

# University of Pretoria Yearbook 2022

## BSc (Mathematical Statistics) (02133274)

**Department** Statistics

**Minimum duration of study** 3 years

**Total credits** 420

**NQF level** 07

## Admission requirements

### Important information for all prospective students for 2022

- The admission requirements apply to students who apply for admission to the University of Pretoria with a **National Senior Certificate (NSC) and Independent Examination Board (IEB) qualifications**.
- Applicants with qualifications other than the abovementioned** should refer to:
  - Brochure:** Undergraduate Programme Information 2022: Qualifications other than the NSC and IEB, available at [click here](#).
- Citizens from countries other than South Africa (applicants who are not South African citizens)** should also refer to:
  - Brochure:** Newcomer's Guide 2021, available at [click here](#).
  - Website:** [click here](#).
- School of Tomorrow (SOT), Accelerated Christian Education (ACE) and General Education Development Test (GED):** The University of Pretoria no longer accepts qualifications awarded by these institutions.
- National Certificate (Vocational) (NCV) Level 4:** The University of Pretoria may consider NCV candidates, provided they meet the exemption for bachelor's status criteria and the programme requirements.

### Transferring students

A transferring student is a student who, at the time of application for a degree programme at the University of Pretoria (UP) –

- is a registered student at another tertiary institution, **or** was previously registered at another tertiary institution and did not complete the programme enrolled for at that institution, and is not currently enrolled at a tertiary institution, **or** has completed studies at another tertiary institution, but is not currently enrolled at a tertiary institution, **or** has started with tertiary studies at UP, then moved to another tertiary institution and wants to be readmitted at UP.

A transferring student will be considered for admission based on

- an NSC or equivalent qualification with exemption to bachelor's or diploma studies (whichever is applicable); **and** meeting the minimum faculty-specific subject requirements at NSC or tertiary level; **or** having completed a higher certificate at a tertiary institution with faculty-specific subjects/modules passed (equal to or more than 50%), as well as complying with faculty rules on admission;
- previous academic performance (must have passed all modules registered for up to the closing date of

- application ) or as per faculty regulation/promotion requirements;
- a certificate of good conduct.

**Note:** Students who have been dismissed at the previous institution due to poor academic performance, will not be considered for admission to UP.

### Returning students

A returning student is a student who, at the time of application for a degree programme –

- is a registered student at UP, and wants to transfer to another degree at UP, **or** was previously registered at UP and did not complete the programme enrolled for, and did not enrol at another tertiary institution in the meantime (including students who applied for leave of absence), **or** has completed studies at UP, but is not currently enrolled or was not enrolled at another tertiary institution after graduation.

A returning student will be considered for admission based on

- an NSC or equivalent qualification with exemption to bachelor's or diploma studies (whichever is applicable); **and** meeting the minimum faculty-specific subject requirements at NSC or tertiary level; **or** previous academic performance (should have a cumulative weighted average of at least 50% for the programme enrolled for);
- having applied for and was granted leave of absence.

**Note:** Students who have been excluded/dismissed from a faculty due to poor academic performance may be considered for admission to another programme at UP. The Admissions Committee may consider such students if they were not dismissed more than twice. Only ONE transfer between UP faculties will be allowed, and a maximum of two (2) transfers within a faculty.

### Important faculty-specific information on undergraduate programmes for 2022

- The closing date is an administrative admission guideline for non-selection programmes. Once a non-selection programme is full and has reached the institutional targets, then that programme will be closed for further admissions, irrespective of the closing date. However, if the institutional targets have not been met by the closing date, then that programme will remain open for admissions until the institutional targets are met.
- The following persons will be considered for admission: Candidates who have a certificate that is deemed by the University to be equivalent to the required National Senior Certificate (NSC) with university endorsement; candidates who are graduates from another tertiary institution or have been granted the status of a graduate of such an institution, and candidates who are graduates of another faculty at the University of Pretoria.
- Life Orientation is excluded when calculating the Admission Point Score (APS).
- Grade 11 results are used for the conditional admission of prospective students. Final admission is based on the final NSC/IEB results.

**University of Pretoria website:** [click here](#)

#### Minimum requirements

##### Achievement level

##### English Home Language or English First Additional Language

##### Mathematics

##### APS

NSC/IEB

NSC/IEB

5

6

34

Candidates who do not comply with the minimum admission requirements for BSc (Mathematical Statistics), may be considered for admission to the BSc – Extended programme – Mathematical Sciences, which requires an additional year of study.

**Please note:** Progression from the BSc – Extended programme – Mathematical Sciences to the mathematics-

intensive programmes will be considered only if students obtained a GPA of 65% in their first-year modules. Students who pass all first-year modules will be advised on alternative academic pathways.

### **BSc - Extended Programme - Mathematical Sciences**

#### **Minimum requirements**

#### **Achievement level**

#### **English Home Language or English First Additional Language**

NSC/IEB

4

#### **Mathematics**

NSC/IEB

5

#### **APS**

**28**

#### **Note:**

\*The BSc - Extended programmes are not available for students who meet all the requirements for the corresponding mainstream programme.

\*Please note that only students who apply in their final NSC or equivalent qualification year will be considered for admission into any of the BSc - Extended programmes.

## **Other programme-specific information**

### **1.1 Requirements for specific modules**

A candidate who:

- does not qualify for STK 110, must enrol for STK 113 and STK 123;
- registers for Mathematical Statistics (WST) and Statistics (STK) modules must take note that WST and STK modules, except for STK 281, may not be taken simultaneously in a programme; a student must take one and only one of the following options:
  - WST 111, WST 121, WST 212, WST 211, WST 221, WST 311, WST 312, WST 322, WST 321, and STK 353  
or
  - WST 111, WST 121, WST 212, WST 211, WST 221, WST 311, WST 312, WST 322, STK320, STK353.  
or
  - STK 110, STK 122, STK 210, STK 220, WST 212, STK 310, STK 320, STK 353.
- registers for a module presented by another faculty must take note of the timetable clashes, prerequisites for that module, subminimum required in examination papers, supplementary examinations, etc.

### **1.2 Fundamental modules**

- It is compulsory for all new first-year students to satisfactorily complete the Academic orientation (UPO 102) and to take Academic information management modules (AIM 111 and AIM 121) and Language and study skills (LST 110). Please see curricula for details.
- Students who intend to apply for admission to MBChB or BChD in the second semester, when places become available in those programmes, may be permitted to register for up to 80 module credits and 4 core modules in the first semester during the first year provided that they obtained a final mark of no less than 70% for Grade 12 Mathematics and achieved an APS of 34 or more in the NSC.

## 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 relevant 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 relevant 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 Senate Appeals Committee.
- Any decision taken by the Senate Appeals Committee is final.

## Curriculum: Year 1

### Minimum credits: 140

Fundamental = 14

Core = 108

Elective = 44 /32

Electives should be chosen as follows:

- Students in Mathematical Statistics who also want to be trained for the Mathematics industry should choose from WTW 123 (8), 115 (8), 152 (8), 162 (8), COS 132 (16) and COS 122 (16) or 151 (8).
- Students in Mathematical Statistics who also want to be trained for the Insurance industry and/or Econometrics, should choose: WTW 152 (8), WTW 123 (8), IAS 111 (6), 121 (6), EKN 110 (10), 120 (10), and either FBS 110 (10), 120 (10) or FBS 112 (10), 122 (10).
- 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)

<b>Module credits</b>	4.00
<b>NQF Level</b>	05
<b>Service modules</b>	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 and Religion
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Information Science
<b>Period of presentation</b>	Semester 1

#### Module content

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

### Academic information management 121 (AIM 121)

<b>Module credits</b>	4.00
<b>NQF Level</b>	05

<b>Service modules</b>	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 and Religion Faculty of Veterinary Science
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<b>Prerequisites</b>	No prerequisites.
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<b>Contact time</b>	2 lectures per week
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<b>Language of tuition</b>	Module is presented in English
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<b>Department</b>	Informatics
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<b>Period of presentation</b>	Semester 2
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### 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)

<b>Module credits</b>	6.00
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<b>NQF Level</b>	05
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<b>Service modules</b>	Faculty of Natural and Agricultural Sciences Faculty of Veterinary Science
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<b>Prerequisites</b>	No prerequisites.
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<b>Contact time</b>	2 lectures per week
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<b>Language of tuition</b>	Module is presented in English
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<b>Department</b>	Unit for Academic Literacy
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<b>Period of presentation</b>	Semester 1
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### 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)

<b>Module credits</b>	0.00
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<b>NQF Level</b>	00
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<b>Language of tuition</b>	Module is presented in English
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<b>Department</b>	Natural and Agricultural Sciences Deans Office
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<b>Period of presentation</b>	Year
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## Core modules

### Mathematical statistics 111 (WST 111)

<b>Module credits</b>	16.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	At least 5 (60-69%) in Mathematics in the Grade 12 examination
<b>Contact time</b>	1 practical per week, 4 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Statistics
<b>Period of presentation</b>	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)

<b>Module credits</b>	16.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	WST 111 GS or WST 133, 143 and 153
<b>Contact time</b>	1 practical per week, 4 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Statistics
<b>Period of presentation</b>	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)

<b>Module credits</b>	16.00
<b>NQF Level</b>	05

<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
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<b>Prerequisites</b>	60% for Mathematics in Grade 12
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<b>Contact time</b>	1 tutorial per week, 4 lectures per week
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<b>Language of tuition</b>	Module is presented in English
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<b>Department</b>	Mathematics and Applied Mathematics
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<b>Period of presentation</b>	Semester 1
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### 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)

<b>Module credits</b>	16.00
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<b>NQF Level</b>	05
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<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
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<b>Prerequisites</b>	WTW 114
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<b>Contact time</b>	1 tutorial per week, 4 lectures per week
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<b>Language of tuition</b>	Module is presented in English
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<b>Department</b>	Mathematics and Applied Mathematics
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<b>Period of presentation</b>	Semester 2
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### 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  $R^n$ , 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 and quadratic curves.

## Elective modules



## Operating systems 122 (COS 122)

<b>Module credits</b>	16.00
<b>NQF Level</b>	05
<b>Prerequisites</b>	COS 132
<b>Contact time</b>	1 practical per week, 1 tutorial per week, 3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Computer Science
<b>Period of presentation</b>	Semester 2

### Module content

Fundamental concepts of modern operating systems in terms of their structure and the mechanisms they use are studied in this module. After completing this module, students will have gained, as outcomes, knowledge of real time, multimedia and multiple processor systems, as these will be defined and analysed. In addition, students will have gained knowledge on modern design issues of process management, deadlock and concurrency control, memory management, input/output management, file systems and operating system security. In order to experience a hands-on approach to the knowledge students would have gained from studying the abovementioned concepts, students will have produced a number of practical implementations of these concepts using the Windows and Linux operating systems.

## Imperative programming 132 (COS 132)

<b>Module credits</b>	16.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	APS of 30 and level 5 (60-69%) Mathematics
<b>Contact time</b>	1 practical per week, 1 tutorial per week, 3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Computer Science
<b>Period of presentation</b>	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.



## Introduction to computer science 151 (COS 151)

<b>Module credits</b>	8.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Education Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	APS of 30 and level 5 (60-69%) Mathematics.
<b>Contact time</b>	1 practical per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Computer Science
<b>Period of presentation</b>	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 focuses on modelling of algorithms.

## Economics 110 (EKN 110)

<b>Module credits</b>	10.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	1 discussion class per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Economics
<b>Period of presentation</b>	Semester 1

### Module content

This module deals with the core principles of economics. A distinction between macroeconomics and microeconomics is made. A discussion of the market system and circular flow of goods, services and money is followed by a section dealing with microeconomic principles, including demand and supply analysis, consumer behaviour and utility maximisation, production and the costs thereof, and the different market models and firm behaviour. Labour market institutions and issues, wage determination, as well as income inequality and poverty are also addressed. A section of money, banking, interest rates and monetary policy concludes the course.

## Economics 120 (EKN 120)

<b>Module credits</b>	10.00
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<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	EKN 110 GS or EKN 113 GS and at least 4 (50-59%) in Mathematics in the Grade 12 examination or 60% in STK 113 and concurrently registered for STK 123
<b>Contact time</b>	1 discussion class per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Economics
<b>Period of presentation</b>	Semester 2

### Module content

This module deals with the core principles of economics, especially macroeconomic measurement the private and public sectors of the South African economy receive attention, while basic macroeconomic relationships and the measurement of domestic output and national income are discussed. Aggregate demand and supply analysis stands core to this course which is also used to introduce students to the analysis of economic growth, unemployment and inflation. The microeconomics of government is addressed in a separate section, followed by a section on international economics, focusing on international trade, exchange rates and the balance of payments. The economics of developing countries and South Africa in the global economy conclude the course.

## Financial management 110 (FBS 110)

<b>Module credits</b>	10.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	No prerequisites.
<b>Contact time</b>	3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Financial Management
<b>Period of presentation</b>	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 112 (FBS 112)

<b>Module credits</b>	10.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	At least 6 (70-79%) in Mathematics in the Grade 12 examination or WTW 133 (60%), WTW 143 (60%), WST 133 (60%) and WST 143 (60%).
<b>Contact time</b>	3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Financial Management
<b>Period of presentation</b>	Semester 1

### Module content

\*Only for students in BSc (Actuarial and Financial Mathematics), BSc (Mathematics), BSc (Applied Mathematics), BSc (Mathematical Statistics), BSc Extended programme – Mathematical Sciences and BCom (Statistics) who comply with the set prerequisites.

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 120 (FBS 120)

<b>Module credits</b>	10.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	BCom Financial Sciences, Investment Management and Law: FRK111 and FRK121 (or FRK100 or 101), STK110,120 or FBS121, and simultaneously registered for FRK211; BSc Construction Management, Quantity Surveying and Real Estate: FBS110, STK110 and STK120
<b>Contact time</b>	3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Financial Management
<b>Period of presentation</b>	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.



## Financial management 122 (FBS 122)

<b>Module credits</b>	10.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	FBS 112 or WST 121 and 07130261 or 07130262 or 02133388 or 02133273 or 02133395 or 02133274 or 02130007 or 02130016
<b>Contact time</b>	3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Financial Management
<b>Period of presentation</b>	Semester 2

### Module content

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.

## Actuarial and Financial Mathematics in practice 111 (IAS 111)

<b>Module credits</b>	6.00
<b>NQF Level</b>	05
<b>Prerequisites</b>	At least 6 (70-79%) in Mathematics and a APS score of 32 in the Grade 12 examination or WTW 133 (60%), WTW 143 (60%), WST 133 (60%) and WST 143 (60%).
<b>Contact time</b>	1 lecture per week, 1 practical per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Actuarial Science
<b>Period of presentation</b>	Semester 1

### Module content

Professionalism, working in multicultural environments, self-development, propositional logic, financial needs.

## Actuarial and Financial Mathematics in practice 121 (IAS 121)

<b>Module credits</b>	6.00
<b>NQF Level</b>	05
<b>Prerequisites</b>	WTW 114 or WTW 153, WST 111 or WST 153, IAS 111.
<b>Contact time</b>	1 lecture per week, 1 practical per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Actuarial Science
<b>Period of presentation</b>	Semester 2

## Module content

Financial service providers, investment examples including an introduction to mathematics of finance, life insurance examples including an introduction to contingencies, general insurance examples including an introduction to reserving using run-off triangles, personal self-development.

## Atmospheric structure and processes 155 (WKD 155)

**Module credits** 16.00

**NQF Level** 05

**Prerequisites** At least 50% for mathematics in grade 12.

**Contact time** 1 practical per week, 4 lectures per week

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

**Department** Geography Geoinformatics and Meteorology

**Period of presentation** Semester 1

## Module content

Introduction to weather and climate. Climate of South Africa. Urban and rural climate. Meteorological instruments. Motion of the earth. Atmospheric mass and pressure. Energy and heat budget. Moisture in the atmosphere. Cloud development. Climate change. ENSO. Electromagnetic spectrum and remote sensing in meteorology. Synoptic weather systems of South Africa.

## Discrete structures 115 (WTW 115)

**Module credits** 8.00

**NQF Level** 05

**Service modules** Faculty of Engineering, Built Environment and Information Technology  
Faculty of Economic and Management Sciences

**Prerequisites** 50% for Mathematics in Grade 12

**Contact time** 1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**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

**NQF Level** 05

**Service modules** Faculty of Engineering, Built Environment and Information Technology

<b>Prerequisites</b>	WTW 114
<b>Contact time</b>	1 practical per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	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)

<b>Module credits</b>	8.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	50% for Mathematics in Grade 12
<b>Contact time</b>	1 practical per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	Semester 1

#### Module content

The module serves as an introduction to computer programming as used in science. Modelling of dynamical processes using difference equations; curve fitting and linear programming are studied. Applications are drawn from real-life situations in, among others, finance, economics and ecology.

### Dynamical processes 162 (WTW 162)

<b>Module credits</b>	8.00
<b>NQF Level</b>	05
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	WTW 114
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	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.



## Curriculum: Year 2

**Minimum credits: 140**

Core = 108

Elective = 32

### Elective Modules (Credits = 44)

- Students in Mathematical Statistics who also want to be trained for the Mathematics industry should choose from WTW 264 (12), WTW 286 (12), 285 (12) and 248 (12).
- Students in Mathematical Statistics who also want to be trained for the Insurance Industry should choose IAS 211 (12) IAS 221 (12), IAS 282 (12)
- Students in Mathematical Statistics who also want to be trained for the Econometrics industry should choose: EKN 214(16), EKN 224 (16).
- Students in Mathematical Statistics with other career requirements, may choose modules from any other subject/faculty to meet their specific needs but should consult with the Department of Statistics in this regard.

## Core modules

### Mathematical statistics 211 (WST 211)

<b>Module credits</b>	24.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	WST 111, WST 121, WTW 114 GS and WTW 124 GS
<b>Contact time</b>	2 practicals per week, 4 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Statistics
<b>Period of presentation</b>	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.

### Applications in data science 212 (WST 212)

**Module credits** 12.00

<b>NQF Level</b>	06
<b>Prerequisites</b>	WST 111, WST 121 or STK 110, STC 122
<b>Contact time</b>	1 practical per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Statistics
<b>Period of presentation</b>	Semester 1

#### Module content

Introductory machine learning concepts. Data base design and use. Data preparation and extraction. Statistical modelling using data base structures. Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

### Mathematical statistics 221 (WST 221)

<b>Module credits</b>	24.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	WST 211 GS
<b>Contact time</b>	2 practicals per week, 4 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Statistics
<b>Period of presentation</b>	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)

<b>Module credits</b>	12.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
<b>Prerequisites</b>	WTW 124
<b>Contact time</b>	1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**Period of presentation** Semester 1

### Module content

This is an introduction to linear algebra on  $\mathbb{R}^n$ . 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

**NQF Level** 06

**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** Module is presented in English

**Department** Mathematics and Applied Mathematics

**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

**NQF Level** 06

**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, WTW 211 and WTW 218

**Contact time** 1 tutorial per week, 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 is recommended as an elective only for students who intend to enrol for WTW 310 and/or WTW 320. Students will not be credited for more than one of the following modules for their degree: WTW 220 and WTW 224.

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

**NQF Level** 06

**Service modules** Faculty of Engineering, Built Environment and Information Technology  
Faculty of Education  
Faculty of Economic and Management Sciences

**Prerequisites** WTW 211 and WTW 218

**Contact time** 1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**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.

## Techniques of analysis 224 (WTW 224)

**Module credits** 12.00

**NQF Level** 06

**Prerequisites** WTW 124 and WTW 211 GS and WTW 218 GS

**Contact time** 1 tutorial per week, 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 does not lead to admission to WTW 310 or WTW 320. Students will not be credited for more than one of the following modules for their degree: WTW 220 and WTW 224.

Sequences of real numbers: convergence and monotone sequences. Series of real numbers: convergence, integral test, comparison tests, alternating series, absolute convergence, ratio and root tests. Power series: representation of functions as power series, Taylor and Maclaurin series. Application to series solutions of differential equations.

## Elective modules

### Economics 214 (EKN 214)

<b>Module credits</b>	16.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	EKN 110 GS & EKN 120 OR EKN 113 GS & EKN 123; & STK 110 GS OR STK 113 & STK 123 & STK 120/121 or concurrently registered for STK 120/121 OR WST 111 & WST121 are prerequisites instead of STK 120/121 or WST 111 and concurrently registered for WST 121.
<b>Contact time</b>	3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Economics
<b>Period of presentation</b>	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)

<b>Module credits</b>	16.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Education Faculty of Humanities Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	EKN 110 GS & EKN 120 OR EKN 113 GS & EKN 123; & STK 110 GS OR STK 113 & STK 123 & STK 120/121 or concurrently registered for STK120/121 OR WST 111 & WST121 are prerequisites instead of STK 120/121 or WST 111 and concurrently registered for WST 121.
<b>Contact time</b>	3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Economics
<b>Period of presentation</b>	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.

## Financial mathematics 211 (IAS 211)

<b>Module credits</b>	12.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Economic and Management Sciences
<b>Prerequisites</b>	IAS 111, IAS 121, WTW 114, WTW 123, WTW 124, WTW 152, WST 111, WST 121
<b>Contact time</b>	1 practical per week, 3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Actuarial Science
<b>Period of presentation</b>	Semester 1

## Module content

Principles of actuarial modelling, cash-flow models, the time value of money, interest rates, discounting and accumulating, level annuities, deferred and increasing annuities, equations of value.

## Contingencies 221 (IAS 221)

<b>Module credits</b>	12.00
<b>NQF Level</b>	06
<b>Prerequisites</b>	IAS 211
<b>Contact time</b>	1 practical per week, 3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Actuarial Science
<b>Period of presentation</b>	Semester 2

## Module content

Fundamentals of survival models, select and ultimate life tables, Assurance and annuity functions, basic calculation of premiums and reserves, principles of pricing and reserving.

## Financial mathematics 282 (IAS 282)

<b>Module credits</b>	12.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Economic and Management Sciences
<b>Prerequisites</b>	IAS 211
<b>Contact time</b>	1 practical per week, 3 lectures per week

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

**Department** Actuarial Science

**Period of presentation** Semester 2

#### Module content

Principles of actuarial modelling, cash-flow models, the time value of money, interest rates, discounting and accumulating, level annuities, deferred and increasing annuities, equations of value, loan schedules, project appraisal, elementary compound interest problems, term structure of interest rates.

### Vector analysis 248 (WTW 248)

**Module credits** 12.00

**NQF Level** 06

**Service modules** Faculty of Engineering, Built Environment and Information Technology  
Faculty of Education

**Prerequisites** WTW 218

**Contact time** 1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**Period of presentation** Semester 2

#### Module content

Vectors and geometry. Calculus of vector functions with applications to differential geometry, kinematics and dynamics. Vector analysis, including vector fields, line integrals of scalar and vector fields, conservative vector fields, surfaces and surface integrals, the Theorems of Green, Gauss and Stokes with applications.

### Differential equations 264 (WTW 264)

**Module credits** 12.00

**NQF Level** 06

**Service modules** Faculty of Engineering, Built Environment and Information Technology  
Faculty of Economic and Management Sciences

**Prerequisites** WTW 114, WTW 124, and WTW 211

**Contact time** 1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**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.

## Discrete structures 285 (WTW 285)

<b>Module credits</b>	12.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology
<b>Prerequisites</b>	WTW 115
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	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)

<b>Module credits</b>	12.00
<b>NQF Level</b>	06
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences
<b>Prerequisites</b>	WTW 114, WTW 124, WTW 162, WTW 211#
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	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.



## Curriculum: Final year

### Minimum credits: 140

Core = 86

Elective = 54

### Additional Information:

- Students in Mathematical Statistics who also want to be trained for the Mathematics industry should choose two of the following: WTW 310 (18), 320 (18), 354 (18), 364 (18), 381 (18), 382 (18), 383 (18), 386 (18), 387 (18), 389 (18).
- Students in Mathematical Statistics who also want to be trained for the Insurance industry should choose WTW 354 (18), WTW 364 (18) and WST 322 (18).
- Students in Mathematical Statistics who also want to be trained for the Econometrics industry should choose three of the following: EKN 310 (20), 320 (20), 314 (20), 325 (20) or WST 322 (18).
- Students in Mathematical Statistics with other career requirements, may choose modules from any other subject/faculty to meet their specific needs but should consult with the Department of Statistics in this regard.

## Core modules

### Statistics 320 (STK 320)

<b>Module credits</b>	25.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	STK 210, STK 220 or WST 211, WST 221
<b>Contact time</b>	1 practical per week, 3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Statistics
<b>Period of presentation</b>	Semester 2

#### Module content

Stationary and non-stationary univariate time series. Properties of ARIMA processes. Identification, estimation and diagnostic testing of a time series models. Forecasting. Multivariate time series. Supervised learning: introduction to generalised linear models. Modelling of binary response variables, logistic regression. Supporting mathematical concepts. Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

### The science of data analytics 353 (STK 353)

<b>Module credits</b>	25.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Natural and Agricultural Sciences

<b>Prerequisites</b>	STK 210, STK 220, WST 212 or WST 211, WST 221, WST 212
<b>Contact time</b>	1 practical per week, 3 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Statistics
<b>Period of presentation</b>	Semester 2

#### Module content

Data exploration. Data wrangling. Statistical coding. Algorithmic thinking. Sampling: basic techniques in probability, non-probability, and resampling methods. Text mining and analytics. Machine learning: classification and clustering. Statistical concepts are demonstrated and interpreted through practical coding and simulation within a data science framework.

### Multivariate analysis 311 (WST 311)

<b>Module credits</b>	18.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	WST 211, WST 221, WTW 211 GS and WTW 218 GS
<b>Contact time</b>	1 practical per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Statistics
<b>Period of presentation</b>	Semester 1

#### Module content

Multivariate statistical distributions: Moments of a distribution, moment generating functions, independence. Multivariate normal distribution: Conditional distributions, partial and multiple correlations. 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. Principal component analysis. The linear model: Models of full rank, least squares estimators, test of hypotheses. The generalised linear model: Exponential family mean and variance, link functions, deviance and residual analysis, test statistics, 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)

<b>Module credits</b>	18.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Economic and Management Sciences Faculty of Natural and Agricultural Sciences
<b>Prerequisites</b>	WST 211, WST 221, WTW 211 GS and WTW 218 GS
<b>Contact time</b>	1 practical per week, 2 lectures per week

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

**Department** 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.

## Elective modules

### Economics 310 (EKN 310)

**Module credits** 20.00

**NQF Level** 07

**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** 1 discussion class per week, 2 lectures per week

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

**Department** 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.

### Development economics 315 (EKN 315)

**Module credits** 20.00

**NQF Level** 07

**Prerequisites** EKN 224

**Contact time** 3 lectures per week

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

**Department** Economics

**Period of presentation** Semester 1

### Module content

Poverty and inequality are among the greatest contemporary challenges of economic development in the World. This course provides an overview of different economic explanations of underdevelopment and policy options to fostering household and individual welfare. We will investigate key development issues such as poverty, inequality, migration, the role of institutions (policy and governance), among others, as they are encountered by developing countries in general and South Africa in particular. During the course, we put special emphasis on the interplay between theory and data.

## Economics 320 (EKN 320)

**Module credits** 20.00

**NQF Level** 07

**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** Module is presented in English

**Department** 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.

## Economics 325 (EKN 325)

**Module credits** 20.00

**NQF Level** 07

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

**Prerequisites** EKN 214, EKN 234

**Contact time** 1 discussion class per week, 2 lectures per week

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

**Department** Economics

**Period of presentation** Semester 2

### Module content

Economic policy and development: Capita select

The course provides an introduction to growth economics and also to some topics on development economics. Firstly, historical evidence is covered and then the canonical Solow growth model and some of its empirical applications (human capital and convergence). Secondly, the new growth theory (the AK and the Romer models of endogenous growth) are covered. Some of the development topics to be covered include technology transfer, social infrastructure and natural resources.

## Survival models 382 (IAS 382)

**Module credits** 18.00

**NQF Level** 07

**Service modules** Faculty of Economic and Management Sciences

**Prerequisites** IAS 221 60%, IAS 282 60%, WST 211, WST 221, WTW 211, WTW 218

**Contact time** 1 practical per week, 2 lectures per week

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

**Department** Actuarial Science

**Period of presentation** Semester 1

### Module content

Survival models and the life table, estimating the lifetime distribution, proportional hazard models, the binomial and Poisson models, exposed to risk, graduation and statistical tests, methods of graduation.

## Actuarial statistics 322 (WST 322)

**Module credits** 18.00

**NQF Level** 07

**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

**Department** Statistics

**Period of presentation** Semester 2

### Module content

Bayes estimation. Loss distributions. Reinsurance. Risk models. Ruin theory. Credibility theory. Extreme value theory. Copulas. Practical statistical modelling and analysis using statistical computer packages.

## Analysis 310 (WTW 310)

<b>Module credits</b>	18.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Education Faculty of Economic and Management Sciences Faculty of Humanities
<b>Prerequisites</b>	WTW 220
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	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)

<b>Module credits</b>	18.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Education
<b>Prerequisites</b>	WTW 218 and WTW 220
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	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)

<b>Module credits</b>	18.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences
<b>Prerequisites</b>	WST 211, WTW 211 and WTW 218
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English

**Department** Mathematics and Applied Mathematics

**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

**NQF Level** 07

**Service modules** Faculty of Economic and Management Sciences

**Prerequisites** WST 211, WTW 124, WTW 218 and WTW 286/264

**Contact time** 1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**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

**NQF Level** 07

**Service modules** Faculty of Engineering, Built Environment and Information Technology  
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** Module is presented in English

**Department** Mathematics and Applied Mathematics

**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)

<b>Module credits</b>	18.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Education Faculty of Economic and Management Sciences
<b>Prerequisites</b>	WTW 218 and WTW 286/264
<b>Contact time</b>	1 tutorial per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	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)

<b>Module credits</b>	18.00
<b>NQF Level</b>	07
<b>Service modules</b>	Faculty of Engineering, Built Environment and Information Technology Faculty of Economic and Management Sciences Faculty of Humanities
<b>Prerequisites</b>	WTW 114, WTW 123 WTW 124 and WTW 211
<b>Contact time</b>	1 practical per week, 2 lectures per week
<b>Language of tuition</b>	Module is presented in English
<b>Department</b>	Mathematics and Applied Mathematics
<b>Period of presentation</b>	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)

<b>Module credits</b>	18.00
<b>NQF Level</b>	07



**Service modules** Faculty of Engineering, Built Environment and Information Technology  
Faculty of Education

**Prerequisites** WTW 248 and WTW 286/264

**Contact time** 1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**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

**NQF Level** 07

**Prerequisites** WTW 248 and WTW 286/264

**Contact time** 1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**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

**NQF Level** 07

**Service modules** Faculty of Engineering, Built Environment and Information Technology  
Faculty of Education  
Faculty of Humanities

**Prerequisites** WTW 211

**Contact time** 1 tutorial per week, 2 lectures per week

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

**Department** Mathematics and Applied Mathematics

**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.

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