# University of Pretoria Yearbook 2016

# BSc Mathematical Statistics (02133273)

| | |
|---|---|
| **Duration of study** | 3 years |
| **Total credits** | 428 |

## Admission requirements

- In order to register NSC/IEB/Cambridge candidates must comply with the minimum requirements for degree studies as well as the minimum requirements for the relevant study programme.
- 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 for 2016 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **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 (Actuarial and Financial Mathematics) and who obtained an APS of 30 to 33 and a minimum of 6 for Mathematics may be considered for admission to BSc (Actuarial and Financial Mathematics) or another degree in Mathematical Sciences based on the results of the NBT.

Candidates who do not comply with the minimum admission requirements of the other study programmes may be considered for admission to BSc (Mathematics) or BSc (Mathematical Statistics) or for the BSc (Four-year Programme) based on the results of the NBT.

## Other programme-specific information

Students may enrol for AIM 111 and AIM 121 instead of AIM 101 (the same content presented over 2 semesters).

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:**

**First year:**

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)

COS 110 (16)

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

## Second year:

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.

## Third year:

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.

Electives are chosen as follows:

First year – 64 credits

Second year – 48 credits

Third year – 47 credits

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.

# Transitional measures

**Transitional measures for Mathematics modules for 2016**

- Students who would have registered for any of the degrees BSc in Environmental Sciences, Geography, Geoinformatics, BCom, BCom in Economics/Statistics or BScIT Information and Knowledge Systems prior to 2016, and not successfully completed WTW 114, WTW 126 or WTW 128 will be allowed to register for WTW 134, WTW 146 and WTW 148, respectively.
- Students who would have registered for BSc in Geology prior to 2016, and not successfully completed WTW 114, WTW 126 or WTW 128 will be allowed to register for WTW 158, WTW 164 or WTW 124 or WTW 148, respectively.
- Students who registered prior to 2016, and who failed both WTW 126 and WTW 128 will register for WTW 124 in 2016 if they wish to continue with mathematics at 200 level, or if WTW 126 and WTW 128 are required for their respective degree programmes.
- Students who do not qualify for WTW 146 and WTW 148 in terms of their degree programmes, and failed one of WTW 126 or WTW 128, will be allowed to register for the respective module in 2016, and will attend the relevant lectures and tutorials of WTW 124. They will write separate semester tests and exams, covering just the relevant material from WTW 124.
- Students who registered prior to 2016 and passed WTW 126 but not WTW 128, will be allowed to continue with WTW 211 and COS 344 in 2016.
- Students who registered prior to 2016 and passed WTW 128 but not WTW 126, will be allowed to continue with

the modules WTW 220, IAS 211 and GLY 265 in 2016, if they also meet the additional entry requirements.

- Students who registered prior to 2016, and who failed both WTW 161 and WTW 168 will register for WTW 164 in 2016.
- Students who failed one of WTW 161 or WTW 168, will be allowed to register for the respective module in 2016, and will attend the relevant lectures and tutorials of WTW 164. They will write separate semester tests and exams, covering just the relevant material from WTW 164.

# 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**

## Fundamental modules

### Academic information management 111 (AIM 111)

| | |
|---|---|
| **Module credits** | 4.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology<br>Faculty of Education<br>Faculty of Economic and Management Sciences<br>Faculty of Humanities<br>Faculty of Law<br>Faculty of Health Sciences<br>Faculty of Natural and Agricultural Sciences<br>Faculty of Theology |
| **Prerequisites** | No prerequisites. |
| **Contact time** | MAMELODI, 2 lectures per week |
| **Language of tuition** | Both Afr and Eng |
| **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<br>Faculty of Education<br>Faculty of Economic and Management Sciences<br>Faculty of Humanities<br>Faculty of Law<br>Faculty of Health Sciences<br>Faculty of Natural and Agricultural Sciences<br>Faculty of Theology<br>Faculty of Veterinary Science |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 2 lectures per week, MAMELODI |
| **Language of tuition** | Both Afr and Eng |
| **Academic organisation** | Information Science |
| **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<br>Faculty of Veterinary Science |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 2 lectures per week |
| **Language of tuition** | 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** | Double Medium |
| **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<br>Faculty of Economic and Management Sciences<br>Faculty of Humanities<br>Faculty of Law<br>Faculty of Health Sciences<br>Faculty of Natural and Agricultural Sciences<br>Faculty of Theology<br>Faculty of Veterinary Science |
| **Contact time** | 2 lectures per week |
| **Language of tuition** | Both Afr and Eng |
| **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<br>Faculty of Economic and Management Sciences<br>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** | Both Afr and Eng |
| **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<br>Faculty of Economic and Management Sciences<br>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** | Both Afr and Eng |
| **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<br>Faculty of Education<br>Faculty of Economic and Management Sciences<br>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 | Both Afr and Eng |
| 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 | Both Afr and Eng |
| 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 |
| **Prerequisites** | COS 153 or COS 131 or COS 132 and Maths level 5 or WTW 133 |
| **Contact time** | 1 tutorial per week, 1 practical per week, 3 lectures per week |
| **Language of tuition** | Both Afr and Eng |
| **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.

## 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** | Both Afr and Eng |
| **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** | Both Afr and Eng |
| **Academic organisation** | Economics |

**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<br>Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 3 lectures per week |
| **Language of tuition** | 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<br>Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 3 lectures per week |
| **Language of tuition** | 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.

## Aspects of human geography 156 (GGY 156)

| | |
|---|---|
| **Module credits** | 8.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology<br>Faculty of Education<br>Faculty of Humanities<br>Faculty of Health Sciences |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 1 tutorial per week, 3 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 2 |

## Module content

This module begins by fostering an understanding of human geography. Then follows with the political ordering of space; cultural diversity as well as ethnic geography globally and locally; population geography of the world and South Africa: and four economic levels of development. The purpose is to place South Africa in a world setting and to understand the future of the country.

## Southern African geomorphology 166 (GGY 166)

| | |
|---|---|
| **Module credits** | 8.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology<br>Faculty of Education<br>Faculty of Humanities<br>Faculty of Health Sciences |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 4 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 3 |

## Module content

Investigating southern African landscapes and placing them in a theoretical and global context. The geomorphological evolution of southern Africa. Introduction to the concepts of Geomorphology and its relationships with other physical sciences (e.g. meteorology, climatology, geology, hydrology and biology). The processes and controls of landform and landscape evolution. Tutorial exercises cover basic techniques of geomorphological analysis, and topical issues in Geomorphology.

## Climate and weather of Southern Africa 164 (WKD 164)

| | |
|---|---|
| **Module credits** | 8.00 |
| **Service modules** | Faculty of Education<br>Faculty of Humanities |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 4 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 4 |

## Module content

An introduction to the climate and general seasonal climatic circulation patterns of Southern Africa. Basic weather types and weather processes within the Southern African context. Interpretation of synoptic maps and synoptic station reports. Impacts of climate change and extreme climate events on society.
*BSc (Geography) and BSc (Environmental Sciences) students may register for WKD 155. Students are not allowed to earn credits for both WKD 155 and WKD 164.

## Discrete structures 115 (WTW 115)

| | |
|---|---|
| **Module credits** | 8.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology<br>Faculty of Education<br>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** | 1 tutorial per week, 2 lectures per week |
| **Language of tuition** | Both Afr and Eng |
| **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.

# 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** | 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** | 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<br>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** | Both Afr and Eng |
| **Academic organisation** | Computer Science |
| **Period of presentation** | Semester 1 |

## Module content

*Note: All students registered for degrees within the School of IT, excluding the two four year programmes, BIS (Information Science) and BIS (Publishing), need to enrol for this module.

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.

## Geoinformatics 120 (GIS 120)

| | |
|---|---|
| **Module credits** | 12.00 |
| **Prerequisites** | GMC110 |
| **Language of tuition** | Both Afr and Eng |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Semester 2 |

## Module content

The importance of geographical data and an overview of geoinformatics. Cartographic analysis to geoinformatics – a historical perspective. Application fields of geoinformatics. Introduction to geographical information systems (GIS): Components, structure and functionality, GIS visualisation and cartography. Data sources and evaluation: fitness for purpose, factors affecting suitability, quality and uncertainty, sources of analogue and digital data. Map projection choice. Analysis of GIS output.

## 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** | 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** | 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.

# Introduction to environmental sciences 101 (ENV 101)

| | |
|---|---|
| **Module credits** | 8.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology<br>Faculty of Education<br>Faculty of Humanities |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 3 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 1 |

## Module content

Introducing the basic concepts and interrelationships required to understand the complexity of natural environmental problems, physical and human environment, human induced environmental problems, the ways in which the natural environment affects human society and biodiversity, an introduction to major environmental issues in Southern Africa and sustainable development in the context of environmental issues.

# Atmospheric structure and processes 155 (WKD 155)

| | |
|---|---|
| **Module credits** | 16.00 |
| **Prerequisites** | At least 50% for mathematics in grade 12. |
| **Contact time** | 1 practical per week, 4 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |

| **Period of presentation** | Semester 1 |
| --- | --- |

**Module content**

*Students are not allowed to earn credits for WKD 155 and WKD 164

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.

# Curriculum: Year 2

**Minimum credits: 144**

## Core modules

### Mathematical statistics 211 (WST 211)

| | |
|---|---|
| **Module credits** | 24.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology<br>Faculty of Economic and Management Sciences<br>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** | Double Medium |
| **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<br>Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | WST 211 GS |
| **Contact time** | 2 practicals per week, 4 lectures per week |
| **Language of tuition** | Double Medium |
| **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<br>Faculty of Education<br>Faculty of Economic and Management Sciences |
| **Prerequisites** | WTW 124 |
| **Contact time** | 1 tutorial per week, 2 lectures per week |
| **Language of tuition** | Both Afr and Eng |
| **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<br>Faculty of Education<br>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** | Both Afr and Eng |
| **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<br>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** | Both Afr and Eng |
| **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<br>Faculty of Economic and Management Sciences |
| **Prerequisites** | WTW 211 |
| **Contact time** | 1 tutorial per week, 2 lectures per week |
| **Language of tuition** | Both Afr and Eng |
| **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<br>Faculty of Education<br>Faculty of Humanities<br>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 | Both Afr and Eng |
|---|---|
| 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<br>Faculty of Humanities<br>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 | Both Afr and Eng |
| 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.

## Process geomorphology 252 (GGY 252)

| Module credits | 12.00 |
|---|---|
| Service modules | Faculty of Education<br>Faculty of Humanities |
| Prerequisites | GGY 166 or GLY 155 |
| Contact time | 4 lectures per week, 2 practicals per week |
| Language of tuition | English |
| Academic organisation | Geography, Geoinf + Meteor |
| Period of presentation | Quarter 2 |

**Module content**

Physical processes that influence the earth's surface and management. Specific processes and their interaction in themes such as weathering; soil erosion; slope, mass movement and fluvial processes. Practical laboratory exercises are based on the themes covered in the module theory component.

## Geomorphology of the built environment 265 (GGY 265)

| | |
|---|---|
| **Module credits** | 12.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 4 lectures per week |
| **Language of tuition** | Double Medium |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 3 |

**Module content**

*This module is for Architecture and Landscape Architecture students only.
The theory component covers geomorphological aspects of the built environment including landscape identification; weathering or deterioration of natural stone and application to design and preservation of buildings and monuments; slope hydrology and stability conditions; soil erosion processes and construction impacts; drainage modification in urban areas; wetland identification, human impacts and rehabilitation; recreational impacts and management. In addition to the theory a field-based project is undertaken.

## Geographic data analysis 220 (GIS 220)

| | |
|---|---|
| **Module credits** | 12.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 2 lectures per week, 1 practical per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Semester 2 |

**Module content**

The nature of geographical data and measurement. Probability, probability distributions and densities, expected values and variances, Central Limit theorem. Sampling techniques. Exploratory data analysis, descriptive statistics, statistical estimation, hypothesis testing, correlation analysis and regression analysis.

## Geographic information systems introduction 221 (GIS 221)

| | |
|---|---|
| **Module credits** | 12.00 |
| **Prerequisites** | Prohibited combination GGY 283 |
| **Contact time** | 1 practical per week, 2 lectures per week |

| Language of tuition | English |
|---|---|
| Academic organisation | Geography, Geoinf + Meteor |
| Period of presentation | Semester 2 |

**Module content**

*The content of this module is the same as GGY 283 and students are not allowed to earn credits for both GGY 283 and GIS 221.
Introduction to Geographic Information Systems (GIS), theoretical concepts and applications of GIS. The focus will be on the GIS process of data input, data analysis, data output and associated technologies.

## Actuarial mathematics 211 (IAS 211)

| Module credits | 12.00 |
|---|---|
| Service modules | Faculty of Economic and Management Sciences |
| Prerequisites | WTW 114, WTW 128, WTW 126, WTW 123, WST 111, WST 121 |
| Contact time | 1 practical per week, 3 lectures per week |
| Language of tuition | Both Afr and Eng |
| 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, life tables, derivation of contingent probabilities from life tables, contingent payments, 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 | Both Afr and Eng |
| Academic organisation | Actuarial Science |
| Period of presentation | Semester 2 |

**Module content**

Fundamentals of survival models, simple laws of mortality, expectation of life, elementary survival contracts, commutation functions, 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 | 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. Loan schedules. 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<br>Faculty of Education<br>Faculty of Natural and Agricultural Sciences |
| Prerequisites | AIM 101 or AIM 111 and AIM 121 |
| Contact time | 2 practicals per week, 2 lectures per week |
| Language of tuition | Both Afr and Eng |
| 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.

## Physical meteorology 261 (WKD 261)

| Module credits | 12.00 |
|---|---|
| Prerequisites | WTW 114 |
| Contact time | 4 lectures per week, 1 tutorial per week |
| Language of tuition | English |
| Academic organisation | Geography, Geoinf + Meteor |
| Period of presentation | Quarter 1 |

**Module content**

Conservative forces and conservation laws. Basic thermodynamic laws for dry and humid air. The equation of state. Adiabatic processes and temperature lapse rates. The Clausuis-Claperon equation. Calculation of the wet adiabat.

# Differential equations 256 (WTW 256)

| | |
|---|---|
| **Module credits** | 8.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology |
| **Prerequisites** | WTW 158 and WTW 164 |
| **Contact time** | 2 lectures per week, 1 discussion class per week |
| **Language of tuition** | Both Afr and Eng |
| **Academic organisation** | Mathematics and Applied Maths |
| **Period of presentation** | Semester 1 |

**Module content**

Theory and solution methods for linear differential equations as well as for systems of linear differential equations. Theory and solution methods for first order non-linear differential equations. The Laplace transform with application to differential equations. Application of differential equations to modelling problems.

# Calculus 258 (WTW 258)

| | |
|---|---|
| **Module credits** | 8.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology |
| **Prerequisites** | WTW 158 and WTW 164 |
| **Contact time** | 2 lectures per week, 1 tutorial per week |
| **Language of tuition** | Both Afr and Eng |
| **Academic organisation** | Mathematics and Applied Maths |
| **Period of presentation** | Semester 1 |

**Module content**

Calculus of multivariable functions, directional derivatives. Extrema. Multiple integrals, polar, cylindrical and spherical coordinates. Line integrals and the theorem of Green. Surface integrals and the theorems of Gauss and Stokes.

# Numerical methods 263 (WTW 263)

| | |
|---|---|
| **Module credits** | 8.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology |
| **Prerequisites** | WTW 164 |
| **Contact time** | 1 tutorial per week, 2 lectures per week |
| **Language of tuition** | Both Afr and Eng |
| **Academic organisation** | Mathematics and Applied Maths |
| **Period of presentation** | Semester 2 |

## Module content

Numerical integration. Numerical methods to approximate the solution of non-linear equations, systems of equations (linear and non-linear), differential equations and systems of differential equations. Direct methods to solve linear systems of equations.

## Discrete structures 285 (WTW 285)

| | |
|---|---|
| **Module credits** | 12.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology<br>Faculty of Education |
| **Prerequisites** | WTW 115 |
| **Contact time** | 1 tutorial per week, 2 lectures per week |
| **Language of tuition** | 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** | 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.

## City structure, environment and society 266 (GGY 266)

| | |
|---|---|
| **Module credits** | 24.00 |
| **Service modules** | Faculty of Education<br>Faculty of Humanities |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 1 practical per week, 3 lectures per week |

| Language of tuition | English |
|---|---|
| Academic organisation | Geography, Geoinf + Meteor |
| Period of presentation | Semester 2 |

#### Module content

An urbanising world. Urban structure and land use. Urban processes. The urban environment. Social structure and change in cities. Living in the city. Economy, society and politics in the city. Third-world cities and South African cities. Urban futures.

## Introduction to dynamic meteorology 263 (WKD 263)

| Module credits | 12.00 |
|---|---|
| Prerequisites | WTW 126 and WTW 128 (students should simultaneously be enrolled for WTW 218). |
| Contact time | 1 tutorial per week, 4 lectures per week |
| Language of tuition | English |
| Academic organisation | Geography, Geoinf + Meteor |
| Period of presentation | Quarter 2 |

#### Module content

Vector algebra, curl of a vector, total and partial derivatives, second law of motion. Spherical coordinates Acceleration in rotating co-ordinates, fundamental forces, momentum equation. Three dimensional flow balance, conservation of mass, heat equation, thermodynamic energy equation. Introduction to finite difference methods. Numerical estimation of the geostrophic wind, vorticity and divergence. Advection of temperature. Development of a two-dimensional temperature advection model.

## Differential equations 264 (WTW 264)

| Module credits | 12.00 |
|---|---|
| Service modules | Faculty of Education<br>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 | 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.

# Economics 234 (EKN 234)

| | |
|---|---|
| **Module credits** | 16.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology<br>Faculty of Education<br>Faculty of Humanities<br>Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | EKN 214, STK 120 |
| **Contact time** | 3 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Economics |
| **Period of presentation** | Semester 2 |

## Module content

Macroeconomics
Application of the principles learned in EKN 214 on the world we live in. We look at international markets and dynamic macroeconomic models, and familiarise the students with the current macroeconomic policy debates. We also take a look at the latest macroeconomic research in the world. The course includes topics of the mathematical and econometric analysis of macroeconomic issues.

# Economics 244 (EKN 244)

| | |
|---|---|
| **Module credits** | 16.00 |
| **Service modules** | Faculty of Humanities<br>Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | EKN 224, STK 120 |
| **Contact time** | 3 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Economics |
| **Period of presentation** | Semester 2 |

## Module content

Microeconomics
From general equilibrium and economic welfare to uncertainty and asymmetric information. In this module we apply the principles learned in EKN 224 on the world around us by looking at the microeconomic principles of labour and capital markets, as well as reasons why the free market system could fail. We touch on the government's role in market failures. The course includes topics of the mathematical and econometric analysis of microeconomic issues.

# Curriculum: Final year

**Minimum credits: 144**

## 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** | 1 practical per week, 3 lectures per week |
| **Language of tuition** | 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<br>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** | Double Medium |
| **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. 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<br>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** | Double Medium |
| **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<br>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** | Double Medium |
| **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<br>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** | Double Medium |

| 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. The generalised linear model: Exponential family, mean and variance, link functions, deviance and residual analysis, test statistics, log-linear and logit models. 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<br>Faculty of Education<br>Faculty of Humanities<br>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 | Double Medium |
| 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 | 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<br>Faculty of Education<br>Faculty of Humanities<br>Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | EKN 310 GS |
| **Contact time** | 1 discussion class per week, 2 lectures per week |
| **Language of tuition** | Double Medium |
| **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.

## Economics 325 (EKN 325)

| | |
|---|---|
| **Module credits** | 20.00 |
| **Service modules** | Faculty of Humanities<br>Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | EKN 214, EKN 234 |
| **Contact time** | 2 lectures per week, 1 discussion class per week |
| **Language of tuition** | English |
| **Academic organisation** | 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.

## Environmental geomorphology 361 (GGY 361)

| | |
|---|---|
| **Module credits** | 18.00 |
| **Service modules** | Faculty of Humanities |
| **Prerequisites** | GGY 252 and only for students studying BSc (Geography) or BSc (Environmental Sciences). |
| **Contact time** | 4 lectures per week, 2 practicals per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 4 |

**Module content**

*Note: The module is available for BSc (Geography) and BSc (Environmental Sciences) students only. The theory content of this module is the same as GGY 363 and students are not allowed to earn credits for both GGY 361 and GGY 363.

Interactions of geomorphic processes within the physical and built environments; themes such as geomorphology and environmental change, slope processes and the environment, geomorphic risks and hazards, soil erosion and conservation, geomorphology in environmental management, applied weathering. Practicals involve fieldwork including sampling and mapping and subsequent laboratory analysis.

## Applied geomorphology 363 (GGY 363)

| | |
|---|---|
| **Module credits** | 12.00 |
| **Service modules** | Faculty of Education |
| **Prerequisites** | GGY 252 |
| **Contact time** | 4 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 4 |

## Module content

*Note: The content of this module is the same as GGY 361 and students are not allowed to earn credits for both GGY 361 and GGY 363.

Interactions of geomorphic processes within the physical and built environments; themes such as geomorphology and environmental change, slope processes and the environment, geomorphic risks and hazards, soil erosion and conservation, geomorphology in environmental management, applied weathering.

## Geographic information systems 310 (GIS 310)

| | |
|---|---|
| **Module credits** | 24.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology |
| **Prerequisites** | GGY 283 or GIS 221 |
| **Contact time** | 1 practical per week, 2 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Semester 1 |

## Module content

Advanced theory and practice of Geographic Information Systems; GIS applications; design and implementation of GIS applications.

## Spatial analysis 320 (GIS 320)

| | |
|---|---|
| **Module credits** | 24.00 |
| **Service modules** | Faculty of Engineering, Built Environment and Information Technology |
| **Prerequisites** | GIS 310 or TDH |
| **Contact time** | 2 lectures per week, 1 practical per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Semester 2 |

## Module content

Construction of Raster Geovisualisations, spatial model construction and use, multi-criteria decision analysis. Factor analysis: Principle component analysis. Geostatistics: Spatial dependence modelling, ordinary kriging. Markov chains and cellular Automata, combined models.

## Insurance and actuarial applications 361 (IAS 361)

| | |
|---|---|
| **Module credits** | 18.00 |
| **Prerequisites** | IAS 211 and IAS 221 |
| **Contact time** | 3 lectures per week |
| **Language of tuition** | English |

| Academic organisation | Actuarial Science |
|---|---|
| Period of presentation | Semester 1 |

**Module content**

Risk and insurance. Stakeholders and the external environment. Professionalism. Actuaries and the regulatory environment. Insurance products and their providers. Pricing of insurance products. Wider fields of actuarial practice. Reinsurance. New developments in the industry.

## 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 | 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.

## Atmospheric vorticity and divergence 352 (WKD 352)

| Module credits | 18.00 |
|---|---|
| Prerequisites | WKD 263 GS and WTW 248 GS |
| Contact time | 1 tutorial per week, 4 lectures per week |
| Language of tuition | English |
| Academic organisation | Geography, Geoinf + Meteor |
| Period of presentation | Quarter 3 |

**Module content**

Scale analyses and simplification of the basic equations. The geostrophic, thermal and gradient wind. The vorticity equation and divergence.

## Quasi-geostrophic analysis 361 (WKD 361)

| Module credits | 20.00 |
|---|---|
| Prerequisites | WKD 352 GS and WKD 254 |
| Contact time | 4 lectures per week, 1 practical per week |

| Language of tuition | English |
|---|---|
| Academic organisation | Geography, Geoinf + Meteor |
| Period of presentation | Quarter 4 |

**Module content**

Tendency and Omega equations. Model of a boroclinic system. Introduction to numerical models. Application in meteorological display and analysis software.

## Analysis 310 (WTW 310)

| Module credits | 18.00 |
|---|---|
| Service modules | Faculty of Education<br>Faculty of Economic and Management Sciences<br>Faculty of Humanities |
| Prerequisites | WTW 220 |
| Contact time | 2 lectures per week, 1 tutorial per week |
| Language of tuition | Double Medium |
| 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.

## 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 | Double Medium |
| 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<br>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** | Double Medium |
| **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** | 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<br>Faculty of Economic and Management Sciences<br>Faculty of Humanities |
| **Prerequisites** | WTW 114 and WTW 211 |
| **Contact time** | 1 tutorial per week, 2 lectures per week |
| **Language of tuition** | Double Medium |
| **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<br>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** | Double Medium |
| **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<br>Faculty of Economic and Management Sciences<br>Faculty of Humanities |
| **Prerequisites** | WTW 114, WTW 124 and WTW 211 |
| **Contact time** | 2 lectures per week, 1 practical per week |
| **Language of tuition** | Double Medium |
| **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** | 1 tutorial per week, 2 lectures per week |
| **Language of tuition** | Double Medium |
| **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** | Double Medium |
| **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<br>Faculty of Education<br>Faculty of Humanities |
| **Prerequisites** | WTW 211 |
| **Contact time** | 2 lectures per week, 1 tutorial per week |
| **Language of tuition** | Double Medium |
| **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.

# Sustainable development 356 (GGY 356)

| | |
|---|---|
| **Module credits** | 18.00 |
| **Service modules** | Faculty of Education<br>Faculty of Humanities |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 3 lectures per week, 1 practical per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 1 |

**Module content**

The module conceptually integrates environmental, economic, and social components of sustainable development. Other topics covered include changing perceptions on development and environment, development paradigms, challenges of sustainable development, actors and actions in sustainable development, rural and urban livelihoods, and a Third World assessment of sustainable development in the developing world.

# Development frameworks 366 (GGY 366)

| | |
|---|---|
| **Module credits** | 18.00 |
| **Service modules** | Faculty of Education<br>Faculty of Humanities |
| **Prerequisites** | No prerequisites. |
| **Contact time** | 3 lectures per week, 1 practical per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |
| **Period of presentation** | Quarter 3 |

**Module content**

Classic development frameworks. Spatial development history and legacy in South Africa. Overview of contemporary environmental legislation in South Africa. Rural development strategy. Rural and agricultural reconstruction. Land reform. Urban development and strategy. Urban spatial reconstruction. National spatial development frameworks.

# Fundamentals of weather forecasting 366 (WKD 366)

| | |
|---|---|
| **Module credits** | 36.00 |
| **Prerequisites** | WKD 155, WKD 261, WKD 254 (students should simultaneously be enrolled for WKD 361) |
| **Contact time** | 1 practical per week, 4 lectures per week |
| **Language of tuition** | English |
| **Academic organisation** | Geography, Geoinf + Meteor |

| **Period of presentation** | Semester 2 |

## Module content

Meterological observations data codes. Weather applications software and computing environments of meteorological analysis and weather forecasting techniques. Applications of remote sensing in weather forecasting. Aaerological diagrams. Applications of numerical weather prediction, and types of weather forecasts. Integration of information to describe the current state of the atmosphere and to predict a future state of the atmosphere.

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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.