University of Pretoria Yearbook 2023

BScHons (Mathematics of Finance) (02240276)

Department	Mathematics and Applied Mathematics
Minimum duration of study	1 year
Total credits	135
NQF level	08

Admission requirements

1. Relevant bachelor's degree
2. At least 60% for all mathematics and applied mathematics modules at final-year level
3. A minimum of 60% for each of the following subjects/modules (or equivalent):

- Real analysis at final-year level
- Linear algebra at second-year level

Promotion to next study year

The progress of all honours candidates is monitored biannually by the postgraduate coordinator/head of department. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

General information

University of Pretoria Programme Qualification Mix (PQM) verification project

The higher education sector has undergone an extensive alignment to the Higher Education Qualification Sub-Framework (HEQF) across all institutions in South Africa. In order to comply with the HEQSF, all institutions are legally required to participate in a national initiative led by regulatory bodies such as the Department of Higher Education and Training (DHET), the Council on Higher Education (CHE), and the South African Qualifications Authority (SAQA). The University of Pretoria is presently engaged in an ongoing effort to align its qualifications and programmes with the HEQSF criteria. Current and prospective students should take note that changes to UP qualification and programme names, may occur as a result of the HEQSF initiative. Students are advised to contact their faculties if they have any questions.

Curriculum: Final year

Minimum credits: 135

Core credits: 120
Elective credits: 15

Additional information:

- WTW 732 and WTW 762 are presented as weekly lectures together with some extra block lectures.
- Students must select either WTW 792 or WTW 795

Core modules

Functional analysis 710 (WTW 710)

Module credits	15.00
NQF Level	08
Prerequisites	Real analysis on third-year level
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

An introduction to the basic mathematical objects of linear functional analysis will be presented. These include metric spaces, Hilbert spaces and Banach spaces. Subspaces, linear operators and functionals will be discussed in detail. The fundamental theorems for normed spaces: The Hahn-Banach theorem, Banach-Steinhaus theorem, open mapping theorem and closed graph theorem. Hilbert space theory: Riesz' theorem, the basics of projections and orthonormal sets.

Mathematical models of financial engineering 732 (WTW 732)

Module credits	15.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

Introduction to markets and instruments. Futures and options trading strategies, exotic options, arbitrage relationships, binomial option pricing method, mean variance hedging, volatility and the Greeks, volatility smiles, Black-Scholes PDE and solutions, derivative disasters.

Numerical analysis 733 (WTW 733)

Module credits	15.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

An analysis as well as an implementation (including computer programs) of methods are covered. Numerical linear algebra: Direct and iterative methods for linear systems and matrix eigenvalue problems: Iterative methods for nonlinear systems of equations. Finite difference method for partial differential equations: Linear elliptic, parabolic, hyperbolic and eigenvalue problems. Introduction to nonlinear problems. Numerical stability, error estimates and convergence are dealt with.

Measure theory and probability 734 (WTW 734)

Module credits	15.00
NQF Level	08
Prerequisites	Real analysis on third-year level
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

Measure and integration theory: The Caratheodory extension procedure for measures defined on a ring, measurable functions, integration with respect to a measure on a σ-ring, in particular the Lebesgue integral, convergence theorems and Fubini's theorem.
Probability theory: Measure theoretic modelling, random variables, expectation values and independence, the Borel-Cantelli lemmas, the law of large numbers. L^1-theory, L^2-theory and the geometry of Hilbert space, Fourier series and the Fourier transform as an operator on L^2, applications of Fourier analysis to random walks, the central limit theorem.

Mathematical models of financial engineering 762 (WTW 762)

Module credits	15.00
NQF Level	08
Prerequisites	WTW 732 or WTW 364
Contact time	2 lectures per week

Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

Exotic options, arbitrage relationships, Black-Scholes PDE and solutions, hedging and the Miller-Modigliani theory, static hedging, numerical methods, interest rate derivatives, BDT model, Vasicek and Hull-White models, complete markets, stochastic differential equations, equivalent Martingale measures.

Stochastic calculus 764 (WTW 764)

Module credits	15.00
NQF Level	08
Prerequisites	WTW 734 or WTW 735
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

Mathematical modelling of Random walk. Conditional expectation and Martingales. Brownian motion and other Lévy processes. Stochastic integration. Ito's Lemma. Stochastic differential equations. Application to finance.

Project 792 (WTW 792)

Module credits	30.00
NQF Level	08
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Year

Module content

Consult Department.

Project 795 (WTW 795)

Module credits	30.00
NQF Level	08
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics

Period of presentation	Year

Module content

Consult Department.

Elective modules

Linear models 710 (LMO 710)

Module credits	15.00
NQF Level	08
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistic
Contact time	1 lecture per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1

Module content

Projection matrices and sums of squares of linear sets. Estimation and the Gauss-Markov theorem. Generalised t- and F- tests.

Linear models 720 (LMO 720)

Module credits	15.00
NQF Level	08
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	LMO 710
Contact time	1 lecture per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

The singular normal distribution. Distributions of quadratic forms. The general linear model. Multiple comparisons. Analysis of covariance. Generalised linear models. Analysis of categorical data.

Multivariate analysis 710 (MVA 710)

Module credits	15.00
NQF Level	08
Service modules	Faculty of Natural and Agricultural Sciences

Prerequisites	Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics
Contact time	1 lecture per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

Matrix algebra. Some multivariate measures. Visualising multivariate data. Multivariate distributions. Samples from multivariate normal populations. The Wishart distribution. Hotelling's T^2 statistic. Inferences about mean vectors.

Multivariate analysis 720 (MVA 720)

Module credits	15.00
NQF Level	08
Service modules	Faculty of Health Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	MVA 710
Contact time	1 lecture per week
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 2

Module content

Discriminant analysis and classification. Principal component analysis. The biplot. Multidimensional scaling. Factor analysis. Probabilistic clustering.

Special topics 727 (WTW 727)

Module credits	15.00
NQF Level	08
Prerequisites	As required by specific topical content.
Contact time	1 lecture per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

A selection of special topics will be presented that reflects the expertise of researchers in the Department. The presentation of a specific topic is contingent on student numbers. Consult the website of the Department of Mathematics and Applied Mathematics for more details.

Mathematical optimisation 750 (WTW 750)

Module credits	15.00
NQF Level	08
Prerequisites	Multivariate Calculus on 2nd-year level; Linear Algebra on 2nd-year level
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 1

Module content

Classical optimisation: Necessary and sufficient conditions for local minima. Equality constraints and Lagrange multipliers. Inequality constraints and the Kuhn-Tucker conditions. Application of saddle point theorems to the solutions of the dual problem. One-dimensional search techniques. Gradient methods for unconstrained optimisation. Quadratically terminating search algorithms. The conjugate gradient method. Fletcher-Reeves. Second order variable metric methods: DFP and BFCS. Boundary following and penalty function methods for constrained problems. Modern multiplier methods and sequential quadratic programming methods. Practical design optimisation project.

Finite element method 763 (WTW 763)

Module credits	15.00
NQF Level	08
Prerequisites	WTW 733 is strongly recommended
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

An analysis as well as an implementation (including computer programs) of methods is covered. Introduction to the theory of Sobolev spaces. Variational and weak formulation of elliptic, parabolic, hyperbolic and eigenvalue problems. Finite element approximation of problems in variational form, interpolation theory in Sobolev spaces, convergence and error estimates.

Mathematical methods and models 772 (WTW 772)

Module credits	15.00
NQF Level	08
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Module is presented in English

Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

This module aims at using advanced undergraduate mathematics and rigorously applying mathematical methods to concrete problems in various areas of natural science and engineering.
The module will be taught by several lecturers from UP, industry and public sector. The content of the module may vary from year to year and is determined by relevant focus areas within the Department. The list of areas from which topics to be covered will be selected, includes: Systems of differential equations; dynamical systems; discrete structures; Fourier analysis; methods of optimisation; numerical methods; mathematical models in biology, finance, physics, etc.

Partial differential equations of mathematical physics 776 (WTW 776)

Module credits	15.00
NQF Level	08
Prerequisites	WTW 710 or WTW 735
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Mathematics and Applied Mathematics
Period of presentation	Semester 2

Module content

Field-theoretic and material models of mathematical physics. The Friedrichs-Sobolev spaces. Energy methods and Hilbert spaces, weak solutions – existence and uniqueness. Separation of variables, Laplace transform, eigenvalue problems and eigenfunction expansions. The regularity theorems for elliptic forms (without proofs) and their applications. Weak solutions for the heat/diffusion and related equations.

Regulations and rules

The regulations and rules for the degrees published here are subject to change and may be amended after the publication of this information.

The General Academic Regulations (G Regulations) and General Student Rules apply to all faculties and registered students of the University, as well as all prospective students who have accepted an offer of a place at the University of Pretoria. On registering for a programme, the student bears the responsibility of ensuring that they familiarise themselves with the General Academic Regulations applicable to their registration, as well as the relevant faculty-specific and programme-specific regulations and information as stipulated in the relevant yearbook. Ignorance concerning these regulations will not be accepted as an excuse for any transgression, or basis for an exception to any of the aforementioned regulations.

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