

MSc Applied Statistics (Specialisation: Economic & Social Statistics OR Industrial & Financial Statistics) –SHSC509

1. Objectives

There is nowadays an almost universal recognition of the need for evidence based decision making. Decisions need to be based on optimum use of all relevant available information. Furthermore, decisions almost always have to be made in the face of uncertainty. Analysing data to provide support for informed decision making and for addressing uncertainty is the business of statistical science. In recent years, a number of specialised statistical tools and techniques have evolved to respond to the needs of industry, business, finance, insurance, social and economic planning. There has also been a shift in the perspective on uncertainty with increased emphasis on an approach that integrates prior information, experience or expert knowledge with data and information on the costs of alternative decisions as opposed to the classical approach that relies exclusively on data.

The objectives of the MSc Applied Statistics are:

- (i) To consolidate the statistical and quantitative skills previously acquired by students so as to provide them with a solid general foundation and a mastery of statistical and quantitative techniques applicable in a wide variety of fields.
- (ii) To develop competencies and skills relevant in specialised application areas of statistical science.
- (iii) To develop competencies in the application of technology to identify solutions through the use of computers, software and computer programming.
- (iv) To provide a solid basis for research in Statistics.

2. General Entry Requirements

Successful completion of an undergraduate degree with

- at least a Second Class or 50%, whichever is applicable or
- a GPA not less than 2.5 out of 4 or equivalent, from a recognised higher education institution

OR alternative qualifications acceptable to the University of Mauritius

3. Programme Requirements

A degree in Statistics, Mathematics or Economics with strong coverage of statistics/econometrics

Or equivalent qualifications acceptable to the University of Mauritius.

4. General and Programme Requirements - Special Cases

The following may be deemed to have satisfied the general and programme requirements for admission:

- (i) Applicants who do not satisfy any of the requirements as per Regulations 3 above but who submit satisfactory evidence of having passed examinations, which are deemed by the Senate to be equivalent to any of those listed.
- (ii) Applicants who do not satisfy any of the requirements as per Regulations 3 above but who in the opinion of Senate submit satisfactory evidence of the capacity and attainments requisite to enable them to pursue the programme proposed.
- (iii) Applicants who hold a full practising professional qualification obtained by examination.

5. Programme Duration

The programme will be offered on a part-time basis.

	Normal (Yrs)	Maximum (Yrs)
Master's Degree:	2	4
Postgraduate Diploma:	2	4

6. Credits per Year

Minimum credits per year – 6 (or as presented by the faculty).

7. Minimum Credits Required for Awards

	Core Modules	Dissertation	Electives	Total
Master's Degree	18 credits	6 credits	12 credits	36 credits
Postgraduate Diploma	18 credits	-	6 credits	24 credits

8. Assessment

Students are required to register for modules, which they intend to follow in a given semester/year.

Each yearly module will be assessed over 100 marks and each semester module will be assessed singly over 100 marks.

Assessment will be based on a written examination of 2 to 3-hour duration (normally a paper of 2 hour duration for modules carrying less or equal to three credits, 2½ hour paper for modules carrying 3.5–4.5 credits and 3 hour paper for modules carrying five-six credits) and on continuous assessment done during the semester or year.

Written examinations for modules, whether taught in semester 1 or in semester 2 or both will be conducted at the end of the academic year.

The continuous assessment will count for 10-40% of the overall percentage mark of the module(s), except for a Programme of Studies where the structure makes for other specific provision(s). Continuous assessment may be based on laboratory work, seminars and/or assignments and should include at least one class test.

A minimum of at least 30% should be attained in each of continuous assessment and written examination with an overall total of 40% for a candidate to pass a module (unless otherwise specified).

Special examinations (e.g. class test) will be arranged at the end of semester 1 or semester 2 for exchange students who have registered only for one semester. In case of yearly modules, credits will be assigned on a pro-rata basis.

Students are required to submit work for continuous assessment by due dates. Failure to do so will normally incur penalties.

All modules carry their own credit value.

Submission Deadlines for Dissertation

- First Draft: End of July in the Final Year
- Final Copy: Last working day of August in the Final Year

9. Repeat and Termination of Registration

If the CPA of a student is < 40 for an academic year, s/he will have to repeat the entire academic year, and retake modules as and when offered. However, s/he will not be required, if s/he wishes, to retake module(s) for which **Grade C** or above has been obtained.

Students will be allowed to repeat **only once** over the entire duration of the Programme of Studies.

Registration of a student will be terminated if

- (i) the CPA < 40 at the end of an academic year and the student has already repeated one year of study; or
- (ii) the maximum duration allowed for completion of the Programme of Studies has been exceeded.

10. Choice of Electives

Students will be required to submit their choice of Electives in order of priority by the middle of Semester 1 of Year 1.

The University reserves the right not to offer a given elective module if the critical number of students is not attained and/or if there are resource constraints. Additional electives may also be offered, depending on availability of resources.

11. List of Modules

CORE MODULES

STAT 5002(1) Survey Methods and Survey Data Analysis²
STAT 5010(1) Statistical Inference and Decision Theory^{1&2}
STAT 5011(1) Applied Linear Models¹
STAT 5012(1) Applied Multivariate Methods²
MATH 6045(1) Computational Statistics¹

ELECTIVES

Application Area: Economic & Social Statistics

STAT 6009(1) Dynamic models and Forecasting
STAT 6011(1) Educational Statistics

STAT 6021(1) Demographic Methods and Population Analysis
 STAT 6022(1) Experiments & Models in Social Research
 STAT 6023(1) Measurement of Economic and Social Phenomena
 ECON 6032(1) Quantitative Development Economics
 SCDV 5101(1) Perspectives on Social Development
 ECON 5118(1) Econometric Methods

Application Area: Industrial & Financial Statistics

MATH 6013(1) Financial Risk Analysis
 MATH 6033(1) Operational Research
 MATH 6051(1) Stochastic Processes
 MATH 6053(1) Statistical Quality Control
 MATH 6055(1) Actuarial Mathematics
 MATH 6056(1) Simulation
 MATH 6057(1) Medical Statistics
 MATH 6058(1) Numerical Analysis
 MATH 6059(1) Statistical Methods in Quantitative Finance
 MATH 6060(1) Mathematics of Finance

12 Programme Plan

YEAR 1

Code Core	Module Name	Hrs/Wk L+P	Credits
STAT5002(1)	Survey Methods and Survey Data Analysis ²	3	3
STAT5010(1)	Statistical Inference and Decision Theory ^{1&2}	3	6
STAT5011(1)	Applied Linear Models ¹	3	3
STAT5012(1)	Applied Multivariate Methods ²	3	3
MATH 6045(1)	Computational Statistics ¹	3	3

1: Taught in first semester 2: Taught in the second semester 1&2 Taught in both semesters

Year 2

Code Electives	Module Name	Hrs/Wk L+P	Credits
	Four electives to be selected from the same Application Area (Three in semester 1 and One in Semester 2)	3 each	12
Project			
	Project in Applied Statistics (To be submitted at end of Semester 2)		6

NOTE:

- (i) Electives will be offered subject to availability of minimum number of students and Faculty resources.
- (ii) Students will take 4 electives, a minimum of 3 should be from one of the same application areas.
- (iii) Students will take three electives in the first semester and one elective in the second semester. All exams are held in the second semester.
- (iv) Project will be handed in at the end of the second semester.

13. Outline Syllabus

CORE MODULES

STAT5002(1) - SURVEY METHODS AND SURVEY DATA ANALYSIS

Issues in data collection. Probability sampling and sampling error. Objectives of sample design. Simple random sampling. Stratified sampling. Cluster sampling without and with subsampling. PPS sampling. Systematic sampling. Questionnaire administration. Non sampling errors. Pretests. Interview Technique. Coding and Data Processing.

STAT5010(1) - STATISTICAL INFERENCE & DECISION THEORY

Probability. Probability Distributions. Likelihood function. Sufficiency and MVUE. Sampling Theory. Hypothesis Testing and Confidence Intervals. More Probability Distributions. Bayes Theorem on Inference. Conjugate distributions and conjugate analysis. Binomial model, Poisson model and the normal model. Decision Theory. An introduction to loss functions and Bayesian decision rule.

STAT5011(1) - APPLIED LINEAR MODELS

The Modelling Process in general. The standard linear model. Estimation and testing model coefficients. Testing assumptions. Measuring goodness of fit. Breakdown of assumptions and corrective procedures. Extensions of the simple linear model. Limitations of the standard linear model. The generalised linear model. Logit and probit analysis. Poisson regression. Analysis of multidimensional contingency tables.

STAT5012(1) - APPLIED MULTIVARIATE METHODS

Bivariate data and correlations. Multivariate data structure. Partial and multiple correlation. Normal distribution and Multivariate normal dist. Principal components analysis – geometrical approach. Factor analysis. Discriminant analysis. ANOVA & MANOVA. Cluster analysis. Application using SPSS.

MATH 6045(1)-COMPUTATIONAL STATISTICS

Use of packages (R/Matlab etc.) to illustrate the following: Input, Output data manipulation, Illustrate different statistical techniques, Monte Carlo experiments with applications in different fields. Function optimisation.

ELECTIVES

APPLICATION AREA: ECONOMIC AND SOCIAL STATISTICS

STAT6009(1) - DYNAMIC MODELS AND FORECASTING

This is a module on dynamic modelling using Bayesian methods. Dynamic Linear Model. Dynamic linear regression. The case of known and unknown variance. Observability. Model superposition and decomposition. Forecasting. Applications in modelling.

STAT 6011(1) - EDUCATIONAL STATISTICS

Educational statistics in Mauritius: Sources, Reliability & Validity, Item analysis & Correlation analysis. Principles of Educational. Research. Multilevel modelling of Educational data using R Statistical Language.Applications: School Effectiveness & School Improvement research; Value Added; Social class & Ethnicity. Evaluating Gender imbalance in Education. Assessing Special Needs and Teaching demands.Introduction to Bayesian Hierarchical Modelling using Winbugs with application to complex Educational Research issues.

STAT6021(1) - DEMOGRAPHIC METHODS AND POPULATION ANALYSIS

Sources of demographic data. The measurement and analysis of fertility and birth intervals, mortality, nuptiality, migration. Bongaarts' framework. Cohort and period approaches to measurement Standardised Rates. Construction and Interpretation of life tables. Stationary and Stable populations.

Population Growth and demographic transition Models. Relations between demographic processes and age structure. Population projections. Population pyramids.

STAT6022(1) - EXPERIMENTS AND MODELS IN SOCIAL RESEARCH

Controlled experiments and the importance of randomisation. Fixed and random effects models. Control of error. Multifactorial experiments. Ethical issues in experimentation. Quasi experimental designs and threats to validity. Social data and selection of models. Probability models for social data. Goodness of fit. Modelling dependence. Markov chains in studies of mobility: social class. Applications of branching processes to social phenomena.

STAT6023(1) - MEASUREMENT OF ECONOMIC AND SOCIAL PHENOMENA

Sources of social and economic data. Problems of data collection and interpretation. Principles of statistical measurement. Techniques for ensuring validity, reproducibility, comparability. Problems of measurement in specific areas such as productivity, poverty, crime etc. Gini coefficient: Properties, Uses, Limitations and disaggregation. Alternative Inequality measures. Price, Wage and other Indices. Methodology of Economic and Social Indicators, simple and composite: Construction, Interpretation and Uses. The measurement of emerging economic and social concerns such as the non observed economy, business confidence, pollution and environmental degradation, gender equity.

ECON 6032(1)- QUANTITATIVE DEVELOPMENT ECONOMICS

This module is about the study of development in low-income countries and addresses both conventional as well as new horizons in the discipline. The detailed syllabus is as follows: Overview of Development: Measurement and Conceptual Issues, Characteristics and Structural Features – Economic Growth Theories; Role of Human capital, Technological Progress, Convergence, Institutional Quality and Geography – Inequality and Development Linkages: Measurement Issues, Growth and Inequality, Role of Savings and Human Capital and Aspects of Poverty – Demography and Development: Population Dynamics, Rural and Urban Interaction and Aspects of Migration – Financial Institutions: The Role of Credit and Insurance, Informal Markets and Microfinance – Trade Policy: Trade Liberalisation, Regionalisation and Policy Discussion.

SCDV5101(1) - PERSPECTIVES ON SOCIAL DEVELOPMENT

Concepts: Social Evolution and Change. Under-development and Development; Causes and consequences of under-development and development. Obstacles to development. Dimensions and indicators: Social, economic and human development. Major theories of economic growth and Development. Capitalist, Market, Mixed and Socialist form of economies. State and Social Welfare. Social Planning and budgetting: National, Sectoral and Decentralised planning. Governance, People and Development: Participation, Capacity Building and Empowerment.

ECON 5118(1) - ECONOMETRIC METHODS

Time-series and cross-sectional regression analysis. Non-nested models and selection mechanisms. Econometrics of expectations. Simultaneous regression models. VAR models. Panel data analysis. Limited dependent variable models. Logit, probit and tobit models.

APPLICATION AREA: INDUSTRIAL & FINANCIAL STATISTICS

MATH 6013(1)- FINANCIAL RISK ANALYSIS

Diversification, Immunization and Hedging and their Limits, Value at Risk, Risk Analysis of fixed income portfolios, Options and dynamic replication, Credit risk (ratings based models, structural models, reduced form models), Credit derivatives, Operational risk Models.

MATH 6033(1)- OPERATIONAL RESEARCH

Multiobjective programming problems, Network optimisation, Game theory, Case studies.

MATH 6051(1)-STOCHASTIC PROCESSES

Discrete-time Markov chains; Martingales, Brownian motion and renewal processes.

MATH 6053(1)- STATISTICAL QUALITY CONTROL

Modelling Process Quality, Statistical Process control, Control charts, Process capability analysis,

Acceptance sampling for attributes.

MATH 6055(1) – ACTUARIAL MATHEMATICS

The economics of insurance, Utility theory, Application of probability to problems of life and death, Determination of single premiums for insurances and annuities in both the discrete and continuous cases.

MATH 6056(1)- SIMULATION

Generation of uniform and non-uniform random numbers, Discrete event simulation, Input modelling, Simulation design, Statistical analysis of simulation output, Monte Carlo Methodologies.

MATH 6057(1)- MEDICAL STATISTICS

Clinical Trials – Concepts and design: controlled and uncontrolled clinical trials; historical controls; protocol; placebo; randomisation; blind and double blind trials; ethical issues; protocol deviations. Size of trials. Multiplicity and meta-analysis: interim analyses; multi- centre trials; combining trials. Cross- over trials. Binary response data: logistic regression modelling; McNemar’s test. Survival Data Analysis – Concepts: survivor function; hazard function; censoring. Single sample methods: lifetables; Kaplan-Meier survival curve; parametric models. Two sample methods: log-rank test; parametric comparisons. Regression models: inclusion of covariates; Cox’s proportional hazards model; competing risks.

MATH 6058(1)-NUMERICAL ANALYSIS

Arithmetic and well-posed computation, matrix inversion and solution of systems of linear equations, Computation of eigen values and eigen vectors.

MATH 6059(1)- STATISTICAL METHODS IN QUANTITATIVE FINANCE

Distribution of asset returns. Non Parametric models. Parametric Models. Model testing. Estimation of volatilities.

MATH 6060(1) - MATHEMATICS OF FINANCE

Time Value of Money, NPV and IRR, Bonds, Yields, Bond Price Volatility, Duration, Convexity, Forward Rates, Forward Rate Agreements, Swaps, term structure of Interest Rates, Deterministic and Stochastic Interest Rates, Term Structure Models, Portfolio management, analysis of Equity Investments