# University of Pretoria Yearbook 2023

# BScHons (Mathematical Statistics) (02240192)

| | |
|---|---|
| **Department** | Statistics |
| **Minimum duration of study** | 1 year |
| **Total credits** | 135 |
| **NQF level** | 08 |

## Admission requirements

1. Bachelor's degree with mathematical statistics **or** relevant bachelor's degree
2. A weighted average of at least 65% for Mathematical Statistics at final-year level
3. An admission examination may be required

Note: Additional modules may be required in order to reach the desired level of competency

## Promotion to next study year

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

## General 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 (HEQF) 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.*

# Curriculum: Final year

**Minimum credits: 135**

Core credits: 60

Elective credits: 75

## Core modules

### Linear models 710 (LMO 710)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistic |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 |

**Module content**

Projection matrices and sums of squares of linear sets. Estimation and the Gauss-Markov theorem. Generalised t- and F- tests.

### Multivariate analysis 710 (MVA 710)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 or Semester 2 |

**Module content**

Matrix algebra. Some multivariate measures. Visualising multivariate data. Multivariate distributions. Samples from multivariate normal populations. The Wishart distribution. Hotelling's $T^2$ statistic. Inferences about mean vectors.

### Research orientation 796 (STK 796)

| | |
|---|---|
| **Module credits** | 0.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Economic and Management Sciences |
| **Prerequisites** | Admission to the relevant programme. |
| **Contact time** | Ad Hoc |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Year |

**Module content**

A compulsory bootcamp must be attended as part of this module – usually presented during the last week of January each year (details are made available by the department ). The bootcamp will cover the basics of research to prepare students for the research component of their degree. The bootcamp should be done in the same year as registration for STK 795/WST 795. Each year of registration for the honours degree will also require the attendance of three departmental seminars. Students should ensure that their attendance is recorded by the postgraduate co-ordinator present at the seminars. The department approves the seminars attended. In addition, students are required to present their STK 795/WST 795 research in the department during the year of registration for these modules.

### Research report: Mathematical statistics 795 (WST 795)

| | |
|---|---|
| **Module credits** | 30.00 |
| **NQF Level** | 08 |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Year |

**Module content**

Refer to the document: Criteria for the research management process and the assessment of the honours essays, available on the web:  www.up.ac.za under the Department of Statistics: postgraduate study.

## Elective modules

### Introduction to statistical learning 720 (EKT 720)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | RAL 780 or WST 311, 312, 321 |

| | |
|---|---|
| **Contact time** | 1 lecture per week, 1 web-based period per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 2 |

**Module content**

The emphasis is on the theoretical understanding and practical application of advances in statistical modelling. The following topics are covered: Single equation models: Nonparametric regression. Bootstrap procedures within regression analysis, k-nearest neighbour classification. Modelling categorical dependent variables - Logit/Probit models. Multiple outputs. Linear regression of an indicator matrix. Ridge regression. Non-linear regression modelling.  Some new developments in regression and classification.
Simultaneous equation models: Specification, identification and estimation of simultaneous equation models.

## Text and behavioural analytics 725 (EKT 725)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics or BScHons Statistics and Data Science or BComHons Statistics and Data Science |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 or Semester 2 |

**Module content**

Mixtures of distributions and regressions, frequentist and Bayes estimation. Latent components, soft allocation and belongings. Applications in unstructured data, including text data. Identification and interpretation of behavioural patterns.

## Linear models 720 (LMO 720)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | LMO 710 |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 2 |

**Module content**
The singular normal distribution. Distributions of quadratic forms. The general linear model. Multiple comparisons. Analysis of covariance. Generalised linear models. Analysis of categorical data.

## Multivariate analysis 720 (MVA 720)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Health Sciences<br>Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | MVA 710 |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 2 |

**Module content**
Discriminant analysis and classification. Principal component analysis. The biplot. Multidimensional scaling. Factor analysis. Probabilistic clustering.

## Parametric stochastic processes 720 (PNP 720)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Economic and Management Sciences |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 or Semester 2 |

**Module content**
Introduction to statistical measure theory. Queueing processes: M/M/1; M/M/S; M/G/1 queues and variants; limiting distribution of the queue length and waiting times. Queuing networks. Some stochastic inventory and storage processes.

## Sampling techniques 720 (SFT 720)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Natural and Agricultural Sciences |

| | |
|---|---|
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics or BScHons Statistics and Data Science or BComHons Statistics and Data Science |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 or Semester 2 |

**Module content**

Simple random sampling. Estimation of proportions and sample sizes. Stratified random sampling. Ratio and regression estimators. Systematic and cluster sampling. Introduction to spatial statistics. Spatial sampling – both model and design based approaches.

## Simulation and computation 710 (STC 710)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics or BScHons Statistics and Data Science or BComHons Statistics and Data Science |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 or Semester 2 |

**Module content**

Efficient programming, Monte Carlo simulation, sampling of discrete and continuous probability models, General transformation methods, Accept-reject methods, Monte Carlo integration, importance sampling, numerical optimisation, Metropolis-Hastings algorithm, GIBBS sampling.

## Capita selecta: Statistics 720 (STC 720)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics or BScHons Statistics and Data Science or BComHons Statistics and Data Science |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 or Semester 2 |

**Module content**
This module considers specific topics from the diverse field of statistics as deemed supportive towards the training of the cohort of scholars.

## Linear mixed models 781 (STK 781)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics or BScHons Statistics and Data Science or BComHons Statistics and Data Science |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 or Semester 2 |

**Module content**

Specification of linear mixed model, model assumptions, estimation (REML and ML), diagnostics, hypothesis tests, interpretation of parameter estimates, calculating predicted values. Specific models: two- and three-level models for clustered data, intraclass correlation coefficients, repeated measures data, random coefficient models for longitudinal data, models for clustered longitudinal data, models for data with crossed random factors. Using statistical software to analyse LMMs.

## Distribution-free methods 710 (VMT 710)

| | |
|---|---|
| **Module credits** | 15.00 |
| **NQF Level** | 08 |
| **Service modules** | Faculty of Natural and Agricultural Sciences |
| **Prerequisites** | Admission to either BScHons Mathematical Statistics or BComHons Mathematical Statistics |
| **Contact time** | 1 lecture per week |
| **Language of tuition** | Module is presented in English |
| **Department** | Statistics |
| **Period of presentation** | Semester 1 or Semester 2 |

**Module content**

A selection of: Nonparametric stochastic processes. Power and asymptotic power of distribution-free procedures. Theory and simulation. Asymptotic relative efficiency. Linear rank tests: Definition, properties and applications. Equal in distribution technique. Counting and ranking statistics. Introduction to one and two sample U-statistics. Permutation and distribution-free rank-like statistics. Multi-sample distribution-free tests, rank correlation and regression. Some nonparametric bootstrap and smoothing methods.

### Regulations and rules

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

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.

### 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 (HEQF) 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.