Monte Carlo Simulation
Generating uniformly distributed random numbers. Transforming uniformly distributed random numbers to normally distributed random numbers with arbitrary mean and standard deviation. Modelling independent and correlated random variables. Use of the Central Limit Theorem to estimate the accuracy of a Monte Carlo simulation model. Modelling discrete processes such as default events. Application to modelling structured credit products such as Credit Default Swaps and Collateralised Debt Obligations. Application to modelling equity derivatives through Monte Carlo Simulation of Geometric Brownian Motion. Application to Corporate Finance; modelling Real Options and solving NPV / IRR problems with uncertain inputs. Use of Cholesky Decomposition to construct a Monte Carlo VaR Model.

Modelling with MATLAB
Introduction to MATLAB Integrated Development Environment; Command Window, Workspace and Script Editor. Use of MATLAB as a financial calculator. Exploration of a selection of financial functions in MATLAB; bond pricing and Black Scholes option model. Use of MATLAB for time series analysis, Econometric Toolbox and Distribution Fitter Application. Creating scripts in MATLAB. Use of graphics in MATLAB. Application, the use of MATLAB for Monte Carlo Simulation, speed comparison versus Excel and VBA. Application of MATLAB to investigate the Weak form of the Efficient Market Hypothesis using the Econometrics Toolbox.

Modelling with R-Studio
Introduction to R and R Studio, overview of the R-Studio Integrated Development Environment. Data Structures in R Vectors Matrices Arrays Data Frames Lists Time Series Importing Data Writing Functions and Scripts Plotting Data

Assessment Breakdown	%
Coursework	50.00%
End of Module Assessment	50.00%

Assessments

Full Time

Coursework

Assessment Type:	Continuous Assessment	**% of total:**	50
Assessment Date:	n/a	**Outcome addressed:**	1,2
Non-Marked:	No		

Assessment Description:
The minor modelling assessment will be designed to test certain principles of modelling, spreadsheet design or coding. Examples of these assignment include 1) modelling a random walk in either Excel, VBA, MATLAB or Python; 2) solving a Real Option problem with Monte Carlo Simulation; 3) building and implementing a function to compute implied volatility given an option price and the remaining pricing inputs.

End of Module Assessment

Assessment Type:	Terminal Exam	**% of total:**	50
Assessment Date:	End-of-Semester	**Outcome addressed:**	1,2,3,4,5
Non-Marked:	No		

Assessment Description:
The major assignment will be a more involved assignment designed to test the ability of the student to apply a range of modelling principles to a financial problem. Examples include building a spreadsheet model to value a company, construction and back-testing of VaR models, valuation of options with non-standard payoffs. The students will be required to prepare and deliver a presentation of their work. Marks will be awarded for the quality of this presentation.

No Workplace Assessment

Reassessment Requirement

Repeat examination
Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.

Reassessment Description
Repeat assessment of this module will consist of a repeat examination which will test all the learning outcomes.

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Module Workload

Module Target Workload Hours 0 Hours

Workload: Full Time

Workload Type	*Workload Description*	*Hours*	*Frequency*	*Average Weekly Learner Workload*
Lecture	Classroom and demonstrations	36	Per Semester	3.00
Directed Learning	Directed e-learning	36	Per Semester	3.00
Independent Learning	Independent learning	178	Per Semester	14.83
			Total Weekly Contact Hours	6.00

Module Resources

Recommended Book Resources

Van Niekerk, M. (2020), VBA Automation for Excel 2019 Cookbook, Packt.

Alexander, C. (2008), Market Risk Analysis Volume I: Quantitative Methods in Finance, Wiley.

Gilat, A. (2014), MATLAB: An Introduction with Applications, 5th Edition. FT Prentice Hall.

Medeiros, K. (2018), R Programming Fundamentals, Packt.

This module does not have any article/paper resources

Other Resources

[Journal], Journal of Finance.

[Journal], Journal of Quantitative Finance.

[Journal], Quarterly Journal of Finance.

[Journal], Journal of Economics and Finance.

[Journal], Journal of Financial and Quantitative Analysis.

[Journal], Journal of Mathematical Finance.

[Journal], Journal of Computational Finance.

[Journal], Journal of Current Issues in Finance, Business and Economics.

[Website], http://www.economist.com.

[Website], http://www.ft.com.

[Website], http://www.wsj.com.

[Website], http://www.bloomberg.com.

[Website], http://www.reuters.com.

[Website], http://www.centralbank.ie.

[Website], www.imf.org.

[Website], http://epp.eurostat.ec.europa.eu/.

Discussion Note:	