School of Innovative Technologies and Engineering

Department of Applied Mathematical Sciences

BSc (Hons) Actuarial Science

PROGRAMME DOCUMENT

VERSION 1.5

BAS v1.5

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BSc (Hons) Actuarial Science

A. Programme Information

This programme is meant for students who would like to have an expertise in mathematical finance and it prepares the students for a successful career in the following sectors: insurance companies, accounting firms, banking institutions and investment organisations, which are considered to be the major pillars in the economic development of the country. Through this programme the students will acquire an excellent grounding in a wide range of statistical and mathematical subjects applicable in many business settings and more importantly in the financial decisions. Students studying the course on a full-time mode will be encouraged to look for placement in insurance and banking firms in Mauritius during the holidays.

This course will offer exemptions to the following professional Core Technical actuarial examinations of the Institute of Actuaries (UK) to those students achieving at least 60% in the modules listed below

Core Technical Subjects	Modules
CT2	ACCF 1101C, QFIN 2109C, QFIN 2110C, QFIN 2209C
CT3	STAT 1215C, STAT1216C, STAT 2213C
CT7	ECON1101C, ECON1102C

To acclaim professional status as an actuary from the Canadian Institute of Actuaries (CIA) and the US based Casualty Actuarial Society (CAS) and Society of Actuaries (SOA), a student needs to clear a set of examinations as prescribed by the organisations. The CAS and SOA jointly administer the first four examinations. Certain modules in Economics, Finance, and Applied Statistical Methods must be taken at University level, for Validation by Education Experience (VEE) with a grade of B or better, which allows students to get credit for CIA/CAS/SOA exams. Our BSc (Hons) Actuarial Science programme offers modules that have been certified as fulfilling these requirements for the period 2009 – 2016 as per the table given below.

VEE Topics	Modules
Applied Statistical Methods	STAT 2213C, STAT 2330C
Corporate Finance	QFIN 2109C
Economics	ECON1101C, ECON1102C

B. Programme Aims

Actuarial science is a fairly distinctive blend of Mathematics, Statistics, Economics and Accounting, designed for dealing with the operational issues which financial business face, predominantly when there are significant financial uncertainties in running the business. Thus, an actuary is a business executive with specialized skills in the mathematical sciences for evaluating financial risks. Indeed, actuaries devise, analyze, value and refine insurance programs so as to meet the requirements of the society.

The main aim of the programme in Actuarial Science is to prepare the students for a career as an actuarial professional and to equip the students with the necessary expertise and specialized knowledge required to pass at least the first few professional actuarial examinations.

C. Programme Objectives

After successful completion of the program, the students are expected to have developed

- knowledge to apply actuarial model and statistical techniques to quantitatively assess risk
- critical business sense relating to accounting, economics and finance
- the skill to study a problem and model a solution using specialized statistical and actuarial methods
- considerable knowledge of actuarial mathematics and interest and contingency theories
- basic computer programming skills and knowledge of software packages for statistical analysis
- an understanding of the steps involved in the modelling process and how to carry out these steps in solving business problems
- effective written and oral communication skills

PART I - Regulations

D. General Entry Requirements

As per UTM's Admission Regulations, and 'Admission to Programmes of Study at Degree Level'

E. Programme Entry Requirements

At least grade **C** in Mathematics at 'A'-level.

F. Programme Mode and Duration

Full Time: 3 years (6 Semesters)
Part Time: 4 ½ years (9 Semesters)

G. Teaching and Learning Strategies

- Lectures, Tutorials and Practical Laboratory Sessions
- Structured Discussions
- Workshops and Seminars

H. Attendance Requirements

As per UTM's Regulations and Policy

I. Credit System

1 module   = 3 or 4 credits

Dissertation   = 8 credits

J. Student Progress and Assessment

The programme is delivered mainly through lectures, tutorials, and practical laboratory sessions. Students are expected to be as autonomous as possible and activities may include reading papers, delivering presentations, quizzes, case-studies among others.

Each module carries 100 marks and will be assessed as follows (*unless otherwise specified*):

- Written and/or practical examination and continuous assessment carrying up to 40% of total marks.
- Continuous assessment can be based on a combination of assignments, field study, workshops, practical labs and class tests.
- Module 'Professionalism and Communication Skills' will be assessed by 100% coursework. The coursework must consist of at least two class tests and one assignment.

K. Evaluation of Performance

1. The % mark at Level 1 contributes a 20% weighting towards the degree classification.
2. The % mark at Level 2 contributes a 30% weighting towards the degree classification.
3. The % mark at Level 3 contributes a 50% weighting towards the degree classification.

Module grading structure:

Grade	Marks x (%)
A	$70 \leq x$
B	$60 \leq x < 70$
C	$50 \leq x < 60$
D	$40 \leq x < 50$
F	$x < 40$
A-D	Pass
F	Fail

L. Award Classification

Overall weighted mark y (%)	Classification
$y \geq 70$	1st Class Honours
$60 \leq y < 70$	2nd Class 1st Division Honours
$50 \leq y < 60$	2nd Class 2nd Division Honours
$45 \leq y < 50$	3rd Class Honours
$40 \leq y < 45$	Pass Degree
$y < 40$	No Award

M. Programme Organisation and Management

Programme Director: Dr Aslam Aly E. F. SAIB

Contact Details:

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- Email: asaib@umail.utm.ac.mu

PART II -Programme Structure

N. BSc (Hons) Actuarial Science – Full Time (Version 1.5)

YEAR 1 (Level 1)							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L+T/P	Credits	Code	Modules	Hrs/Wk L+T/P	Credits
MATH 1305C	Calculus Fundamentals	2+1	3	MATH 1306C	Matrices and Multivariable Calculus	2+1	3
STAT 1215C	Probability and Statistics I	2+1	3	STAT 1216C	Probability and Statistics II	2+1	3
ECON 1101C	Microeconomics	2+1	3	ECON 1102C	Macroeconomics	2+1	3
ACCF 1101C	Accounting	2+1	3	QFIN 1207C	Actuarial Methods	2+2	4
COMM 1117C	Professionalism and Communication Skills	2+2	4	QFIN 1208C	Financial Mathematics	2+1	3
				COMP 1107C	Computing Concepts	2+2	4

YEAR 2 (Level 2)							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L+T/P	Credits	Code	Modules	Hrs/Wk L+T/P	Credits
STAT 2324C	Statistical Methods for Insurance	2+1	3	STAT 2330C	Time Series Analysis and Modelling	2+2	4
QFIN 1108C	Investment Mathematics	2+1	3	QFIN 2209C	Investment and Asset Analysis	2+1	3
STAT 2213C	Linear Models	2+1	3	QFIN 2109C	Corporate and Legal Finance	2+1	3
MATH 1324C	Calculus and Linear Algebra	2+1	3	QFIN 2110C	Financial Reporting	2+1	3
QFIN 2124C	Life Insurance Basics	2+1	3	QFIN 2119C	Contingencies 1	2+1	3
MATH 2325C	Numerical Analysis	2+2	4				

YEAR 3 (Level 3)							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L+T/P	Credits	Code	Modules	Hrs/Wk L+T/P	Credits
QFIN 3123C	Financial Economics I	2+1	3	QFIN 3122C	Financial Economics II	2+1	3
STAT 2332C	Stochastic Processes	2+1	3	STAT 3331C	Survival Analysis	2+2	4
QFIN 2120C	Contingencies 2	2+1	3	QFIN 3210C	Actuarial Risk Management	2+1	3
QFIN 3111C	General Insurance	2+1	3	QFIN 3121C/ STAT 3333C	Contingencies 3 or Data Mining Techniques	2+1	3
QFIN 3113C	Pension Funds	2+1	3				
PROJ 3112C	Dissertation						8

O. BSc (Hons) ACTUARIAL SCIENCE – Part Time (Version 1.5)

YEAR 1 (Level 1)							
Semester 1				**Semester 2**			
Code	Modules	Hrs/Wk L+T/P	Credits	Code	Modules	Hrs/Wk L+T/P	Credits
MATH 1305C	Calculus Fundamentals	2+1	3	MATH 1306C	Matrices and Multivariable Calculus	2+1	3
STAT 1215C	Probability and Statistics I	2+1	3	STAT 1216C	Probability and Statistics II	2+1	3
ECON 1101C	Microeconomics	2+1	3	ECON 1102C	Macroeconomics	2+1	3
ACCF 1101C	Accounting	2+1	3	COMM 1117C	Professionalism and Communication Skills	2+2	4

YEAR 2 (Level 1 and 2)							
Semester 1				**Semester 2**			
Code	Modules	Hrs/Wk L+T/P	Credits	Code	Modules	Hrs/Wk L+T/P	Credits
QFIN 1207C	Actuarial Methods	2+2	4	STAT 2324C	Statistical Methods for Insurance	2+1	3
QFIN 1208C	Financial Mathematics	2+1	3	QFIN 1108C	Investment Mathematics	2+1	3
COMP 1107C	Computing Concepts	2+2	4	STAT 2213C	Linear Models	2+1	3
				MATH 1324C	Calculus and Linear Algebra	2+1	3

YEAR 3 (Level 2)							
Semester 1				**Semester 2**			
Code	Modules	Hrs/Wk L+T/P	Credits	Code	Modules	Hrs/Wk L+T/P	Credits
QFIN 2124C	Life Insurance Basics	2+1	3	QFIN 2209C	Investment and Asset Analysis	2+1	3
MATH 2325C	Numerical Analysis	2+2	4	QFIN 2109C	Corporate and Legal Finance	2+1	3
STAT 2330C	Time Series Analysis and Modelling	2+2	4	QFIN 2110C	Financial Reporting	2+1	3
				QFIN 2119C	Contingencies 1	2+1	3

YEAR 4 (Level 3)							
Semester 1				**Semester 2**			
Code	Modules	Hrs/Wk L+T/P	Credits	Code	Modules	Hrs/Wk L+T/P	Credits
QFIN 3123C	Financial Economics I	2+1	3	QFIN 3122C	Financial Economics II	2+1	3
STAT 2332C	Stochastic Processes	2+1	3	QFIN 3111C	General Insurance	2+1	3
QFIN 2120C	Contingencies 2	2+1	3	STAT 3331C	Survival Analysis	2+2	4
QFIN 3113C	Pension Funds	2+1	3	PROJ 3112C	Dissertation		-

YEAR 5 (Level 3)			
Semester 1			
Code	Modules	Hrs/Wk L+T/P	Credits
QFIN 3210C	Actuarial Risk Management	2+1	3
QFIN 3121C/ STAT 3333C	Contingencies 3 or Data Mining Techniques	2+1	3
PROJ 3112C	Dissertation		8

P.   MODULE OUTLINE

MATH 1305C: CALCULUS FUNDAMENTALS
- Functions, limits, derivatives and Mean Value Theorem
- Differential Calculus: further differentiation of trigonometric and inverse trigonometric functions, Taylor's Theorem
- Indeterminate forms
- Hyperbolic functions
- First order differential equations: separable equations, homogeneous equations, integrating factors
- Linear ordinary differential equations of second and higher order
- Complex numbers
- Polar coordinates

STAT 1215C: PROBABILITY AND STATISTICS I
- Population and variates
- Measures of the centre of a set of observations
- Samples and populations
- The measure of variability
- Probability
- Probabilities of compound events
- Discrete and continuous random variables
- Expectation of random variables
- Conditional Expectation
- Joint distributions
- The normal distribution

ECON 1101C: MICROECONOMICS
- Basic concepts and principles of microeconomics
- Demand and supply
- Elasticity
- Utility theory
- Theory of cost and production
- Market structures & competition
- Analysis of factor markets
- Risk & insurance

ACCF 1101C: ACCOUNTING
- Basic principles of accounting
- The role of accounting standards
- Different types of business entity
- Basic structure of company accounts
- Interpretation and limitation of company accounts
- Principles of double entry book-keeping
- Preparation of financial statements: final account and cash flow as per IAS1

- Interpretation of financial statements
- Management information for decision making:
- Cost classification
- Cost control
- Budget and budgetary control
- Constructing flexible and cash budgets

COMM 1117C : PROFESSIONALISM AND COMMUNICATION SKILLS
Part I
- Characteristics and standards of a profession including the need for:
    - Specialized skill and education
    - Ongoing training and development
    - High quality of advice
    - Exercise of independent judgment
    - Objectivity, integrity and accountability
    - Code of conduct
- Discipline process
- Practice standards set by actuarial bodies and other stakeholders
- Regulatory roles of actuaries
- The professional role of the actuary
    - Analysis and resolution of ethical issues
    - Identifying and managing conflicts, misuse of or undue influence on advice
    - Nature of advice
    - The public interest

Part II
- Written Communication
    - Structures in report-writing, drafting of contracts and tender/marketing document, memoranda,
    - Specialised forms of writing: letter, editing and proof reading, minutes
    - Use of actuarial numerical examples for illustrations and better understanding
- Oral Communication
    - Spoken communication: introduction, speaker, effective speaking, public speaking, persuasive speaking
    - Accent neutralisation: correct pronunciations of English vowels, intonation
    - Listening as communication: skills for effective listening
    - Techniques for presentation, interviewing, Quantitative appraisal of documentation: FOG index

MATH 1306C: MATRICES AND MULTIVARIATE CALCULUS
- Matrices, Determinants, Inverse and Rank
- Solution of linear systems of equations
- Eigenvalues and eigenvectors
- Diagonalisation and the Cayley Hamilton Theorem
- Dot product, cross product, lines and planes.
- Directional derivatives, gradient, divergence, curl
- Polar, cylindrical and spherical coordinates
- Partial differentiation
- Multiple integrals and change of variables
- Green's Theorem, Stoke's Theorem and the Divergence Theorem

STAT 1216C: PROBABILITY AND STATISTICS II
- Estimation
- Confidence Intervals
- Data collection
- Significance testing
- Sampling distributions
- Hypothesis testing
- Correlation and regression
- The analysis of variance
- Data analysis

ECON 1102C: MACROECONOMICS
- Introduction to Macroeconomics
- Determinants and measurement of national income
- Macroeconomic dynamics, the multiplier effect, business cycle and economic growth
- Unemployment and inflation
- Fiscal and monetary policies
- Exchange rate and balance of payments
- International trade & finance

QFIN 1207C: ACTUARIAL METHODS
- Compound interest calculations
- Demography theory and techniques
- Pricing and operation of simple life insurance contract
- Interest rates and discount rates
- Equations of value and compound interest calculations
- Discounted cash flow
- Types of investment
- Concept of arbitrage
- Introduction to the term structure of interest rates
- Stochastic interest rate models.
- Spreadsheet skills in Finance and Actuarial methods

QFIN 1208C: FINANCIAL MATHEMATICS
- Generalized cash flow models
- Financial transactions
- Time value of money
- Interest rates and discount rates
- Annuities and derivations of compound interest functions
- Continuous payments
- Equation of value
- Loan repayments
- Project appraisal
- Arbitrage and forward/future contracts
- Financial derivatives
- Option pricing using binomial tress, Cox-Ross-Rubinstein models

COMP 1107C: COMPUTING CONCEPTS
- Programming using MATLAB
- Variables and constants
- Arrays and matrices
- Scripts
- The debugger
- Generating 2D and 3D Graphics
- Simple statistical analysis
- String manipulation
- Boolean logic and if statements
- Loops (while, for)
- Functions & Files
- Program design
- MATLAB structures
- Complexity
- Introduction to Excel and Latex

STAT 2324C: STATISTICAL METHODS FOR INSURANCE
- Decision theory
- Loss distributions
- Risk models (individual and collective)
- Ruin probabilities
- Bayesian Statistics and Bayesian estimators
- Rating
- Analysis of a delay triangle
- Simulation methods

QFIN 1108C: INVESTMENT MATHEMATICS
- Investment valuation
- Capital gains tax
- Real returns
- Index-linked bonds
- Yield curves
- Spot and forward interest rates
- Analysis of compound interest problems
- Stochastic interest rate models
- Immunization

STAT 2213C: LINEAR MODELS
- Bivariate data
- Simple regression model
- Least squares estimators and their properties
- Estimation of residual variance
- Inference from the linear model
- Multiple linear regression model
- Regression diagnostic
- One-way ANOVA model and assumptions
- Parameter estimation using least square methods
- ANOVA table and F ratio test
- Analysis of covariance
- Random effect models
- Generalised linear models
- Introduction to R programming

MATH 1324C: CALCULUS AND LINEAR ALGEBRA
- The Laplace transform
- The inverse Laplace transform
- Applications to differential equations
- Fourier series and integrals
- Vector spaces and subspaces
- Linear transformations
- Eigenvalues and eigenvectors.
- Inner products
- The Gram-Schmidt process
- Orthogonal transformations.

MATH 2325C: NUMERICAL ANALYSIS
- Nonlinear equations
- System of linear equations
- Interpolation and spline
- Numerical differentiation
- Numerical integration and quadrature
- Initial value problems for ordinary differential equations
- Finite difference method for boundary value problems
- Monte Carlo methods

STAT 2330C: TIME SERIES ANALYSIS AND MODELLING
- Stationary time series
- ARIMA models
- Forecasting
- Model identification
- Parameter estimation
- Intervention analysis
- Testing for trends and unit roots
- ARCH and GARCH models
- Spectral analysis
- Modelling: Model structures, Selection process, Calibration, Validation, Scenario setting, Sensitivity testing, Limitations, Computer applications of modelling, Documentation and audit trail

QFIN 2209C: INVESTMENT AND ASSET ANALYSIS
- Types of investment (bonds, shares, property and derivatives)
- Valuation of investments
- Portfolio selection - incorporating assessment of relative value
- Performance measurement
- Portfolio management
- Management of investments with respect to liabilities using techniques such as immunisation, asset-liability management and liability driven investment.

QFIN 2109C: CORPORATE AND LEGAL FINANCE
- Concept of Shareholders' wealth
- Capital markets
- Valuation of securities
- Risk and return
- Dividend policy and dividend valuation model
- Efficient market hypothesis
- Capital asset pricing model
- Interpretation of financial statements
- Capital structure
- Investment fundamentals
- Negotiable instruments: distinction between assignability and negotiability, bills of exchange, cheques, promising notes, bankruptcy, receivership, liquidity.

QFIN 2110C: FINANCIAL REPORTING
- The problems of profit measurement and the effect of alternative approaches to asset valuation; current cost and current purchasing power bases and the real terms system; accounting for changing prices and hyperinflation .
- The principle of substance over form and its influence in dealing with transactions such as sale and repurchase agreements, debt factoring, securitized assets, loan transfers, consignment stock and public- and private-sector financial collaboration.
- The accounting treatment of goodwill, intangible and tangible assets.
- Impairment of non–current assets, including brands and goodwill.
- Capitalization of interest and discounting.
- Provisions and contingencies
- Financial instruments classified as liabilities or shareholders' funds and the allocation of finance cost over the term of the borrowing
- The measurement and disclosure of financial instruments

QFIN 2119C: CONTINGENCIES 1
- Simple insurance and annuity contracts
- Practical methods of evaluating expected values and variances of simple contracts
- Describe and calculate net premiums and net premium reserves of simple insurance contracts using ultimate or select mortality

- Describe the calculation of net premiums and net premium reserves for increasing and decreasing benefits and annuities using ultimate or select mortality
- Calculating net premium based on increases or decreases by constant compound rate and monetary amount

QFIN 2120C: CONTINGENCIES 2
- Calculate net premiums and net premium reserves under profits contracts
- Calculation of Gross premiums and reserves of assurance and annuity contracts
- Define and use straightforward functions involving two lives
- Contingent and reversionary benefits

QFIN 3123C: FINANCIAL ECONOMICS I
- Measures of investment risk
- Mean-variance portfolio theory
- Single and multifactor models of asset returns
- Asset pricing models
- Efficient markets hypothesis
- Stochastic models of the behaviour of security prices
- Properties of option prices, valuation methods and hedging techniques

QFIN 3122C: FINANCIAL ECONOMICS II
- Simple models for credit risk
- Modigliani-Miller theorems on capital structure
- MM with taxes, formal derivation of required rates of return
- MM with personal taxes. Myer's debt overhang problem
- Agency costs of equity and debt: Fringe benefits, Risk shifting, debt & effort
- Initial public offerings
- Mergers and acquisitions

STAT 2332C: STOCHASTIC PROCESSES
- Probability Theory
- Markov Chains
- Random Walk Models
- Poisson Process
- Brownian Motion
- Birth-and-death process
- Branching process
- Renewal Process

QFIN 2124C: LIFE INSURANCE BASICS
- Types of life insurance products
- Profits distribution with profits policyholders
- Technique of asset shares
- Effect of general business environment
- Roles of reinsurance and underwriting and Managing risks
- Actuarial models for decision making
- Unit-linked life insurance contracts
- Evaluation of cost of guarantees and options
- Supervisory reserves
- Principles of investment
- Design of life insurance contracts
- Monitoring and assessment of the experience of a life insurance company
- Pricing of life insurance contracts

STAT 3331C: SURVIVAL ANALYSIS

- Principles of actuarial modelling
- Estimation procedures for lifetime distributions
- Statistical models of transfer between multiple states
- Probabilities of transfer and transition intensities
- Maximum likelihood estimators for the transition intensities
- Binomial model of mortality
- Maximum likelihood estimator for the probability of death
- Estimation of transition intensities
- Graduation Testing
- Use of software (R or SPSS) for survival analysis and simulations

QFIN 3111C: GENERAL INSURANCE

- Types of general insurance products
- Types of general reinsurance products
- Adjustment coefficient and Lundberg's inequality
- Risk and uncertainty in general insurance business
- Data quality
- Empirical approach to credibility theory
- Reserving bases for general insurance business

QFIN 3210C: ACTUARIAL RISK MANAGEMENT

- Assessment of risks; risk types and risk measures
- Design and development of products and/or services
- Pricing of products and services and assumptions underlying the pricing
- Reserving and valuation of liabilities
- Management of risks and methods of reducing risk exposure, such as reinsurance
- Management of the relationships between assets and liabilities
- Monitoring the experience and exposure to risk
- Solvency and profitability of the enterprise and the management of capital
- Principles of regulation of financial institutions

QFIN 3113C: PENSION FUNDS

- Provision of pension funds
- Systems of social security, individual accounts, occupational pension schemes and personal pensions
- Issues surrounding sponsor covenant
- Population projection

QFIN 3121C: CONTINGENCIES 3

- Methods for modelling cash flows contingent upon competing risks
- Technique of discounted emerging costs
- Multiple decrement tables
- Principal forms of heterogeneity within a population

STAT 3333C: DATA MINING TECHNIQUES

- Data preparation
- Association rules
- Classification and regression trees
- Cluster analysis
- Classical statistical models
- Non-linear models such as neural networks
- Applications in insurance

PROJ 3112C: DISSERTATION

Dissertation guidelines will be given in the Dissertation Handbook