Subject Code: STA201

Subject Title: Scientific Statistics

Point Value: 8

Abstract: This subject is oriented towards the sciences and develops a range of techniques and concepts from biometry and statistics for interpretation of both experimental and observed data. Differences in statistical inference for experimental and observed data, design of controlled experiments, randomisation, causality, cost and efficiency will be illustrated by examples drawn from agriculture, biology, environmental science, industry and medical science. Statistical tests based on error sums of squares will be unified by the concept of a model and a reduced model.

Enrolment Restrictions: Nil

Prerequisite(s): Nil

Corequisite(s): Nil

Objectives: Upon completion of this subject, students will be able to:
• Use graphs as an aid to the interpretation of results
• Carry out various statistical analyses and understand the relationships between probability, statistics, and hypothesis tests
• Select appropriate statistical techniques and experimental designs based on considerations of required inference, sample size, cost and statistical efficiency

Curriculum: The subject will cover the following topics:
• Basic statistics: graphs and statistics as summaries, frequency tables, concept of population, sample and random variation, measurement levels (categorical, ordinal, interval, ratio), measures of location and dispersion, mean and median, standard deviation, range and coefficient of variation, quantiles, probability estimate from relative frequency
• Basic probability: sum and product rules, dependence and independence, Bayes rule, continuous and discrete probability distributions, relation of probability to statistics, use of probability tables, Binomial and Normal distributions
• Statistical inference: using a sample to gain information about a population, fitting distributions to data, checking distributions graphically and by chi-square, testing 2-way tables of counts by chi-square, qualitative data, controlled experimentation, randomisation and causality, distribution
of sample means and proportions, confidence intervals, t and z tests
- Regression: with intercept only, slope only, intercept and slope, normal equations, error sum of squares, correlation, relation to slope, F and t tests of slope, model and reduced model
- Analysis of Variance: one-way ANOVAR for testing differences in two or more means, relation to t-test, relation to regression, general procedure for tests based on error sum of squares
- Experimental Design: difference in inference between experimental and observed data, issues of cost, sample size, statistical efficiency, manual analysis of variance for simple orthogonal designs (single factor, randomised blocks, latin square, graeco-latin square), computer analysis of non-orthogonal data as multiple regressions (balanced incomplete block, missing values, analysis of covariance)
- Introduction to Factorial Designs: linear variables versus factor levels, response versus factors, complete 2-factor experiments with interaction

**Prescribed Text(s)**


**Recommended Reading:**


Subject Code: STA308
Subject Title: Experimental Design and Analysis
Point Value: 8

Abstract: Proper experimental design is a prerequisite to the efficient and cost effective resolution of comparative quantitative research questions. This subject introduces experimental design and analysis by examples and by the study of the underlying linear model. Use of appropriate computer packages allows testing of assumptions and investigation of advanced topics. Extension of the basic methodology are explored.

Enrolment Restrictions: Nil

Prerequisite(s): STA201 or equivalent
Corequisite(s): Nil

Objectives: Upon completion of this subject, students will be able to:
• recognise situations for which a linear model is appropriate;
• perform basic linear algebra tasks;
• design and check basic experiments;
• perform the analysis of such experiments and report the results in terms of the original problem;
• critically test any assumptions underpinning the use of the linear model;
• perform design and analysis tasks on recognised software platforms; and
• be aware of the limitations of the independence assumption and appreciate the various alternatives available.

Curriculum: The subject will cover the following topics:
• review of basic designs
• overview of linear models and their applications in general;
• review of basic linear algebra;
• univariate linear model for independent data - underlying concepts and assumptions
• regression; observational data
• experimental design and analysis - fixed effects, random effects and different error strata;
• tests of assumptions;
• software platforms - SPSS, GENSTAT, Splus; and
• multivariate linear model (introductory), multivariate regression (GLS), MANOVA.

Prescribed Text(s):

Recommended Reading:
Subject Code: STA347
Title: Multivariate Statistical Analysis
Point Value: 8

Abstract: This subject introduces students to multivariate modelling through an applied approach to data analysis. The emphasis will be on demonstration of techniques and their applicability via empirical investigations of the various methodologies. Topics include: principal components analysis, canonical correlation, discriminant analysis, multivariate analysis of variance, factor analysis, cluster analysis, conjoint analysis and multidimensional scaling.

Enrolment Restrictions: Nil
Prerequisites: STA201 or equivalent.
Corequisite(s): Nil
Objectives: Upon completion of this subject students will:

- Classify given problems by their appropriate analysis technique;
- Apply the chosen technique to the solution of the problem;
- Report and explain the results of the analysis;

Curriculum:
- Review of multiple linear regression (MLR) and the analysis of variance (ANOVA).
- Introduction to multivariate models by examples.
- Principal components analysis: dimensionality reduction; handling multicollinearity.
- Canonical correlation.
- Discriminant analysis.
- Multivariate analysis of variance (MANOVA).
- Factor analysis.
- Cluster analysis.
- Conjoint analysis.
• Multidimensional scaling.

Prescribed Text(s):

Recommended Reading:


Subject Code: STA404

Subject Title: Statistical Reasoning

Point Value: 8

Abstract: This subject explores the use of statistical techniques to answer questions posed by experimental researchers. The rationale of the statistical approach to problem solving is examined via case studies of successful and unsuccessful applications. Topics on specific techniques will mirror those methods peculiar to the program of student research. Empirical demonstration of statistical concepts will provide the underlying theme of this expository subject.

Enrolment Restrictions: Nil

Prerequisite(s): STA201 or equivalent

Corequisite(s): Nil

Objectives: Upon completion of this subject, students will be able to:

• understand the role of statistical methodology in scientific investigations;
• be aware of the fundamental differences between experimentla design and observational studies;
• be able to identify the type of analysis suggested by the nature of the problem under investigation;

Curriculum: The subject will cover the following core and topics:

The core consists of an introduction via the rationale, benefits and limitations of the statistical approach. Of major concern will be the articulation of the statistical method with the user discipline. This connection will be highlighted by case studies.

The topics included are :

• Factorial Designs;
• Split-plot designs;
• Repeated Measures Designs;
• Multivariate Graphical Methods;
• Multivariate Analysis of Variance;
• Logistic Regression, and
• Poisson Regression.

Prescribed Text(s): There is no prescribed text.
Recommended Reading:  


This subject provides an introduction to generalised linear models by an overview of the unified approach dictated by the exponential form of the distribution. This overview is pursued into varied applications in diverse areas which appeared to be previously unconnected.

Objectives:
Upon completion of this subject students will have:

- a sound appreciation of the role of generalised linear models in the scheme of statistical methodology, as well as the scope of techniques that will have been made available by this new technique.

- the ability to use a computer package to analyse data using the approach that is offered by the theory of generalised linear models.

Contents:

- Exponential Family of Distributions.

- GLIM computer package.

- Binary Data.

- Log-Linear Models.

- Gamma Data.

Prescribed Text:

Recommended Reading:

DOBSON A., An Introduction to Generalised Linear Models,


Subject Code: SPA402
Subject Title: Spatial Statistics
Point Value: 8

Abstract: Provides an introduction to and overview of the application of statistical techniques in spatial data analysis. The fundamental approach used will be to highlight the practical value of using modern techniques instead of previous compromises. To this end, case studies from several discipline areas will be used together with a brief historical perspective. A feature of this subject will be the practical component involving data analysis and interpretation for various problems using computer packages and algorithms.

Enrolment Restrictions: Nil

Prerequisite(s): STA201 or equivalent
Corequisite(s): Nil

Objectives: Upon completion of this subject, students will be able to:
• describe the use of smoothing and interpolation in producing maps and in estimation problems;
• sample spatial features, test their patterns and estimate their densities;
• interpret the results of an analysis of a mapped point pattern;
• demonstrate an understanding of the different techniques that are required across a range of applications such as geostatistics, field experiments, ecology and landscape; and
• develop the required skills to use computer facilities in execution of spatial analysis and interpretation.

Curriculum: An overview of
• history of the subject and areas of application via case studies
• sampling methods for 2D data
• smoothing techniques and their role in other analyses
• graphical methods for interpretation
• packages and computer skills

An indepth coverage of
• spatial patterns
• sampling methods in 2D
• smoothing and interpolation
• use of the variogram and autocorrelation
• 'kriging' and 'cokriging'
• case studies in ecology, geostatistics and field experiments

Prescribed Text(s):


Recommended Reading:

Baddeley et. al. (1991) *Spatial statistics and digital image analysis*. National Research Council,
National Academy Press: Washington, D. C.


(Lawes Agricultural Trust). Oxford: UK.


New York.


New York.


Hayward, CA.


