UNIVERSITY of TECHNOLOGY, MAURITIUS

School of Innovative Technologies & Engineering

Department of Industrial Systems Engineering

MSc Biometry

PROGRAMME DOCUMENT

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MSc BIOMETRY

A. Programme Information

i. Introduction

A career as a …

Biometrician

Making sense of biological variation

What is Statistics? …and ….What is Biometry?

STATISTICS gives meaning to numbers and includes all the ways in which data are collected, processed and interpreted.

BIOMETRY is the branch of statistics which is concerned with applications in the biological sciences.

What sort of work does a statistician do?

- Planning and collection of data
- Processing and analysis of data
- Drawing conclusions from data
- Making reasonable decisions based on the results of the data analysis

Professionals in many fields, such as commerce, actuarial science, operations research and economics require a sound knowledge of statistics.

Statisticians would have a mathematical aptitude and have a good sense for analysing problems. They should also be able to interact with, and to present their findings in an understandable fashion, to a variety of people who are not skilled in statistical matters. Statisticians and Biometricians are required to deal with large data sets. The processing and analysis of this data makes extensive use of the computer. They should therefore be able to use computers competently (and more specifically, statistical packages).

Biometry is thus an exciting scientific field in which statistical practice and methodology go hand in hand with research in agriculture, biology, medicine, environmental studies, biotechnology etc. Indeed, the rapid growth of biological and medical research promises that, on a worldwide scale, the need and the role of biometricians/biostatisticians will continue to grow.

ii. Learning Objectives.

Biometricians working in the biological sciences may be tackling problems in:

- Genetics – for example, analysing the heritability of a rare disease through genetic pedigrees, or the patterns of gene expression using microarrays
- Agriculture – for example, testing the performance of new crop varieties, or the efficacy of precision application for reducing pesticide inputs
- Epidemiology – for example, modelling the spread of citrus disease in an orchard, or estimating the prevalence of *E. coli* in cattle
- Medical Research – for example, modelling the spread of HIV, or estimating the prevalence of *diabetes type II* in Mauritius.
- Forensics – for example, modelling the data for e.g. Fingerprints, DNA analysis in criminal investigation
- Toxicology – for example, developing methods for reducing the number of animals in dose-response

studies
- Ecology – for example, modelling population change of sea mammals
- Meteorology – for example, modelling data about climate change
- Environment – for example, modelling data about environment impact assessment (EIA) and especially the different factors affecting environmental equilibrium, e.g. a study on the extent to which mangroves helps in preventing soil erosion on our beaches

iii. Target Audience

Students mainly come from mathematically oriented fields. Graduates from other scientific fields like Biology, Botany, Biotechnology, Food Science, Microbiology, Chemistry, Biochemistry, Agriculture, Environmental studies and Medical studies are also encouraged to apply provided they can prove excellent mathematical skills.

This new course offers a well-balanced, fine-tuned programme with lecture courses, homework assignments, hands-on experience and papers all focused on the same subject: biometry.

iv. Work Placement

There are possibilities of placement in some organizations (students will be informed of these organizations). The duration of the work placement will be about six weeks. It will not be assessed, but it will be mandatory that students submit a report which has to be dully signed by the student and the supervisor of the organization.

B. Programme Aims

i. Aim of Programme

The MSc in Biometry programme focuses on developing students' readiness in solving problems of complex systems in science and biotechnology by means of computational modelling, analysis and simulations. Furthermore, they learn to develop novel, robust computational procedures to be utilized effectively in different settings.

Scientific interdisciplinary problem-solving will be emphasized, through a Master Project that may be done internally or with the industry.

This programme will prepare the intended postgraduate to be a highly versatile person who can operate beyond the traditional boundaries of separate disciplines.

Graduates will be prepared for positions in scientific research, for MPhil/PhD programmes, national and international alike, and positions in the Biotechnology industry, Agriculture and Agro-Industry, Medical and paramedical, Environmental sciences and related fields.

ii. Relevance to other programmes within the school

UTM students who have already done a BSc in computing related field can readily apply for this MSc if they wish to go for an interdisciplinary field. UTM students would already have the necessary programming skills, basic mathematical background, the essential analysis and design skills and obviously the skills in developing software.

iii. Employment job Prospects

Possibility of employment may come from the following local and international organisations/companies:

1. Agricultural Research Extension Unit (AREU)
2. The Ministry of Agro-industry and Fisheries (MOAF)
3. The Ministry of Environment (MOE)
4. The Ministry of Health (MOH)
5. Mauritius Oceanography Institute (MOI)

6. Mauritius Sugar Industry Research Institute (MSIRI)
7. University of Mauritius (UOM)
8. Central Statistical Office (CSO)
9. SSR Medical Research Centre
10. Food and Agricultural Research Council (FARC)
11. World Health Organisation (WHO)
12. UNESCO
13. Mauritius Wildlife Foundation(MWF)
14. Dairy Product companies like Panagora Marketing
15. The Forensic department of the Police Force (Forensic Science laboratory)
16. The Meteorological station
17. Human Resource Development Council (HRDC)
18. University of Technology, Mauritius (UTM)

C. Programme Objectives

i. Learning outcome

Semester 1: Provide the basic knowledge on different application areas of biometry and use of some basic statistical tools & packages; it introduces the students to Life Sciences, Statistics for Life Sciences; Medical & Epidemiological Statistics, and more importantly it provides the students with required skills for research with the module Experimental Design and Research.

Semester 2: Provides for more advanced concepts, e.g. Multivariate data analysis, Time to Event analysis, Generalised Linear Models and Statistical Genetics.

ii. Objectives

- To collect data effectively and in a scientific manner. Data collection is a typical aspect of modern research.
- To present the data (graphically)
- To handle data (summary statistics)
- To interpret data
- To provide the appropriate statistical inference (output) for the scientific questions under consideration
- To encourage students to use some statistical software like SPSS, R, SAS, S Plus or any other statistical software
- To be responsible for the design of the sampling procedures and experiments
- To assess the reliability of the scientific conclusions
- To prepare students to become a member of a multidisciplinary team. The students therefore should have good communication skills. Moreover they should be able to deliver clear scientific reports.
- To provide for regular communication workshop, statistical reading & scientific reporting
- To introduce students to basic development of statistical software or expert systems and this is a growing requirement for ensuring knowledge transfer to research users, e.g. Biological problems may require the development of innovative statistical methodology which is suitable for publication in statistics journals.

In collaboration with researchers the biometrician translates the relevant scientific questions into appropriate statistical models. The statistical inference for these models, based on well-collected and clean data, provides the backbone of good scientific conclusions. Therefore, a well-trained biometrician should be able to:

- provide statistical expertise so that the experiment is correctly designed
- advise project teams on the statistical elements of the experiment/study (selection of relevant-biological/medical parameters)
- produce summary statistics, analyses and reports and give a professional interpretation of the results of the statistical analyses

PART I – Regulations

D. General Entry Requirements

As per UTM'S Admission Regulations, and 'Admission to Programmes of Study at Master's Degree Level'

E. Programme Entry Requirements

At least an Honours Degree with significant content of Mathematics or other qualifications (academic or professional) acceptable to the University of Technology, Mauritius

Applicants from programmes involving Statistics / Mathematics / Biology / Biotechnology / Food Science / Agriculture / Environmental Studies / Biomedical studies / Medical and paramedical / Biochemistry will have definite advantage. Students from other backgrounds like Computer Science / Software Engineering are also encouraged to apply if they have an interest in biostatistics as will those from a programme in Mathematics and Science with project work having involved Computing.

F. Programme Mode and Duration

One Semester consists of 15 weeks (excluding examination period)

Full Time: 1 Year (2 semesters)
Part Time: 1½ Years (3 semesters)

G. Teaching and Learning Strategies

- Lectures, Tutorials and Practicals
- Class Tests and Assignments
- Industrial Project
- Workshops / Seminars / Lab Sessions
- Structured Discussions & Self Directed Study
- Case Study material & scenarios centred on real world problems

H. Student Support and Guidance

Academic Tutoring: 3 hours per week per module

I. Attendance Requirements

As per UTM's Regulations and Policy

J. Credit System

1 module = 3 or 4 credits
Industrial Project = 12 credits

K. Student Progress and Assessment

The programme is delivered mainly through lectures, tutorials, and practical laboratory sessions. Students are expected to be as autonomous and research oriented as possible and activities may include reading research papers, delivering presentations, taking part in quizzes, case-studying amongst others.

Each module carries 100 marks and unless otherwise specified, will be assessed as follows:

Written examination, inclusive of reading time, of duration of 2 - 3 hours for 3 credits modules and not less than 3 hours for 4 credits modules and continuous assessment carrying up to 40% of total marks. Continuous assessment can be based on a combination of assignments, field study, workshops and class tests.

Master Project

For the Master Project, interesting research subjects are proposed by academic staff and specialists from industry to enable the students to develop Research and Development skills and to gain practical experience of applying the techniques covered in the taught part of the programme to realistic situations.

L. Evaluation and Performance

The percentage mark contributes a 100 percent weighting towards the degree classification.

Maximum marks attainable: 1100

Module grading structure:

Grade	Marks x (%)
A	$70 \leq x$
B	$60 \leq x < 70$
C	$50 \leq x < 60$
D	$40 \leq x < 50$
F	$x < 40$
A-D	Pass
F	Fail

M. Award Classification

Overall weighted mark x (%)	Classification
$70 \leq x$	MSc with Distinction
$60 \leq x < 70$	MSc with Merit
$40 \leq x < 60$	MSc
$x < 40$	No Award

Minimum Credits Required for Award of:

Master's Degree:	42
Postgraduate Diploma:	30
Postgraduate Certificate:	18

N. Programme Organisation & Management

Programme Director and Coordinator: Mr. A. Gopee

Contact Details:

- Room: G 2.27
- Telephone Number: 207 52 50
- Email: agopee@umail.utm.ac.mu

Part II - Programme Structure

O. MSc Biometry – Full Time (Version 3.0)

Semester 1				***Semester 2***			
Code	Module	L+P/T	Credit	Code	Module	L+P/T	Credit
BIOL 5101C	Life Sciences 1	2+1	3	MATH 5325C	Multivariate Data Analysis	2+2	4
MATH 5321C	Statistics for Life Sciences	2 + 2	4	MATH 5320C	Time to Event Analysis	2+2	4
MATH 5322C	Experimental Design and Research	2+2	4	MATH 5323C	Generalised Linear Models	2+2	4
BIOL 5102C	Medical and epidemiological statistics	2+2	4	BIOL 5103C	Statistical Genetics	2+1	3
PROJ5202C	Master Project						12

P. MSc Biometry – Part Time (Version 3.0)

Semester 1				***Semester 2***			
Code	Module	L+P/T	Credit	Code	Module	L+P/T	Credit
BIOL 5101C	Life Sciences 1	2+1	3	BIOL 5102C	Medical and epidemiological statistics	2+2	4
MATH 5321C	Statistics for Life Sciences	2 + 2	4	MATH 5325C	Multivariate Data Analysis	2+2	4
MATH 5322C	Experimental Design and Research	2+2	4	MATH 5320C	Time to Events Analysis	2+2	4
				PROJ 5202C	Master Project		

Semester 3			
Code	Module	L+P/T	Credit
MATH 5323C	Generalised Linear Models	2+2	4
BIOL 5103C	Statistical Genetics	2+1	3
PROJ 5202C	Master project		12

Q. MODULE OUTLINE

BIOL 5101C: LIFE SCIENCES 1

- Basics of biology and biochemistry
- Environmental science & ecology
- Microbiology, biotechnology
- Cell structure & biological molecules
- Enzymes & proteins
- Transport & gas exchange
- Reproduction
- Infectious disease & immunity
- Biodiversity & conservation
- Selection & evolution
- Photosynthesis
- Regulation & control
- Gene technology
- Applications of biology

MATH 5321C: STATISTICS FOR LIFE SCIENCES

- Types of data
- Describing and displaying data
- Probability and probability distributions
    - Binomial, Poisson, normal distributions
- Population and samples
- Estimation and confidence intervals
- Hypothesis testing
- T-tests
- Chi-square distributions
- Central limit theorem
- Analyzing proportions
- Fitting probability models to frequency data
- Contingency analysis
- Comparison of means
- ANOVA
- The R Language (including Data visualization and graphics, Data Mining)

MATH 5322C: EXPERIMENTAL DESIGN AND RESEARCH

- Distributions of sums of squares
- Efficient score and Fisher's information for binary data
- Bayesian methods & normally distribution observations
- Fundamental principles and philosophies of design
- Quantitative treatments
- Replication, blocking and control
- Likelihood, uncertainty & hypothesis
- Research methods
- Statistical inference
- Research ethics
- Literature review & technical writing
- Assessment and presentation

BIOL 5102C: MEDICAL AND EPIDEMIOLOGICAL STATISTICS

- The purpose & design of clinical trials
- Allocation to treatment
- Testing for superiority, non-inferiority and equivalence
- Sample size determination
- Meta analysis & Ethical issues of clinical trials
- Sequential clinical trials
- Epidemiological study designs: cross sectional, cohort, case-control and experimental
- Risk and odds, relative risk and odds ratio
- Interaction and confounding
- Sample size & logistic regression

MATH 5325C: MULTIVARIATE DATA ANALYSIS

- Matrix algebra
- Displaying multivariate data
- Test of significance with multivariate data
- Measuring and testing multivariate data
- Principal component analysis
- Factor analysis
- Discriminant function analysis
- Cluster analysis

MATH 5320C: TIME TO EVENT ANALYSIS

- Descriptive methods of survival data
- Estimation of the survivor function and hazard function
- Log rank test for comparing two groups
- Cox proportional hazards model
- Parametric models for time-to-event data
- The Weibull proportional hazards model
- Model checking diagnostics

MATH 5323C: GENERALISED LINEAR MODELS

- Model fitting
- Exponential family
- Normal linear models
- Binary variables and logistic regression
- Nominal and ordinal logistic regression
- Log-linear models for counts
- Analysis of multidimensional contingency tables
- Clustered and longitudinal data

BIOL 5103C: STATISTICAL GENETICS

- Introduction to genetics
- Simple population genetics
- Pedigrees and patterns of inheritance
- Association mapping
- Linkage Analysis
- DNA profiling