BScHons Financial Engineering (02240277)

Minimum 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 BSc or 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 Ccalculus, Ddifferential equations and Llinear algebra on second-year level each with a mark of at least 60% (UP modules WTW 218, WTW 264 / WTW 286 and WTW 211 / WTW 221).

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
Department	Industrial and Systems Engineering
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

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.

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
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.

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
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.

Project 792 (WTW 792)

Module credits	30.00
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

Systems thinking and engineering 780 (ISE 780)

Module credits	16.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	No prerequisites.
Contact time	20 contact hours per semester
Language of tuition	Module is presented in English
Department	Engineering and Technology Management
Period of presentation	Semester 1 and Semester 2

Module content

A company's ability to remain competitive in modern times hinges increasingly on its ability to perform systems engineering. The technology and complexity of a company's products appears to steadily increase and with it, the risks that need to be managed. This module provides specialised knowledge to apply systems engineering by understanding the tools, processes and management fundamentals.

Linear models 710 (LMO 710)

Module credits	15.00
Service modules	Faculty of Natural and Agricultural 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
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
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
Service modules	Faculty of Health Sciences
Prerequisites	WST 311, WST 312, WST 321and WST 322
Contact time	1 lecture per week
Language of tuition	Module is presented in English
Department	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 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

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
Department	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
Department	Mathematics and Applied Mathematics
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
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.

Main principles of analysis in application 735 (WTW 735)

Module credits	15.00
Prerequisites	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)
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

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.

Finite element method 763 (WTW 763)

Module credits	15.00
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.