POSTGRADUATE INSTITUTE OF SCIENCE

UNIVERSITY OF PERADENIYA

M.Sc. in Applied Statistics
2010/2011

1. INTRODUCTION

The curricula of most science-based degrees do not give adequate coverage of designing experiments, analyses and interpretation of results. Even in social sciences the treatment of data collection methods and data analyses is dealt at a superficial level. Therefore, graduates most often do not possess basic skills of conducting research projects, which can withstand critical scientific scrutiny.

A knowledge of statistics is essential not only to analyse data, but more importantly at the designing stage of an experiment. It is essential that every institute that conducts research must have at least one qualified statistician (applied statistician or biometrician as the case may be).

2. OBJECTIVES OF THE PROGRAMME

The objective of this programme is to provide graduates who possess a knack for Mathematics, an adequate coverage of basic statistical theory, applications in design of experiments and surveys, data analysis and methods of presentation and interpretation of results. At the completion of this course the candidate will be able to fit in as an applied statistician in a research institute, planning institute or a government institute.

3. PROGRAMME ELIGIBILITY

Applicants must possess a Bachelors degree or an equivalent qualification acceptable to the Postgraduate Institute of Science. Graduates who are not familiar with calculus, set theory and matrix algebra are expected to follow a pre-requisite course in mathematics. Graduate who have no basic knowledge in statistics are expected to follow the preliminary courses in statistics. Preliminary courses are non-credit courses. Depending on the courses followed at the degree level and on the recommendation of the advisor a candidate may be exempted from certain other courses.

4. PROGRAMME FEE

	M.Sc. programme fee
Local candidates	Rs. 60,000/-
SAARC countries	US $ 2000/-
Other countries	US $ 4000/-

Programme fees shall be paid in two instalments *(50% at the registration and the balance 50% within six months).* Other payments including registration fee, medical fee, library subscription, examination fee and deposits (science and library) should be paid according to the procedure stipulated by the PGIS.

5. THE PROGRAMME STRUCTURE AND DURATION

This is a full-time programme consisting of course work and a research project. Course work will be conducted over a period of two semesters of 15 - weeks each *(during weekends and/or weekdays) w*hich will involve about 12 months. The entire programme duration will be about 15 - 18 months inclusive of further 3 - 6 months for the research project. Satisfactory completion of a minimum of 24 credits of course work is required for the programme in addition to the six credits allocated for the full-time research project. Continuous attendance is compulsory during the period of research work.

Each candidate will be assigned an academic advisor, whose advice should be sought when planning the M.Sc. programme, and the programme must be approved by the programme coordinator prior to the commencement of the programme. English will be the medium of instruction.

Programme Summary

Course Code	Course	No. of Credits
Preliminary Courses		
SC 401	Mathematics*[1]	-
SC 402	Computer Programming*[2]	-
SC 403	Statistical Methods*[3]	-
Semester I		
SC 501	Theory of Statistics	2
SC 502	Data Analysis and Presentation	3
SC 503	Design and Analysis of Experiments	3
SC 504	Regression Analysis	2
SC 505	Sampling Techniques	2
SC 506	Multivariate Methods I*	2
SC 507	Stochastic Processes and Applications*	2
Semester II		
SC 516	Time Series Analysis	2
SC 517	Non-Parametrics and categorical data analysis	2
SC 518	Independent Study	2
SC 519	Multivariate Methods II*	2
SC 520	Experimental Techniques*	2
SC 521	Biased Estimation*	2
SC 522	Binary Data Analysis*	2
SC 523	Quality Control Statistics*	2
SC 524	Special Topics**	2
SC 599	Research Project (3 - 6 months)	6

*[1] *Compulsory for those without a mathematics background*
*[2] *Compulsory for those without a computer background*
*[3] *Compulsory for those without a basic statistics background*
* *Optional courses. Students are required to obtain 4 credits from optional courses.*
** *Special topics will be notified to the students each year*

6. PROGRAMME CONTENTS

SC 401: Mathematics
Number Systems, Inequalities, Elements of Set Theory. Coordinate Geometry: Lines, Circles and Parabolas. Calculus: Limits and Derivatives. Maxima, Minima and Inflextion points. Indefinite Integral, Definite Integral, Evaluation of area between curves, Integration by substitution, Partial differentiation. Matrix Algebra : Matrices, determinants and inverse of a matrix. Matrix approach to solution of system of equations. Rank of a matrix, eigen values.

SC 402: Computer Programming
Introduction to computers. Windows and Disk operating system and commands. Elements of a program, Data types, Expressions and operators. Programs and modules. Statements and functions. Input/Output, Program flow control, different types of conditional looping. Operations with strings. Sequential and random access files. Sub programs. Abstract data types, principles of object oriented paradigm.

SC 403: Statistical Methods
Variability in observations. Parameters and statistics. Measures of location and spread. Frequency distributions, Histograms, Stem and Leaf, Box plots. Discrete data: Probability structure and cumulative distributions. Continuous data: Distribution functions, Family of Normal distributions. Expected values, Sampling distributions. Test of hypothesis. Estimation and tests on difference between 2 means and proportions. Simple linear regression and correlation, lack of fit, residual plots. Extension to multiple linear regression. One way and two-way ANOVA. Analysis of 2-way contingency tables.

SC 501: Theory of Statistics *(2 credits)*
Probability : Properties, conditional probability, independence. Discrete random variables: Probability mass functions and cumulative distributions. Some common discrete distributions. Continuous random variables: Marginal and conditional distributions, Bayes' Rule. Expectations and Central Limit Theorem. Sampling from the Normal distribution.
Point and Interval estimation. Test of Hypotheses: Simple and composite hypothesis. Maximum likelihood estimation. Generalized Likelihood Ratio Tests. Tests on means and variances.

SC 502: Data Analysis and Presentation *(3 credits)*
Introduction to Statistical Software. MINITAB: Data management, Descriptive statistics. ANOVA, GLM and Regression. Non parametrics. SAS : Data entry and editing. Structure of a SAS programme. Procedures used for ANOVA, GLM, Regression, Orthogonal and Non-orthogonal analysis, Categorical data analysis, and Multivariate analysis. Presentation of results.

SC 503: Design and Analysis of Experiments *(3 credits)*
Principles of design. Completely randomized and complete Block Design. Latin Square Design and its variations. Covariance analysis. Factorial experiments, fixed and random effects model, split plot designs. Nested factorials. Incomplete block designs. Balanced and partially balanced incomplete block designs. Confounding and fractional factorials in 2^n, 3^n and p^n experiments. Asymmetric factorials. Lattice designs. Diallel experiments. Basic ideas in construction of design.

SC 504: Regression Analysis *(2 credits)*
Simple linear regression and correlation, lack of fit, residual plots, Extension to multiple linear regression, Matrix approach to linear regression, Linear models. Multiple linear regression, Interpretation of coefficients. Inferences in regression analysis. Sequential and partial regression sums of squares. Analysis of aptness of the model. Model selection procedures. Introduction to non-linear regression.

SC 505: Sampling Techniques *(2 credits)*
Population and sample. Taxonomy of sampling procedures. Accuracy and precision. Survey methods. Questionnaire designing. Validation of data. Simple random sampling: properties of estimates, standard error of estimates. Estimation of ratios. Sampling proportions. Estimation of sample sizes. Stratified random sampling, Proportional and optimum allocation. Cluster sampling. Systematic sampling, Selection with probability proportional to size. Multistage sampling. Regression and ratio estimates. Applications.

SC 506: Multivariate Methods I *(2 credits)*
Introduction to multivariate analysis. Multivariate normal distribution. Expected values. Variance - Covariance matrix. Principal component analysis (PCA). Interpretation using illustrative examples. Factor analysis. Comparison with PCA, factor loadings, rotations, Interpretation.

SC 507: Stochastic Processes & Applications *(2 credits)*
Recurrent events, Random walks, Markov chains, Transition probabilities, Limiting distributions, Discrete branching processes, Markov processes in continuous time, Poisson processes and their applications, Birth & Death processes, Queuing theory and applications.

SC 516: Time Series Analysis *(2 credits)*
Trends, Seasonal and Cyclical Variation. Time series model. Lagged models. Autocorrelation. Analysis of ARMA and ARIMA models. Forecasting.

SC 517: Non Parametrics and Categorical Data Analysis *(2 credits)*
Types of data. Rank tests for comparing 2 treatments. Paired comparisons. Testing distributions. Completely randomized and randomized Block designs for comparing more than 2 treatments. Rank correlation and multidimensional models. Maximum likelihood estimates for complete tables. Model selection procedures.

SC 518: Independent Study (2 credits)
Students will study the information on selected research papers and present them in the form of seminars. By involving in an industry related study students will write research proposals and present it.

SC 519: Multivariate Methods II (2 credits)
Two-groups Discriminant analysis. Multiple-group Discriminant analysis. Multivariate analysis of variance. Canonical correlation. Covariance structure models.

SC 520: Experimental Techniques *(2 credits)*
Methods of increasing precision of experiments. Size shape and orientation of plots and blocks. Use of control. Choosing levels of a factor, number of replicates. Yield density models, growth curves, optimum levels of input. Stability analysis. Tree crop experimentation, special features in experimentation with animals. Clinical trials and ethics.

SC 521: Biased estimation (2 credits)
The method of least Squares and the Gauss-Markov theorem. Consequences of modification to the conditions of the Gauss-Markov theorem. Best linear unbiased estimation. Multicollinearity. Ridge regression. Shrunken estimation. Iteration and Inversion estimation. Principal component estimation. Geometric properties of some biased estimators.

SC 522: Binary Data Analysis *(2 credits)*
Statistical inference for binary data: The binomial distribution, inference on success probability. Odds ratio and relative risk. Models for binomial data, linear logistic and probit models. Comparing stimulus - response relationships. Modelling data from epidemiological and clinical studies. Bioassay and other applications. Analysis of survival data.

SC 523: Quality Control Statistics *(2 credits)*
Basic concepts of quality control charts for continuous variables and attributes. Tolerance. Statistical methods useful in Quality improvement. Statistical Process Control. Process Improvement with Designed Experiments. Acceptance sampling, Reliability. Incorporating cost aspects in quality control.

SC 524: Special Topics *(2 credits)*
The special topics will be different in different years and will be based on the latest developments in Statistics/Applied Statistics.

SC 599 - Research Project *(6 credits)*
Students will be required to carry out an independent research project on a topic which requires a fair amount of Statistical theory. The minimum period of the project will be 3 months. At the end of the research project the candidates are required to present their results in the form of a dissertation and a seminar before the degree is awarded.

7. PROGRAMME EVALUATION

Programme evaluation will be as stipulated in the PGIS Handbook 2002.

8. TEACHING PANEL

Dr. G.E.M.D.C. Bandara, Production Engineering, Faculty of Engineering, Univ. of Peradeniya *M.Sc. (Bulgaria), Ph.D. (Bulgaria)*
Dr. W.B. Daundesekara, Dept. of Mathematics, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), M.A. (Albama), Ph.D. (Albama)
Prof. R.A. Dayananda, Dept. of Stat. & Comp. Science, Univ. of Sri Jayawrdenapura.
B.Sc. (Cey.) Ph.D. (Wales)
Dr. L.H.P. Gunaratne, Dept. of Crop Science, Faculty of Agriculture, Univ. of Peradeniya
B.Sc. Agric. (Perad.), M.Sc., Ph.D. (Hawii)
Ms. T.K. Hewapathirana, Dept. of Stat. & Comp. Science, Univ. of kelaniya.
B.Sc. (Kelaniya), Dip. in Stat. (Colombo), M.Sc. (Bath)
Mr. S.R. Kodituwakku, Dept. of Stat. & Comp.Sc., Faculty of Science, Univ. of Peradeniya *B.Sc. (Perad.), M.Sc. (AIT)*
Dr. A.A.S. Perera, Dept. of Mathematics, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (SUNY/Albany)
Dr. K. Perera, Dept. of Eng. Mathematics, Faculty of Engineering, Univ. of Peradeniya
B.Sc. (J'pura), M.A., Ph.D. (New York)
Dr. B.L. Peiris, Dept. of Crop Science, Faculty of Agriculture, Univ. of Peradeniya
B.Sc., M.Phil. (Perad.), M.Sc. Ph.D. (Iowa)
Dr. T.S.G. Peiris, Coconut Research Institute, Lunuwila
B.Sc. (Colomb.), M.Sc. (Cantb. NZ), Ph.D. (Colomb)
Dr. S. Samita, Dept. of Crop Science, Faculty of Agriculture, Univ. of Peradeniya
B.Sc. Agirc. (Perad.), M.Phil. (Cey.), Ph.D. (Edin.)
Mr. D.J.C. Suriyaarachchi, Dept. of Statistics & Computer Science, Faculty of Science, Univ. of Peradeniya *B.Sc. (Cey.), Dip. in Math (Peradeniya), M.Sc. (Manches.)*
Prof. R.O. Thattil, Dept. of Crop Science, Faculty of Agriculture, Univ. of Peradeniya
B.Sc. Agric. (Cey.), M.Sc. (Philippines), Ph.D. (VPI&SU)
Dr. P. Wijekoon, Dept. of Stat. & Comp.Sc., Faculty of Science, Univ. of Peradeniya
B.Sc. (Kel.), Ph.D. (Dortmund)

PROGRAMME COORDINATOR

Dr. Kanthi.Perera
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Faculty of Science
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