UTM

UNIVERSITY of TECHNOLOGY, MAURITIUS

School of Innovative Technologies and Engineering

Department of Applied Mathematical Sciences

MSc Applied Statistics

with

Operational Research

PROGRAMME DOCUMENT

VERSION 1.1

MASOR v 1.1

December 2014

A. Programme Information

In this data deluge era, decision making and planning processes in almost all major institutions are increasingly becoming data dependent. Statistics provides the reasoning and techniques for producing and understanding data. This Master degree programme aims to bridge the gap between University and Industry by considering statistical and mathematical models relevant to the industry. The programme is designed as an intensive two-semester (full-time mode) or three-semester (part-time mode) course which focuses on training in statistics, predictive modelling and analysis with complex datasets for problems in forecasting and the understanding of the problem solving process required when supporting management decision-making. The focus on operational research will further equip students with the necessary analytical abilities involved in efficient decision making processes. The MSc consists of seven compulsory modules, an elective module plus a project.

B. Programme Aims

The MSc Applied Statistics with operational research course is designed to train students who wish to pursue career in the field of or as:

- Statisticians

- Academia

- Data collection research and analysis

- Modelling and forecasting of time dependent phenomena

- Operations research analysts

- Marketing and quality improvement

- Population research and surveys

- Social science statistics

- Statistics/OR practitioners (health, manufacturing, transport)

The degree programme also serves an excellent basis for students wishing to pursue studies for an MPhil/PhD, hence leading to careers as researchers in the field of statistics or modelling and forecasting.

C. Programme Objectives

Upon successful completion of the programme, students will be expected to

- be able to manipulate, analyse and interpret real-world data

- demonstrate a sound understanding on the advanced techniques employed to analyse complex organisational problems and help make better decisions

- possess problem solving techniques strongly transferable for immediate use within industry

- be able to deliver their competencies in the statistical models, relevant to the industry and hence become confident statistical analysts

- be fluent with the main computational techniques used in applied statistics and operational research

PART I - Regulations

D. General Entry Requirements

As per UTM'S Admissions 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 Statistics.

For instance, a bachelor honours degree in Statistics, Mathematics, Engineering, Business, Actuarial Science, Finance or a closely related field or other qualifications (academic or professional) acceptable to the University of Technology, Mauritius can be considered.

F. Programme Mode and Duration

Full Time: 1 Year   (2 semesters)

Part Time: 1 1/2 Years   (3 semesters)

G. Teaching and Learning Strategies

*   Lectures, Tutorials and Practical Laboratory Sessions
*   Structured Discussions
*   Workshops and Seminars

H. Attendance Requirements

As per UTM's Regulations and Policy

I. Credit System

Module   =3 or 4 credits

Master Project   =12 credits

J. 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 or 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 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.

K. Evaluation of Performance

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

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

L. 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

Note: There is no re-sit in Master Project

M. Programme Organisation and Management

Programme Director: Mr Aslam Aly El-Faidal SAIB

Contact Details: Telephone Number: 207 52 50   Email: asaib@umail.utm.ac.mu

Part II - Programme Structure

N. MSc Applied Statistics with Operational Research– Full Time (Version 1.1)

Semester 1				Semester 2			
Code	**Modules**	**L+T/P**	**Credits**	**Code**	**Modules**	**L+T/P**	**Credits**
STAT 5320C	*Fundamentals of Applied Statistics*	2+2	4	STAT 5323C	*Time Series Econometrics*	2+2	4
MATH 5321C	*Methods for Operational Research*	2+2	4	MATH 5314C	*Advanced Operational Research Methods*	2+2	4
STAT 5322C	*Credit Scores and Data Mining*	2+1	3	STAT 5318C	*Multivariate Data Analysis*	2+2	4
COMP 5106C	*Simulation Techniques*	2+2	4		*Elective Module**	2+1	3
PROJ 5201C	*Master's Dissertation*						12

* A list of the elective modules proposed is provided on page 8

O. MSc Applied Statistics with Operational Research – Part Time (Version 1.1)

Semester 1			
Code	**Modules**	**L+T/P**	**Credits**
STAT 5320C	*Fundamentals of Applied Statistics*	2+2	4
MATH 5321C	*Methods for Operational Research*	2+2	4
STAT 5322C	*Credit Scores and Data Mining*	2+1	3

Semester 2				Semester 3			
Code	**Modules**	**L+T/P**	**Credits**	**Code**	**Modules**	**L+T/P**	**Credits**
COMP 5106C	*Simulation Techniques*	2+2	4	STAT 5318C	*Multivariate Data Analysis*	2+2	4
STAT 5323C	*Time Series Econometrics*	2+2	4		*Elective Module**	2+1	3
MATH 5314C	*Advanced Operational Research Methods*	2+2	4				
PROJ 5201C	*Master's Dissertation*						12

* A list of the elective modules proposed is provided on page 8

P. Module Outlines

CORE MODULES

STAT 5320C: FUNDAMENTALS OF APPLIED STATISTICS
- Statistical concepts and methods
- Probability techniques
- Statistical inference
- Linear models
- Experimental and survey design
- Introduction to R

MATH 5321C: METHODS FOR OPERATIONAL RESEARCH
- Linear programming using R/MatLab®- graphical solution, simplex, duality
  - Sensitivity analysis, post optimal analysis
  - Transportation problem, assignment problem
- Integer programming using R/MatLab®- Cutting plane algorithm and branch & bound technique
- Network optimization- Travelling salesman and distribution problems, maximum flow problems
- Inventory, replacement and queuing models

STAT 5322C: CREDIT SCORES AND DATA MINING
- Credit scoring- Consumer credit scoring, behavioural and collection scores
  - Predicting bankruptcy, score cards
- Data pre-processing- Sample, segmentation, credit bureau characteristics
  - Nominal vs. ordinal measures
- Recalibration and tracking score cards
- Data mining using R or software like ACL- Validation, cross validation, branch-and-bound algorithm
  Classification techniques- Decision trees, neural networks, Bayesian
- Statistical reporting, Strategic curves

COMP 5106C: SIMULATION TECHNIQUES
- Examples of discrete-event simulations
- Random number generation
- Tests for randomness
- Random variate generation
- Input modelling
- Variance reduction techniques
- Monte Carlo methods: analysis and applications
- R/Spreadsheets practicals

STAT 5323: TIME SERIES ECONOMETRICS
- Characteristics of time series
- Exponential smoothing
- Decomposition methods
- Seasonality trends, cyclical components, seasonal and non-seasonal
- Autoregressive models
- ARIMA models
- Heteroscedasticity
- Use of R package

MATH 5314C: ADVANCED OPERATIONAL RESEARCH METHODS

- Deterministic and probabilistic dynamic programming
- Derivative-based and derivative-free optimisation
- Nonlinear programming algorithms
- R/MatLab® practicals

STAT 5318C: 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

*ELECTIVE MODULES

STAT 5325C: MARKOV CHAINS AND QUEUEING SYSTEMS
- Markov chains- Absorption problems
- Solutions of birth-death processes, man power planning systems
- Queueing systems- Markovian
                        Non-Markovian queues
- Priority queues, queues with batch arrival, retrial queues
- Single class queues optimisation- problems/applications
                                        Poling systems, client server systems

MATH 5313: MANAGEMENT SCIENCE AND SYSTEM DYNAMICS
- Feedback- causal loop diagrams
- System dynamics models- Simple structures, model formulation
                            Model testing, sensitivity analysis
                            Model evaluation techniques
- Policy analysis- Inventory management
- Commodity cycles- new product diffusion
- Mental models
- System dynamics in organisations

STAT 5326C: DECISION SCIENCES AND SOFT SYSTEMS ANALYSIS
- Decision analysis, decision making under uncertainty and risk
- Decision analysis and strategy making
- Soft system modelling and analysis- Soft systems methodology
- Viable system model
- Interactive planning- influence diagrams
- Bayesian belief networks

QFIN 5206C: OPERATIONAL RESEARCH METHODS IN FINANCE
- Linear programming in computation of dedicated bond portfolio, asset pricing
- Integer programming - Construction of index fund, Lockbox problem
                            Portfolio optimisation with minimum transaction levels
- Quadratic programming- QP problem, optimality conditions
                            Interior point methods, central path
- QP and portfolio optimization- Mean variance portfolio optimization

PROJ 5201C: MASTER'S DISSERTATION
Dissertation guidelines will be given in the Dissertation Handbook