University of Pretoria Yearbook 2017

BSc Mathematical Statistics (02133274)

Duration of study	3 years
Total credits	428

Admission requirements

- The following persons will be considered for admission: a candidate who is in possession of a certificate that is deemed by the University to be equivalent to the required Grade 12 certificate with university endorsement; a candidate who is a graduate from another tertiary institution or has been granted the status of a graduate of such an institution; and a candidate who is a graduate of another faculty at the University of Pretoria.
- Life Orientation is excluded in the calculation of the Admission Point Score (APS).
- Grade 11 results are used for the provisional admission of prospective students. Final admission is based on the Grade 12 results.

Minimum requirements								
Achievement level								
Afrikaans or English				**Mathematics**				**APS**
NSC/IEB	HIGCSE	AS-Level	A-Level	NSC/IEB	HIGCSE	AS-Level	A-Level	
5	3	C	C	6	2	B	B	32

Candidates who do not comply with the minimum admission requirements for BSc (Mathematical Statistics), may be considered for admission to the BSc – Extended programme for Mathematical Sciences. The BSc – Extended programme takes place over a period of four years instead of the normal three years.

BSc - Extended programme for Mathematical Sciences:

Minimum requirements									
Achievement level									
	Afrikaans or English				**Mathematics**				**APS**
	NSC/IEB	HIGCSE	AS-Level	A-Level	NSC/IEB	HIGCSE	AS-Level	A-Level	
BSc – Extended programme for Mathematical Sciences	4	3	D	D	5	3	C	C	26

Other programme-specific information

A student must pass all the minimum prescribed and elective module credits as set out at the end of each year within a programme as well as the total required credits to comply with the particular degree programme. Please refer to the curricula of the respective programmes. At least 144 credits must be obtained at 300-/400-level, or otherwise as indicated by curriculum. The minimum module credits needed to comply with degree requirements

is set out at the end of each study programme. Subject to the programmes as indicated a maximum of 150 credits will be recognised at 100-level. A student may, in consultation with the Head of Department and subject to the permission by the Dean, select or replace prescribed module credits not indicated in BSc three-year study programmes to the equivalent of a maximum of 36 module credits.

It is important that the total number of prescribed module credits is completed during the course of the study programme. The Dean may, on the recommendation of the Head of Department, approve deviations in this regard. Subject to the programmes as indicated in the respective curricula, a student may not register for more than 75 module credits per semester at first-year level subject to permission by the Dean. A student may be permitted to register for up to 80 module credits in a the first semester during the first year provided that he or she obtained a final mark of no less than 70% for grade 12 Mathematics and achieved an APS of 34 or more in the NSC.

Students who are already in possession of a bachelor's degree, will not receive credit for modules of which the content overlap with modules from the degree that was already conferred. Credits will not be considered for more than half the credits passed previously for an uncompleted degree. No credits at the final-year or 300- and 400-level will be granted.

The Dean may, on the recommendation of the programme manager, approve deviations with regard to the composition of the study programme.

Please note: Where elective modules are not specified, these may be chosen from any modules appearing in the list of modules.

It remains the student's responsibility to acertain, prior to registration, whether they comply with the prerequisites of the modules they want to register for.

The prerequisites are listed in the Alphabetical list of modules.

Promotion to next study year

A student will be promoted to the following year of study if he or she passed 100 credits of the prescribed credits for a year of study, unless the Dean on the recommendation of the head of department decides otherwise. A student who does not comply with the requirements for promotion to the following year of study, retains the credit for the modules already passed and may be admitted by the Dean, on recommendation of the head of department, to modules of the following year of study to a maximum of 48 credits, provided that it will fit in with both the lecture and examination timetable.

General promotion requirements in the faculty

All students whose academic progress is not acceptable can be suspended from further studies.

- A student who is excluded from further studies in terms of the stipulations of the abovementioned regulations, will be notified in writing by the Dean or Admissions Committee at the end of the relevant semester.
- A student who has been excluded from further studies may apply in writing to the Admissions Committee of the Faculty of Natural and Agricultural Sciences for re-admission.
- Should the student be re-admitted by the Admissions Committee, strict conditions will be set which the student must comply with in order to proceed with his/her studies.
- Should the student not be re-admitted to further studies by the Admissions Committee, he/she will be informed in writing.

- Students who are not re-admitted by the Admissions Committee have the right to appeal to the Senior Appeals Committee.
- Any decision taken by the Senior Appeals Committee is final.

Pass with distinction

A student obtains his or her degree with distinction if all prescribed modules at 300-level (or higher) are passed in one academic year with a weighted average of at least 75%, and obtain at least a subminimum of 65% in each of the relevant modules.

Curriculum: Year 1

Minimum credits: 140

Minimum credits:

Fundamental = 12

Core = 64

Elective = 65

Additional information:

Students who do not qualify for AIM 102 must register for AIM 111 and AIM 121.

It is recommended that COS 132 be taken as a first-year elective by all students in this programme.

Additional electives should be chosen as follows:

Students in Mathematical Statistics who also want to be trained for the Mathematics industry normally choose from WTW 123 (8), 115 (8), 152 (8), 162 (8) and COS 110 (16)

Students in Mathematical Statistics who also want to be trained for the Insurance industry, Econometrics, normally choose:

EKN 113, 123 (30), FBS 110, 120 (20) or FBS 112, 122 (20) and COS 110 (16)

Students in Mathematical Statistics with other career requirements, choose modules from any other subject/faculty to meet their specific needs.

Fundamental modules

Academic information management 111 (AIM 111)

Module credits	4.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities Faculty of Law Faculty of Health Sciences Faculty of Natural and Agricultural Sciences Faculty of Theology
Prerequisites	No prerequisites.
Contact time	MAMELODI, 2 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Information Science
Period of presentation	Semester 1

Module content

Find, evaluate, process, manage and present information resources for academic purposes using appropriate technology.

Academic information management 121 (AIM 121)

Module credits	4.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities Faculty of Law Faculty of Health Sciences Faculty of Natural and Agricultural Sciences Faculty of Theology Faculty of Veterinary Science
Prerequisites	No prerequisites.
Contact time	2 lectures per week, MAMELODI
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Informatics
Period of presentation	Semester 2

Module content

Apply effective search strategies in different technological environments. Demonstrate the ethical and fair use of information resources. Integrate 21st-century communications into the management of academic information.

Language and study skills 110 (LST 110)

Module credits	6.00
Service modules	Faculty of Natural and Agricultural Sciences Faculty of Veterinary Science
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Unit for Academic Literacy
Period of presentation	Semester 1

Module content

The module aims to equip students with the ability to cope with the reading and writing demands of scientific disciplines.

Academic orientation 102 (UPO 102)

Module credits	0.00
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Natural + Agric Sciences Dean
Period of presentation	Year

Academic information management 102 (AIM 102)

Module credits	6.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities Faculty of Law Faculty of Health Sciences Faculty of Natural and Agricultural Sciences Faculty of Theology Faculty of Veterinary Science
Contact time	2 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Information Science
Period of presentation	Semester 2

Module content

Find, evaluate, process, manage and present information resources for academic purposes using appropriate technology. Apply effective search strategies in different technological environments. Demonstrate the ethical and fair use of information resources. Integrate 21st-century communications into the management of academic information.

Core modules

Mathematical statistics 111 (WST 111)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	At least 5 (60-69%) in Mathematics in the Grade 12 examination
Contact time	4 lectures per week, 1 practical per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Statistics
Period of presentation	Semester 1

Module content

Characterisation of a set of measurements: Graphical and numerical methods. Random sampling. Probability theory. Discrete and continuous random variables. Probability distributions. Generating functions and moments.

Mathematical statistics 121 (WST 121)

Module credits	16.00

Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 111 GS or WST 133, 143 and 153
Contact time	1 practical per week, 4 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Statistics
Period of presentation	Semester 2

Module content

Sampling distributions and the central limit theorem. Statistical inference: Point and interval estimation. Hypothesis testing with applications in one and two-sample cases. Introductory methods for: Linear regression and correlation, analysis of variance, categorical data analysis and non-parametric statistics. Identification, use, evaluation and interpretation of statistical computer packages and statistical techniques.

Calculus 114 (WTW 114)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	Refer to Regulation 1.2. Mathematics 60% Grade 12.
Contact time	1 tutorial per week, 4 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

*This module serves as preparation for students majoring in Mathematics (including all students who intend to enrol for WTW 218 and WTW 220). Students will not be credited for more than one of the following modules for their degree: WTW 114, WTW 158, WTW 134, WTW 165.
Functions, limits and continuity. Differential calculus of single variable functions, rate of change, graph sketching, applications. The mean value theorem, the rule of L'Hospital. Definite and indefinite integrals, evaluating definite integrals using anti-derivatives, the substitution rule.

Mathematics 124 (WTW 124)

Module credits	16.00
Prerequisites	WTW 114
Contact time	4 lectures per week, 1 tutorial per week
Language of tuition	Separate classes for Afrikaans and English

Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

*Students will not be credited for more than one of the following modules for their degree:
WTW 124, WTW 146, WTW 148 and WTW 164. This module serves as preparation for students majoring in Mathematics (including all students who intend to enrol for WTW 218, WTW 211 and WTW 220).

The vector space Rn, vector algebra with applications to lines and planes, matrix algebra, systems of linear equations, determinants. Complex numbers and factorisation of polynomials. Integration techniques and applications of integration. The formal definition of a limit. The fundamental theorem of Calculus and applications. Vector functions, polar curves and quadratic curves.

Elective modules

Program design: Introduction 110 (COS 110)

Module credits	16.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	COS 132 , COS 151 and Maths level 5
Contact time	1 tutorial per week, 1 practical per week, 3 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Computer Science
Period of presentation	Semester 2

Module content

The focus is on object-oriented (OO) programming. Concepts including inheritance and multiple inheritance, polymorphism, operator overloading, memory management (static and dynamic binding), interfaces, encapsulation, reuse, etc. will be covered in the module. The module teaches sound program design with the emphasis on modular code, leading to well structured, robust and documented programs. A modern OO programming language is used as the vehicle to develop these skills. The module will introduce the student to basic data structures, lists, stacks and queues.

Introduction to computer science 151 (COS 151)

Module credits	8.00
Service modules	Faculty of Education Faculty of Natural and Agricultural Sciences
Prerequisites	APS of 30 and level 5 (60-69%) Mathematics.
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Computer Science

Period of presentation	Semester 1

Module content

This module introduces concepts and terminology related to the computer science discipline. General topics covered include the history of computing, machine level representation of data, Boolean logic and gates, basic computer systems organisation, algorithms and complexity and automata theory. The module also introduces some of the subdisciplines of computer science, such as computer networks, database systems, compilers, information security and intelligent systems. The module also focues on modelling of algorithms.

Economics 113 (EKN 113)

Module credits	15.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	Reg. 1.2 (e)
Contact time	3 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Economics
Period of presentation	Semester 1

Module content

Introduction to economics and principles of microeconomics
The scope of economics; the basic theory of demand and supply; price, income and cross elasticity of demand; consumer utility, the utility function and case studies in terms of the utility function; the theory of the firm in the short and long run; market structures, namely the perfect market, monopoly, oligopoly and monopolistic competition; public sector finances; microeconomics versus macroeconomics and economic statistics.

Economics 123 (EKN 123)

Module credits	15.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	Reg. 1.2 (e); EKN 113 GS
Contact time	3 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Economics
Period of presentation	Semester 2

Module content

National income and principles of macroeconomics
The mechanics of national income accounts, the Keynesian macroeconomic model, the money market, demand for money and money supply, money and credit creation and the role of the monetary authorities. The IS-LM model of macroeconomic equilibrium and monetary and fiscal policy applications. The aggregate demand and supply models with the debate between the classical school, the monetarists and the Keynesian school. The problems of inflation and unemployment. Macroeconomic issues, namely macroeconomic policy, international trade, the balance of payments and economic growth.

Financial management 110 (FBS 110)

Module credits	10.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences
Prerequisites	No prerequisites.
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Financial Management
Period of presentation	Semester 1

Module content

*Only for BSc (Mathematical Statistics. Construction Management, Real Estate and Quantity Surveying) and BEng (Industrial Engineering) students.
Purpose and functioning of financial management. Basic financial management concepts. Accounting concepts and the use of the basic accounting equation to describe the financial position of a business. Recording of financial transactions. Relationship between cash and accounting profit. Internal control and the management of cash. Debtors and short-term investments. Stock valuation models. Depreciation. Financial statements of a business. Distinguishing characteristics of the different forms of businesses. Overview of financial markets and the role of financial institutions. Risk and return characteristics of various financial instruments. Issuing ordinary shares and debt instruments.

Financial management 120 (FBS 120)

Module credits	10.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences
Prerequisites	No prerequisites.
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Financial Management
Period of presentation	Semester 2

Module content

*Only for BSc (Mathematical Statistics, Construction Management, Real Estate and Quantity Surveying) students. Analysis of financial statements. Budgeting and budgetary control. Tax principles and normal income tax for individuals. Time value of money and its use for financial and investment decisions. Calculating the cost of capital and the financing of a business to maintain the optimal capital structure. Capital investment decisions and a study of the financial selection criteria in the evaluation of capital investment projects. The dividend decision and an overview of financial risk management.

Discrete structures 115 (WTW 115)

Module credits	8.00

Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	Refer to Regulation 1.2: A candidate must have passed Mathematics with at least 50% in the Grade 12 examination
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Propositional logic: truth tables, logical equivalence, implication, arguments. Mathematical induction and well-ordering principle. Introduction to set theory. Counting techniques: elementary probability, multiplication and addition rules, permutations and combinations, binomial theorem, inclusion-exclusion rule.

Numerical analysis 123 (WTW 123)

Module credits	8.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	WTW 114 GS
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Non-linear equations, numerical integration, initial value problems for differential equations, systems of linear equations. Algorithms for elementary numerical techniques are derived and implemented in computer programmes. Error estimates and convergence results are treated.

Mathematical modelling 152 (WTW 152)

Module credits	8.00
Service modules	Faculty of Engineering, Built Environment and Information Technology
Prerequisites	Refer to Regulation 1.2
Contact time	1 tutorial per week, 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 the modelling of dynamical processes using difference equations. Curve fitting. Introduction to linear programming. Matlab programming. Applications to real-life situations in, among others, finance, economics and ecology.

Dynamical processes 162 (WTW 162)

Module credits	8.00
Prerequisites	WTW 114 GS
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Module is presented in English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

*Students will not be credited for more than one of the following modules for their degree: WTW 162 and WTW 264.

Introduction to the modelling of dynamical processes using elementary differential equations. Solution methods for first order differential equations and analysis of properties of solutions (graphs). Applications to real life situations.

Imperative programming 132 (COS 132)

Module credits	16.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	APS of 30 and level 5 (60-69%) Mathematics
Contact time	1 tutorial per week, 1 practical per week, 3 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Computer Science
Period of presentation	Semester 1

Module content

This module introduces imperative computer programming, which is a fundamental building block of computer science. The process of constructing a program for solving a given problem, of editing it, compiling (both manually and automatically), running and debugging it, is covered from the beginning. The aim is to master the elements of a programming language and be able to put them together in order to construct programs using types, control structures, arrays, functions and libraries. An introduction to object orientation will be given. After completing this module, the student should understand the fundamental elements of a program, the importance of good program design and user-friendly interfaces. Students should be able to conduct basic program analysis and write complete elementary programs.

Financial management 112 (FBS 112)

Module credits	10.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	To be taken concurrently with WST 111
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Financial Management
Period of presentation	Semester 1

Module content

*Only for BSc (Actuarial and Financial Mathematics and Mathematical Statistics) and BCom (Statistics with option Mathematical Statistics) students.
Key principles of financial management. Company ownership. Taxation. Introduction to financial statements. Structure of financial statements. Depreciation and reserves. Preparing financial statements. Group financial statements and insurance company financial statements. Interpretation of financial statements. Limitation of financial statements. Issue of share capital.

Financial management 122 (FBS 122)

Module credits	10.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	FBS 112, to be taken concurrently with WST 121
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Financial Management
Period of presentation	Semester 2

Module content

*Only for BSc (Actuarial and Financial Mathematics; Mathematical Statistics) and BCom (Statistics with option Mathematical Statistics) students.

Financial instruments. Use of financial derivatives. Financial institutions. Time value of money. Component cost of capital. Weighted average cost of capital. Capital structure and dividend policy. Capital project appraisal. Evaluating risky investments.

Curriculum: Year 2

Minimum credits: 144

Minimum credits:

Core = 96

Elective = 48

Additional information:

Students in Mathematical Statistics who also want to be trained for the Mathematics industry normally choose from WTW 264 (12) or WTW 286 (12), 285 (12).

Students in Mathematical Statistics who also want to be trained for the Insurance Industry normally choose IAS 221 (12), IAS 282 (12) (note the prerequisite specified by the Department of Insurance and Actuarial Science).

Students in Mathematical Statistics who also want to be trained for the Econometrics industry normally choose from: EKN 214(16), 224 (16) and STK 281 (10).

Students in Mathematical Statistics with other career requirements, choose modules from any other subject/faculty to meet their specific needs.

Core modules

Mathematical statistics 211 (WST 211)

Module credits	24.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 111, WST 121, WTW 114 GS and WTW 124 GS
Contact time	2 practicals per week, 4 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Statistics
Period of presentation	Semester 1

Module content

Set theory. Probability measure functions. Random variables. Distribution functions. Probability mass functions. Density functions. Expected values. Moments. Moment generating functions. Special probability distributions: Bernoulli, binomial, hypergeometric, geometric, negative binomial, Poisson, Poisson process, discrete uniform, uniform, gamma,exponential, Weibull, Pareto, normal. Joint distributions: Multinomial, extended hypergeometric, joint continuous distributions. Marginal distributions. Independent random variables. Conditional distributions. Covariance, correlation. Conditional expected values. Transformation of random variables: Convolution formula. Order statistics. Stochastic convergence: Convergence in distribution. Central limit theorem. Practical applications. Practical statistical modelling and analysis using statistical computer packages and the interpretation of the output.

Mathematical statistics 221 (WST 221)

Module credits	24.00

Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211 GS
Contact time	4 lectures per week, 2 practicals per week
Language of tuition	Module is presented in English
Academic organisation	Statistics
Period of presentation	Semester 2

Module content

Stochastic convergence: Asymptotic normal distributions, convergence in probability. Statistics and sampling distributions: Chi-squared distribution. Distribution of the sample mean and sample variance for random samples from a normal population. T-distribution. F-distribution. Beta distribution. Point estimation: Method of moments. Maximum likelihood estimation. Unbiased estimators. Uniform minimum variance unbiased estimators. Cramer-Rao inequality. Efficiency. Consistency. Asymptotic relative efficiency.
Bayes estimators. Sufficient statistics. Completeness. The exponential class. Confidence intervals. Test of statistical hypotheses. Reliability and survival distributions. Practical applications. Practical statistical modelling and analysis using statistical computer packages and the interpretation of the output.

Linear algebra 211 (WTW 211)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 124
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

This is an introduction to linear algebra on Rn. Matrices and linear equations, linear combinations and spans, linear independence, subspaces, basis and dimension, eigenvalues, eigenvectors, similarity and diagonalisation of matrices, linear transformations.

Calculus 218 (WTW 218)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 114 and WTW 124
Contact time	1 tutorial per week, 2 lectures per week

Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Calculus of multivariable functions, directional derivatives. Extrema and Lagrange multipliers. Multiple integrals, polar, cylindrical and spherical coordinates.

Analysis 220 (WTW 220)

Module credits	12.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 114 and WTW 124
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Properties of real numbers. Analysis of sequences and series of real numbers. Power series and theorems of convergence. The Bolzano-Weierstrass theorem. The intermediate value theorem and analysis of real-valued functions on an interval. The Riemann integral: Existence and properties of the interval.

Linear algebra 221 (WTW 221)

Module credits	12.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 211
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Abstract vector spaces, change of basis, matrix representation of linear transformations, orthogonality, diagonalisability of symmetric matrices, some applications.

Elective modules

Economics 214 (EKN 214)

Module credits	16.00

Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	EKN 110 GS and EKN 120 or EKN 113 GS and EKN 123 and STK 110 GS and STK 120 GS
Contact time	3 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Economics
Period of presentation	Semester 1

Module content

Macroeconomics
From Wall and Bay Street to Diagonal Street: a thorough understanding of the mechanisms and theories explaining the workings of the economy is essential. Macroeconomic insight is provided on the real market, the money market, two market equilibrium, monetarism, growth theory, cyclical analysis, inflation, Keynesian general equilibrium analysis and fiscal and monetary policy issues.

Economics 224 (EKN 224)

Module credits	16.00
Service modules	Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	EKN 110 GS and EKN 120 or EKN 113 GS and EKN 123; and STK 110 GS and 120 GS
Contact time	3 lectures per week
Language of tuition	Separate classes for Afrikaans and English
Academic organisation	Economics
Period of presentation	Semester 1

Module content

Microeconomics
Microeconomic insight is provided into: consumer and producer theory, general microeconomic equilibrium, Pareto-optimality and optimality of the price mechanism, welfare economics, market forms and the production structure of South Africa. Statistic and econometric analysis of microeconomic issues.

Actuarial mathematics 211 (IAS 211)

Module credits	12.00
Service modules	Faculty of Economic and Management Sciences
Prerequisites	Pass WTW 114 and (WTW 126 and WTW 128 or (WTW 124) and WTW 123 and WST 111 and WST 121)

Contact time	1 practical per week, 3 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Actuarial Science
Period of presentation	Semester 1

Module content

Accumulation functions, interest, time value of money, compounding periods, cash flow models, equations of value, annuities certain, continuous time application, loan schedules, performance measurement, valuation of fixed interest securities..

Actuarial mathematics 221 (IAS 221)

Module credits	12.00
Prerequisites	IAS 211
Contact time	3 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Academic organisation	Actuarial Science
Period of presentation	Semester 2

Module content

Fundamentals of survival models, simple laws of mortality,derivation of contingent probablities from life tables,contingent payments, expectation of life, elementary survival contracts,select and ultimate life tables, life annuities, accumulation and discounting, life insurance, net and gross premiums, reserves, statistical considerations.

Financial mathematics 282 (IAS 282)

Module credits	12.00
Service modules	Faculty of Economic and Management Sciences
Prerequisites	IAS 211 60%
Contact time	3 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Academic organisation	Actuarial Science
Period of presentation	Semester 2

Module content

Generalised cash-flow model. The time value of money. Interest rates. Discounting and accumulating. Compound interest functions. Equations of value. Project appraisal. Investments. Simple compound interest problems. The ''No Arbitrage'' assumption and forward contracts. Term structure of interest rates. Stochastic interest rate models.

Informatics 214 (INF 214)

Module credits	14.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Natural and Agricultural Sciences
Prerequisites	AIM 101 or AIM 111 and AIM 121
Contact time	2 lectures per week, 2 practicals per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Informatics
Period of presentation	Semester 1

Module content

Database design: the relational model, structured query language (SQL), entity relationship modelling, normalisation, database development life cycle; practical introduction to database design. Databases: advanced entity relationship modelling and normalisation, object-oriented databases, database development life cycle, advanced practical database design.

Discrete structures 285 (WTW 285)

Module credits	12.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education
Prerequisites	WTW 115
Contact time	1 tutorial per week, 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

Setting up and solving recurrence relations. Equivalence and partial order relations. Graphs: paths, cycles, trees, isomorphism. Graph algorithms: Kruskal, Prim, Fleury. Finite state automata.

Differential equations 286 (WTW 286)

Module credits	12.00
Service modules	Faculty of Economic and Management Sciences
Prerequisites	WTW 114, WTW 124 and WTW 162
Contact time	1 tutorial per week, 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
*Students will not be credited for more than one of the modules for their degree: WTW 264, WTW 286
Theory and solution methods for ordinary differential equations and initial value problems: separable and linear first-order equations, linear equations of higher order, systems of linear equations. Application to mathematical models. Numerical methods applied to nonlinear systems.Qualitative analysis of linear systems.

Differential equations 264 (WTW 264)

Module credits	12.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 114 and WTW 124
Contact time	1 tutorial per week, 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
*Students will not be credited for both WTW 162 and WTW 264 or both WTW 264 and WTW 286 for their degree.

Theory and solution methods for ordinary differential equations and initial value problems: separable and linear first order equations, linear equations of higher order, systems of linear equations. Laplace transform.

Curriculum: Final year

Minimum credits: 144

Minimum credits:

Core = 97

Elective = 47

Additional information:

Students in Mathematical Statistics who also want to be trained for the Mathematics industry normally choose from: WTW 310 (18), 320 (18), 354 (18), 364 (18), 381 (18), 382 (18), 383 (18), 385 (18), 386 (18), 387 (18), 389 (18).

Students in Mathematical Statistics who also want to be trained for the Insurance industry normally choose IAS 382 (20).

Students in Mathematical Statistics who also want to be trained for the Econometrics industry normally choose from: EKN 310, 320 and 314 (60).

Students in Mathematical Statistics with other career requirements, choose modules from any other subject/faculty to meet their specific needs.

Core modules

The science of data analytics 353 (STK 353)

Module credits	25.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	STK 210, STK 220 or WST 211, WST 221
Contact time	3 lectures per week, 1 practical per week
Language of tuition	Module is presented in English
Academic organisation	Statistics
Period of presentation	Semester 2

Module content

Sampling: basic techniques in probability, non-probability, and sampling methods. Designing experiments: experimental and control groups, different data types and relationships. Big and small data: exploring popular trends used in practice. Consultation practice: ethical considerations, study design, data collection and presentation, report writing and presentation. Hands-on application of statistical software and packages to real-life datasets.

Multivariate analysis 311 (WST 311)

Module credits	18.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences

Prerequisites	WST 211, WST 221, WTW 211 GS and WTW 218 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Statistics
Period of presentation	Semester 1

Module content

Multivariate statistical distributions: Moments of a distribution, moment generating functions, independence. Multivariate normal distribution: Conditional distributions, partial and multiple correlations. Multinomial and multivariate Poisson distributions: Asymptotic normality and estimation of parameters. Distribution of quadratic forms in normal variables. Multivariate normal samples: Estimation of the mean vector and covariance matrix, estimation of correlation coefficients, distribution of the sample mean, sample covariance matrix and sample correlation coefficients. The linear model: Models of full rank, least squares estimators, test of hypotheses.The generalised linear model: Exponential family mean and variance, kink functions,deviance and residual analysis, test statistices, log- linear and logit models. Practical applications: Practical statistical modelling and analysis using statistical computer packages and interpretation of the output.

Stochastic processes 312 (WST 312)

Module credits	18.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211, WST 221, WTW 211 GS and WTW 218 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Statistics
Period of presentation	Semester 1

Module content

Definition of a stochastic process. Stationarity. Covariance stationary. Markov property. Random walk. Brownian motion. Markov chains. Chapman-Kolmogorov equations. Recurrent and transient states. First passage time. Occupation times. Markov jump processes. Poisson process. Birth and death processes. Structures of processes. Structure of the time-homogeneous Markov jump process. Applications in insurance. Practical statistical modelling, analysis and simulation using statistical computer packages and the interpretation of the output.

Time-series analysis 321 (WST 321)

Module credits	18.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211, WST 221, WST 311 GS, WTW 211 GS and WTW 218 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Afrikaans and English is used in one class

Academic organisation	Statistics
Period of presentation	Semester 2

Module content

Stationary and non-stationary univariate time-series. Properties of autoregressive moving average (ARMA) and autoregressive integrated moving average (ARIMA) processes. Identification, estimation and diagnostic testing of a time-series model. Forecasting. Multivariate time-series. Practical statistical modelling and analysis using statistical computer packages.

Actuarial statistics 322 (WST 322)

Module credits	18.00
Service modules	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
Prerequisites	WST 211, WST 221, WTW 211 GS and WTW 218 GS
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Statistics
Period of presentation	Semester 2

Module content

Decision theory. Loss distributions. Reinsurance. Risk models. Ruin theory. Credibility theory. Methods to forecast future claim numbers and amounts. Practical statistical modelling and analysis using statistical computer packages.

Elective modules

Economics 310 (EKN 310)

Module credits	20.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	EKN 214, EKN 234 or EKN 224, EKN 244
Contact time	2 lectures per week, 1 discussion class per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Economics
Period of presentation	Semester 1

Module content

Public finance
Role of government in the economy. Welfare economics and theory of optimality. Ways of correcting market failures. Government expenditure theories, models and programmes. Government revenue. Models on taxation, effects of taxation on the economy. Assessment of taxation from an optimality and efficiency point of view. South African perspective on public finance.

Economics 314 (EKN 314)

Module credits	20.00
Service modules	Faculty of Natural and Agricultural Sciences
Prerequisites	EKN 234, EKN 244
Contact time	3 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Economics
Period of presentation	Semester 1

Module content

International trade/finance
International economic insight is provided into international economic relations and history, theory of international trade, international capital movements, international trade politics, economic and customs unions and other forms or regional cooperation and integration, international monetary relations, foreign exchange markets, exchange rate issues and the balance of payments, as well as open economy macroeconomic issues.

Economics 320 (EKN 320)

Module credits	20.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
Prerequisites	EKN 310 GS
Contact time	1 discussion class per week, 2 lectures per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Economics
Period of presentation	Semester 2

Module content

Economic analyses
Identification, collection and interpretation process of relevant economic data; the national accounts (i.e. income and production accounts, the national financial account, the balance of payments and input-output tables); economic growth; inflation; employment, unemployment, wages, productivity and income distribution; business cycles; financial indicators; fiscal indicators; social indicators; international comparisons; relationships between economic time series - regression analysis; long-term future studies and scenario analysis; overall assessment of the South African economy from 1994 onwards.

Actuarial modelling 382 (IAS 382)

Module credits	20.00
Service modules	Faculty of Economic and Management Sciences
Prerequisites	WST 312 60%
Contact time	1 practical per week, 2 lectures per week
Language of tuition	Module is presented in English
Academic organisation	Actuarial Science
Period of presentation	Semester 2

Module content

Principles of actuarial modelling and stochastic processes. Markov chains and continuous-time Markov jump processes. Simulation of stochastic processes. Survival models and the life table. Estimating the lifetime distribution Fx(t). The Cox regression model. The two-state Markov model. The general Markov model. Binomial and Poisson models. Graduation and statistical tests. Methods of graduation. Exposed to risk. The evaluation of assurances and annuities. Premiums and reserves.

Analysis 310 (WTW 310)

Module credits	18.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	WTW 220
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Topology of finite dimensional spaces: Open and closed sets, compactness, connectedness and completeness. Theorems of Bolzano-Weierstrass and Heine-Borel. Properties of continuous functions and applications. Integration theory for functions of one real variable. Sequences of functions.

Complex analysis 320 (WTW 320)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	WTW 218 and WTW 220
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Series of functions, power series and Taylor series. Complex functions, Cauchy- Riemann equations, Cauchy's theorem and integral formulas. Laurent series, residue theorem and calculation of real integrals using residues.

Financial engineering 354 (WTW 354)

Module credits	18.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences
Prerequisites	WST 211, WTW 211 and WTW 218
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Mean variance portfolio theory. Market equilibrium models such as the capital asset pricing model. Factor models and arbitrage pricing theory. Measures of investment risk. Efficient market hypothesis. Stochastic models of security prices

Financial engineering 364 (WTW 364)

Module credits	18.00
Prerequisites	WST 211, WTW 126, WTW 218 and WTW 286 or WTW 264
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Module is presented in English
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Discrete time financial models: Arbitrage and hedging; the binomial model. Continuous time financial models: The Black-Scholes formula; pricing of options and the other derivatives; interest rate models; numerical procedures.

Algebra 381 (WTW 381)

Module credits	18.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	WTW 114 and WTW 211
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Group theory: Definition, examples, elementary properties, subgroups, permutation groups, isomorphism, order, cyclic groups, homomorphisms, factor groups. Ring theory: Definition, examples, elementary properties, ideals, homomorphisms, factor rings, polynomial rings, factorisation of polynomials. Field extensions, applications to straight-edge and compass constructions.

Dynamical systems 382 (WTW 382)

Module credits	18.00
Service modules	Faculty of Education Faculty of Economic and Management Sciences
Prerequisites	WTW 218 and WTW 286 or WTW 264
Contact time	1 tutorial per week, 2 lectures per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Matrix exponential function: homogeneous and non-homogeneous linear systems of differential equations. Qualitative analysis of systems: phase portraits, stability, linearisation, energy method and Liapunov's method. Introduction to chaotic systems. Application to real life problems.

Numerical analysis 383 (WTW 383)

Module credits	18.00
Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Humanities
Prerequisites	WTW 114, WTW 124 and WTW 211
Contact time	2 lectures per week, 1 practical per week
Language of tuition	Afrikaans and English is used in one class

Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Direct methods for the numerical solution of systems of linear equations, pivoting strategies. Iterative methods for solving systems of linear equations and eigenvalue problems. Iterative methods for solving systems of nonlinear equations. Introduction to optimization. Algorithms for the considered numerical methods are derived and implemented in computer programmes. Complexity of computation is investigated. Error estimates and convergence results are proved.

Partial differential equations 386 (WTW 386)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	WTW 248 and WTW 286 or WTW 264
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 1

Module content

Conservation laws and modelling. Fourier analysis. Heat equation, wave equation and Laplace's equation. Solution methods including Fourier series. Energy and other qualitative methods.

Continuum mechanics 387 (WTW 387)

Module credits	18.00
Service modules	Faculty of Education
Prerequisites	WTW 248 and WTW 286 or WTW 264
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Kinematics of a continuum: Configurations, spatial and material description of motion. Conservation laws. Analysis of stress, strain and rate of deformation. Linear constitutive equations. Applications: Vibration of beams, equilibrium problems in elasticity and special cases of fluid motion.

Geometry 389 (WTW 389)

Module credits	18.00

Service modules	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities
Prerequisites	WTW 211
Contact time	2 lectures per week, 1 tutorial per week
Language of tuition	Afrikaans and English is used in one class
Academic organisation	Mathematics and Applied Maths
Period of presentation	Semester 2

Module content

Axiomatic development of neutral, Euclidean and hyperbolic geometry. Using models of geometries to show that the parallel postulate is independent of the other postulates of Euclid.

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.