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# University of Pretoria Yearbook 2017

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## BScHons Financial Engineering (02240277)

**Duration of study** 1 year

**Total credits** 135

### Programme information

#### Renewal of registration

- i. Subject to exceptions approved by the Dean, on the recommendation of the head of department, and in the case of distance education where the Dean formulates the stipulations that will apply, a student may not sit for an examination for the honours degree more than twice in the same module.
- ii. A student for an honours degree must complete his or her study, in the case of full-time students, within two years and, in the case of after-hours students, within three years of first registering for the degree and, in the case of distance education students, within the period stipulated by the Dean. Under special circumstances, the Dean, on the recommendation of the head of department, may give approval for a limited extension of this period.

In calculating marks, General Regulation G.12.2 applies.

Apart from the prescribed coursework, a research project is an integral part of the study.

### Admission requirements

An appropriate bachelor's degree with a minimum of 60% for all modules on third-year level. In the selection procedure the candidates complete undergraduate academic record will be considered. In particular, it is required that the candidate has completed Calculus, Differential equations and Linear algebra on second-year level (each with a mark of at least 60%).

### 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.

### Pass with distinction

The BScHons degree is awarded with distinction to a candidate who obtains a weighted average of at least 75% in all the prescribed modules and a minimum of 65% in any one module.



## Curriculum: Final year

**Minimum credits: 135**

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Core credits: 91

Elective credits: 44

**The Postgraduate Coordinator has to approve the final programme composition for this programme.**

1. Students who have included Statistics, Mathematical Statistics or Industrial Engineering in their undergraduate degree programme, will not be allowed to take BAN 780. Additional modules from the list of electives should be included in the programme composition.
2. Lectures for BAN 780 and ISE 780 are scheduled in “blocks” - consult the relevant departments at the Faculty of Engineering, Built Environment and Information Technology.
3. WTW 732 and WTW 762 will be presented weekly as well as some extra “block” lectures.
4. TRA 720 not allowed for students who have already passed the UP module WST 321 (or equivalent) at undergraduate level.

### Core modules

#### Industrial analysis 780 (BAN 780)

**Module credits** 16.00

**Service modules** Faculty of Natural and Agricultural Sciences

**Prerequisites** Not for Industrial Engineering students

**Contact time** 24 contact hours per semester

**Language of tuition** Module is presented in English

**Academic organisation** Industrial and Systems Eng

**Period of presentation** Semester 1 or Semester 2

#### Module content

- Monte Carlo Simulation
- Continuous Simulation
- System Dynamics
- Multi-objective Decision-making
- Operations Research
- Decision Analysis
- Discrete Simulation

#### Mathematical models of financial engineering 732 (WTW 732)

**Module credits** 15.00

**Prerequisites** No prerequisites.

**Contact time** 2 lectures per week

**Language of tuition** Module is presented in English



**Academic organisation** Mathematics and Applied Maths

**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.

**Mathematical models of financial engineering 762 (WTW 762)**

**Module credits** 15.00

**Prerequisites** WTW 732 or WTW 364

**Contact time** 2 lectures per week

**Language of tuition** Module is presented in English

**Academic organisation** Mathematics and Applied Maths

**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.

**Project 792 (WTW 792)**

**Module credits** 30.00

**Prerequisites** No prerequisites.

**Language of tuition** Module is presented in English

**Academic organisation** Mathematics and Applied Maths

**Period of presentation** Year

**Module content**

Consult Department.

**Mathematical optimisation 750 (WTW 750)**

**Module credits** 15.00

**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

**Academic organisation** Mathematics and Applied Maths

**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 BFGS. Boundary following and penalty function methods for constrained problems. Modern multiplier methods and sequential quadratic programming methods. Practical design optimisation project.

## Elective modules

### Systems thinking 780 (ISE 780)

<b>Module credits</b>	16.00
<b>Service modules</b>	Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	20 contact hours per semester
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Engineering and Technology Mgt
<b>Period of presentation</b>	Semester 1 and Semester 2

## Module content

The modern world is made up of “systems”. This is evident from everyday discussions amongst even the general public. Statements such as “The system failed us”, or “The national energy system is under pressure” abound. Unfortunately most people have little or no understanding what a system is, or how to deal with it. Digging deeper into the concept of “system” leads one to realise that engineers and scientists without any working knowledge of “systems thinking” cannot succeed when attempting to solve complex problems. The module will equip students with the ability to solve problems from a “whole”, “big picture” or holistic perspective. Students will develop a range of critical skills allowing them to successfully function in a complex world made up of many interrelated systems. The module will also provide students with an overview of systems engineering resulting from systems thinking, including the requisite tools and processes. This module will challenge much about a students’ work environment, but it also will be unlike any other module a student has ever completed, mostly presented independent of any traditional engineering discipline.

### Linear models 710 (LMO 710)

<b>Module credits</b>	15.00
<b>Service modules</b>	Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	WST 311, WST 312, WST 321 and WST 322
<b>Contact time</b>	1 lecture per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Statistics
<b>Period of presentation</b>	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

**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

**Academic organisation** 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

**Service modules** Faculty of Health Sciences

**Prerequisites** WST 311, WST 312, WST 321 and WST 322

**Contact time** 1 lecture per week

**Language of tuition** Module is presented in English

**Academic organisation** Statistics

**Period of presentation** Semester 1

### 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

**Service modules** Faculty of Natural and Agricultural Sciences

**Prerequisites** MVA 710

**Contact time** 1 lecture per week

**Language of tuition** Module is presented in English

**Academic organisation** Statistics

**Period of presentation** Semester 2



## Module content

The matrix normal distribution, correlation structures and inference of covariance matrices. Discriminant analysis. Principal component analysis. The biplot. Multidimensional scaling. Exploratory factor analysis. Confirmatory Factor analysis and structural equation models.

### Analysis of time series 720 (TRA 720)

**Module credits** 15.00

**Service modules** Faculty of Natural and Agricultural Sciences

**Prerequisites** STK 310 and STK 320

**Contact time** 1 lecture per week

**Language of tuition** Module is presented in English

**Academic organisation** Statistics

**Period of presentation** Semester 2

## Module content

In this module certain basic topics relating to discrete, equally spaced stationary and non-stationary time series are introduced as well as the identification, estimation and testing of time series models and forecasting. Theoretical results are compared to corresponding results obtained from computer simulated time series.

### Modern portfolio theory 712 (WTW 712)

**Module credits** 15.00

**Prerequisites** Enrolment for WTW 732 required.

**Contact time** 1 lecture per week

**Language of tuition** Module is presented in English

**Academic organisation** Mathematics and Applied Maths

**Period of presentation** Year

## Module content

An introduction to Markowitz portfolio theory and the capital asset pricing model. Analysis of the deficiencies in these methods. Sensitivity based risk management. Standard methods for Value-at-Risk calculations. RiskMetrics, delta-normal methods, Monte Carlo simulations, back and stress testing.

### Numerical analysis 733 (WTW 733)

**Module credits** 15.00

**Prerequisites** No prerequisites.

**Contact time** 2 lectures per week

**Language of tuition** Module is presented in English

**Academic organisation** Mathematics and Applied Maths

**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.

## Finite element method 763 (WTW 763)

<b>Module credits</b>	15.00
<b>Prerequisites</b>	WTW 733 is strongly recommended
<b>Contact time</b>	2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Mathematics and Applied Maths
<b>Period of presentation</b>	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.

## Main principles of analysis in application 735 (WTW 735)

<b>Module credits</b>	15.00
<b>Prerequisites</b>	Calculus at 2nd-year level (eg WTW 218) and one 3rd-year level module on analysis or applications of analysis (eg WTW 310, WTW 382, WTW 383 or WTW 386)
<b>Contact time</b>	2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Academic organisation</b>	Mathematics and Applied Maths
<b>Period of presentation</b>	Semester 1

## Module content

Study of main principles of analysis in the context of their applications to modelling, differential equations and numerical computation. Specific principles to be considered are those related to mathematical biology, continuum mechanics and mathematical physics as presented in the modules WTW 772, WTW 787 and WTW 776, respectively.

The information published here is subject to change and may be amended after the publication of this information. The [General Regulations \(G Regulations\)](#) apply to all faculties of the University of Pretoria. It is expected of students to familiarise themselves well with these regulations as well as with the information contained in the [General Rules](#) section. Ignorance concerning these regulations and rules will not be accepted as an excuse for any transgression.