University of Pretoria Yearbook 2025

MSc specialising in eScience (Coursework) (02250197)

Department	Statistics
Minimum duration of study	2 years
Total credits	180
NQF level	09

Programme information

The curriculum for this degree programme comprises 180 credits of coursework and a research component. One of the key features of the curriculum is a capstone project that runs parallel with coursework modules in the first year of study. During the capstone project, students will go through the entire cycles of solving a real-world data science problem, collecting and processing real-world data, designing methods to solve the problem, and implementing a solution. The capstone project and coursework prepare the student for the mini-dissertation problem supervised by an expert.

Admission requirements

General Admission Regulations:

Refer to the UP Institutional Admissions Policy as well as the General Academic Regulations and Student Rules (*Go to www.up.ac.za./yearbooks/home and click on General Rules and Regulations, then on General Academic Regulations and Student Rules*)

1. All applications must be accompanied by the following documents:
   a. Certified full academic transcripts from undergraduate to current level;
   b. Certified copy of ID or passport;
   c. A research concept note (not applicable to honours or coursework master's degrees): A description of the proposed research field indicating a research topic and the broad scope of the proposed study, not exceeding 500 words.
2. All applicants with international qualifications must submit the following documents, subject to provision number 9:
   a. A SAQA evaluation of the completed qualification or a comprehensive Foreign Qualification Report
   b. *TOEFL or IELTS or Pearson Test of English or Oxford Test of English test results (if applicable)
   c. Certified copy of passport.
3. All postgraduate applications are subject to departmental admissions processes.
4. Admissions is based on the content of and performance in the prior degree, bridging arrangements

(where required), academic merit and prior work experience (if applicable).
5. Admission to all qualifications is subject to supervisory capacity and/or research projects in the field of specialisation in a department, therefore the relevant department has the right to limit the number of students per year.
6. Complying with the minimum admissions requirements, does not automatically guarantee admission to the degree.
7. Proposed research studies for masters and doctoral applicants should align with the research focus of the relevant department.
8. *If a qualifying candidate has expressed an interest in a field of study that the relevant department cannot accommodate, the applicant may be considered for an alternative project.*
9. All postgraduate applicants must be proficient in English as English is the official language of tuition, communication and correspondence at the University of Pretoria. Candidates who cannot provide evidence that previous studies were completed in English, must submit TOEFL or IELTS or Pearson Test of English or Oxford Test of English test results with their application.
10. All applicants must be computer literate.
11. All students need to have access to an internet enabled device, as well as consistent email and internet access.
12. Allowance will be made for the diversity profile of students in accordance with the University strategy.

Minimum admissions requirements

1. Honours degree in either Statistics, Mathematics, Computer Science, Physics, or related fields
2. Demonstrate knowledge of basic principles of probability and statistics, computing, calculus and linear algebra
3. A weighted average of at least 65% at final-year level, but students with a weighted average of at least 70% will receive preference

Note: An admissions examination may be required

Promotion to next study year

The progress of all master's candidates is monitored biannually by the supervisor and the postgraduate coordinator. A candidate's study may be terminated if the progress is unsatisfactory or if the candidate is unable to finish his/her studies during the prescribed period.

Subject to exceptions approved by the Dean, on recommendation of the head of department, and where applicable, a student may not enter for the master's examination in the same module more than twice.

Curriculum: Year 1

Choose 4 modules to the value of 60 credits from the list of electives.

Core modules

Research methods and capstone project in data science 801 (NEP 801)

Module credits	15.00
NQF Level	09
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

Scientific writing styles; layouts for assignments, projects, theses or publications; research methodologies; scientific assignments; integration of all the aforementioned content items for a capstone project in data science.

Data privacy and ethics 802 (NEP 802)

Module credits	15.00
NQF Level	09
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

Technical processes of data collection, storage, exchange and access; Ethical aspects of data management; Legal and regulatory frameworks in South Africa and in relevant jurisdictions; Data policies; Data privacy; Data ownership; Legal liabilities of analytical decisions and discrimination; and the Technical and algorithmic approaches to enhance data privacy, and relevant case studies.

Elective modules

Adaptive computation and machine learning 803 (NEP 803)

Module credits	15.00
NQF Level	09
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English

Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

Introduction: Basic concepts. Supervised learning setup: Least means squares, logistic regression, perceptron, exponential family, generative learning algorithms, Gaussian discriminant analysis, naïve Bayes, support vector machines, model selection and feature selection. Learning theory: bias/variance tradeoff, union and Chernoff/Hoeffding bounds, VC dimension, worst case (online) learning. Unsupervised learning: clustering, k-means, expectation maximisation, mixture of Gaussians, factor analysis, principal components analysis, independent components analysis. Reinforcement learning and control: Markov decision processes, Bellman equations, value iteration and policy iteration, Q-learning, value function approximation, policy search, reinforce, partially observable Markov decision problems.

Data visualisation and exploration 804 (NEP 804)

Module credits	15.00
NQF Level	09
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

Data and image models; visualisation attributes (colour) and design (layout); exploratory data analysis; interactive data visualisation; multidimensional data; graphical perception; visualisation software (Python & R); and types of visualisation (animation, networks and text).

Large-scale computing systems and scientific computing 805 (NEP 805)

Module credits	15.00
NQF Level	09
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

Introduction to scientific computing architectures in Python, introduction to distributed systems, introduction to distributed databases, introduction to parallelism, large-data computation and storage models, introduction to well-known distributed systems architectures, and programming large-data applications on open-source infrastructures for data processing and storage systems.

Mathematical foundations of data science 806 (NEP 806)

Module credits	15.00

NQF Level	09
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

High-dimensional space, best-fit subspaces and singular value decomposition, random walks and Markov chains, statistical machine learning, clustering, random graphs, topic models, matrix factorisation, hidden Markov models, graphical models, wavelets, and sparse representations.

Special topics in data science 807 (NEP 807)

Module credits	15.00
NQF Level	09
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

Specialised and applied concepts and trends in data science.

Statistical foundations of data science 808 (NEP 808)

Module credits	15.00
NQF Level	09
Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

An understanding of multivariate statistics, hypothesis testing and confidence intervals. The ability to model data using well-known statistical distributions as well as the ability to handle data that is both continuous and categorical. The ability to perform statistical modelling including multivariate linear regression and adjust for multiple hypotheses. Forecasting, extrapolation, prediction and modelling using statistical methods. Bayesian statistics, an understanding of bootstrapping and Monte Carlo simulation.

Large-scale optimisation for data science 809 (NEP 809)

Module credits	15.00
NQF Level	09

Prerequisites	No prerequisites.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Semester 1 or Semester 2

Module content

Introduction to convex optimisation, subgradient methods, decomposition and distributed optimisation, proximal and operator splitting methods, conjugate gradients, and nonconvex problems.

Curriculum: Final year

Fundamental modules

Mini-dissertation: eScience 800 (NEP 800)

Module credits	90.00
NQF Level	09
Prerequisites	Completion of the coursework programme.
Language of tuition	Module is presented in English
Department	Statistics
Period of presentation	Year

Module content

This is the research component of the MSc (eScience) degree and comprises a mini-dissertation which develops the research skills and bridges the gap between theory and practice.

General Academic Regulations and Student Rules

The General Academic Regulations (G Regulations) and General Student Rules apply to all faculties and registered students of the University, as well as all prospective students who have accepted an offer of a place at the University of Pretoria. On registering for a programme, the student bears the responsibility of ensuring that they familiarise themselves with the General Academic Regulations applicable to their registration, as well as the relevant faculty-specific and programme-specific regulations and information as stipulated in the relevant yearbook. Ignorance concerning these regulations will not be accepted as an excuse for any transgression, or basis for an exception to any of the aforementioned regulations. The G Regulations are updated annually and may be amended after the publication of this information.

Regulations, degree requirements and information

The faculty regulations, information on and requirements for the degrees published here are subject to change and may be amended after the publication of this information.

University of Pretoria Programme Qualification Mix (PQM) verification project

The higher education sector has undergone an extensive alignment to the Higher Education Qualification Sub-Framework (HEQSF) across all institutions in South Africa. In order to comply with the HEQSF, all institutions are legally required to participate in a national initiative led by regulatory bodies such as the Department of Higher Education and Training (DHET), the Council on Higher Education (CHE), and the South African Qualifications Authority (SAQA). The University of Pretoria is presently engaged in an ongoing effort to align its qualifications and programmes with the HEQSF criteria. Current and prospective students should take note that changes to UP qualification and programme names, may occur as a result of the HEQSF initiative. Students are advised to contact their faculties if they have any questions.