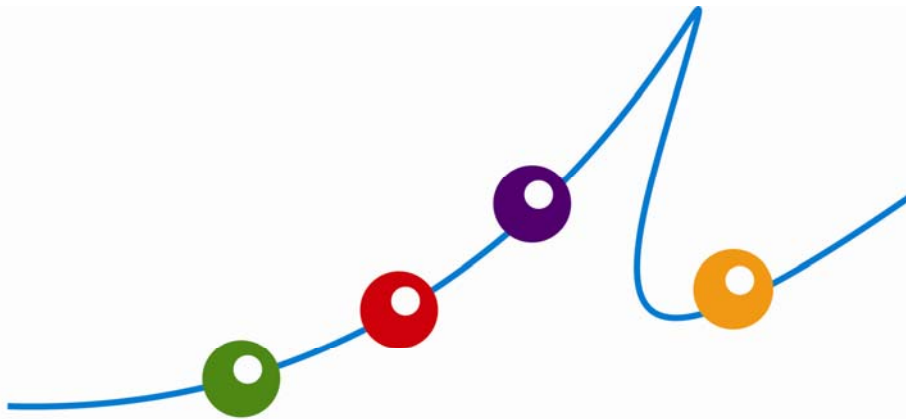


Lancaster University  
*Faculty of Science and Technology*  
*Department of Mathematics and Statistics*

QUANTITATIVE METHODS FOR SCIENCE, SOCIAL  
SCIENCE AND MEDICINE

POSTGRADUATE DEGREE COURSE PROGRAMME  
2011 – 2012



Postgraduate Statistics Centre

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## CONTENTS

<b>1</b>	<b>Introduction.....</b>	<b>3</b>
1.1	<i>The Department.....</i>	3
1.2	<i>Admission requirements .....</i>	3
1.3	<i>Course Office.....</i>	3
1.4	<i>Staff .....</i>	4
<b>2</b>	<b>MSc in Quantitative Methods.....</b>	<b>5</b>
2.1	<i>Aims and Objectives.....</i>	5
2.2	<i>Structure of MSc in Quantitative Methods .....</i>	6
<b>3</b>	<b>Integrated PhD in Quantitative Methods.....</b>	<b>8</b>
3.1	<i>Assessment and Progression .....</i>	8
<b>4</b>	<b>Element Descriptions .....</b>	<b>9</b>
4.1	<i>Compulsory Modules.....</i>	9
4.2	<i>Supporting Modules.....</i>	19
4.3	<i>Optional Modules.....</i>	22
4.4	<i>Software Modules.....</i>	47
4.5	<i>Dissertation.....</i>	54
4.6	<i>Other Non-assessed Module .....</i>	55
<b>5</b>	<b>Other Information .....</b>	<b>56</b>
5.1	<i>Term Dates.....</i>	56
5.2	<i>Coursework Submission.....</i>	56
5.3	<i>Plagiarism.....</i>	57
5.4	<i>General Information on Assessment .....</i>	57
5.5	<i>Procedures for Consideration of Results .....</i>	60
5.6	<i>Guidelines for the Preparation of Dissertations .....</i>	62
5.7	<i>Seminars and Research Workshops .....</i>	62
5.8	<i>Facilities for Postgraduate Students .....</i>	62
5.9	<i>Safety Information .....</i>	65
5.10	<i>Academic Support.....</i>	65
5.11	<i>Quality Assurance .....</i>	66

# 1 Introduction

This booklet contains details of the MSc in Quantitative Methods for Science, Social Science and Medicine. It outlines the modules available to postgraduate students within this degree scheme and provides other information about assessment procedures, guidelines for preparing dissertations and other departmental policies. For any other information contact the Course Director, Dr. Gillian Lancaster.

## 1.1 The Department

The Department of Mathematics and Statistics is made up of the sections of Pure Mathematics and Statistics. The Statistics group at Lancaster forms one of the strongest statistical research groups in the UK.

In recognition of teaching excellence, in 2005 the Department was awarded a large grant by the Higher Education Funding Council for England to fund a *Centre of Excellence in Teaching and Learning* (CETL) which specialises in postgraduate statistics.

A new state-of-the-art building, the Postgraduate Statistics Centre, was opened in February 2008, providing excellent teaching facilities and attractive spaces where postgraduate students and staff can interact. MSc students have their own base-room and social area in this new building.

The Department of Mathematics and Statistics is located in the Postgraduate Statistics Centre and on B floor of Fylde College, to which it is connected by a linking bridge.

## 1.2 Admission requirements

Candidates would normally hold at least an upper second class honours degree in a relevant discipline from a British University or CNAAB; a comparable degree from a university or recognised degree awarding body in another country, or a relevant professional qualification or experience at an equivalent level.

A background of at least 'A level' mathematics or equivalent is an advantage.

## 1.3 Course Office

For current students enquiries about the day-to-day running of the course should be addressed to Angela Mercer in the course office (B78, Postgraduate Statistics Centre) or by email to [a.j.mercer@lancaster.ac.uk](mailto:a.j.mercer@lancaster.ac.uk).

## **1.4 Staff**

### **Director of Postgraduate Studies**

*Dr Gillian Lancaster*

### **Course Director**

*Dr Gillian Lancaster*

### **MSc Coordinator**

*Angela Mercer*

### **Lecturing Staff:**

*Dr Damon Berridge  
Dr Debbie Costain  
Dr Emma Eastoe  
Prof Brian Francis  
Dr Juliet Harman  
Dr Leslie Humphreys  
Dr Gillian Lancaster  
Dr David Lucy  
Dr Dennis Prangle  
Dr Andrew Titman*

### **Visiting Lecturers:**

*Karen Dunn  
Dr Michael Green*

## 2 MSc in Quantitative Methods

### 2.1 Aims and Objectives

#### 2.1.1 Aims

The MSc in Quantitative Methods is designed to provide students with a firm grounding in the joint roles of substantive theory, data collection and statistical analysis. Students are encouraged to explore ways in which this knowledge can be applied to study scientific, economic, sociological and management issues. Given staff expertise in applied statistics, Lancaster University is ideally placed to provide such a course.

#### 2.1.2 Learning and Assessment Objectives

- **Knowledge and understanding**

By the end of the course, students should have acquired:

- a) advanced knowledge of the interdependent roles of substantive theory, methods of data collection and statistical methods of analysing data,
- b) a thorough understanding of problems inherent in designing, executing and evaluating research projects and published work.

These will have been acquired via:

- a) direct transmission in classes,
- b) discussion with tutors and peers,
- c) independent study,
- d) direct practical experience.

Assessment will have been based on a dissertation (an original investigation supervised by an expert on the topic) and on coursework relating to the taught modules (ranging from assignments involving traditional essays to the writing up of practical work and other exercises).

- **Skills and other attributes**

Students will have gained essential practical skills associated with conducting applied statistical research, including:

- a) research design, data analysis, modelling and interpretation,
- b) using a range of software,
- c) synthesising information from a variety of sources,
- d) oral and written presentation skills.

Students will have been encouraged to relate their work and interests to those of researchers from areas of science, medicine, education, management, social services, criminal justice, market research, housing and ethnic relations. They will also have developed skills of scientific reasoning and analysis, and transferable skills of communication. The dissertation will have provided the opportunity to consolidate these through experience of the research process. The range of skills will have been assessed through judgement of students' written work and oral presentations.

## 2.2 Structure of MSc in Quantitative Methods

The MSc programme consists of some core modules (50 credits), some optional modules (70 credits), followed by a dissertation (60 credits). Students can self-select their optional modules or follow designated pathways, thereby tailoring their training programmes according to their own requirements and research interests. (Total 180 credits).

Module assessment is by coursework except for MATH563 and MATH564 (Statistical Methods for Health and Medicine pathway) which also include an examination.

### **Compulsory core modules (50 credits):**

These modules cover the main methods of data collection, fundamental aspects of research design, and statistical methods of data analysis.

- CFAS402a: Sampling Design (*5 credits*)
- CFAS402b: Questionnaire Design (*5 credits*)
- CFAS403: Secondary Data Analysis (*5 credits*)
- CFAS406: Statistical Inference (*15 credits*)
- CFAS407: Generalized Linear Models (*10 credits*)
- CFAS411: Multi-Level Models (*10 credits*)

### **Optional Modules (70 credits):**

In addition to the core modules students take a selection of optional modules from the list below. They may choose any module that is of interest to them. The designated pathways provide a suggested optional structure for those with particular professional interests.

The CFAS450: Statistics in Practice module provides students with the range of practical skills necessary for applied statistical work, including team working, oral presentation, statistical consultancy and the preparation of written reports. CFAS435: Teaching Statistics is a distance learning course for those who choose the Teaching Statistics pathway of the MSc. It is more suited to part-time study and typically takes 18 months.

- CFAS409: Duration Analysis (*10 credits*)
- CFAS412: Data Mining (*10 credits*)
- CFAS414: Methods for Missing Data (*10 credits*)
- CFAS415: Structural Equation Modelling (*10 credits*)
- CFAS416: Bayesian Methods (*10 credits*)

CFAS450: Statistics in Practice (*10 credits*)

For Scientific Research Methods pathway:

CFAS436: Quantitative Methods for Scientific Research I (*10 credits*)

CFAS437: Quantitative Methods for Scientific Research II (*10 credits*)

For Crime and Social Statistics pathway:

CFAS433: Quantifying and Evaluating Forensic Evidence (*10 credits*)

CFAS434: Quantitative Criminology (*10 credits*)

CFAS410: Event History Analysis (*10 credits*) – not available 2011/12

For Statistical Methods for Health and Medicine pathway:

MATH563: Clinical Trials (*10 credits*)

MATH564: Principles of Epidemiology (*10 credits*)

For Teaching Statistics pathway:

CFAS435: Teaching Statistics – by distance-learning (*60 credits*)

### **Non-credit-bearing modules**

Non-credit-bearing modules are available to supplement the substantive and methodology modules.

### **Software modules:**

The module on the R software package is compulsory. R is used in some of the methodology modules and is assessed through these modules.

CFAS417a: Atlas.ti (*non-credit*)

CFAS422: R (*compulsory*)

CFAS424: SPSS for Windows: I (*non-credit*)

CFAS425: SPSS for Windows: II (*non-credit*)

CFAS426: STATA (desirable for CFAS411: Multi-level Models) (*non-credit*)

### **Optional Support Modules:**

These modules are provided as an introduction to the course and to give training in the fundamentals of mathematics and statistics:

CFAS401: Methodological Debates (*non-credit*)

CFAS404: Mathematics for Statistics (*non-credit*)

CFAS405: Statistical Methods (*non-credit*)

### **Dissertation (60 credits)**

Following successful completion of the taught part of the course, students conduct an original piece of research with subsequent submission of a dissertation of 50 pages maximum, based on empirical work undertaken in an area of applied statistics.

Students who do not complete the MSc programme may be eligible for an alternative qualification. Students who receive 120 credits from the taught courses will be eligible for the Postgraduate Diploma in Quantitative Methods.

## 3 Integrated PhD in Quantitative Methods

Students awarded a 1+3 studentship (for MSc and PhD) may, by agreement with the scheme director, replace one or more optional modules with appropriate modules provided by another department, provided the topic is related to the proposed PhD or provides generic research training.

In addition, students may be expected to attend external advanced courses in statistics which are given as part of the national Graduate Training Programme in Statistics organised by the Royal Statistical Society. There is no formal assessment of these courses.

### 3.1 Assessment and Progression

#### Year 1

An MSc will be awarded at the end of Year 1 if the weighted mean module mark is over 50% (with no individual mark below 40%) and at least 50% in the dissertation. Also see section 5.5.

To continue into Year 2 and study towards a PhD, students should have a weighted mean mark above 60% over all Year 1 modules and dissertation, and have no individual mark below 50%.

#### Years 2, 3 and 4

The PhD project will be reviewed by a supervisory panel and satisfactory performance will be needed for progression. The PhD will be examined in the usual way and satisfy the normal criteria for the award.

More information about PhD regulations can be found at:  
<http://www.lancs.ac.uk/users/gradschool/regulations.htm>

## 4 Element Descriptions

### 4.1 Compulsory Modules

#### 4.1.1 CFAS402a Sampling Design

**Lecturers:** Dr Damon Berridge

**Prerequisites:** Statistical Methods

**Contact hours and type:** 5.5 hrs lecture/tutorial + 2 hrs practical

Outline: The main aim of this module is to give a solid foundation to the understanding of sampling and sampling methods. Various methods of survey sampling will be considered and practical examples given throughout the module.

Topics covered will include:

- Basic ideas of sampling
- Sampling designs
- Sample size determination and sampling frames
- Experiments and investigations
- Ways of collecting information

Learning: Students will learn through the application of concepts and techniques covered in the module by application to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Students will acquire a knowledge of:

- The basic principles of sampling
- Different types of sampling designs and which is appropriate to use in a particular circumstance
- Methods of collecting information

Assessment: An assignment covering all aspects of the module material.

#### **Bibliography:**

Barnett, V. (2002) *Sample Survey: Principles and Methods* Hodder Arnold

Kish, L.(1995) *Survey Sampling* . Wiley Classics Library.

Lohr, S (1999) *Sampling: Design and Analysis*

Moser C.A., Kalton G., *Survey Methods in Social Investigation*

### 4.1.2 CFAS402b Questionnaire Design

**Lecturers:** Dr. Damon Berridge & Dr Gillian Lancaster

**Prerequisites:** none

**Contact hours and type:** 7.5 hrs lecture/discussion practical

Outline: This module will provide students with the tools required to design questionnaires in an efficient and effective manner. There will be opportunity for students to discuss their own research interests.

Topics covered will include: useful resources, including the Question Bank; examples of current widely used questionnaires in the social sciences (such as BHPS, SCOLI); examples of good and bad practice; interview schedule vs. self-completion form; structured vs. semi-structured instruments; types of questions and responses; wording of questions; routing, branching and funnel sequences; questionnaires for use in longitudinal surveys; designing web-based questionnaires; the concepts of validity and reliability.

Learning: Students will learn through the practical application of the techniques covered in the module. Students will be encouraged to participate and share their experiences.

Knowledge and Understanding:

By the end of the module students will:

1. Be familiar with a range of useful resources, including the Question Bank
2. Have an increased understanding of types of questions and responses and of the wording of questions
3. Be familiar with routing, branching and funnel sequences
4. Have increased competence in the design of questionnaires in a number of formats
5. Have an appreciation of how to address validity and reliability issues

Assessment will involve the design and piloting of a short questionnaire and an evaluation of its strengths and weaknesses.

## Bibliography:

- Fink, A. et al. 1995. *The Survey Kit*. Sage.
- Foddy, W. 1994. *Constructing questions for interviews and questionnaires: theory and practice in social research*. Cambridge University Press.
- Houtkoop-Steenstra, H. 2000. *Interaction and the standardised survey interview: the living questionnaire*. Cambridge University Press.
- Moser, C. & Kalton, G. 1979. *Survey methods in social investigations*. Heinemann.
- Oppenheim, A.N. 1992. *Questionnaire design, interviewing and attitude measurement*. Pinter.
- Rossi, P.H., Wright, J.D. & Anderson, A.B. 1983. *Handbook of Survey Research*. Academic Press.
- Schuman, H. & Presser, S. 1981 *Questions and answers in attitude surveys: experiments on question form, wording and context*. Academic Press.
- Wilson, N. & McClean, S. 1994. *Questionnaire Design: A Practical Introduction*. University of Ulster.

### 4.1.3 CFAS403 Secondary Data Analysis

**Lecturer:** Dr Leslie Humphreys

**Prerequisites:** Methodological Debates; SPSS for Windows: I (or equivalent)

**Contact hours and type:** 5 hrs lecture/demonstration + 2.5 hrs practical

**Outline:** This module introduces the skills and techniques involved in sourcing and analysing secondary data. The module consists of two parts. The first part is concerned with using the internet to discover secondary data sources and other material both in the UK and in other countries, and in finding both quantitative resources for research. The major British social surveys will be covered. Online access to the UK census data will also be demonstrated.

The second part of the module explores in detail two publicly available datasets, the Home Office Offenders Index birth cohort series and the ESRC British Household Panel survey. The module will show methods of merging and aggregating datasets to produce information sources suitable for secondary analysis. Problems of data quality will also be addressed.

**Learning:** Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Successful students will:

1. be familiar with the major sites for information on secondary data sources in the UK
2. understand how to search for data at the ESRC data archive
3. be aware of how to obtain UK Census data
4. be able to download data and follow data documentation
5. be able to construct data subsets by merging and aggregating data files from a major social science dataset using SPSS
6. be aware of data quality issues in secondary data
7. gain experience of using a simple GIS system for displaying spatial data.
8. Learn how to aggregate and merge and transform datasets to convert complex secondary datasets to those ready for statistical analysis

**Assessment:** By coursework, addressing a relevant social issue by extracting data from the BHPS and providing a suitable data analysis.

## **Bibliography:**

Marc Riedel, *Research Strategies for Secondary Data*, Sage.

Angela Dale, Sara Arber and Michael Procter, *Doing secondary analysis*.  
London : Unwin Hyman

Catherine Hakim, *Secondary analysis in social research: a guide to data sources and with examples*. London : Allen & Unwin

Jill Kiecolt and Laura Nathan, *Secondary analysis of survey data*, Sage.

#### **4.1.4 CFAS406 Statistical Inference**

**Lecturer:** Dr Emma Eastoe

**Prerequisites:** Statistical Methods

**Contact hours and type:** 15 hrs (mix of lectures and tutorials)

Outline: The main aim of this module is to give a solid foundation to the understanding of statistics as a general approach to the problem of making valid inferences about relationships using data from observational or experimental studies. Examples of analyses from the social sciences will be used to illustrate this approach. The emphasis will be on the principle of Likelihood as a unifying theory for the development of statistical analysis.

Topics covered will be:

Revision of probability theory and parametric statistical models  
The properties of statistical hypothesis tests, statistical estimation and sampling distributions  
Maximum Likelihood Estimation of model parameters  
Asymptotic distributions of the maximum likelihood estimator and associated statistics for use in hypothesis testing  
Application of likelihood inference to simple statistical analyses including linear regression and contingency tables

Learning: Students will learn through the application of concepts and techniques covered in the module by application to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Students will acquire a knowledge of:

1. the basic principles of probability theory
2. the properties of a statistical test
3. Maximum Likelihood as a theory for estimation and inference
4. the application of the methodology to hypothesis testing for model parameters, the analysis of contingency tables and linear regression

and develop skills to:

5. apply theoretical concepts
6. identify and solve problems

Assessment: One assignment covering all aspects of the module material.

## **Bibliography:**

Dobson A.J., (1983) *An Introduction to Statistical Modelling*, Chapman and Hall

Eliason, S.R. (1993) *Maximum Likelihood Estimation : Logic and Practice*, Sage Publications

Pickles A., *An Introduction to Likelihood Analysis*, CATMOG series

Patiwan, Y,(2001) *In all Likelihood*, Oxford University Press, Oxford.

#### 4.1.5 CFAS407 Generalized Linear Models

**Lecturers:** Professor Brian Francis and Dr Andrew Titman

**Prerequisites:** Statistical Inference (or equivalent); experience in R

**Contact hours and type:** 10 hrs lecture/demonstration + 5 hrs practical

Outline: The aim of this module is to consider generalized linear models as a broad class of statistical models applying the general principles of likelihood inference to a variety of commonly encountered data analysis problems in the social sciences. The module will also introduce the software package R as tool for such statistical analysis.

Concepts introduced in the module *Statistical Inference* will be reviewed and extended to this broad class of models. The use of factors, covariates and their interactions to build a flexible class of relationships will be considered. Applications to the modelling of categorical and duration data will be described.

Topics covered will be:

An introduction to model fitting in the R software package. The general linear model. Logistic regression models for binary data. The generalized linear model. Log-linear models for multi-way contingency tables. An introduction to the analysis of duration data.

Learning:

Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Successful students will be able to:

1. carry out advanced statistical procedures
2. identify the appropriate procedure for a particular substantive issue
3. apply theoretical concepts
4. identify and solve problems
5. analyse data and interpret statistical output
6. apply strategies for appropriate selection of information

Assessment: A series of short assignments covering all aspects of the module material plus a larger assignment (50%) that will test the student's ability to select the appropriate statistical techniques to address a substantive issue.

## Bibliography:

- Agresti A., *Analysis of Categorical Data*, Wiley, New York
- Aitkin M.A., Anderson D.A., Francis B.J. and Hinde J.P., *Statistical Modelling in GLIM*, OUP
- Dobson A., *An Introduction to Generalized Linear Models*, Chapman and Hall
- Fox, John, *An R and S-Plus Companion to Applied Regression*, Sage
- Liao, Tim Futing, *Interpreting Probability Models : Logit, Probit, and Other Generalized Linear Models*, Sage
- Lindsey J.K., *Analysis of Categorical Data using GLIM*, Springer Verlag, Berlin
- R Development Core Team, *An Introduction to R*,  
<http://www.stats.bris.ac.uk/R/>
- Venables W.N. and Ripley B.D., *Modern Applied Statistics with S-Plus*, Springer
- Tacq, Jacques, *Multivariate Analysis Techniques in Social Science Research*, Sage

#### 4.1.6 CFAS411 Multi-level Models

<b>Lecturers:</b>	<b>Dr Damon Berridge &amp; Dr Michael Green (Visiting Lecturer)</b>
<b>Prerequisites:</b>	<b>Generalized Linear Models (or equivalent); STATA</b>
<b>Contact hours and type:</b>	<b>10 hrs lecture/tutorial + 5 hrs practical</b>

Outline: The aim of this module is to highlight the problems that occur when the hierarchical nature of many social surveys is ignored in routine statistical analysis. The classical 'variance components' ANOVA model will be described and extended to the multilevel model. Estimation techniques such as REML will be outlined. The analysis of such models will be illustrated using appropriate software.

Topics covered will be:

The nature of heterogeneity and intraclass correlation. Random effects in ANOVA models, variance components and REML. The problem of bias in naïve statistical methods. Multilevel models and random parameter models. Estimation methods. Illustrations of statistical inference in statistical software such as GLLAMM.

Learning: Students will learn through the application of concepts and techniques covered in the module to real substantive issues.

Successful students will be able to:

understand the issue of heterogeneity in social studies  
carry out advanced statistical procedures  
apply theoretical concepts  
identify and solve problems  
analyse data and interpret statistical output

Assessment: A single assignment covering all aspects of the module material.

#### **Bibliography:**

- Bryk, A. S., and Raudenbush, S. W., (1992) *Hierarchical Linear Models*, Sage.
- Goldstein, H., (2003) *Multilevel Statistical Models*. London, Edward Arnold
- Hox, J., (2002) *Multilevel Analysis: Techniques and Applications*, Mahwah, N.J: Lawrence Erlbaum Associates.
- Longford, N. T., (1993) *Random Coefficient Models*. Oxford University Press.
- Snijders, T. A. B., and Bosker, R. J., (1999) *Multilevel Analysis. An Introduction to Basic and Advanced Multilevel Modelling*. London: Sage.

## 4.2 Supporting Modules

### 4.2.1 CFAS401 Methodological Debates (non-credit)

**Lecturer:** Dr Damon Berridge

**Prerequisite:** None

**Contact hours and type:** 3 hrs (lectures)

Outline: This session introduces students to the principles and practice of applied quantitative research. It emphasizes the importance of issues of analysis in the design process, in particular the choice of an appropriate statistical model.

Topics covered will include:

- understanding and identifying different types of data
- basic statistical methods and exploratory data analysis
- working within a statistical modelling framework
- orientation and extensions to the statistical modelling framework

Learning: Students will learn through the discussion of concepts and techniques covered in the module to real substantive issues.

Successful students will be able to:

- identify different types of data used in data collection;
- select the most appropriate basic methods of analysis to use in exploring the data;
- understand the usefulness and need for working within a statistical modelling framework;
- appreciate when more advanced statistical procedures may be necessary.

This session is not assessed.

#### **Bibliography:**

Agresti A (2002) *Categorical Data Analysis* [2<sup>nd</sup> edition]

Altman D G (2008) *Practical Statistics for Medical Research* (2<sup>nd</sup> Edition). Chapman and Hall

Dobson AJ *An Introduction to Generalized Linear Models*' (2<sup>nd</sup> ed.), Boca Raton : Chapman & Hall/CRC, 2001.

Newman, W (2006) *Social Research Methods* [6<sup>th</sup> edition]

#### 4.2.2 CFAS404 Mathematics for Statistics (non-credit)

**Lecturers:** Dr David Lucy

**Prerequisites:** none

**Contact hours:** 10 hrs

Outline: This module is an introduction to the basic (and not so basic) mathematics needed in the Statistics World. The module will revise some topics covered in the A-level syllabus, and then introduce other topics students need to grasp in order to cope with the statistics used in this degree.

Therefore this module is intended for those people having only a GCSE in Mathematics, but who need to gain knowledge of material covered at A-level, such as Calculus, Matrices and Probability.

The following topics will be covered:

1. Sets, Permutations, Combinations and Probability
2. Mappings and Functions
3. Equations
4. Vectors and Matrices
5. Calculus

Learning: Students will self teach the concepts by going through the web based material, and then through the exercises and answers. If problems arise, the tutor will be accessible via e-mail.

Successful students will:

1. be able to cope with the Mathematics needed in the other courses
2. be familiar with calculus.
3. know how to manipulate vectors and matrices
4. know how to work out probability

#### **Bibliography:**

Pearson J.M., *Mathematics for Economists (A First Course)*

Jacques I., *Mathematics for Economics and Business*

Hagle T., *Basic Math For Social Scientists (Concepts)*

Croft A. and Davison R., *Foundation Maths (Prentice Hall)*

### 4.2.3 CFAS405 Statistical Methods (non-credit)

**Lecturer:** Dr Emma Eastoe

**Prerequisites:** Mathematics for Statistics (or equivalent)

**Contact hours and type:** 15 hrs (mix of lectures and tutorials)

The aim of this module is to take the ideas of summary statistics and graphical presentations and develop the basic concepts of the theory of statistical methodology. These will include the treatment of common distributions, general properties of distributions and the development of the principles of statistical tests. These ideas will be illustrated by examples from the social sciences and related disciplines. Emphasis will be on the practical application of these ideas.

Students will acquire a knowledge of:

1. the basic principles of probability theory and statistical distributions
2. the concept of a sampling distribution
3. the principles of estimation and inference
4. the application of the methodology to the comparison of means and the application of least squares in linear regression

and develop skills to:

5. apply theoretical concepts
6. identify and solve problems

Topics covered will be:

Probability theory: discrete and continuous distributions, expectation and variance of a distribution; sampling distributions and parameter estimation; hypothesis tests: critical regions, p-values and confidence intervals; linear regression: ANOVA, least squares and interpretation; Pearson's chi-squared statistic.

#### **Bibliography**

Attwood, G., Skipworth, G. and Dyer, G. (2000) *Statistics 1 - 6*, Oxford:Heinemann/Edexcel (series of six books)

Daly F., Hand D.J., Jones M.C., Lunn A.D. and McConway K.J. (1995) *Elements of Statistics*, Addison Wesley.

Rice, J.A. (2007) *Mathematical Statistics and Data Analysis*, Duxbury

Upton G. and Cook I. (1996) *Understanding Statistics*, Oxford University Press

## 4.3 Optional Modules

### 4.3.1 CFAS409 Duration Analysis

<b>Lecturers:</b>	<b>Dr Juliet Harman &amp; Dr Andrew Titman</b>
<b>Prerequisites:</b>	<b>Generalized Linear Models (or equivalent); experience in R</b>
<b>Contact hours and type:</b>	<b>10 hrs lecture/tutorial + 5 hrs practical sessions in which R will be used to apply the techniques</b>

Outline: The main aim of this module is to give a solid foundation to the understanding of the statistical techniques required to make valid inferences about duration (time to event) data from observational or experimental longitudinal studies. Examples of analyses from the social and health sciences will be used to illustrate these techniques. The emphasis will be on the practical application of techniques using the R software package and on the interpretation of resulting output.

Topics covered will include:

Basic concepts, incl. hazard and survival functions  
Exploratory analyses, incl. Kaplan-Meier estimate of survival function  
Semi-parametric statistical models, incl. Cox's proportional hazards  
Fully parametric statistical models, incl. Weibull and other distributions  
Competing risks; time-varying explanatory variables

Learning: Students will learn by applying the concepts and techniques covered in the module to data from the social and health sciences. Students will be encouraged to examine issues of substantive interest in these studies.

Knowledge and understanding:

By the end of the module successful students will:

1. Be able to analyse duration data effectively, and interpret the results
2. Be familiar with models for duration data
3. Have increased confidence in the use of the software R

Skills and other attributes:

Intellectual and thinking skills - successful students will be able to:

4. apply relevant theoretical concepts
5. identify and solve problems
6. analyse data and interpret results

Assessment: One assignment covering all aspects of the module material.

### **Bibliography:**

Collett, D. (2003) *Modelling survival data in medical research*, 2nd edition. Chapman & Hall.

Cox, D.R. and Oakes, D. (1984) *Analysis of survival data*. Chapman and Hall.

Crowder, M.J., Kimber, A.C., Smith, R.L. and Sweeting, T.J. (1991) *Statistical analysis of reliability data*. Chapman Hall.

Elandt-Johnson, R.C. and Johnson, N. L. (1980) *Survival models and data analysis*. Wiley.

Hosmer, D. W. and Lemeshow, S. (1999) *Applied survival analysis: regression modelling of time to event data*. Wiley.

Kalbfleisch, J.D. and Prentice, R.L. (2002) *The statistical analysis of failure time data*. 2<sup>nd</sup> edition. Wiley.

Klein, J.P. and Moeschberger, M.L. (1997) *Survival analysis: techniques for censored and truncated data*. Springer.

Lawless, J.F. (2003) *Statistical models and methods for lifetime data*. Wiley-Interscience.

Machin, D, Cheung YB, Parmar, MKB (2006), *Survival Analysis: A Practical Approach*, Wiley

Pintilie, M. (2006) *Competing Risks: A Practical Perspective*, Wiley

Smith, P.J. (2002) *Analysis of failure and survival data*. Chapman and Hall.

Tableman, M. and Kim, J.S. (2004) *Survival analysis using S: analysis of time-to-event data*. Chapman and Hall.

Therneau, T. and Grambsch, P.M. (2000) *Modeling survival data: extending the Cox model*. Springer.

### 4.3.2 CFAS410 Event History Analysis (not available 2011/12)

<b>Lecturers:</b>	<b>Dr Damon Berridge</b>
<b>Prerequisites:</b>	<b>Duration Analysis (or equivalent)</b>
<b>Contact hours and type:</b>	<b>10 hrs lecture/tutorial + 5 hrs practical sessions in which SABRE will be used to apply the techniques.</b>

The main aim of this module is to give a solid foundation to the understanding of the statistical techniques required to make valid inferences about event history data from observational or experimental longitudinal studies. Examples of analyses from the social sciences will be used to illustrate these techniques. The emphasis will be on the practical application of these techniques using software such as SABRE in R, and on the interpretation of resulting output.

Knowledge and understanding:

By the end of the module successful students will:

1. Be able to analyse event history data effectively, and interpret the results
2. Be familiar with models for event history data
3. Have confidence in the use of the software SABRE in R

Skills and other attributes:

Intellectual and thinking skills - successful students will be able to:

4. apply relevant theoretical concepts
5. identify and solve problems
6. analyse data and interpret results

Topics covered will include:

Specific issues arising in the analysis of event history data, incl. residual heterogeneity, state dependence, initial conditions, etc.  
Random effects modelling of binary recurrent events  
Duration effects, lagged response variables and two-state Markov models  
Ordinal recurrent events

Assessment will be by a single assignment covering aspects of the module material.

## Bibliography

Allison, P.D. (1984) *Event history analysis: regression for longitudinal event data*. Sage.

Bijleveld, C.C.J.H., van der Kamp, L.J.Th., Mooijaart, A., van der Kloot, W.A., van der Leeden, R. and Van Der Burg, E. (1998) *Longitudinal data analysis: designs, models and methods*. Sage.

Blossfeld, H.-P. and Rohwer, G. (1995) *Techniques of event history modelling: new approaches to causal analysis*. Lawrence Erlbaum Associates.

Hagenaars, J.A. (1990) *Categorical longitudinal data: log-linear panel, trend, and cohort analysis*. Sage.

Hand, D. and Crowder, M. (1996) *Practical longitudinal data analysis*. Chapman and Hall.

Jones, R.H. (1993) *Longitudinal data with serial correlation: a state-space approach*. Chapman and Hall.

Singer, J.D. and Willett, J.B. (2003) *Applied longitudinal data analysis: modelling change and event occurrence*. Oxford University Press.

Taris, T. (2000) *A primer in longitudinal data analysis*. Sage.

Twisk, J.W.R. (2003) *Applied longitudinal data analysis for epidemiology*. Cambridge University Press.

Yamaguchi, K. (1991) *Event history analysis*. Sage.

### 4.3.3 CFAS412 Data Mining Techniques

<b>Lecturer:</b>	<b>Professor Brian Francis</b>
<b>Prerequisites:</b>	<b>Generalized Linear Models (or equivalent)</b>
<b>Contact hours and type:</b>	<b>10 hrs lecture/demonstration + 5 hrs computer-based practical sessions</b>

Outline: The main aim of data mining is to extract knowledge, or information, which is stored in very large databases. This module covers many of the concepts that are fundamental to understanding and successfully applying data mining methods. Statistical concepts are discussed without mathematically complex formulation. Practical sessions will use the latest versions of standard software rather than data mining – the emphasis of the module is on techniques rather than data mining software.

The module will include the following:

1. formulating research objectives that can be translated into suitable analytical methods;
2. data structure and organisation;
3. model comparison and assessment;
4. data splitting;
5. assessing and interpreting predictive models;
6. introduction to variable selection;
7. benefits and drawbacks of neural networks;
8. examining the benefits and drawbacks of regression trees;
9. cluster analysis and latent class analysis;
10. bootstrap and cross-validation.

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of empirical interest in these studies.

Successful students will be able to:

1. identify empirical problems and determine suitable analytical methods;
2. understand the difficulties presented by massive, opportunistic data;
3. understand the concepts of using logistic regression, neural networks, projection methods and decision trees for predictive modelling;
4. prepare data for analysis, including partitioning data;
5. train, assess and compare regression models, neural networks and decision trees;
6. understand the advantages and disadvantages of cluster analysis, latent class modelling and other latent variable methods.

Assessment: A series of short assignments covering all aspects of the module material (50%) plus a larger assignment (50%) that will test the student's ability to select the appropriate data mining techniques for a particular data set.

### **Bibliography:**

Fayyad, U.M., Piatetsky-Shapiro, G., Smyth, P. and Uthurusamy, R. (Eds) (1996) *Advances in knowledge discovery and data mining*. Menlo Park, CA: AAAI Press.

Hand, D.J. (2000) 'Data mining - New challenges for statisticians', *Social Science Computer Review*, 18, 4, 442-449.

Hand, D.J., Mannila, H. and Smyth, P. (2001) *Principles of data mining*. Cambridge, MA: MIT press.

SAS Institute Inc.(2000) *Getting started with SAS Enterprise Miner*. Cary, NC: SAS Institute Inc.

SAS Institute Inc.(2000) *Data Mining using SAS Enterprise Miner Software : A Case Study Approach*. Cary, NC: SAS Institute Inc.

SAS Institute Web-based '*Enterprise Miner tutorial*', available on-line at <http://www.sas.com/software/tutorials/v8/em/mainmenu.htm>

#### 4.3.4 CFAS414 Methods for Missing Data

<b>Lecturer:</b>	<b>Dr Dennis Prangle</b>
<b>Prerequisites:</b>	<b>Generalized Linear Models (or equivalent)</b>
<b>Contact hours and type:</b>	<b>10 hrs lecture/demonstration + 5 hrs practical/tutorial</b>

Outline: This module deals with the problem of missing data common in many social surveys; problems of bias and inefficiency of naive statistical methods; alternative procedures: basics and complications; MCAR, MAR and non-ignorable missing data; selection bias and the problem of 'dropout' in panel studies. The module will also cover appropriate statistical analysis in appropriate software. The methods will be illustrated by case study analyses.

Particular topics will be:

Assumptions for missing data methods; problems with conventional methods; Maximum Likelihood (ML) with missing data; ML with the EM algorithm; ML for contingency tables; multiple imputation (MI) for missing data; data augmentation; MI for the multivariate normal model; Markov Chain Monte Carlo (MCMC) approach; MI with SAS; MI with categorical and non-normal data; combining MI results; likelihood ratio tests; nonparametric methods; Bayesian statistics; bootstrap methods.

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Successful students will be able to:

- understand the problems of missing data in social studies
- perform advanced statistical procedures
- apply theoretical concepts
- identify and solve problems
- analyse data and interpret statistical output

Assessment: A single assignment covering all aspects of the module material.

#### **Bibliography:**

Allison, P.D. (2002) *Missing data*. Sage.  
Breen, R. (1996) *Regression models: censored, sample selected or truncated data*. Sage.  
Little, R.J.A. and Rubin, D.B. (2002) *Statistical analysis with missing data*. 2<sup>nd</sup> edition. Wiley.  
Schafer, J.L. (1997) *Analysis of incomplete multivariate data*. Chapman and Hall.

### 4.3.5 CFAS415 Structural Equation Modelling

**Lecturers:** Dr Michael Green and Karen Dunn (Visiting Lecturers)

**Prerequisites:** SPSS for Windows I (or equivalent); Generalized Linear Models (or equivalent)

**Contact hours and type:** 8 hrs lecture/demonstration + 4 hrs practical

Outline: This module will introduce participants to latent variables (variables which are not directly measured themselves) and to the use of factor analysis in investigating relationships between latent variables and observed, or measured, variables. These techniques will then be extended into the wider area of structural equation modelling, where complex models involving several latent variables will be introduced.

The module is aimed at researchers and research students who have experience of statistical modelling (up to linear regression) and hypothesis testing, who wish to develop techniques to analyse more complex data involving latent variables. The aim of the module is to provide a background of theory with opportunities to apply the techniques in practice, and each session will consist of a lecture/ demonstration and a practical. The software packages used will be IBM SPSS and AMOS, and while participants will be expected to be familiar with SPSS, no knowledge of the structural equation modelling package AMOS will be assumed.

In summary, the following topics will be covered:

1. introduction to latent variables and measurement error
2. exploratory and confirmatory factor analysis; measurement models
3. structural equation models
4. theoretical issues involved in the development and application of structural equation models.

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Successful students will be:

1. familiar with latent variables and factor models
2. able to investigate data using factor analysis
3. able to confirm hypotheses and develop structural equation models
4. able to apply theoretical concepts
5. able to identify and solve problems
6. able to analyse data using appropriate techniques
7. able to interpret statistical output.

Assessment: One assignment (100%) to be submitted in the form of two reports covering all aspects of the module material. The projects involve investigating datasets that require the student to investigate a substantive issue using appropriate statistical techniques and interpreting the results.

### **Bibliography:**

**Byrne, B.M.** (2010) *Structural Equation Modelling with AMOS: Basic Concepts, Applications and Programming*. New York: Routledge

**Kline, R. B.** (2010) *Principles and Practices of Structural Equation Modelling* London: The Guildford Press

#### **4.3.6 CFAS416 Bayesian Methods**

**Lecturer:** Dr David Lucy

**Prerequisites:** Generalized Linear Models (or equivalent)

**Contact hours and type:** 15 hrs (10 hrs lectures + 5 hrs practical)

This module introduces students to the use of Bayesian methods for data analysis in the social and empirical sciences. It also provides an introduction to the basic concepts of Bayesian approaches to statistics, ideas such as the subjective interpretation of probability, types of prior distributions, the use of Bayes theorem in updating information, and inference procedures such as Bayesian parameter estimates will be introduced to the student. The main focus of the module will be the application of Bayesian models in social sciences and related disciplines.

Students will acquire a knowledge of:

- 1.the fundamental notion of Bayes' theorem and the theory of inverse probability
- 2.the relationship between Bayesian methods and classical likelihood methods
- 3.the use of Bayesian methods to combine prior information with data
- 4.the basic concepts of Bayesian inference, including posterior conditioning, credible intervals, prior distributions, and the likelihood principle
- 5.an introduction to Monte Carlo Markov Chain (MCMC) methods
- 6.application of MCMC using OpenBUGS to real estimation problems

and develop skills to:

- 1.apply theoretical concepts
- 2.examine model fitting in practice using Bayesian principles
- 3.explore applied Bayesian modelling

Topics covered will be:

An introduction to Bayesian analysis, single parameter Bayesian modelling, informative priors, noninformative priors, posterior and predictive distributions, conjugate distributions, Bayesian forms of confidence intervals, Bayesian regression and General Linear Models using MCMC methods and OpenBUGS.

Exercises will be provided as part of the practical sessions. The assessment will be a short assignment on Bayesian model fitting using OpenBUGS.

## Bibliography

Gelman, A. Carlin, J.B. Stern, H.S. and Rubin, D.B. (2004) *Bayesian Data Analysis*. Chapman & Hall/CRC, Boca Raton.

Lee, P (1998). *Bayesian Statistics: an introduction*. Halsted Press, New York.

Ntzoufras, I.(2009) *Bayesian Modeling Using WinBUGS*, Wileys.

Spiegelhalter, D. J, Thomas, A., Best, N., and Lunn, D. (2003). *WinBUGS Version 1.4 User Manual*. MRC Biostatistics Unit, Cambridge, UK. ( a version of WinBUGS, OpenBUGS, is freely available from <http://www.openbugs.info/w/>).

### 4.3.7 CFAS433 Quantifying and Evaluating Forensic Evidence

**Lecturer:** Dr David Lucy

**Prerequisites:** Basic numeracy: arithmetic and a little algebra

**Contact hours and type:** 10 hrs lecture/demonstration + 5 hrs practical/tutorial

This course is aimed at professionals from law, law enforcement, and forensic science, who have a need for greater quantification of their findings for presentation in the criminal, or civil justice systems. It aims to give, to those whose mathematical skills may be minimal, a basic grounding in the evaluation of observations commonly made by forensic scientists within a context of evidence.

The course will enable students to:

- evaluate forensic and other forms of legal evidence (including DNA and object matching types of evidence) using a likelihood ratio approach.
- regard observations as evidence within a structured framework of propositions, and to appropriately treat these observations using statistical methods.

**Outline:** An introduction to probability theory. The third law of probability and generalization to dependent events, and joint, unconditional and conditional probability. This will lead to Bayes' theorem and extension to non-data priors, then the likelihood ratio will be introduced as a measure of evidential strength.

Simple examples from forensic casework will be taught as an interactive session. Then the ideas will be developed to statistical genetics, including Hardy-Weinberg equilibrium, linkage equilibrium; the evaluation of DNA matching evidence, this will include sub-population effects, and which databases to use.

**Assessment:** A single assignment covering all aspects of the module material.

#### **Bibliography:**

Aitken, C.G.G. & Taroni, F (2004) Statistics and the Evaluation of Evidence for Forensic Scientists, John Wiley & Sons Ltd.

Evett, I.W. & Weir, B.S. (1998) DNA Evidence: Statistical Genetics for Forensic Scientists, Sinauer Associates Inc. Sunderland, Massachusetts.

Lucy, D. (2005) Introduction to Statistics for Forensic Scientists. John Wiley & Sons Ltd.

Balding, D. (2005) *Weight of Evidence for forensic DNA profiles*. John Wiley & Sons Ltd.

Robertson, B. & Vignaux, G.A. (1995) *Interpreting Evidence: Evaluating Forensic Science in the Courtroom*, John Wiley & Sons Ltd.

### 4.3.8 CFAS434 Quantitative Criminology

<b>Lecturer:</b>	<b>Professor Brian Francis</b>
<b>Prerequisites:</b>	<b>Generalized Linear Models (or equivalent); Multi-level Models</b>
<b>Contact hours and type:</b>	<b>10 hrs lecture/demonstration + 5 hrs practical/tutorial</b>

The aim of this course is to enable students to understand and to use the latest methods in analysing quantitative datasets in criminology, and to understand the need for good design in carrying out quantitative studies for evaluation.

The topics covered will be:

Measuring crime. Experimental studies in criminology; quasi-experimental designs. Randomised trials in criminology. Case-control and matched case-control designs. Propensity score matching. Use of propensity scores in criminology. Multi-level models for modelling crime data.

Introduction to Latent structure models. Latent class models. Classifying patterns of criminal careers. The Moffitt taxonomy of criminal behaviour. Use of latent trajectory models. Growth mixture models and latent growth models. Examples from the literature.

The software used will be a mix of SAS, R and specialist software such as MPLUS.

Successful students will be able to:

- understand and fit a wide variety of latent structure models to criminological data
- understand the various types of research design used in quantitative criminological studies
- carry out a propensity score analysis
- gain state of the art knowledge in the analysis of criminological data and to be able to carry out such analyses
- understand and criticise a number of recent papers published in the literature
- understand the need for design in evaluation, and the various methods used in such evaluation.

## **Bibliography:**

Bushway, S. and Wiesburd, D.(2005) Quantitative methods in criminology. Ashgate

Collins, L. And Lanza, S. (2010) Latent Class and Latent Transition Analysis: with Applications in the Social, Behavioral, and Health Sciences. Wiley, New York.

Curran, P.J. (2005) Latent curve models. Wiley: New York.

Guo,S, and Fraser, M.W. (2009) Propensity Score Analysis. Sage.

Piquero, A. and Wiesburd, D. (2010) Handbook of Quantitative Criminology. Springer: New York.

Von Montfort, K., Ord , J. and Satorra, A.(2010) Longitudinal research with latent variables. Springer: New York.

### 4.3.9 CFAS436 Quantitative Methods for Scientific Research I

**Lecturer:** Dr Gillian Lancaster and Dr Andrew Titman

**Prerequisites:** None

**Contact hours and type:** 15 hrs (lectures + practicals)

Outline: The aim of this course is to provide an overview of the basic concepts and statistical issues that researchers need to be aware of when designing a research project. The research process is outlined and different types of study design are discussed. Issues for interpreting and presenting results are highlighted and the information required for carrying out a sample size calculation is explained and illustrated. Examples from the literature and media highlight the importance of good study design, and the need for methodological rigour and integrity in research practice.

The module includes time for discussion of participants own research interests to facilitate a wider appreciation of research carried out in different subject areas within the scientific community

The topics covered will include:

- The research process and formulating a research question
- Design of scientific experiments
- Interpretation of data
- Presentation of results
- Sample size estimation

The software used will be SPSS.

Learning: Students will learn through the application of concepts and techniques covered in the module in practical work and discussion. Students will be encouraged to examine and share issues of substantive interest relevant to their own work.

Successful students will be able to:

Discuss the key elements of the research process;  
Formulate a research question related to their own work;  
Interpret the results of a hypothesis test and confidence interval;  
Determine how to best present their findings graphically and using tables;  
Appreciate the information required for carrying out a sample size calculation;  
Calculate sample sizes for determining the difference between two means and two proportions.

#### **Bibliography:**

Altman D G (2008) Practical Statistics for Medical Research (2<sup>nd</sup> Edition). Chapman and Hall

Field A (2009) Discovering statistics using SPSS, 3<sup>rd</sup> edition. Sage.

#### 4.3.10 CFAS437 Quantitative Methods for Scientific Research II

<b>Lecturer:</b>	<b>Dr Gillian Lancaster and Dr Andrew Titman</b>
<b>Prerequisites:</b>	<b>Quantitative Methods for Scientific Research I</b>
<b>Contact hours and type:</b>	<b>15 hrs (lectures + practicals)</b>

Outline: The aim of this course is to build upon the knowledge gained in the first module in providing an overview of the statistical issues that researchers need to be aware of when designing and conducting a research project. This module overviews basic statistical methods of analysis stressing the importance of exploratory data analysis and includes an introduction to multiple regression, diagnostic test studies, method comparison studies and Bayesian methods of analysis. Examples from the literature and media highlight the importance of good study design. This module introduces tools and tips on how to critically appraise the research literature.

The module includes time for discussion of participants own research interests to facilitate a wider appreciation of research carried out in different subject areas within the scientific community

The topics covered will be:

- Exploratory data analysis
- Regression relationships
- Diagnostic test and method comparison studies
- Bayesian methods
- Critical appraisal of the research literature

The software used will be SPSS.

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets, and through group discussion. Students will be encouraged to share issues of substantive interest in their own work.

Successful students will be able to:

Determine the appropriate statistical test to use in carrying out an exploratory data analysis;

Understand how to interpret the parameter estimates from the results of a multiple regression analysis;

Design and analyse a simple diagnostic test or method comparison study;

Appreciate the usefulness and application of Bayesian methods of analysis;

Critically appraise the research evidence found in peer-reviewed journals.

#### **Bibliography:**

Altman D G (2008) Practical Statistics for Medical Research (2<sup>nd</sup> Edition). Chapman and Hall

Bowers D, House A, Owens D (2001). Understanding clinical papers. Wiley.

Brace N, Kemp R, Snelgar R (2006). SPSS for psychologists, 3<sup>rd</sup> edition. Palgrave.

Field A (2009) Discovering statistics using SPSS, 3<sup>rd</sup> edition. Sage.

Greenhalgh T (2010) How to read a paper, the basics of evidence-based medicine, fourth edition. John Wiley and Sons Ltd.

### 4.3.11 CFAS435 Teaching Statistics

**Module Coordinator:** Dr Gillian Lancaster and Dr Andrew Titman

**Prerequisites:** Basic numeracy preferably to A level

**Contact hours and type:** By distance learning with 4 contact away days

This course has been designed to allow the development of effective pedagogy in teaching statistics. It is studied by distance learning, supplemented by four contact away days. Throughout the course, opportunities will be given to learn and discuss the actual statistical processes and methodology.

The content of the course is outlined in four sections which centre around preparation for four contact away days, where the learning materials are reinforced and discussed.

#### **Section 1. Thinking Statistically - the Stages of Statistical Problem Solving**

The focus of the preparation materials for each of the contact days is the development of subject knowledge. Students will be issued with some preparation materials to enable them to focus on some initial aspects of Statistics. They will be expected to have read chapters 1, 2 and 4, and parts of chapter 3 of Agresti and Franklin before coming to the first contact day.

#### **Section 2. Statistical Problem Solving and Learning Statistics**

This section will include consideration of the following items:

- Agresti and Franklin: Chapters 5, 6 and 7.
- Sampling Distributions.
- Sampling, inference, and an introduction to hypothesis testing
- Preparation of short talk on the Problem Solving Approach.

#### **Section 3. Statistical Problem Solving and Teaching Statistics.**

This section will include consideration of the following items:

- Agresti and Franklin Chapters 8 and 9.
- Confidence intervals and hypothesis tests.
- Identification of the topics in typical Statistics courses at this level and also those required in other disciplines.
- A reflection on the differences between the two and how different cohorts of students with different needs might be taught.
- A review of resources available including textbooks and websites

#### **Section 4. Statistical Problem Solving and Assessment**

This section will include a consideration of the opportunities and limitations of using real data in teaching and assessment. By this stage of the course, the topics covered in Agresti and Franklin, Chapters 1 - 9 need to be known. In addition, depending on the courses students are going to teach, further topics included in Agresti and Franklin may need to be covered.

Assessment: There is an assignment associated with each section of work. The course is assessed primarily on the basis of these assignments and a personal journal that together form the portfolio of work.

**Course books:**

Participants on the course will be encouraged to use the books specified for the courses they are currently teaching. In addition, the course will draw mainly on the material in, and refer to, the following books:

(1) Agresti, A. and Franklin, C. (2009) *Statistics - the Art and Science of Learning from Data*. Second edition. New York: Pearson Prentice Hall. (<http://www.pearsonhighered.com/educator/academic/product/0,3110,0135131995,00.html>)

*This is the main book that will be used throughout the course, together with the computer resources available which accompany it.*

(2) Clarke, G. M. and Cooke, D. (2004) *A Basic course in Statistics*. London: Arnold. (<http://www.basicstatistics.co.uk/>)

*This book covers the theoretical aspects of the course and reference to it will be made where appropriate throughout the course.*

Other course materials will be available electronically. Each of the four sections of the course will have components that will be written in the form of study guides. Reference will be made to software such as Excel, Autograph, SPSS or Minitab.

#### 4.3.12 CFAS450 Statistics in Practice

**Lecturers:** Dr Debbie Costain, Dr Gillian Lancaster and Dr Chris Sherlock

**Prerequisites:** None

**Contact hours and type:** 26 hrs lecture/workshop (spread over Terms 1 and 2)

Outline: The aim of this module is to provide students with a range of skills which are necessary for applied statistical work, including team-working, oral presentation, statistical consultancy and the preparation of written reports of various kinds.

The topics covered will include:

- **Scientific writing** (Term 1)
  - LaTeX
  - Scientific writing style (e.g. consulting report, journal article)
  - Literature search and referencing
  - Graphical and tabular presentation
- **Oral presentation** (Term 2)
  - How to communicate effectively, design of slides/overheads/handouts, good and bad-habits in public speaking
  - Beamer as a presentation package
- **Study design, consultancy and communication** (Term 2)
  - Overview of the principles of study design and be able to recognise and discuss statistical design issues
  - Appreciate and advocate the role of the statistician in the research process
  - Consolidate the skills necessary to become a statistical consultant, including professionalism.

Learning: On completion of the module a student should be able to use type-setting software; demonstrate appropriate report writing structure; present data appropriately in graphs and tables and undertake basic statistical consulting.

Assessment: A set of exercises with one piece of assessed work under each of the three headings:

- written report of an analysis to include mathematical, tabular and graphical material
- oral presentation of an analysis using Beamer to produce over-heads
- designing a study to address a specific problem

## **Bibliography:**

- Altman D G (2008) Practical Statistics for Medical Research (2<sup>nd</sup> Edition).  
Chapman and Hall
- Chatfield C (1988) Problem solving. Chapman and Hall, London.
- Lamport L (1994) LaTeX: a document preparation system. Addison Wesley.
- Tufte ER (2001) The visual display of quantitative information. Graphics Press

### 4.3.13 MATH563: Clinical Trials

**Lecturers:** Dr Debbie Costain

**Prerequisites:** Basic probability and statistics to the level of MATH230 and MATH235; MATH550 computing and scientific writing or equivalent

**Contact hours and type:** 20 hours (lectures and practicals)

#### **Objectives of the module:**

This course aims to introduce students to aspects of statistics, which are important in the design and analysis of clinical trials. By the end of the course students should understand the basic elements of clinical trials, be able to recognise and use principles of good study design, and be able to analyse and interpret study results to make correct scientific inferences.

#### **Syllabus:**

Clinical trials are planned experiments on human beings designed to assess the relative benefits of one or more forms of treatment. For instance, we might be interested in studying whether aspirin reduces the incidence of pregnancy-induced hypertension; or we may wish to assess whether a new immunosuppressive drug improves the survival rate of transplant recipients.

This course combines the study of technical methodology with discussion of more general research issues. The course begins with a discussion of the relative advantages and disadvantages of different types of medical studies. The basic aspects of clinical trials as experimental designs are then discussed. This includes a section on definition and estimation of treatment effects. Furthermore, cross-over trials, issues of sample size determination, and equivalence trials are covered. The course gives an introduction to flexible trial designs that allow a sample size re-estimation during the ongoing trial. Finally, other relevant topics such as meta-analysis and accommodating confounding at the design stage are briefly discussed.

**Assessment:** 50% project and 50% examination

#### **Bibliography:**

D.G. Altman, Practical Statistics for Medical Research, Chapman and Hall, 1991.

S. Senn, Cross-over trials in clinical research, Wiley, 1993.

S. Piantadosi, Clinical Trials: A Methodologic Perspective, John Wiley & Sons, 1997.

ICH Harmonised Tripartite Guideline. Statistical principles for clinical trials. International Conference on Harmonisation E9 Expert Working Group. *Statistics in Medicine*. 1999 Aug 15; 18(15): 1905-42. Can be downloaded from: <http://www.ifpma.org/pdfifpma/e7.pdf>

J.N.S. Matthews, *Introduction to Randomised Controlled Clinical Trials*, Arnold, 2000.

Waller, L. And Gotway, C. A. (2004). *Applied Spatial Statistics for Public Health Data*. New York: Wiley.

#### 4.3.14 MATH564: Principles of Epidemiology

<b>Lecturers:</b>	<b>Dr Gillian Lancaster and Dr Andrew Titman</b>
<b>Prerequisites:</b>	<b>Basic probability and statistics to the level of MATH230 and MATH235; MATH550 scientific writing or equivalent, computing in R</b>
<b>Contact hours and type:</b>	<b>20 hours (lectures and practicals)</b>

#### **Objectives of the module:**

Epidemiology is the study of the distribution and determinants of disease in human populations. This course provides an introduction to the principles and statistical methods of epidemiology. Various concepts and strategies used in epidemiological studies are examined. Most inference will be likelihood based, although the emphasis is on conceptual considerations.

#### **Syllabus:**

- The history of epidemiology and the role of statistics
- Measures of health and disease: incidence, prevalence and cumulative incidence risk
- Types of epidemiological studies: Randomized controlled trials, cohort studies, case-control studies, cross-sectional and ecological studies
- Causation in epidemiology
- Potential errors in epidemiological studies: selection bias, confounding
- Remedies for confounding: Standardized rates, stratification and matching
- Diagnostic test studies

**Assessment:** 50% project and 50% examination

#### **Bibliography:**

R. Beaglehole, R. Bonita and T. Kjellstroem (1993) *Basic epidemiology*. Geneva: World Health Organization.

D. Clayton and M. Hills (1993) *Statistical models in epidemiology*. Oxford: Oxford University Press.

Woodward M (1999) *Epidemiology: Study design and data analysis*. Chapman & Hall, Boca Raton

## 4.4 Software Modules

### 4.4.1 CFAS417a Atlas.ti

<b>Lecturer:</b>	<b>Dr Leslie Humphreys</b>
<b>Prerequisites:</b>	<b>None</b>
<b>Contact hours and type:</b>	<b>4.5 hrs lecture/demonstration + 3 hrs computer-based practical sessions</b>

Outline: This module covers the basics of Atlas.ti, a popular textual analysis tool, and situates the program within the wider methodological framework of social science analysis.

The module will include the following:

1. assigning documents;
2. creating quotations and codes;
3. different ways of coding text - including automatic coding;
4. using the query tool to search for co-occurrences of codes;
5. creating subgroups (families) of documents or codes;
6. examining the output available;
7. creating network diagrams to display relationships;

The module will also comment on issues of typicality, representativeness and control using contemporary social scientific examples. Students will also be shown how to link data from Atlas.ti to other statistical packages such as SPSS.

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of empirical interest in these studies.

Successful students will:

1. understand the concepts of systematic textual analysis;
2. be able to use Atlas.ti and have an understanding of its potential for various styles of research;
3. be able to prepare data for analysis;
4. be able to code and analyse textual data systematically;
5. be able to assemble network relationship diagrams;
6. be able to interpret the results of Atlas.ti output;
7. understand the strengths and weaknesses of the different approaches to textual analysis;

## Bibliography:

Agar, M. Microcomputers as field tools, *Computers and the humanities*, 17, 19-26.

Alexa, M. & Zuell, C. (2000) Text analysis software: commonalities, differences and limitations: the results of a review, *Quality & Quantity*, 34, 299-321.

Bryman, A. & Burgess, R. (eds) (1994) *Analysing Qualitative Data*. Routledge

Gilbert, N. (ed) (2001) *Researching Social Life* (2nd ed). Sage London

Muhr, T. (1991) Atlas-ti - A prototype for the support of text interpretation, *Qualitative Sociology*, 14, 4, 349-71

#### 4.4.2 CFAS422 R

**Lecturers:** Dr David Lucy & Dr Juliet Harman

**Prerequisites:** Statistical Methods (or equivalent)

**Contact hours and type:** 10 hrs lecture/demonstration + 5 hrs practical

Outline: R is both statistical language and a major statistical software product, providing the main route to dissemination of recent statistical methodology (free to download from the internet). This module introduces R, explains the syntax and introduces a wide range of statistical models which can be fitted.

Topics covered include: an introduction to the R language, reading data, data description and graphics, the general linear model (GLM), analysis of variance, logistic regression, survival analysis, multivariate techniques, the use of R libraries and www resources in R.

In summary, the following topics will be covered:

1. manipulation and management of data in the R environment
2. summarising data numerically and graphically
3. fitting linear models in R
4. statistical analysis using R
5. functions, iterations, and conditions in R

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Successful students will:

1. have an increased understanding of the R programming language
2. be able to produce basic statistics and create graphs
3. be familiar with the R syntax for writing functions, iterations and conditions
4. be familiar with linear models in R

#### **Bibliography:**

- Crawley, M.J. (2005) Statistics: an introduction using R Wiley, New York.  
Dalggaard, P. (2002) Introductory Statistics with R. Springer. Faraway, J (2004) Linear models with R. Chapman and Hall..  
Maindonald, J. and Braun, J. (2003) Data analysis and graphics using R. Cambridge University Press.  
Venables, W and Ripley, B (2002) Modern Applied Statistics with S . Springer.  
Venables, W and Smith, D (2002) In introduction to R. Network Theory Ltd.  
(Or downloaded for free from <http://cran.r-project.org/manuals.html>)  
R downloadable from: <http://cran.r-project.org/>  
R Web book: <http://cran.r-project.org/doc/FAQ/R-FAQ.html>

#### **4.4.3 CFAS424 SPSS for Windows: I**

**Lecturers: Dr Leslie Humphreys & Dr Juliet Harman**

**Prerequisites: Statistical Methods**

**Contact hours and type: 10 hrs lecture/demonstration + 5 hrs practical**

Outline: SPSS for Windows is a statistical software package that has become synonymous with data management and analysis in the social sciences. This module will introduce participants to the manipulation and management of data in the SPSS Windows environment. In addition, participants will develop the confidence to manipulate data files in order to summarise data numerically and graphically and to perform simple statistical procedures including formal tests of hypotheses of interest.

This module is aimed at researchers and research students, with little experience of Windows computing, who would like to use SPSS in an efficient and effective manner. The aim of the module is to provide participants with as many opportunities to experiment with the package as possible. Consequently, each session will be centred around a computer-based practical encouraging participants to investigate data taken from various sources.

The following topics will be covered:

1. manipulation and management of data in the SPSS Windows environment
2. summarising data numerically and graphically
3. simple statistical procedures including formal tests of hypotheses of interest

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Successful students will be able to:

1. manipulate and manage data in the SPSS Windows environment
2. summarise data numerically and graphically
3. carry out simple statistical procedures including formal tests of hypotheses of interest
4. apply theoretical concepts
5. identify and solve problems
6. analyse data and interpret statistical output
7. apply strategies for appropriate selection of information

## **Bibliography:**

Bryman A. and Cramer D., *Quantitative Data Analysis with SPSS for Windows*, Routledge

Kinnear P. R., *SPSS for Windows made Simple*, Hove

Norusis M., *The SPSSX guide to Data Analysis*, SPSS Inc

#### 4.4.4 CFAS425 SPSS for Windows: II

<b>Lecturers:</b>	<b>Dr Juliet Harman &amp; Dr Leslie Humphreys</b>
<b>Prerequisites:</b>	<b>SPSS for Windows: I (or equivalent)</b>
<b>Contact hours and type:</b>	<b>10 hrs lecture/demonstration + 5 hrs practical</b>

Outline: This module builds on previous introductory modules to cover more advanced techniques of statistical analysis. The principles of statistical inference are reviewed and applied to the general linear model. This framework is then extended to a wider class of statistical models, including non-linear, multivariate and non-normal models. The general principles of model selection and hypothesis testing are illustrated in each case by application to substantive issues in real data examples.

Topics covered will be:

General methodology for linear models: ANOVA and ANACOVA models  
Extensions to: non-linear models, factor analysis, logistic regression and log-linear models

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Successful students will be able to:

1. perform advanced statistical procedures
2. identify the appropriate procedure for a particular substantive issue
3. apply theoretical concepts
4. identify and solve problems
5. analyse data and interpret statistical output
6. apply strategies for appropriate selection of information

#### **Bibliography:**

- Agresti, A., *Analysis of Categorical Data*, Wiley, New York.  
Liao, T.F., *Interpreting Probability Models: Logit, Probit, and Other Generalized Linear Models*, Sage  
Lindsey, J.K., *Analysis of Categorical Data using GLIM*, Springer Verlag, Berlin  
Stevens, J., *Applied Mutivariate Statistics for the Social Sciences*, Lawrence Erlbaum Assoc.  
Tacq, J., *Multivariate Analysis Techniques in Social Science Research*, Sage

#### 4.4.5 CFAS426 STATA

<b>Lecturer:</b>	<b>Professor Brian Francis</b>
<b>Prerequisites:</b>	<b>Generalized Linear Models (or equivalent)</b>
<b>Contact hours and type:</b>	<b>10 hrs lecture/demonstration + 5 hrs practical</b>

Outline: This module introduces the STATA package, explains the syntax and introduces a wide range of statistical models which can be fitted. This comprehensive statistical system is popular with economists, epidemiologists and other social and biomedical researchers.

The module will cover data input and manipulation, data description and tabulation, graphics, ANOVA, normal and logistic regression, regression diagnostics, Poisson regression and log-linear models. Other capabilities, extensions and resources of STATA will also be discussed.

In summary, the following topics will be covered:

1. manipulation and management of data in the STATA environment
2. summarising data numerically and graphically
3. simple statistical procedures including formal tests of hypotheses of interest
4. ANOVA, normal, logistic and Poisson Regression
5. regression diagnostics
6. log-linear models

Learning: Students will learn through the application of concepts and techniques covered in the module to real data sets. Students will be encouraged to examine issues of substantive interest in these studies.

Successful students will be able to:

1. manipulate and manage data in the STATA environment
2. summarise data numerically and graphically
3. perform simple statistical procedures including formal tests of hypotheses of interest
4. apply theoretical concepts
5. identify and solve problems
6. analyse data and interpret statistical output
7. apply strategies for appropriate selection of information

#### **Bibliography:**

A handbook of statistical analysis using STATA (Rabe-Hesketh, Everitt)  
Hamilton, L.(2004) Statistics with STATA.  
STATA online Web books: <http://www.ats.ucla.edu/stat/stata/webbooks>

## 4.5 Dissertation

### CFAS490 Dissertation

**Dissertation Coordinator: Dr. David Lucy**

**Prerequisites: successful completion of taught modules**

**Contact hours and type: 25 hours total supervision**

Outline: After successful completion of the taught modules students should be able to apply the knowledge that they have learnt and apply them to a project in applied statistics of direct relevance to their career or career plans.

A suitable topic for the dissertation will be agreed with the student after discussion and an appropriate supervisor (or two supervisors) will be nominated. These will generally be members of university academic staff.

Learning: Students will demonstrate that they have understood the interdependencies between data, methods of analysis and substantive theory in a piece of applied research undertaken on an individual basis with regular supervision.

Students should:

- be able to apply the knowledge that they have learnt through the taught modules to a new substantive area
- demonstrate skills of research, problem solving, analysis, synthesis and academic writing
- demonstrate the ability to communicate through written and oral presentation

#### **Assessment:**

The dissertation should contain a maximum of 50 pages of single spaced A4 typescript, including all figures, tables, references and appendices. A 12pt font and standard margins should be used.

It should be presented in the style of a formal scientific report, with chapters and sections, and including an abstract, introduction, conclusions and a reference list.

Part of the assessment of the dissertation is through a 15 minute oral presentation, which will take place in early September 2012.

There will be a strict deadline in mid-September 2012 for the submission of completed dissertations. Two hard copies and an electronic copy should be submitted to the MSc Coordinator in the Course Office.

## 4.6 Other Non-assessed Module

### CFAS430 Dissertation Writing

**Module Coordinator:** Dr. Damon Berridge

**Prerequisites:** none

**Contact hours and type:** 3 hrs seminar/groupwork/presentations

#### Outline:

This module provides a forum for students' questions about dissertation writing. Through groupwork and presentations, it will guide the students into understanding the nature of scientific writing. It will also cover the skills necessary to carry out a dissertation project including time management issues. It will encourage awareness of areas of writing in which students commonly have problems, and suggest ways of developing strategies to counter these problems.

Topics covered will be time management, dissertation writing, scientific style.

#### Successful students will be able to:

- demonstrate how to effectively manage the stages of the project and hand in on schedule [time management]
- adopt an appropriate academic scientific style for their projects
- understand some of the key expectations of dissertation writing and the criteria used in assessment
- demonstrate different ways of and models for structuring dissertations through analysis of past examples
- identify the qualities of a good project through analysis of past examples

#### Bibliography

Burton, D. (Editor) (2000) *Research Training for Social Scientists: A Handbook for Postgraduate Researchers*. Sage Publications Ltd

Cooley, L. and Lewkowicz, J. (2003) *Dissertation Writing in Practice: Turning Ideas into Text*. Hongkong University Press

Craswell, G. (2004) *Writing for Academic Success: A Postgraduate Guide*. Sage Publications Ltd

Hart, C. (2004) *Doing Your Masters Dissertation* (Essential Study Skills) Sage Publications Ltd

Mittelbach, F., Goossens, M., Braams, J., Carlisle, D., Rowley, C. (2004) *The LaTeX Companion* (2<sup>nd</sup> Edition). Prentice Hall.

Rudestam, K.E. and Newton R.R. (2000) *Surviving Your Dissertation: A Comprehensive Guide to Content and Process*. Sage Publications Ltd

## 5 Other Information

### 5.1 Term Dates

The following are the term dates for 2011-2012

*Michaelmas Term:*

7 October 2011 to 16 December 2011

*Lent Term:*

13 January 2012 to 23 March 2012

*Summer Term:*

20 April 2012 to 29 June 2012

Please note that postgraduate courses run throughout the year, including vacations.

### 5.2 Coursework Submission

At the end of each credit-bearing module students will be given an assignment by the course tutor. This will have to be completed within about four weeks. There will be a published deadline for the submission of each piece of work.

**One paper** copy and **one electronic** copy of each completed assignment must be submitted.

The paper copy must be deposited by **12 noon on the deadline date** in the box labelled 'MSc/MRes in Quantitative Methods' in the Fylde-PSC link corridor (B Floor). It must be accompanied by a Coursework Cover Sheet and students must declare the work as their own. See Section 5.3 on the penalties for plagiarism. Binders should not be used when submitting coursework, but a single staple may be used.

The **electronic copy** must be uploaded on **LUVLE** by 5pm on the deadline date.

Students should comply strictly to the deadlines set for coursework submission. If there are exceptional circumstances, application can be made for an extension using the "Application for Extension" form (available from the course office, PSC B78) giving reasons. Otherwise penalties as described in Section 5.5.4 apply.

## 5.3 Plagiarism

Plagiarism involves the unacknowledged use of someone else's work, and passing it off as one's own. The University deals very severely with students found guilty of plagiarism.

This category of cheating includes the following:

- a) Collusion, where a piece of work prepared by a group is represented as if it were the student's own;
- b) Commission or use of work by the student which is not his/her own and representing it as if it were:
  - purchase of a paper from a commercial service, including internet sites, whether pre-written or specially prepared for the student concerned
  - submission of a paper written by another person, either by a fellow student or a person who is not a member of the university;
- c) Duplication of the same or almost identical work for more than one module;
- d) The act of copying or paraphrasing a paper from a source text, whether in manuscript, printed or electronic form, without appropriate acknowledgement;
- e) Submission of another student's work, with or without that student's knowledge or consent.

There is an approved framework to deal with plagiarism. Full details can be found at: [http://www.lancs.ac.uk/celt/celtweb/plagiarism\\_framework](http://www.lancs.ac.uk/celt/celtweb/plagiarism_framework)

## 5.4 General Information on Assessment

### 5.4.1 Introduction

Taught postgraduate courses are assessed by assignments. Assessment is linked to each individual module. The regulation for assignments is contained in the University Examination Regulations, which can be consulted via the web address:

<https://gap.lancs.ac.uk/ASQ/QAE/MARP/Pages/default.aspx>

This booklet gives more detailed information on assignments in the MSc in the Quantitative Methods programme.

### 5.4.2 Assessment Registration

Students are automatically registered for assessment for all the taught modules that they have registered to take. Students are required to choose their options during Term 1 of each year, but options may be changed at the discretion of the Course Director. Should a student wish to drop an option

(after being entered for assessment), he/she should inform Angela Mercer, MSc Coordinator as soon as possible.

### 5.4.3 External Examiners

All assignments will be independently checked. Assignments, model solutions and marking schemes will be scrutinised by appointed external examiners. Precise marking schemes will be employed for assignments. The Course Director will have responsibility for overall comparability.

Marked assignments and submitted dissertations will be examined by the external examiners who will assess the dissertation in the same manner as an MPhil/PhD degree, with the exception of dissertation length and minimum period of study. An internal examiner (who may be the Course Director, provided he/she is not the supervisor) will liaise with the external examiners and provide any additional information as is necessary.

### 5.4.4 Marking Criteria for Assessment

Students will receive written comments prepared by internal assessors on individual pieces of coursework, together with a percentage mark. These are provisional marks which will be moderated by external examiners and require ratification by the Board of Examiners. The information below gives guidance on the general criteria used to assess submitted work. Specific assessment criteria relating to individual modules will be explained by the module tutor.

#### Criteria for Substantive Courses

**70 and above** – equivalent to a distinction

An outstanding piece of work in every regard which demonstrates:

- A thorough and wide-ranging knowledge of the substantive issues
- A thorough and insightful understanding of the substantive issues involved
- An ability to analyse critical contributions on the substantive issues
- An ability to research and bring together material to support an argument
- An ability to express an original, reasoned argument in a lucid manner
- Excellent research competencies in terms of presentation, language and referencing

**60-69** – equivalent to a pass

A good piece of work which demonstrates:

- A sound understanding of the substantive issues involved
- A good knowledge of the critical contributions on the substantive issues
- An ability to organise research material
- An ability to present a clear, convincing argument
- Good research competencies in terms of presentation, language and referencing

**50-59** – equivalent to a pass

A fair piece of work which demonstrates:

- A reasonable understanding of the substantive issues
- A familiarity with critical contributions on the substantive issues
- An ability to use research material to support ideas and arguments
- Competent research skills in terms of presentation, language and referencing

**40-49** – equivalent to a fail (see Rules)

Work at this level will demonstrate:

- A general, but incomplete understanding of the substantive issues
- Some knowledge of the literature on the substantive issues
- Some ability to develop and support an argument
- A tendency to express ideas through description and anecdote rather than analysis

- Difficulties with presentation, language and referencing

**39 and below – fail**

This is an unsatisfactory piece of work which demonstrates:

- Little understanding of the substantive issues and their implications
- A limited amount of reading and poor knowledge of the previous contributions on the substantive issues
- Limited ability to formulate and sustain a clear argument
- Poor presentation skills and serious problems with language and referencing

**0** – in cases where there is clear evidence of plagiarism or collusion the work will normally receive a mark of 0%.

**Criteria for Methodology and Software Courses**

**70 and above – equivalent to a distinction**

An outstanding piece of work in every regard which demonstrates:

- Good discussion of the limitations of the data and the modelling
- High competence in the use of appropriate statistical method(s) and software
- An ability to make good substantive interpretation of output in nearly all situations
- An ability to make an in-depth interpretation of output in most situations
- Excellent research competencies in terms of presentation, language and referencing
- Good suggestions for improvements in the design and analysis of the study being analysed

**60-69 – equivalent to a pass**

A good piece of work which demonstrates:

- High competence in the use of appropriate statistical method(s) and software
- An ability to make a basic level interpretation of output in most situations
- An ability to make an in-depth interpretation of output in a substantial number of situations
- Good research competencies in terms of presentation, language and referencing

**50-59 – equivalent to a pass**

A fair piece of work which demonstrates:

- Moderate competence in the use of appropriate statistical method(s) and software
- An ability to make a basic level interpretation of output in most situations
- An ability to make an in-depth interpretation of output in a substantial number of situations but not most situations
- Competent research skills in terms of presentation, language and referencing

**40-49 – equivalent to a fail (see Rules)**

Work at this level will demonstrate:

- Low competence in the use of appropriate statistical method(s) and software
- An ability to make a basic level interpretation of output in a substantial number of situations but not most situations
- An ability to make an in-depth interpretation of output in less than a substantial number of situations
- Difficulties with presentation, language and referencing

**39 and below – fail**

This is an unsatisfactory piece of work which demonstrates:

- Very low competence in the use of appropriate statistical method(s) and software
- An ability to make a basic level interpretation of output in less than a substantial number of situations
- An ability to make an in-depth interpretation of output in less than a substantial number of situations
- Poor presentation skills and serious problems with language and referencing

**0** – in cases where there is clear evidence of plagiarism or collusion the work will normally receive a mark of 0%.

### ***Plagiarism and Collusion***

Plagiarism occurs where a student submits another person's work as though it were his/her own. All forms of plagiarism are considered serious academic offences and you will receive 0% for any work found to be plagiarised.

- (1) Students must not by implication or otherwise represent the work of others as their own, including the work of other students and material found in published, unpublished, or electronic sources.
- (2) All sources, books, articles, etc. must be explicitly acknowledged in the essay or dissertation and in the bibliography. All quotations and close paraphrases must be clearly attributed.
- (3) Students must not submit work that is identical or substantially similar for assessment in more than one course, whether in the same department, another department, or at another university.

Cases of plagiarism will be reported to the Board of Examiners and will normally result in a fail mark for a module and can result in the failure of the course as a whole. Deliberate plagiarism is uncommon, but you may break the regulations inadvertently by failing to explicitly attribute your sources. You must avoid this by adopting a recognised referencing system used consistently in the preparation and presentation of your work.

## **5.5 Procedures for Consideration of Results**

### **5.5.1 Pass**

The University's minimum threshold of attainment for the award of the postgraduate diploma or MSc shall be signified by a weighted mean mark of 50% in taught modules (plus 50% in the dissertation for MSc).

### **5.5.2 Distinction**

The University's minimum threshold of attainment for the award of the qualification of MSc with Distinction shall be signified by an overall weighted mean mark of 70%. A Distinction may be awarded only to a candidate demonstrating a consistently high level of attainment across all assessed elements (including dissertation for MSc) of the programme.

### **5.5.3 Moderation**

Each taught module will be subject to second marking: all completed assignments will be assessed by more than one marker, but the second marker will know the mark allocated by the first marker. Marks for individual modules may be moderated by a scaling procedure to ensure comparability with other modules.

Each MSc candidate submits two loose bound copies of their dissertation (and an electronic copy) to the Course Office. The dissertation is marked by two internal examiners (one usually being the project supervisor). Each internal examiner prepares a written report within one month of submission. The internal examiners make one of the following recommendations to the external examiner:

pass with distinction, pass, pass – minor textual corrections within one month, fail – permission to resubmit at discretion of examiners, fail – award diploma.

#### **5.5.4 Late submission of coursework**

There are published deadlines for the submission of coursework; there are published procedures for the granting of extensions; work submitted after a deadline but within the time limit of an approved extension shall not be subject to penalty; work submitted late without an approved extension shall normally be penalised, as follows: work submitted 1-7 days late will have 10 marks deducted and material submitted more than 7 days late will be awarded a mark of 0.

#### **5.5.5 Reassessment of failed modules/dissertation**

Where a candidate obtains a mark of less than 50% for a module, he/she shall be entitled to one opportunity for reassessment in each failed module/element within the programme, provided that the total number of failed modules/elements is equivalent to no more than 50% of the weighted programme. Modules, if passed, may each be awarded a mark no greater than 50%. A failed dissertation may be resubmitted once, and reassessed for a maximum mark of 50%, at the discretion of the examiners. Such reassessment must normally be completed within 12 months of the first attempt.

#### **5.5.6 Condonation/compensation**

To qualify for an award, candidates should pass all the assessments required by their programme. Notwithstanding this requirement, candidates shall be eligible for an award by condonation/compensation in respect of up to a maximum of 45 credits of a taught Masters programme (30 credits of a postgraduate diploma) provided that:

- (a) no single module mark falls below 40%
- (b) the candidate's weighted mean mark is 50% or greater
- (c) the module(s) failed have not been designated by the department as essential to achievement of the programme's learning outcomes.

#### **5.5.7 Dissemination of results**

Under the Data Protection Act, the University is not allowed to disclose your results to any third party without your permission, except for the purpose of formal assessment. As soon as results can be released, they are made available via the Course Director. Note that the results are not officially confirmed until they have been seen by the External Examiners and approved by Senate. Please note that an award will be notified officially only after clearance procedures have been carried out.

## 5.6 Guidelines for the Preparation of Dissertations

The guidelines for the supervision and preparation of dissertations for the award of MSc in Quantitative Methods follow those for an MPhil/PhD degree, with the exception of dissertation length (maximum 50 pages) and minimum period of study (3 months full-time or part-time equivalent).

The University's general regulations on the supervision and preparation of dissertations for the award of an MPhil/PhD degree can be found at:

<https://gap.lancs.ac.uk/ASQ/QAE/MARP/Pages/default.aspx>

Dissertations must be submitted at the end of the course, and will be examined once a year, in October.

## 5.7 Seminars and Research Workshops

Students would also be encouraged to attend seminars and forum talks arranged by the Statistics Group, comprising staff and students from the Department of Mathematics and Statistics. The seminars, presented by invited speakers, usually take place on Friday afternoons. The forum, at which members of the Statistics Group present their current research work, usually takes place at Thursday lunchtimes.

## 5.8 Facilities for Postgraduate Students

### 5.8.1 Computing

Students will be able to attend introductory sessions on computing facilities and software and will also be introduced to the campus e-mail system. Students will have access to a wide range of University and Departmental equipment and IT facilities. Software will be provided free of charge to UK-based students.

Computer access is provided in the Postgraduate Statistics Centre, which is available for postgraduate use when it is not booked for teaching.

### 5.8.2 Library

Students have access to the facilities offered by the University library and the Department's small library, which is situated in the Postgraduate Statistics Centre.

### 5.8.3 General

Outside the Department, the University has in place a series of systems offering academic, administrative and personal advice and support. These comprise a wide range of student support facilities including the Student Support Office, Student Registry, Counselling Service, Medical Centre, Chaplaincy Centre, Harassment Network, Pre-School Centre, Disabilities Advisor, Effective Learning Advisor, Students' Union and Nightline. All postgraduate students will automatically become members of Graduate College.

### 5.8.4 Effective Learning Advisor

The Faculty of Science and Technology / School of Health and Medicine have an Effective Learning Advisor, Robert Blake, who can help you to develop more effective study strategies, exam techniques and improve your scientific writing.

For more information see: <http://www.lancs.ac.uk/celt/slhc/about/about.html>

For student support or to book a place in a study and writing drop-in please email: [studyadvice.fstandshm@lancaster.ac.uk](mailto:studyadvice.fstandshm@lancaster.ac.uk)

### 5.8.5 Student Support Services

We hope you have an enjoyable and productive time at Lancaster, but recognise that sometimes problems can affect your ability to study.

Please do not forget that it is your degree and your responsibility to seek help if you are experiencing difficulties. The University will do whatever is possible to assist you, within the Rules and Guidelines of the University, if you are having problems provided that we are aware of those problems. The problems may be personal, financial or academic. If you find yourself getting into difficulties we strongly urge you to consult your department, the Graduate College, the Postgraduate Studies Office, the Student Support Office, the Counselling Service, or the Students' Union Advice Centre.

Student Support Services are available via the Base, A-Floor, University House. See <http://www.lancs.ac.uk/sbs/>.

**COUNSELLING** and **MENTAL HEALTH** - provides confidential and professional support on issues such as personal, family, social or academic matters over the short term, to more complex or difficult longer term problems. The service offers both appointment and drop-in sessions. A specialist student mental health advisor provides support for students with declared mental health difficulties.

**HEALTHCARE** - Students enjoy excellent health services with a GP practice, pharmacy and a private dental practice on site. Also there is a range of alternative medical healthcare treatments available through the chaplaincy centre.

**DISABILITY** - provides help for disabled students from the first enquiry to graduation.

**INTERNATIONAL STUDENTS** - provides advice on visa extension, rules on working in the UK, general welfare and cultural orientation. They are the designated point of advice for immigration issues.

**STUDENT FUNDING** - provides information and advice on financial support and aid, including loans and advice on living costs and budgeting. The section manages a range of University financial awards.

**GENERAL WELFARE** - assists with a range of issues (personal, general, welfare, study-related) impacting on academic life and experience. This includes guidance on changing direction by suspending, transferring or withdrawing from a course of study.

**CENTRE FOR EMPLOYABILITY, ENTERPRISE AND CAREERS (CEEC)**

Whether you are thinking about going into work or thinking about further study, this service will support you through the whole process of identifying career choices.

### **Other Central Services**

Please see: <http://www.lancs.ac.uk/sbs/network/>

**THE CHAPLAINCY CENTRE:**

An ecumenical environment providing another source of welfare, advice and often practical support from the various Chaplains.

**HARASSMENT NETWORK:**

The Harassment Network provides confidential support for any student or staff member who feels they are subject to harassment. Contact network members by phone (see internal telephone directory or by email at [HarassNet@lancaster.ac.uk](mailto:HarassNet@lancaster.ac.uk)).

**STUDENTS' UNION ADVICE CENTRE:** offers a full range of financial and welfare advice to students.

## 5.9 Safety Information

### 5.9.1 Safety at the University

Under Health and Safety regulations, all members of the University, including students, have an individual responsibility to co-operate to enable the University to comply with the law, and to ensure the workplace is safe for everyone. Students must take reasonable care for the health and safety of themselves and other persons who may be affected by the way in which they carry out their work.

The University has a general Statement of Safety Policy, a copy of which can be accessed at the web address:

<http://www.lancs.ac.uk/depts/safety/policy/default.htm>

Please observe all safety notices in University buildings. In particular, take note of any emergency exit signs and any notices detailing actions in the event of a fire or other emergency.

### 5.9.2 Safety within the Department

The Head of Department, Professor John Whitehead, has overall responsibility for safety within the Department. The Departmental Safety Officer is Dr Daniel Elton.

A fire drill is held in each University building at least once per term. The Fire Alarm signal is a loud ringing bell tone. You should treat all Fire Alarm signals as an emergency. In the event of a fire, raise the alarm and leave the building quickly and carefully, do not use the lifts, and make sure you assemble well away from the building as directed by security staff. In the event of an accident, you should try to contact a first-aider or the duty doctor at the University Health Centre (internal number 94130) and then make sure it is reported to the Departmental Office.

It is important that if you become aware of any safety hazards or if a problem has occurred then you should report the problem to a member of staff.

The Departmental Safety Policy is documented in the Manual of Safety, which provides further information about safety aspects within the Department. A hard copy of this policy can be obtained from the Departmental Office on request. A copy can also be accessed via the University web page at the address:

<http://www.lancs.ac.uk/depts/safety/default.htm>

## 5.10 Academic Support

Each student will be allocated a tutor who will provide general academic and pastoral support. Additional support will be provided within the Department of Mathematics and Statistics by the Course Director, the Postgraduate Tutor,

course lecturers and other members of academic staff. The Course Director will meet on a regular basis with students to discuss progress.

### 5.11 Quality Assurance

The programme will be reviewed each year in line with other current postgraduate courses. External examiners will be asked to submit a report commenting specifically on the quality of the course in terms of assignments and dissertations, student experience and as an activity within the current postgraduate portfolio of the Faculty of Science and Technology.

A formal appraisal of student progress and academic teaching and supervision will take place at regular staff-student course committee meetings.

Standard departmental and extra-departmental staff development and appraisal schemes will be used as mechanisms for assuring high teaching quality. Individual teaching profiles will incorporate student feedback gathered through feedback questionnaires on each taught module. Any specific concerns can then be raised together with an individual appraiser during an annual appraisal. Formal staff development opportunities within the HEDC may be useful in facilitating development in response to specific concerns.

The external examiners' comments and student feedback will be fed into the annual academic review along with staff experiences of success or shortcomings of particular modules and/or teaching methods. The annual academic review will take place in November.